



CONFERENCE PROCEEDINGS

# EDAMBA 2022

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FOR DOCTORAL STUDENTS  
AND POST-DOCTORAL SCHOLARS

UNIVERSITY OF ECONOMICS IN BRATISLAVA, SLOVAK REPUBLIC  
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# **EDAMBA 2022**

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for  
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## Foreword

Our jubilee 25th International Scientific Conference for Doctoral Students and Post-Doctoral Scholars has taken a new turn when it tied the collaboration with the Slovak Economic Association (SEA). In 2017, SEA was accepted as a full member of the International Economic Association (IEA), a world federation of national economic societies founded in 1950 for the development of economic science and economic policy. Membership in the IEA is an international recognition of the SEA as a representative of the community of Slovak economists since each country can be represented by only one economic association. The collaboration with SEA was an opportunity for our young scholars to meet and greet the abroad recognized Slovak researchers and collect the feedback they need for their research papers. I believe that many papers in these proceedings have benefited from this opportunity, and the collaboration will be meaningful for other editions, too.

The world we all face calls for bold ideas based on better understanding of not just business-as-usual practices but more so on abrupt demonstrations of various global trends such as climate change, digitalization, or on unprecedented course of pandemics. The experience and knowledge we have collected might not be enough for the nonlinear effects on global variables and we are proud that our young minds gathered at 25th EDAMBA edition responded to this call for more scrutiny on social tipping points.

The keynote addresses of 2022 EDAMBA aligned. Professor Michal Kolesar from Princeton University focused on contamination bias and ways how to improve causal inference in linear regressions while Professor Tymofiy Mylovanov from Kyiv School of Economics and University of Pittsburgh addressed the economic impact of the war in Ukraine. The subsequent sessions at the conference involved presentations on impacts of COVID-19 pandemics, Russian invasion to Ukraine, Brexit, as well as on resilience of societies to the risks arisen from these events. In many papers, the new order or qualitatively new state prompted by these events has been identified such as new employment patterns, society regulations. It appears that the past years have witnessed a social tipping point that changed our lives in certain ways potentially forever.

We can only hope that this collection of works can show to our interested readers the evidence they seek in this gradually puzzling world and make enjoyable and inspiring reading.

**Paula Puškárová**

*Conference Chair  
Vice-Rector for Research and Doctoral Studies  
University of Economics in Bratislava*



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# Use of Gamification in Employee Training and Development

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**Abstract.** Gamifying employee training and development is becoming more and more attractive to companies from year to year. By using the right elements of gamification in employee training and development, HRM can identify the strengths and weaknesses of its employees. Training and development programs tailored to the needs of employees can be considered an effective tool for helping employees to transform their weaknesses into strength. The lack of information, research, and comparisons on the ways of gamifying employee training and development focused on employees' soft skills and its effectiveness hinders its wider dissemination. In the article, we identify and describe different situational stories, when gamification is used by HRM to increase, develop employees' soft skills such as: decision making, willingness to change, teamwork and resilience. We also measure the effectiveness of gamified employee training and development focused on their soft skills by comparing the percentage results before and after use of gamification in this area within bank „Technology“.

**Keywords:** Gamification, Employee training and development, HRM.

**JEL classification:** M12, M53, M54

## 1 Introduction

Having well-trained, prepared employees is key because human capital is recognized as a determinant of company's competitive advantage and a major differentiator in today's dynamic, competitive market environment. Employee training and development is the process of improving their skills, abilities, and knowledge to meet specific job requirements.

The use of gamification in employee training and development is becoming more and more attractive to companies from year to year. By using the right elements of gamification in employee training and development, HRM can identify the strengths and weaknesses of its employees. Training and development programs tailored to the

needs of employees can be considered as an effective tool for helping them to transform their weaknesses into strength.

The main goal of this research is to identify ways of gamifying employee training and development to increase its effectiveness by developing, increasing employees' soft skills.

The contribution of this research is in identifying and explaining how HRM gamify employee training and development focused on employees' soft skills and to what extent HRM increase its effectiveness.

We believe that the lack of information, research, and comparisons on the ways of gamifying employee training and development focused on employees' soft skills and its effectiveness hinders its wider dissemination. We expect that the information provided by our article will result in increased interest of companies for implementing this tool in employee training and development programs, especially those that focus on the soft skills of employees.

## **2 Literature Review**

Various authors, researchers, have defined gamification as the process of using or applying game elements and principles in gamified work contexts. This can be understood as the use of game philosophy, game thinking and game mechanics in non-game areas to increase motivation and encourage employees to solve specific tasks. Game components used in gamification can be considered: design, aspects, principles, points, badges, levels, and leaderboards [1,2].

Gamification can also be considered as process, activity of reaching company's goals by having fun. According to Mollick and Rothbard [3], it can be defined based on the perspective of employer – as a tool to engage employees in competition and thus contributing to the achievement of company's goals.

Gamification can have one or few following goals, that can be achieved: to make boring tasks more entertaining, so people are more likely to perform them, to increase employee's motivation, engagement, loyalty, to promote positive organizational culture, to create a friendly atmosphere in teams, to decrease stress level among employees and so [4].

Every year more and more companies are noticed in using of gamification, which can be explained by the fact that the new, digital savvy generations Y and Z prefer to have continues fun at working and to fulfil traditional activities in digital environment [5].

Gamification can be used by HRM as a powerful tool for: recruiting and retaining employees, identifying their strength and weaknesses, designing, and providing proper training, identifying employees with the highest level of performance, motivating, engaging, and promoting them, creating, or modifying their career plans, identifying, and predicting employees, who may leave the company, create the desirable EVP (Employ Value Proposition), increasing attractiveness of Employer Branding, etc. In other words, gamification can help to convert work, company related employees' experiences into more interesting, satisfying, fun, productive, interactive, and playful

at every stage from the training of employees to the onboarding process, product testing, sales force, performance management [6,7,8,9].

## **2.2 Employee Training and Development**

Having well-trained, prepared employees is key, because human capital is recognized as a determinant of company's competitive advantage and a major differentiator in today's dynamic, competitive market environment [10,11,12]. Training and development are the process of improving the skills, abilities, and knowledge of employees to meet specific job requirements [13]. With help of employee training and development HRM can create a win-win situation between employer-employee relationship. Through proper training and development, employee can become more effective, efficient, and more productive, which can lead to higher company performance, efficiency, effectiveness, differentiation, etc. [14].

The main goal of employee training and development is to:

- refresh and develop existing employee's knowledge, skills, and abilities,
- familiarize new employees with the organizational mission, vision, rules, regulations, requirement and working conditions,
- keep employees updated on technological and interval/external environmental changes.

Employee training and development can:

- improve employee's satisfaction and engagement. According to various authors, training and development can help increase employee satisfaction as well as reduce absenteeism and turnover [12,15],
- decrease the level of supervision. A well-trained employee will be well acquainted with the job and will need less of supervision. Thus, there will be less wastage of time and efforts.
- decrease accidents and errors rates. Poorly and improperly trained employees are more likely to have accidents and errors if they lack knowledge and skills required for doing a particular job. On the other hand, well-trained employees can significantly increase company's efficiency level by committing less accidents and errors in job [16],
- increase chances of promotion. By acquiring or developing skills, knowledge and abilities, employees may become more eligible for promotion. Some authors consider well-trained and developed employees to be the company's main asset,
- increase employee productivity. Proper training and development improve efficiency and productivity of employees. Well-trained employees show both quantity and quality performance. Company may have less wastage of time, money, and resources if employees are properly trained [17].

In today's turbulent dynamic market, among other important factors that affect the current or future state of the company, employee preparedness and readiness play a key role in the company's vitality. To remain sustainable in the market, every company needs to pay attention to human capital due to its intangible characteristics, such as knowledge, skills, and abilities [18].

### **2.3 Gamifying Employee Training and Development**

By gamifying employee training and development HRM use game elements, components and mechanisms such are: badges (provides positive reinforcement to employees), leaderboard (helps to raise employees' intrinsic motivations based on competition), levels (gives feedback on employees' progress), rewards (helps to rise employees' extrinsic motivations as experience points and badges can be converted into real world rewards), experience points (earned by employees based on their progress through their training), visualization (video game, avatars, virtual reality), role-play (playing different characters) and so [19,20].

Use elements, components and mechanisms in employee training and development can: make whole process more fun, increase engaging, increase competition, decrease stress, shorten feedback time, increase participant's empowerment and so [20,21].

Before implementing gamification HRM needs to determine specific goal(s), purpose(s) of gamification, which should be achieved in accordance with the needs of its employees. Once the goal(s), purpose(s) of employees training and development have been determined, HRM must carefully select the right game elements, components, and mechanisms to avoid overuse, which may increase employee involvement, engagement but cannot provide any positive results [22].

The use of gamification in employee training and development is becoming more and more attractive to companies from year to year [19]. By using the right elements of gamification in employee training and development, HRM can identify the strengths and weaknesses of its employees. Training and development programs tailored to the needs of employees can be considered an effective tool for helping employees to transform their weaknesses into strength [23].

## **3 Methods**

In the theoretical part of research, we use deduction and analyze methods to identify, analyze current knowledge on employee training and development, gamification and gamifying employee training and development. We also used an induction method on use of gamification in employee training and development. By synthesizing, comparing, and inducting current knowledge, we have identified and defined a gap in how HRM can gamify employee training and development to increase its effectiveness by developing, increasing employees' soft skills. We have identified the lack of knowledge on the ways of gamifying employee training and development focused on employees' soft skills and its effectiveness. Subsequently, we created a research goal and questions for our study.

Main research goal: identify ways of gamifying employee training and development to increase its effectiveness by developing, increasing employees' soft skills.

Research questions: how can HRM gamify employee training and development focused on employees' soft skills? to what extent can HRM increase its effectiveness?

The practical part of the research is based on a case study examining a Greek bank as a main object headquartered in Athens, Greece. The bank's management did not allow us to state the name of their company in our publication and instead offered us to

refer them as „Technology,, bank. They have 412 branches in Greece with approx. 8,900 employees and gamify employee training and development for their clerks since 2018 with help of partner company.

At „Technology,, bank, HRM gamify clerks’ training and development to develop their soft skills such as: decision making, willingness to change, teamwork and resilience. Main source of practical part of research is the statistical report provided by HRM, based on which we identified, analyzed ways of gamifying employee training and development, and measured its effectiveness by comparing its results before and after using gamification. We also used an interview with the HR manager to get a detailed explanation of the statistical report.

## 4 Results

### 4.1 Case Study – Gamifying Employee Training and Development within the Company - „Technology “

HRM at bank „Technology“ headquartered in Athens, Greece use gamification in the employee training and development for their clerks. „Technology“ bank has 412 branches in Greece with approx. 8,900 employees. „Technology“ bank belongs between three leading banks in Greece in terms of market shares in loans and branch network. It provides a wide range of financial products and services for individuals, financial institutions, small and large businesses across Greece.

Gamification of clerks’ training and development is realized on their web-platform and manages to attract hundreds of employees monthly and turns their everyday activities into fun and effective experience. Their gamification includes employee-motivation elements, such as progress bars, ranking, experience points, rewards, leaderboard, visualization, and specialized badges.

Main purpose of gamifying clerks’ training and development is to develop their soft skills such as: decision making, willingness to change, teamwork and resilience. Their gamification is based on roleplay in different working situations, where clerks’ abilities, behaviours and above-mentioned soft skills are evaluated.

**Decision making.** At „Technology “clerks are required to come up with a decision quickly and effectively. HRM pay attention to clerks’ key decision-making ability and skills such as: receive, understand, integrate, and work with information, identify relevance of information, find different options, analyse, and understand pros and cons of each option, forecast their outcomes and select the best variant from available options in particular situation, which can generate best possible results.

HRM gamify decision making process based on roleplay within working situation to increase clerk’s level of confidence in decision-making and their ability to make a quick and right decisions, to choose wisely among different options and to learn from own mistakes in decision-making.

In the gamified decision-making, clerks have different situational stories in which they are free to decide how to behave, manage the situation and apply the required skills correctly and accordingly. For example: in one situational story HRM test clerks’ ability to recognize a problem and take an action to handle it, in other story clerks’ skills



are tested based on situation, when their supervisors are out of office and they have to make quick decision on business matter, in another situational story they need to make decision based on business matter about which they have zero or limited knowledge. HRM also evaluate clerks' ability how they can manage each situation, what outcomes they can get, and how well they can handle outcomes of bad decision made by them.

**Employee willingness to change.** HRM pay attention to clerks' willingness: to adapt on changing, turbulence situations, to show proper behavioural responses in different situations if and when it's necessary, to take, adapt on new, unexpected duties and tasks, to select or modify behaviours and skills in response of changing situations, circumstances, to demonstrate creativity, communication, negotiation and excellent time management skills, to stay calm in face of difficulties, others mistakes and turbulences.

HRM gamify willingness to change process based on roleplay within working situation to increase clerks' ability and skills: to use creative ways of finding innovative solutions in turbulence and unexpected situations, to successfully work with changing priorities, tasks, and workloads, to have effective time-management within unexpected circumstances and to receive feedback or advice.

In the gamified employee willingness to change, clerks have different situational stories in which they are free to decide how to behave, manage the situation and apply the required skills correctly and accordingly. In different situational stories HRM test clerks' ability, skills and behaviours: to task, which is outside of their job description, to task when they had to meet deadline but couldn't manage it because of being interrupted by co-workers, to completely new task, that they have never done before, though team activity when team member's performance do not meet their expectations, to a task that is almost done, but they get sudden and time-consuming new instructions that should be included in the task.

**Resilience.** At „Technology“, it is crucial to have highly resilient clerks. HRM pay attention to clerks' ability and skills: to quickly recover from professional or personal failures, to work on the failure until they find successful, win solution, that can make job done, to easily find a solution that will lead to great results, to perform well under pressure and can easily recover from conflicts, failure, increased workload and personal criticism.

HRM gamify employee resilience based on roleplay within working situation to increase clerks' ability and skills: to perform well under pressure, to stay calm and positive in difficult working situations, to keep work-life balance and well-being, to stay engaged and committed in difficult working situations.

In the gamified employee resilience, clerks have different situational stories in which they are free to decide how to behave, manage the situation and apply the required skills correctly and accordingly. In different situational stories HRM test clerks' ability, skills and behaviours: to situation where they have to work under stress, pressure (how they can handle each situation), to failure caused by working under stress, pressure and ways how they react (give up, find new solution and so.), to criticism about their performance received from their colleagues, clients and supervisor, to deal with an upset customers who communicate their complaints, to the ways of dealing and manage a pressure at work.

**Teamwork.** HRM pay attention to clerks' team working skills, abilities, and behaviours such as: interpersonal interactions, team members' relationships, collaborations among team members on the common goals or visions, verbal, cognitive and behavioural activities needed to reach team's goals, sacrificing personal interests for teams' best, sharing knowledge across the team and learning from others.

HRM gamify employee teamwork activities based on roleplay within working situation in order to increase clerks' ability and skills: to easily understand teams' common goals or objectives that have to be achieved, to develop their teamworking competencies and skills, to freely express their opinions, feelings in the manner that can deliver positive result to teamwork, to keep or even improve performance when company faces new difficulties and challenges.

In the gamified employee teamwork activities, clerks have different situational stories in which they are free to decide how to behave, manage the situation and apply the required skills correctly and accordingly. In different situational stories, HRM test clerks' ability, skills and behaviours: to situation when one or few team members have bad attitude that blocks team performance (how clerk can handle situation, through what skills and behaviours), to situation when clerk doesn't trust other team members in delivering their part of work, to situations when conflict occurred in team, to situation when new changes and challenges were accepted inside the team, to situation when clerk is not able collaborate with his/her co-workers.

**Gamification data.** HRM at the bank "Technology" has been using gamification in employee training and development since 2018. The data presented in Table 1 shows a percentage comparison employee training and development programs' results before and after the use of gamification in the clerks' soft skills: decision-making, willingness to change, resilience, teamwork.

**Table 1.** Clerks' soft skills before and after using gamification.

Clerks' soft skills	Before using Gamification	After using Gamification	Difference
Decision making	78%	94%	Increased by 16%
Willingness to change	69%	81%	Increased by 12%
Resilience	74%	88%	Increased by 14%
Teamwork	65%	83%	Increased by 18%

Source: Data report of „Technology“, 2021

As Table 1 shows, after more than 3 years of using gamification in employee training and development, HRM managed to increase: clerks' decision making skills, abilities by 16% (before gamification 78% - after gamification 94%), their willingness to change by 12% (before gamification 69% - after gamification 81%), their abilities and skills of resilience by 14% (before gamification 74% - after gamification 88%), their teamwork abilities and skills by 18% (before gamification 65% - after gamification 83%).

## 5 Discussion and Conclusion

In the literature, through induction, deduction and comparison of existing knowledge provided by various authors in the form of research articles, papers we defined and explained: characteristics, elements, principles, ways, and areas of using gamification by HRM, characteristics of employee training and development, its importance, goals, benefits, and areas of focus and lastly characteristics of gamified employee training and development, its elements, and potential benefits. By deduction, inducting, synthesizing, and comparing current knowledge, we have identified and defined a gap in how HRM can gamify employee training and development to increase its effectiveness by developing, increasing employees' soft skills. We found a lack of knowledge in this area of using gamification and we set it as the main goal of our research.

The first research questions of this study were to identify, examine how can HRM gamify employee training and development focused on employees' soft skills? Based on case study of our research object - bank "Technology", we identified, explained that HRM gamify their clerks' training and development, which is realized on their web-platform. Through gamification HRM managed to attract hundreds of clerks monthly, turned their everyday activities into fun and effective experience. Their gamification includes employee-motivation elements, such as: progress bars, ranking, experience points, rewards, leaderboard, visualization, and specialized badges. Main areas of gamifying clerks' training and development is to increase and develop their soft skills such as: decision making, willingness to change, teamwork and resilience. Their gamification is based on roleplay in different working situations, where clerks' abilities, behaviours and mentioned soft skills are tested based on different, specific challenges.

The second question of this research was to identify to what extent can HRM increase effectiveness of clerks' training and development? Based on the statistical report of the bank "Technology", we compared employee training and development programs' perceptual results before and after the use of gamification in the clerks' soft skills: decision-making, willingness to change, resilience, teamwork. We found that after more than 3 years of using gamification in employee training and development, HRM managed to increase: clerks' decision making skills, abilities by 16% (before gamification 78% - after gamification 94%), their willingness to change by 12% (before gamification 69% - after gamification 81%), their abilities and skills of resilience by 14% (before gamification 74% - after gamification 88%), their teamwork abilities and skills by 18% (before gamification 65% - after gamification 83%). We have proven, that gamification can increase effectiveness of employee training and development in employees' soft skills.

By answering research questions, we succeeded to fulfil goal of our research, which was to identify ways of gamifying employee training and development to increase its effectiveness by developing, increasing employees' soft skills.

Gamifying employee training and development to increase and develop clerks' soft skills has an impact on their career growth at the bank "Technology", as HRM can easily see how well and on what level they are ready to be promoted on new job position by measuring, controlling required skills, knowledge, behaviours, and abilities.

Gamifying clerks' soft skills is recognized as one of the main influencing factors of company's benefits, as possibility of training and development is on third place among most wanted benefits at bank "Technology". Through gamifying of this area HRM can see, which branch has employees with highest soft skills and can predict their future performance at bank "Technology".

Our research has several barriers, limitations in the application of its results, which may also be topics of future research. Our study does not provide information on whether gamifying employee training and development can increase and develop clerks' soft skills with equal effectiveness for all age groups, as results of the elder generation may differ from the younger ones. We have also not proven whether the increase in the results of employee training and development can be transferred at the same level to real performance. Results of our study provided insights on the employee training and development over a period of 3-4 years, and we couldn't identify and show how the impact of gamification can change on increasing and developing clerks' soft skills in the long run.

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# Factors Affecting the Financial Performance of Enterprises Listed on the Slovakia Stock Exchange

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**Abstract.** The financial performance of a company is one of the key indicators that show the public whether the company is doing well, moreover, improving financial performance should be a top priority in order to be attractive to investors. Financial performance is reflected in financial statements, which provide financial information by which investors make their investment decisions. A company's performance could be explained as the rate of achievement of set targets. The aim of this study is to find out the factors that affect financial performance and identify the key factors among the selected ones. The subject of this study is the companies listed on the Stock Exchange of the Slovak Republic during the period 2010-2021. The data for this study is based on secondary data collected by analysing the financial statements of the selected companies. The data is then analysed using IBM SPSS Statistics 26 software. The research findings yielded the following results: all the selected independent variables show an impact on financial performance. Firm age showed a clear positive effect, cost of capital showed a clear negative effect and factors such as liquidity, debt, firm size and credit risk did not show a clear negative or positive effect.

**Keywords:** Company performance, Cost of capital, Credit risk, Firm age, Firm size, Leverage, Liquidity, Multiple regression, Slovak Stock Exchange.

**JEL classification:** C19, P47

## **1 Introduction**

Financial performance determines the level at which a company generates revenue and manages its assets, liabilities and the financial interests of its shareholders and stakeholders. The most commonly used financial performance ratios include Gross Profit, Net Profit, Working Capital, Operating Cash Flow, Current Ratio, Debt-to-Equity Ratio, Inventory Turnover, Return on Equity. Before investing their funds, investors should first obtain information about the company's performance. The easiest way to find out a company's performance is to look at the company's financial statements. Thus, financial performance emphasizes variables directly related to financial management. In addition, a new trend is emerging - corporate sustainability, from voluntary engagement in sustainable activities to requirements arising from societal expectations and regulatory pressure. The number of companies using sustainability strategies and disclosing environmental, social and governance information is steadily increasing. [31]

Given the importance of firm performance and the availability of influencing variables, the topic remains topical and often debated. Moreover, firm performance plays an important role in the structure and development of a firm, but its improvement is often challenged by many factors that lead to a slowdown. High financial performance attracts the main attention of every manager, including trade creditors, bondholders, investors and employees. Therefore, the study of the determinants of financial performance becomes essential for companies in every industry.

It is essential to use financial performance analysis to evaluate financial performance and the influencing factors. Financial performance analysis is the process of identifying operational and financial characteristics to determine efficiency. This study examines how financial and non-financial factors such as leverage, liquidity, size, age, credit risk, cost of capital and others affect the financial performance of firms. These factors can be easily measured using available data.

## **2 Financial performance of enterprises**

Although there has been a growing interest in studying the relationship that may exist between stock market liquidity and the economic performance of companies, studies have been done only sparingly in this regard. Three measures namely Economic Value Added (EVA), Return on Investment (ROI) and Return on Assets (ROA), can be used to assess the economic performance of companies, each of which has specific advantages. [5]

The literature has long examined the relationship between financial performance and other factors that affect it. Consequently, this interaction is comprehensively analysed in a regression framework. The results for causal effects are then revealed by replacing the dependent and independent variables, they are accepted as a strong indicator. [15]

Performance measurement is an integral part of managing any business strategy and is constantly evolving as a separate body of knowledge with a primary focus on financial performance. [32] The association of EVA and traditional performance

measures with stock prices and stock returns suggests an insignificant correlation of stock prices or stock returns with EVA or residual income. On the other hand, scholars establish the relationship between the firm's market value added, current operating value, and the value of future growth. Their result further reinforces the importance of EVA in predicting the market value of firms. [7,29]

As corporate social responsibility (CSR) continues to be a hot topic for firms and the investment community, many of the largest firms are not only investing significant resources in implementing these initiatives but are also working to disclose their social activities to various stakeholders and potential investors through a variety of including annual sustainability reports. Given the increased attention paid to CSR by financial markets, it is not surprising that firms with good performance seem to have better access to capital. In addition, green bonds are becoming more prevalent to finance CSR-focused projects among firms where environmental issues are particularly acute. [6]

## **2.1 Factors affecting financial performance**

Leverage refers to the relative proportion of equity and debt that a company has in its financial structure. As an alternative to the debt-equity ratio, we use the equity ratio, which measures the proportion of total assets financed by shareholders rather than creditors. Leverage shows the potential risks or rewards that shareholders face in different economic situations. When a company makes an economic profit, shareholders of companies with low debt receive a high return. [18] The link between financial performance and leverage is undeniable. Various authors in the 20th century suggested the direction of the current capital structure theory, the ideal debt-equity ratio maximizing the value of the firm should be as low as possible. From the lender's point of view, it should reach a maximum value of 1. [26]

Liquidity is defined as the immediacy of repayment of liabilities. Operating liquidity is a major area of working capital and is therefore also referred to as working capital management policy in the financial literature. The main components of liquidity include the amount of cash and cash equivalents, accounts receivable and inventories as expressed in the financial statements. [26]

Both pecking order theory and trade-off theory consider firm size as a variable of capital structure. Firm size is an inverse proxy for bankruptcy costs and earnings volatility. [25] The pecking order theory also predicts that firm size is positively correlated with leverage, as a large firm has high quality and reliable information, which allows for a declining cost of debt. Further research also confirms that firm size is positively correlated with leverage. In [12], the authors also incorporate one of the basic organizational characteristics into the analysis - firm size and the advantage caused by family involvement is significant in private firms with different scales. The static positive effect of family involvement decreased as the scale of the firm increased. After reaching a certain scale, family involvement would have a negative effect on firm performance. [20]

The age of the company means the number of years the company has been in operation. According to [10], shares are negatively related to the age of companies and the results also suggest that obsolete companies are better at using short-term debt than



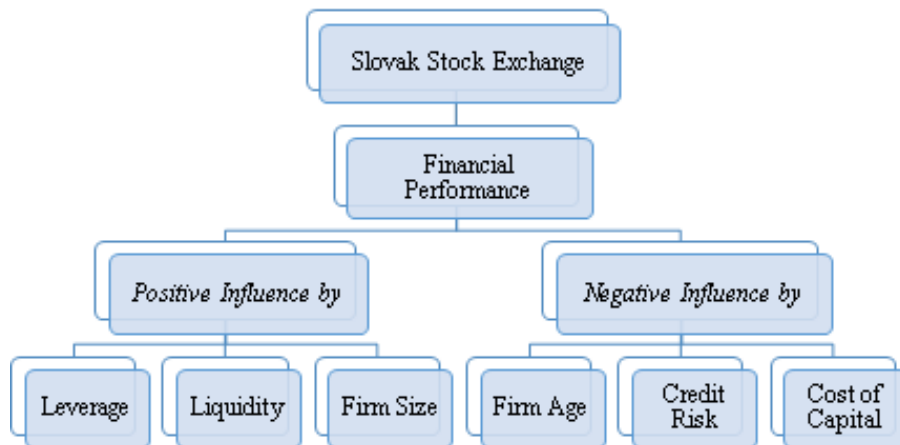
younger companies. Also, [24] provide evidence that there is a negative correlation between leverage ratio and the age of companies. A young company might be forced to accept debt if it faces constraints in raising the finance it has retained in the first year.

The results of various studies and empirical evidence point to a mixed trend in the impact of credit risk on performance. While some declare a negative relationship between performance and credit risk, some have found a positive relationship. Moreover, some results confirm no relationship between credit risk and profitability. Total risk is mostly considered as a determinant of performance. [22]

The cost of capital is the price of external financing and hence the rate of return required by investors. It is also defined as the cost of raising fund or capital. It is the rate paid for the use of capital. Equity and debt are the only source of financing for firms and the only component of the cost of capital. [16] The reservoir theory points out that the purpose of holding financial assets is to prevent the distortion and distribution of capital caused by cash flow shocks that adversely affect business operations. [32]

### 3 Goal and methods

The purpose of the study is to investigate how and whether Financial Performance is affected by selected variables: leverage, liquidity, size, age, credit risk, cost of capital. The fulfilment of the main objective is preceded by the sub-tasks of selecting the independent variables - as discussed below, selecting the method of measuring the dependent variable, selecting the method of calculating the dependent variable, and finally calculating according to the selected variables using the selected method.



**Fig. 1.** Thinking framework

Subsequently, a sample was selected - companies listed on the Slovak Stock Exchange with consistently disclosed data on their financial statements. Furthermore, the research period 2010 - 2021 was selected, which represents a total of 33 data samples.

**Table 1.** Sampling criteria

<b>Sampling criteria</b>	<b>Total</b>
Number of firms listed at Slovak Stock Exchange	3
Number of firms listed at Slovak Stock Exchange with consistently published data of their financial statements in the year of the study, the reporting year 2010 – 2021.	3
Companies which fulfil the criteria	3
Research period 2010 to 2021 (Number of years)	11
Total data used as sample	33

### 3.1 Operational definition and the measurement of scale financial performance

Financial performance is measured using **economic value added (EVA)**. EVA was established by Stern Stewart in 1993 and is one of the methods of evaluating financial performance. EVA has become very popular as "the wonder drug of the millennium in overcoming all corporate ills at once and ultimately helps in increasing shareholder wealth, which is synonymous with maximizing firm value" [8]. EVA is defined as the difference between NOPAT (net operating profit after tax) and the cost of capital - WACC (weighted average cost of capital) multiplied by CI (capital invested). [33] In the study, a well-known formula was used:

$$EVA = NOPAT - WACC \times CI$$

According to Ali et al. **leverage** has a negative but statistically significant effect on firm performance. In this study [2], leverage is measured by the debt-to-equity ratio (DER). According to [27], the debt-to-equity ratio is the total liabilities of a firm divided by its total equity. The formula is as follows:

$$Debt - to - EquityRatio(DER) = \frac{Total\ Debt}{Total\ Equity}$$

**Liquidity** refers to a firm's ability to meet its obligations as they fall due and has an impact on firm performance [14]. In this study, liquidity is measured by Current Ratio (CR) as:

$$Current\ Ratio\ (CR) = \frac{Current\ Assets}{Current\ Liabilities}$$

According to [19], there is a positive relationship between **firm size** and financial performance. Absolute firm size plays a significant role in firm performance along with other factors. The following formula has been used to determine the value of firm size:

$$Firm\ Size = \text{Logarithm Natural (LN) of Total Assets}$$

**Firm age** is a relevant variable that should be given due consideration in the context of firm performance. A positive effect of this variable on performance is observed in the early years. We also encounter a contradictory effect, namely that firm age on the one hand increases experience, but on the other hand it also increases rigidity. [11] In the study, the year of the firm's establishment was used to determine the age of the firm, as shown in the following formula:

$$\text{Firm Age} = \text{The number of years since establishment}$$

**Credit risk** is the probability that a borrower will default on its debt obligations. This condition will affect the capital structure of the firm. According to [3], there is a negative relationship between a firm's capital structure and firm performance. The formula is as follows:

$$\text{Credit Risk} = \frac{\text{External Sources}}{\text{Total Assets}}$$

Both long-term and short-term debt has a negative and significant impact on firm performance. [23] **Cost of capital** must be considered as a vital variable that affects firm performance. For the purpose of this study, the cost of capital is calculated as the weighted average cost of capital (WACC) representing the average rate of return that the firm expects to pay to all its shareholders including debt holders, equity shareholders and preference shareholders. The formula is as follows:

$$\text{WACC} = \text{Cost of Equity} \times \%E + \text{Cost of Debt} \times \%D \times (1 - TR)$$

The data collected in this study is secondary data that comes from the financial statements of the companies that were used as a sample. The data was obtained from the available sources from portals like Finstat, Register of Accounts and the data on Beta coefficient and ERP required for the calculation of EVA were drawn by Damodaran.

### 3.2 Data analysis method

#### **Descriptive statistics**

In this study, we used descriptive statistics, which are generally used to tabulate or graphically represent the data obtained. In this study, we used descriptive statistics using tabular representation to show the number of samples, mean, maximum, minimum, standard deviations and results obtained from the data under study.

#### **Pearson test (correlation test)**

Pearson's correlation coefficient is used to measure the strength of the linear association between two variables. The coefficient is denoted by the letter r. The

correlation represents the degree of monotonic association between two variables. A monotonic relationship between variables is defined as a relationship where:

1. the value of one variable increase and the value of the other variable also increases.
2. the value of one variable increase and the value of the other variable decreases. [28]

The coefficient is considered to be a dimensionless measure of covariance that ranges from -1 to +1. [30] A value of 0 means that there is no correlation between the two variables under study. A value greater than 0 indicates a positive association between the variables, a value less than 0 indicates a negative association between the variables.

### **Normality test**

Normal distribution is the most important probability distribution. Various statistical methods used to analyse data assume the normality of the data they are working with, including correlation, regression, t-tests, and analysis of variance. [4] Incorrect selection of representative data and subsequent calculation of significance levels (p-values) can provide incorrect interpretations. [17]

Therefore, we initially test the normality of the collected data. There are two ways to assess the normality of the data: graphical and numerical. [9]

We know various methods to test the normality of data, the most popular of which are Shapiro-Wilk test, Kolmogorov-Smirnov test, box plot, P-P plot and Q-Q plot. Two well-known normality tests, the Kolmogorov-Smirnov test and the Shapiro-Wilk test, are the most widely used methods for testing the normality of data. [21]

The Shapiro-Wilk test is more appropriate when working with a smaller sample of data ( $n < 50$ ), although it can be used with a larger sample. For a larger sample of data ( $n \geq 50$ ), the Kolmogorov-Smirnov test is used. In both of the above tests, the null hypothesis that the data have a normal distribution is given. When the p-value  $> 0.05$ , we consider the null hypothesis accepted and state that the data are normally distributed. [21]

### **Durbin-Watson test (autocorrelation test)**

Autocorrelation represents a series of dependencies of random variables or residuals. Autocorrelation is a series of dependencies of random variables or residuals. The Durbin-Watson (DW) test is the most common first-order autocorrelation test in regression analysis. It can be used with a larger sample that has a normal distribution. However, this test has some limitations, such as:

- The critical value depends on the matrix, which can lead to an "indeterminate result".
- Only valid for first order autocorrelation.
- Not suitable for dynamic model. [1]

The value of the test statistic should range from 0 to 4. If the test statistic is less than 2, we can speak of positive serial autocorrelation. If the test statistic shows values greater than 2, then we speak of negative serial autocorrelation.

### Multiple regression analysis

Multiple regression analysis was used because we were examining the impact of several independent variables (leverage, liquidity, firm size, firm age, credit risk and cost of capital) on one dependent variable, which was the financial performance of the company represented by EVA. The following multiple regression analysis equation was used for the calculation: [13]

$$Y_{it} = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \epsilon_{it}$$

## 4 Results

The authors used IBM SPSS Statistics 26 software to analyse the data collected for the period 2010-2021. In the following section, the tables present the results they obtained along with their interpretation.

**Table 2.** Descriptive statistics Company A

	<i>Minimum</i>	<i>Maximum</i>	<i>Mean</i>	<i>Std. Deviation</i>
<b>DER</b>	0.053975	3.762281	1.759133	1.269690
<b>CR</b>	0.182782	33.405597	5.53998	9.134576
<b>FS</b>	19.477110	20.027345	19.759682	0.210525
<b>FA</b>	18.000000	29.000000	23.500000	3.606000
<b>CRisk</b>	0.088183	0.822037	0.583257	0.290613
<b>CC</b>	1.990572	22.349178	8.881818	6.638212
<b>FP</b>	-6 276 470 789	0.000000	-1 983 142 695	2 141 741 794

According to the results of descriptive statistics of Company A, the authors found that the main dependent variable Financial Performance (FP) showed negative values as the maximum value of the variable was 0. The values of the independent variables were in positive numbers during the reference period as their minimum values were greater than 0.

**Table 3.** Descriptive statistics Company B

	<i>Minimum</i>	<i>Maximum</i>	<i>Mean</i>	<i>Std. Deviation</i>
<b>DER</b>	-11.421704	13.058406	2.1722041	7.473035
<b>CR</b>	0.304721	1.703682	0.981393	0.439209
<b>FS</b>	17.553561	19.156576	18.311431	0.529915
<b>FA</b>	18.000000	28.000000	23.000000	3.317000
<b>CRisk</b>	0.879358	1.398585	1.088082	0.205253
<b>CC</b>	-9.982173	2.590988	-1.976061	4.591369
<b>FP</b>	-88 116 247	38 773 799	69 668 316	179 884 518

According to the results of the descriptive statistics of Company B, the authors state that the main, i.e., the dependent variable FP showed negative values in some years, since the minimum value of the variable was - 88 116 247 and the maximum value was 38 773 799. The values of the independent variables for the period under review were in the positive range in most cases, as their minimum values were greater than 0. In the case of financial leverage (DER) and cost of capital (CC), the values reached negative numbers DER - 11.421704 and CC - 9.982173.

**Table 4.** Descriptive statistics Company C

	<i>Minimum</i>	<i>Maximum</i>	<i>Mean</i>	<i>Std. Deviation</i>
<b>DER</b>	0.000021	0.315492	0.131363	0.106057
<b>CR</b>	1.629110	6.167333	2.862865	1.465373
<b>FS</b>	17.233356	17.823413	17.532625	0.192717
<b>FA</b>	18.000000	28.000000	23.000000	3.317000
<b>CRisk</b>	0.104933	0.336381	0.235066	0.076586
<b>CC</b>	0.000000	19.901125	14.754992	5.454369
<b>FP</b>	-926 952 865	9 223.372037	-539 858 351	229 047 586

According to the results of the descriptive statistics of Company C, the authors conclude that the dependent variable financial performance showed negative values in some years, since the minimum value of the indicator was - 926,952,865 and the maximum value was relatively low only 9,223.372037. The values of the independent variables ranged in the positive range during the period under study as their minimum values were greater than 0. In the case of CC and DER, it can be said that the values were equal to 0.

**Table 5.** Coefficient of Determination

	<i>R</i>	<i>R Squared</i>	<i>Adjusted R Squared</i>
<b>Company A</b>	0,995	0,990	0,927
<b>Company B</b>	1,000	0,999	0,996
<b>Company C</b>	0,982	0,982	0,875

According to the above table, the correlation coefficient (R), which represents the correlation between the dependent and independent variables, is greater than 0, which means that the relationship between the selected variables is positive. Based on this fact, the authors hypothesized that all the selected factors should have a positive effect on financial performance. However, this fact could not ultimately be confirmed.

The adjusted R-squared indicates that the independent variables describe the dependent variable in Company A at 92.7%, in Company B at 99.6% and in Company C the independent variables can only describe the dependent variable at 87.5%.

The following tables show the regression results of each factor on the financial performance of all companies. These results are based on the assumption that if one independent variable increases by one unit, the other independent variables remain constant.

**Table 6.** Coefficient of Regression Company A

	<i>Coefficients</i>	<i>Std. Error</i>	<i>t Stat</i>	<i>P-value</i>
<b>FP</b>	204 994 000 000	159 852 000 000	1.28239	0.25593
<b>DER</b>	1 662 949 639	843 867 104	1.97063	0.10583
<b>CR</b>	-146 889 680	48 653 411	-3.01910	0.02944
<b>FS</b>	-11 517 593 724	8 696 450 299	-1.32440	0.24267
<b>FA</b>	914 189 562	511 397 453	1.78763	0.13387
<b>CRisk</b>	-6 090 475 328	3 030 667 817	-2.00961	0.10069
<b>CC</b>	74 377 453	79 505 885	0.93549	0.39247

According to Company A's data, the authors used multiple regression to arrive at the following results:

- If the financial leverage variable increases by 1-unit, then financial performance increases by 1,662,949,639 units.
- If the liquidity variable increases by 1-unit, then financial performance decreases by -146,889,680 units.
- If the firm size variable increases by 1-unit, then financial performance will decrease by -11,517,593,724 units.
- If the firm age variable increases by 1-unit, then financial performance increases by 914,189,562 units.
- If the credit risk variable increases by 1-unit, financial performance decreases - 6,090,475,328 units.
- If the cost of capital variable increases by 1-unit, then financial performance will increase by 74,377,453 units.

**Table 7.** Coefficient of Regression Company B

	<i>Coefficients</i>	<i>Std. Error</i>	<i>t Stat</i>	<i>P-value</i>
<b>FP</b>	6 260 600 212	9 155 753 488	0.68378	0.53166
<b>DER</b>	-3 027 123.103	8 111 199.431	-0.37320	0.72793
<b>CR</b>	-63 840 411.74	165 474 516.1	-0.38580	0.71928
<b>FS</b>	-284 367 243.2	412 363 937.6	-0.68960	0.52836
<b>FA</b>	-38 562 427.1	65 761 858.05	-0.58639	0.58910
<b>CRisk</b>	-70 432 957.66	129 455 396.1	-0.54407	0.61529
<b>CC</b>	-19 821 355.34	17 464 968.26	-1.13492	0.31980

According to the data on Company B, the authors use multiple regression to arrive at the following results:

- If the financial leverage variable increases by 1-unit, then financial performance decreases by - 3,027,123 units.
- If the liquidity variable increases by 1-unit, then financial performance decreases by - 63,840,411-units.
- If the firm size variable increases by 1-unit, then financial performance decreases by - 284,367,243 units.
- If the firm age variable increases by 1-unit, then financial performance decreases by - 38,562,427 units.
- If the credit risk variable increases by 1-unit, then financial performance will decrease by - 70,432,957 units.
- If the variable cost of capital increases by 1-unit, then financial performance decreases by - 19,821,355 units.

**Table 8.** Coefficient of Regression Company C

	<i>Coefficients</i>	<i>Std. Error</i>	<i>t Stat</i>	<i>P-value</i>
<b>FP</b>	51 227 653 270	14 863 545 521	3.4465	0.02613
<b>DER</b>	752 027 011.6	1 622 866 841	0.46339	0.66717
<b>CR</b>	11 838 404.58	31 341 811.98	0.37771	0.72482
<b>FS</b>	-2 830 314 215	790 117 817.8	-3.58214	0.02312
<b>FA</b>	-85 028 358.04	45 313 630.28	-1.87644	0.13383
<b>CRisk</b>	1 014 584.985	2 471 668 443	0.00041	0.99969
<b>CC</b>	-20 112 535.27	7 631 414.073	-2.63549	0.05785

According to Company C's data, the authors obtained the following results based on multiple regression:

- If the financial leverage variable increases by 1-unit, then financial performance increases by 752,027,011-units.
- If the liquidity variable increases by 1-unit, then financial performance increases by 11,838,404 units.
- If the firm size variable increases by 1-unit, then financial performance decreases by -2,830,314,215 units.
- If the firm age variable increases by 1-unit, then financial performance decreases by - 85,028,358 units.
- If the credit risk variable increases by 1-unit, then financial performance increases by 1,014,584 units.
- If the variable cost of capital increases by 1-unit, then the financial performance decreases by - 20,112,535 units, while the other independent variables remain constant.



Based on the results shown in Tables 6, 7, and 8, the authors agreed that the key factors that should be more closely monitored in companies include cost factors and therefore credit risk along with the cost of capital due to the negative impact reporting. Other factors that the authors consider important are leverage and liquidity. These factors show higher values in all three companies among the factors studied.

**Table 9.** Coefficient of Regression Result

	<i>F-statistics</i>	<i>Prob. F-statistics</i>
<b>Company A</b>	3.839356	0.080695
<b>Company B</b>	0.931951	0.553998
<b>Company C</b>	5.313840	0.063939

According to the above F-statistic data, (Company A) 3.839356; (Company B) 0.931951 and (Company C) 5.313840, the authors conclude that the value is higher than the tabulated F-statistic value of 3.2172 in two out of three cases. Based on this, it is proved that there is an effect of leverage, liquidity, firm size, firm age, credit risk and cost of capital on financial performance when they are compared simultaneously. This is supported by the fact that the probability values of the F-statistic are higher than the alpha significance level of 0.05.

## 5 Conclusion

As shown in the introduction, financial performance should be one of the most important indicators that companies should focus on. Not only does financial health help to meet stated objectives, but such companies appear more attractive for investment opportunities to new investors, who in turn can increase their economic strength. In this study, we investigated the factors that affect the financial performance of companies listed on the Slovak stock exchange. Based on the results of the analysis conducted by the authors using data of companies listed on the Slovak Stock Exchange for the period 2010-2021, we have reached the following conclusions:

**Table 10.** Coefficients of Correlation

	<i>Company A</i>	<i>Company B</i>	<i>Company C</i>
<b>DER</b>	0.637	-0.503	-0.253
<b>CR</b>	-0.732	0.119	-0.370
<b>FS</b>	0.599	-0.179	-0.712
<b>FA</b>	0.683	0.025	0.527
<b>CRisk</b>	0.721	0.801	-0.299
<b>CC</b>	-0.763	-0.829	-0.429

In the analysis of the first independent variable, Leverage, there is a significant negative impact on financial performance. A strong negative correlation was shown for companies B and C (company B -0.503; company C -0.253).

Moreover, liquidity shows a negative impact on financial performance as demonstrated for companies A and C (Company A -0.732; Company C -0.370). Company B (0.119) shows a moderate positive correlation.

The independent variable firm size affects financial performance in both ways, which may be due to the large differences in the amount of assets of the companies, specifically Company A (0.599) shows a strong positive correlation due to the many times larger assets of the firm compared to Companies B and C.

Firm age shows a clear positive correlation, the longer a firm has been in the market, the more experience it has, which translates into an improvement in financial performance.

The independent variable Credit Risk can have a positive or negative impact on financial performance, and the authors hypothesize that the impact of this variable on financial performance may depend on other financial factors that vary from company to company.

Finally, Cost of Capital clearly shows a strong negative correlation with financial performance for each company A (-0.763), B (-0.829), C (-0.429).

In conclusion, the study has shown a significant effect of all the selected variables on the financial performance of the sample companies. However, the authors' assumption based on Table 5 that all factors would have a positive impact was not confirmed. The results showed that only Firm Age has a clear positive impact, which proves that companies operating in the market longer have more experience and information, which is reflected in the financial performance. Cost of Capital showed a clear negative impact, which was expected since costs generally negatively affect financial performance. Leverage, Liquidity, Firm Size and Credit Risk do not show a clear positive or negative impact on financial performance. This ambiguous effect for the factors may be due to size differences among the companies studied.

In conclusion, the authors confirm their statement that the key factors influencing the financial performance of companies include, credit risk, cost of capital, leverage and liquidity.

## **6 Limitations and recommendation**

The authors are aware that the study they have conducted has its limitations. The sample they use is limited by the number of companies listed on the Slovak stock exchange. They use only six independent variables that have an impact on the financial performance of the firm. In the study, they analyse a short period that does not reflect the overall condition of the selected companies, namely the period 2010-2021 and there is a difference in size between the companies studied.

These limitations can serve as a basis to extend the issue under study to a larger market, a larger number of independent variables, which affect financial performance, and consider a longer time period to provide a more comprehensive view of the state of the companies studied.

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# Use of Frameworks, Norms and Standards in Information Technology Service Management

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**Abstract.** Information Technology Service Management (ITSM) can be defined as the implementation, management and provision of quality information technology services that meet the needs of the enterprise to support business goals and customer needs in the area of IT operations. ITSM is an important factor in the success of many organizations and for this reason a large number of norms, standards, frameworks and models have been created (ITIL, COBIT, ISO/IEC 20000, ETOM, TOGAF, MOF and others) through which the company can use best practices and management practices information technology services. The most widely used standard is ITIL, which in its current version is aligned with the digital technologies of the digital era, so that together with consumers they create value, support business strategy and embrace digital transformation. The aim of the scientific article is to map the use of conceptual frameworks, norms and standards in the field of information technology service management. Business entities should use frameworks, standards and norms to be competitive, efficient and more profitable.

**Keywords:** IT Service Management, ITSM, ITIL

**JEL classification:** *M15*

## 1 Introduction

Information Technology is an important aspect of the business of business entities, their implementation and use is growing due to digitalization, the use of digital technologies and digital transformation. Business entities are forced to use IT for the purpose of carrying out business activities, the transition to electronic business, it is also necessary to use them when communicating with public administration institutions. Information technology has great benefits in business entities, but for the efficiency and execution of business activity, it needs to be managed and managed, which will be an approach to design, deliver, manage and improve the way in which businesses use IT success is not accidental, but it is considered and deliberate implementation of IT service delivery

excellence. IT administration and management is mostly a long-term process with a series of coordinated transitional steps to achieve the desired improvement. With proper planning, communication and implementation, ITSM can elevate small and medium-sized companies in terms of growth and profitability. IT service management is not going away, but rather will evolve to meet the needs of businesses. New digital technologies (Artificial Intelligence, Cloud Computing, Internet of Things, Automation and other) can help streamline processes or automate changes, but the need to manage services according to business expectations will remain.

## **2 Literature review**

Management and managerial work represent a special kind of interaction between a person and the environment through information (Szabo, 2016). Today, information, knowledge and processing capacity are constant and ubiquitous, and the growing connections between people, objects, devices and systems are changing the conditions under which individuals, businesses and societies live and function (Brunetti et al., 2020). An essential part of modern tools are economic information forming elements of the information subsystem of the economic system, and links in the information system express information flows (Kokles & Romanová, 2014). Yandri et al. (2019) state that information along with information technology (IT) and information systems (IS) are extremely important guidelines for achieving corporate governance success.

Information technology includes any technology or equipment (computing, telecommunications, consumer electronics and broadcasting) used by a company, institution or any other organization that works with information. (Grauer, 2001). ISACA, international professional association focused on IT Governance (2022) defines information technology as hardware, software, communication and other facilities used to input, store, process, transmit and output data in whatever form. Information and communication technology (ICT) is an umbrella term encompassing any communication device or application (e.g. mobile phones, computer or network hardware, software, internet and satellite systems) and also refers to the various services associated with them (Schiliro & Choo, 2017). For most companies, IT is one of the most important assets in the infrastructure of organizations (Serrano et al., 2021) and the main tool for business changes in private and public sector organizations (Juiz & Tomme, 2015). Harguem (2021) states that information technology is revolutionizing the world of business, in addition to providing support for daily operations, IT is an integral part of business processes within and outside the organization.

In many organizations, information technology has become crucial in the support, sustainability and growth of business, and the pervasive use of technology in organizations has created a critical dependence on IT that requires a specific focus on IT Governance (De Haes & Van Grembergen, 2009; Almeida, Pereira & Silva, 2013). Organizations are increasingly dependent on information technology for competitive advantage through extensive use of information, effective operational control, rapid innovation, speed to market and increased customer satisfaction (Hiekkanen et al., 2013). Dependence on information technology in business is growing, as is its

complexity, forcing organizations to manage IT more effectively (Serrano et al., 2021). One of the consequences of the growing dependence on technology is that IT management is becoming a key factor in organizations, especially during the current period of the COVID-19 pandemic (Rubio Sánchez, 2021). According to Al-ashmoery et al., the use of information technology in enterprises. (2021) increased because organizations focus on implementing their services and processes using IT concepts to guarantee the quality of business processes and services and accordingly it is important for every organization to use ITSM concepts - Information Technology Service Management to develop their activities.

## **2.1 Information Technology Service Management**

The key to success in using technology is not the technology itself, but the ability to manage it well (Lucas, 2005). Brenner (2006) states that providing information technology to customers with better and guaranteed quality has been the goal of many diverse efforts that are carried out under the common denominator of "IT Service Management". The term "IT Service Management" or "Information Technology Management" under the abbreviation "ITSM" was introduced in the 1980s, when it was primarily used in the management of data centers. During those years, the role of IT changed its focus from software development to IT service management with responsibility throughout the IT service life cycle (Kubiak & Rass, 2018).

ITSM is a part of service science that focuses on IT operations such as: service delivery and service support (Galup et al., 2009). IT services (ITS) are services provided through IT, processes and people (Mora et al., 2020). ITS have a great impact on competitive advantage because they are important for effective and efficient management (Serrano et al., 2021). ITSM services are means of providing value to customers by facilitating the results that customers want to achieve without owning specific costs and risks (Mora et al., 2020).

ITSM according to Young (2000) can be defined as a set of processes that work together to ensure the quality of active IT services according to service levels agreed by the customer. ITSM is defined as an approach to IT operations characterized by an emphasis on IT services, customers, service level agreements, and managing day-to-day IT activities through processes (Conger, Winniford, & Erickson-Harris, 2008). Conger, Winniford & Erickson-Harris (2008) also state that ITSM focuses on defining, managing and delivering IT services to support business goals and customer needs, usually in the area of IT Operations. ITSM is a process-oriented discipline that combines process management and environmental best practices into a standard approach to optimizing IT services (Mesquida, Mas et al., 2012). IT service management is the implementation and management of quality IT services that meet business needs (Binders & Romanovs, 2014; Mora et al., 2020 ) and is performed by IT service providers through an appropriate mix of people, processes and information management (Binders & Romanovs, 2014 ). ITSM refers to the principle that uses generally accepted "good practices" to organize processes and people around customer-oriented services, rather than around tasks related to the management of systems and physical infrastructures (Winkler & Wulf, 2019). Axelos (2021) states that ITSM is a



concept that enables organizations to maximize business value from the use of information technology and positions ITS as a key means of delivering and capturing value when an internal or external provider collaborates with business customers while taking responsibility for associated costs and risks. . Atlassian (2021) states that ITSM is the way IT teams manage the end-to-end delivery of IT services to customers and this includes the processes and activities aimed at designing, creating, delivering and supporting IT services. Information Technology Service Management, according to Serrano et al. (2021) considers it as a set of frameworks that support service management organizations - helping IT service providers to improve their service management practices and further according to the authors, ITSM focuses on IT operations and especially on service delivery and support - supports organizations in adding value to their services by improving their quality. IT Service Management is an IT management process framework designed to align IT service delivery with customer needs (UC Berkley, 2022).

The goal of ITSM is to optimize IT services to meet business requirements and manage IT infrastructure while better aligning IT with organizational goals (Galup et al. 2009). Unlike more technology-oriented approaches to the operation of information technology, ITSM considers its primary goal to design and provide IT services that meet customer requirements (Wulf, Winkler & Brenner, 2015). The main task of IT service management is the stable operation of the IT infrastructure (Kubiak & Rass, 2018).

## **2.2 Norms, frameworks and standards of IT Service Management**

ITSM is becoming an important success factor for many organizations and a large number of ITSM standards and models have been created to provide guidance on how services can be managed throughout their lifecycle (Calvo-Manzano, 2015). Various process frameworks can be used to improve IT service management processes (Lahtela & Jäntti, 2016). In order to achieve effective and efficient IT service management, many organizations invest in IT service management frameworks (Shrestha et al., 2020; Serrano et al., 2021). Due to the popularity of ITSM frameworks, an increasing number of companies are implementing reference models to improve their ITSM processes (Trinidad, Orta & Ruiz, 2021). Kubiak & Rass (2018) state that ITSM frameworks and processes bring together a set of best practices for the ITS lifecycle, and a best practice is defined as a method or technique that consistently performs better than its alternatives. According to Sturm, Pollard & Craig (2017), ITSM practices are well defined across the industry and provide a common language and framework that enables cross-functional IT professionals to collaborate more effectively.

The most used ITSM conceptual frameworks include:

1. **Information Technology Infrastructure Library (ITIL)** – an adaptable ITSM framework providing comprehensive, practical and proven guidance that supports traditional service management activities. The latest version of ITIL 4 updates ITIL by reworking most of the common ITSM practices in the broader context of customer experience, value streams and digital transformation, as well as by adopting new ways of working such as: Lean,

Agile and DevOps. ITIL 4 provides the guidance that organizations need to address new challenges in service management and exploit the potential of modern technologies and is designed to provide a flexible, coordinated and integrated system for effective management and control of IT-enabled services. Within the digital era, ITIL 4 is aligned with transformational technologies (Cloud, Automation, Artificial Intelligence) so that digital technologies together with consumers create value, support business strategy and embrace digital transformation. In ITIL 4, management practice is a set of organizational resources designed to perform work or achieve a goal. The ITIL SVS (Service Value System) includes a total of 34 management practices and they are: 14 general management practices, 17 service management practices and 3 technical management practices, all of which are subject to the four dimensions of service management - organizations and people, information and technology, partners and suppliers, and value streams and processes. (Axelos, 2019)

2. **Control Objectives for Information and Related Technologies (COBIT)** - a framework for Governance and Management of corporate I & T (information and technologies) focused on the entire enterprise and not only on the IT department of the enterprise. The latest iteration of COBIT 2019 includes 40 governance objectives grouped into two areas - Governance and Management and 5 domains that express the key purpose and areas of activity of the objective contained in them. (ISACA, 2018)
3. **ISO/IEC 20000** – international standard for IT service management describing an integrated set of management processes that form a service management system for the efficient provision of services to the company and its customers (APMG International, 2022).
4. **Microsoft Operations Framework (MOF)** – an alternative framework to ITIL that contains guidelines for the entire IT service life cycle and is a series of 23 documents guiding IT professionals through the processes of creating, implementing and managing efficient and cost-effective services (TechTarget, 2022).
5. **FitSM** – free and lightweight standards aimed at facilitating service management in the provision of IT services, including federated scenarios (European Commission, 2022).
6. **The Open Group Architecture Framework (TOGAF)** – standard, proven methodology and enterprise architecture framework for improving business efficiency (Open Group, 2022).
7. **Business Process Framework (eTOM)** – a reference process framework with a hierarchical classification scheme with descriptions of the key business processes needed to operate a service-oriented business (TM Forum, 2022).
8. **ISO/IEC 38500** – an international standard providing principles, definitions for management bodies to use in the evaluation, guidance of management bodies in managing the use of IT in their organizations. (ISO, 2022).

9. **Six Sigma** – a business quality improvement methodology that measures how many defects there are in the current process and tries to systematically remove them (TechTarget, 2022).

### **3 Research objectives and methodology**

The aim of the scientific article is to map the use of conceptual frameworks, norms and standards in the field of information technology service management.

Methods of evaluation and interpretation of results were used in the scientific article, such as: algorithmization, analysis, deduction, description, comparison, selection and synthesis.

The starting point for the development of a scientific article was the study, analysis, synthesis and comparison of domestic and foreign literature in the form of: professional articles primarily from scientific databases Web of Science, Scopus, Elsevier and others, books, studies, reports of technology companies, standards, etc.

### **4 Results and discussion**

Several studies focus on the adoption of ITSM frameworks as well as specific IT frameworks measured on IT services. The most popular and used information technology service management framework is ITIL, followed by ISO/IEC 20000 and COBIT.

Marrone and Kolbe (2011) report that Winniford et al. (2009) claim that approximately 45% of US companies use an ITSM framework and 15% plan to use it. The IT Governance Institute estimated in 2008 that the operational IT framework with the highest adoption rate is ITIL (IT Infrastructure Library) with 24%, followed by COBIT (Control Objectives for Information and related Technology) with an adoption rate of 41%.

Kubiak & Rass (2018) state the most popular frameworks based on a survey of 261 workers from around the world as follows: ITIL (47%), eTOM (36%), COBIT (36%), MOF (34%), ISO/IEC (29%), Knowledge Controlled Service (28%), Lean (22%), SIAM/MSI (21%), Six Sigma (21%), FitSM (18%), Kaizen (17%), DevOps (14%) .

Research in the field of IT management at the world level was carried out by Invesis Learning in 2021, which synthesized and compared results from companies such as: Gartner, HDI, itSMF USA, Axelos and PayScale, which carried out research in 380 global companies. According to the survey, ITSM frameworks are most implemented in business areas (Fig. 1.) such as: customer service and support, facilities management, human resources, training, financial services and others.

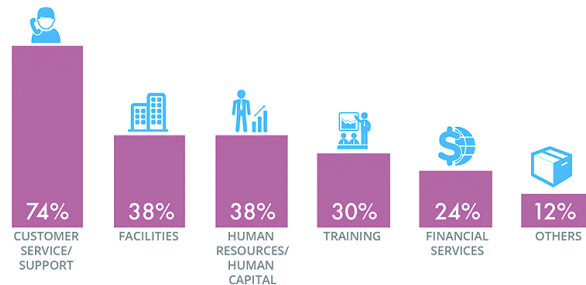


Fig. 1. Use of ITSM in business processes (Invesis Learning, 2021)

The research found that the most used ITSM frameworks are: Itil with a 64% share, Six Sigma with a 26% share and Leans with a 24% share (Fig. 2).

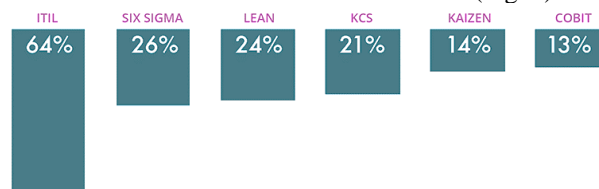


Fig. 2. Use of ITSM frameworks (Invesis Learning, 2021)

According to the company Axelos and their research from the 3rd quarter of 2014, almost 213 thousand professionals passed the ITIL certification exams, and the largest 37% share was from Europe, where there were 77,555 professionals (Fig. 3).

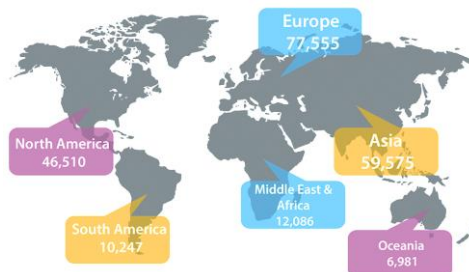


Fig. 3. Share of ITIL experts for 2014 in the world (Invesis Learning, 2021)

In the Slovak Republic, the ITSM survey in 2016 was carried out by IBM in cooperation with Tempest on 70 Slovak companies. It was found that 94% of the surveyed companies have identified IT services in the corporate environment and 6% of the surveyed companies do not use IT service management and, if necessary, the company calls in an expert. IBM further states that among the companies that have an ITSM solution in place and from a survey of selected companies, it follows that: 36% use ITIL, through which they map their IT services; 33% use approaches based on their own corporate standards (usually a combination of ITIL in cooperation with other frameworks) and 25% do not use ITIL, but use other frameworks such as: Six Sigma,

COBIT and others. In the companies that used the ITSM framework of ITIL, it was investigated what business areas they plan to cover with the conceptual framework of ITIL and it follows that: 20% of the company said that they want to cover Service Desk together with Incident Management; 16% of the company said that they do not plan to cover, or cannot cover; 15% of companies apply the Change Management framework; 13% of companies use ITIL for Configuration Management, 13% for Service Level Management, 12% for Problem Management and 11% of companies for Service Catalog.

The survey by Computer Economics (2019) shows that a significant number of organizations do not show interest in ITIL, namely 33% of organizations surveyed do not report any activity, 20% of organizations implement ITIL, 21% of organizations practicing informally, 18% of organizations practicing formally but inconsistently and 8% of organizations practicing formally and consistently. IT Governance (2022) states that the most used framework in IT Service Management is ITIL 4 .

## **5 Conclusion**

Business processes currently need IS and IT support for their meaningful functioning. The complexity of the business informatics environment, enhanced by the use of diverse information technologies, a wide range of external suppliers, combined with various used methods, procedures, taking into account both technical and economic aspects, requires the search for adequate methods and approaches that will help solve these complex tasks. Information technology is a necessity for the functioning of business entities, and the importance of IT has fueled the era of digitization. In the world of information technology, entrepreneurs and especially small and medium-sized enterprises need an adequate mechanism to ensure the provision of quality IT services. For businesses that ignore or have not adopted the principles of IT service management, it will be increasingly difficult to be efficient and competitive with other market participants.

IT Service Management - IT Service Management (ITSM) includes a set of policies, processes and procedures to manage the implementation, improvement and support of customer-oriented IT services. Unlike other IT management practices that focus on hardware, network or systems, ITSM is focused on continuously improving IT customer service in line with business objectives. ITSM includes several IT management frameworks, norms and standards, and these can be applied to centralized and decentralized systems either individually or synergistically.

From a survey of the use of norms, frameworks and standards in practice, the most used framework is ITIL, which is focused purely on IT service management, followed by ISO/IEC 20000, which represents a standard for IT service management with an integrated set of management processes and the third most used the framework is COBIT, which in its current version combines Governance and Management of corporate information and technologies.

The future of the use of frameworks, standards and norms is significant due to the growing digitization and the use of digital technologies, which are already pointed out

by the current versions of standards, norms and frameworks. Businesses should clearly use norms, standards and frameworks in order to have a more efficient management of business processes, to be more profitable and more competitive, because without properly set IT and IS business could not function.

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# Dedoles: Behind the Growth Ambitions

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**Abstract.** The growth ambitions are elementary for business success but taken too far, the growth ambitions could also lead to company failure. The growth ambitions are necessary for the beginning of the growth process, they are also the force that keeps the morale growing. The growth ambitions alone are not enough. Corresponding to the ambitions there should be a meticulously prepared business growth plan. Every managerial decision should be strategically considered, each internal process should change suitably to the speed of growth. There are also external macroeconomic factors that the company should deal with. The main aim of the paper is to analyze the growth of the company Dedoles as an example of a fast-growing company with an ambitious entrepreneur. Dedoles was the company that achieved rapid growth, but now is coping with problems connected to huge growth ambitions without appropriate managerial decisions and consideration of external factors. The paper analyzes the causes of the situation, and the consequences of the managerial growth decisions and presents the company's solution to the situation of not achieving the planned growth by Dedoles.

**Keywords:** Growth, Ambitions, Dedoles.

**JEL classification:** *O30, M13*

## 1 Introduction

Business growth has always been and will be a driving force for companies and their managers. The growth ambitions lead all business activities. To achieve rapid growth is brave, but in the current highly competitive market environment also necessary. Technologically innovative companies have huge growth potential, although they often cannot release and maintain it. It is expected for these companies to achieve exponential growth. Despite this fact, their growth is usually long and slow.

Achieving the growth ambition and what is more, making it sustainable is not easy at all. It requires a well-prepared business growth plan. Managers should consider the fact that growth needs to be fed. It means that an essential part of company growth is

investing financial resources, especially in hiring new employees and marketing. The company should prepare that these investments will accumulate.

Scaling the business towards growth has an unquestionable impact on every single part of the company. It significantly affects all internal business processes and relationships with stakeholders, which requires suitable managerial decisions and actions. The business growth journey is a massive challenge. Scaling up tests business capabilities to cope with opportunities. Once the company starts to fill its growth ambitions, it cannot be stopped. All decisions are irreversible.

## **2 Theoretical background**

This part of the paper summarizes the current state of the researched problem. It is aimed at the growth ambitions of entrepreneurs, factors influencing the growth ambitions, the crucial role of a well-prepared growth plan, the need for consideration of internal factors, external factors, and the risky over-optimism and acceptance of all opportunities offered. In this part, there is also introduced the main researched object.

### **2.1 Growth ambitions**

Scaling up the business towards growth primarily arises from the growth ambitions of the entrepreneurs. A study from 2015 defines ambitious entrepreneurs as people with high aspirations and high expectations. Some entrepreneurs aim to create as much value as possible and find ways to act upon it by exploiting opportunities and accessing the requested resources. [11]

The key role in the process of scaling up a business towards growth plays the entrepreneur. An entrepreneur is the one, who should explore the growth potential, possibilities, and opportunities. The one who inspires employees to the business growth, motivates them to continue and leads them through the growth journey. An entrepreneur or a manager is the person who should recognize what to do, where, when, and how to do it. They are the people who should know that growth ambitions are just the beginning of the growth process and that every step to the growth should be meticulously considered. The company needs to have a growth plan because the growth influences all internal processes and is affected by external factors.

Swedish research from 2018 examined the effects of internal and external resources on the early business performance of the sample of 401 new technologies-based firms. Growth orientation is found to be negatively related to business performance, which might suggest a certain level of over-optimism among entrepreneurs with an aspiration to grow fast. [23]

The research from 2018 found strong evidence between entrepreneurs' growth orientation and their experience as an entrepreneur. According to the research, there is a negative association between them. Research suggests that those who do not have extensive entrepreneurial experience are more likely to be growth-orientated in comparison to entrepreneurs who have extensive experience. This finding can be caused by too optimistic evaluation capabilities of nascent entrepreneurs in growth orientation. In contrast, more experienced entrepreneurs tend to be less optimistic. [22]

When an entrepreneur in a company has growth ambitions, something which is highly possible to happen is to seize all offered opportunities. Acting like this can be very dangerous in business. The more the entrepreneur says yes to offered opportunities, the more opportunities become available to the company. But saying yes too often siphons momentum. Sometimes, there is a need to learn to say no, because the faster pace and exciting results will open doors to more opportunities. Important is that increased opportunities can also increase the distraction from the company's main purpose. The few new opportunities to consider are those that directly contribute to the company's growth goals. All other opportunities become a diversion that will slow the hard-won momentum of growth. Successful entrepreneurs say no to distractions and yes to accelerating momentum on the growth curve. [30]

The study from 2016 examines the influential factors of entrepreneurial growth ambitions in technological startups. The study finds that these factors include startups' institutional and market contexts, the scalability of their business models, their personal characteristics and experience, and their perceptions of the barriers and constraints of the field. [29]

Another research from 2022 suggests that an ambitious entrepreneurial profile has an impact on stimulating the creativity embodied in technological innovations. [21]

The research results from 2016 indicate that entrepreneurs with intrinsic motivation, ambition for growth, and a risk-taking predisposition stimulate small- and medium-sized enterprises' innovativeness. Based on the research, the ambition of the founding entrepreneur for growth turns out to be decisive in the development of technological companies. However, the disproportion between entrepreneurial ambitions and company resources can lead to company failure. [19]

## **2.2 Characteristic of the company Dedoles**

Dedoles is a Slovak company established in 2011 that focuses on selling clothing and happy products. The most famous products from the Dedoles are happy socks. Surprisingly, happy socks which are now connected to this brand were not the main products of Dedoles since the brand's establishment. At the very beginning, Dedoles sold T-shirts of the American brand The Mountain. Today, the product portfolio except for happy socks also includes underwear, nylon tights, face masks, cycling shorts, leggings, sports bras, hats, shirt dresses, flip-flops, slides, and swimwear made from recycled plastics. Dedoles' happy products are unique mostly because they combine the imaginative design of talented Slovak designers with verified and certified features. [1]

The trademark was invented by the founder during a walk. It is a combination of „Dedo“ which symbolizes wisdom and „les“, which symbolizes a connection to nature.[17] The key values are satisfaction and humanity, improvement, and sustainability. [6]

The story of Dedoles started written when the founder Jaroslav Chrapko decided to establish a company with respect for nature. He said that beginning was quite difficult because he did not have enough capital or necessary experience. He was just learning what was going on in the business. Saying it in his words, it was hard for anyone to describe to him, how to do something when he had no idea what it was all about. [16]

The founder had been learning from his mistakes and step by step the process improved, and the business grew.

### **3 Research Design**

The main aim of the paper is to summarize the most important results connected to managing business growth and entrepreneurial business growth ambitions in the current home and abroad research papers and to present and analyze the business growth process of Dedoles, analyze the entrepreneurial growth decisions and consequences of managing the business growth of the company Dedoles.

The research object is the company Dedoles, which represents a technological fast-growing company with growth ambitious entrepreneur Jaroslav Chrapko. This company is an example of how important a need for a growth plan with consideration of internal processes is. It shows us that every single aspect of business doing matters and should correspond to the speed of growth and that there are also external factors, which could affect the growth results. The growth ambitions are not enough without appropriate strategic managerial decisions and actions.

The research methodology is based on a literature review on the theme of business growth, growth ambitions, entrepreneurial growth aspirations, scaling up the business towards growth, managing business growth, and growth plans, especially with the connection to the examination of technology ventures, startups, scaleups, and new technology-based firms. In the results of the paper, there is a summarization and financial evaluation of Dedoles' business growth process. There is a summary of information from the company website, publicly available articles about the company, and interviews with the founder published between the year 2015 and the year 2022. All articles and interviews were studied and analyzed, and the main findings were presented in a comprehensive form.

### **4 Results of the Paper**

This part of the paper is focused on the process of Dedoles' business growth, the decisions which lead to business results, and the consequences of these decisions. There is also a financial evaluation of Dedoles sales through revenues.

#### **4.1 Dedoles business growth story**

In 2015 Dedoles achieved its first huge success. It launched a new e-shop and today well-known characteristic design. The company set a new basic e-commerce business model. It was a turning point because since then the company has started to name itself a successful business. [16] Revenues climbed to the limit of 1 million €. The next success points were in 2016 when the revenues exceeded 3 million € and in 2017 4 million €. In 2018, the company started to sell its first collection of happy socks, and revenues raised to almost 6 million €. [2] From 2015 to 2018 Dedoles growth was great. Despite this fact, the company felt that the current business plan had a problem. At this

point, the company stopped expanding for a while, and then it came up with the idea of having its own brand of products. Setting up working processes and the business model was challenging.[16] The business model modification focused on product development and building the brand. [33]

In 2019 the revenues turned to about 15 million €. Dedoles has a team of internal designers which means that 90 % of their designs arise there. [2] Dedoles' designers try to make designs timelessly. They reflect the current lifestyle and popular activities and respond to things people like. That includes listening to customers who often send them suggestions for new products, and the brand tries to implement them. They want to achieve that people will also be able to express themselves.

In that year Dedoles employed about 100 employees. In 2020 Dedoles launched a massive marketing campaign with dancing hamsters to sell a collection of happy socks and the revenues were raised to almost 50 million €. [2] Happy socks commercial with dancing hamsters to the original song named Wild hamster party won the most successful marketing campaign on the YouTube Ads Leaderboard. The famous commercial was created in cooperation with creative Agentur Somebody & Somebody. Head of Brand Strategy in Dedoles Richard Mareček explained that the main goal of the recognizable commercial was to increase the awareness of the brand. The company was looking for a concept that well presents the products, dramatizes cheerfulness, and creates unique features typical for Dedoles. [15] It started to use a new logo and corporate design. In 2021, the revenues of Dedoles grew to 93,5 million € and the number of employees raised to 800. [2] It reviewed the strategy, starting to focus on "Dedoles as a clothing brand recognized for jolly colorful designs". The mentioned change of strategy was accompanied by a replacement of the logo, which now represents joyfulness and colorfulness. [9]

Dedoles currently operates in 21 European countries. In 2012 the company expanded to the Czech Republic, and in 2015 it started to sell the products in Austria and Hungary. In 2016 Dedoles expanded also to Germany and Romania, and in 2017 to Poland. In 2020 Dedoles launched a sale in Bulgaria, Croatia, Slovenia, German, Great Britain, France, Netherlands, Belgium, Ireland, Sweden, Finland, Denmark, Spain, and Italy. Chrapko said that Dedoles operates in 21 European countries through its online stores. Almost 80% of our sales are made outside the Slovak Republic. Income from all over the EU remains in Slovakia as taxes, levies, and profits, which we reinvest into the development of the company and the creation of job opportunities in the 21st century.[3] The largest market is the Czech Republic, then Slovakia, Germany, France, and Poland. The Czech Republic and the Slovak Republic make about half of the revenues of Dedoles. The company saw future opportunities for business growth in foreign markets. [12]

The German magazine Computer Bild, together with the renowned market research institute Statista, has selected candidates out of 10,000 online stores in German that have seen extraordinary growth in the last two years. It was also considered total turnover, number of visitors, and technical quality of the e-shop. The German version of Slovak e-shop Dedoles received the best grades in established criteria in the category of Fashion and accessories. [10]

In December of 2020 when the whole world was suffering due to the global pandemic, Dedoles was creating 180 new jobs. Chrapko then said that two years ago, Dedoles was a small Slovak company with 20 employees and that despite the complicated situation due to the pandemic, it could grow and provide jobs for several hundred Slovaks. [4] Chrapko saw opportunities in these global changes that he wanted to exploit.

Jaroslav Chrapko in 2021 said about the plans of Dedoles that the company wanted to continue to expand its business model, to find new places in the world where it can break through and expand. Its huge ambition is to move into new business sectors and become a global brand. [16] For Trend magazine, he was talking about business growth plans for 2022. He said that the European fashion market has a value of 364 billion € and grows about 4 % per annum. He wants to focus on completely new customers and innovate their products. [32] When Dedoles expanded to the 13 European countries in 2020 it helped the company scale up towards growth. He claimed that the stunning increase in the revenues at this time was mainly due to the launch of its line of products and expansion into several European markets. [3] The company even had to slow down the potential growth to be able to process all orders. [20]

Jaroslav Chrapko said for Forbes magazine that the company grows too fast, and it has large reserves in between what the processes in a company should look like and what they look like. In the short term, it can be maintained thanks to the hard-working team, but it is not sustainable in the long term. He emphasizes the complexity of high-speed growth and the fact that rapid exponential growth creates pressure. From the cash flow perspective, he said that the company has enough finances from banks and other legal persons for financing growth in 2021. [12]

Chrapko claims that rapid growth is difficult to manage. His company changes from month to month which requires continuous development of processes. The business model must adapt to the circumstances. The company is constantly looking for opportunities to enrich the current business model and make it competitive. [28]

Even though Dedoles was the perfect example of exponential growth and the plans for next years were even more ambitious, recently leaked information about serious problems connected to rapid growth to the public. Dedoles confirmed that it had a problem paying invoices, and because of that, the company had to dismiss employees. These problems were firstly recognized by the magazine Index, which wrote that Dedoles overestimated its strengths with growth. At the beginning of 2022 Dedoles employed 800 employees, recently it had to dismiss 200 of them. The company is experiencing a decline in sales of the products, which is related to the problems with invoices payment. [28]

The founder of Dedoles admits that he has made wrong managerial decisions because, from his point of view, high growth is always associated with great inefficiency. The company grew fast, but it was not capitalized enough. [18] When Dedoles started growing so rapidly, the company was dealing with associated internal problems, which every company that is growing rapidly encounters. But since the season did not go as planned and Dedoles did not achieve the planned revenues, mostly because of the global pandemic, it could not generate enough cash and sell out inventory. The company was left with large stocks and as a result an uncomfortable

cash situation because Dedoles did not make a profit that would support the balance sheet. By not achieving the ambitious growth plans and worsening the macroeconomic situation as well, the company had to cut costs. That is why Dedoles had to reduce the number of employees at the headquarters in Slovakia. The company urgently needs to solve the cash flow situation, which requires the support of banks or investors and suppliers to have time to sell out inventory.

#### 4.2 Development of the Dedoles' revenues

Revenues, as a total amount of company income generated mostly by the sale of goods, are the key indicator of business success. Every single company wants to succeed in the generation of revenues. The development of the revenues between the years 2015 and 2021 is captured in figure 1 below.

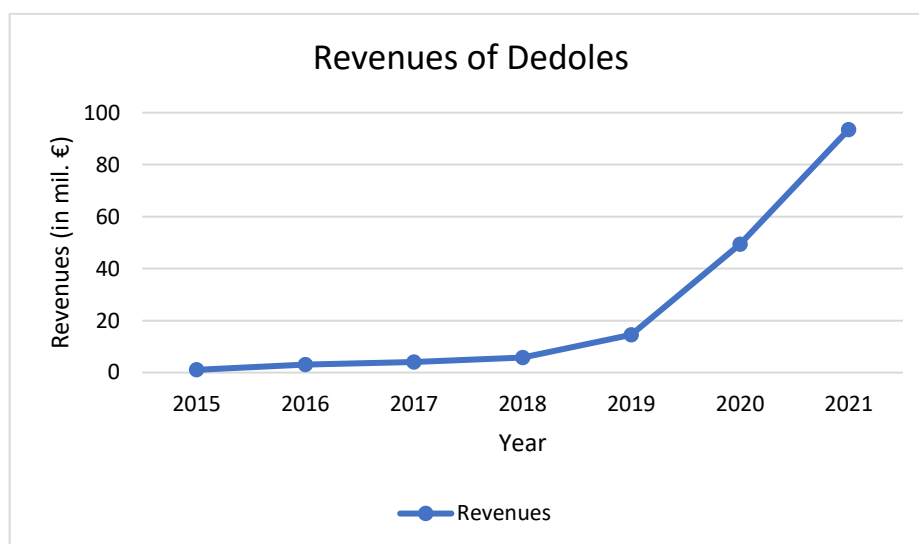


Fig. 1. Development of Dedoles' revenues between the years 2015 and 2021

Table 1. Revenues of Dedoles

Year	2015	2016	2017	2018	2019	2020	2021
Revenues (in mil. €)	1,06	3,10	4,12	5,83	14,59	49,44	93,50

Between the years 2015 and 2016, the revenue growth was 192,45 % which was a huge breakthrough point for Dedoles. Then the revenue growth slow down, and between the years 2016 and 2017, it was 32,90 %, and between the years 2017 and 2018, 41,50%. Between the years 2018 and 2019, there was a 150,26 % growth in revenues. With a massive marketing campaign launched in 2020, the revenue growth



between 2019 and 2020 represented 238,86 % and between 2020 and 2021, there was 89,12%, even though Dedoles expected the revenues in 2021 to be 150 million €. [18] If the assumption would be true, the revenue growth between the years 2020 and 2021 would be 203,40 %, but it did not happen.

## 5 Discussion

Based on positive business results, when the company managed to increase revenues, in 2021 it prepared for an ambitious growth plan. According to this, Dedoles has significantly increased the number of employees and invested not only in marketing and brand building but also in information systems, especially in a new warehouse. However, the expected growth did not occur. At the same time, e-commerce was experiencing shock and decline culmination of the pandemic, thus not providing a sufficient degree of stability for the interest of strategic investors, whose were for Dedoles growth speed necessary.

The negative situation connected to rapid growth without appropriate managerial decisions has some further analyzed causes.

Firstly, despite the rapid growth during the global pandemic, the company's sale was slowed down by the unfavorable logistics situation in the global trade. It is necessary to emphasize that a huge part of Dedoles' production is produced in China, Turkey, and the latest also in Italy. [26] The import was delayed.

Secondly, Dedoles invested in warehouse equipment and IT systems. The company was preparing for even higher growth, so it invested money in IT systems, warehouses, and infrastructure. Intelligent warehousing process systems, as well as the involvement of robots by Anasoft and by Photoneo, should have helped Dedoles significantly reduce the human error rate and increase efficiency in completing orders. [24] By operating in many countries and several currencies, the complexity in each department increases. The need to work on processes and strengthen IT infrastructure was enormous.

Another cause is that Dedoles became in March 2020 100% owner of the British company Something different Europe Ltd. [27] The main expectation from this transaction was that the British company would serve as a shipping center for Western Europe. At the same time, it had a solid turnaround through Amazon and eBay. Dedoles expected expansion to platforms and other countries of the world. [13] This transaction needed to be feed.

Fourthly, Dedoles expanded product lines and planned to reach new target groups of customers. The company expanded beyond the online space and opened kiosks and stores. [5] Dedoles was moving from the segment of happy products more to fashion. But also aimed to move into completely different business areas. [31]

We need to realize that Dedoles does not sell necessary products. The company sells discretionary products [25], so when people limit their spending because of significant changes in energy and commodities prices connected to the macroeconomic global situation, it will affect retail of the company.

Another cause is that Dedoles ordered part of the products with the prediction of higher growth, and therefore the company is still getting large quantities of goods,

which are more difficult to sell out during this period. It has two times more stock than the company need. Dedoles has inventories at sales prices of 40 million euros, which is a much higher amount than the liabilities. [25] The previously mentioned supply chain crisis and related delayed orders affect the sale of the seasonal collection, which must be sold out to stabilize the current situation. The surge in retail has the negative that Dedoles must pour a lot of money into stocks, which is difficult to fund from its own resources. However, both investors and banks were cautious during the pandemic.

The founder states several factors that led to this situation. These are mostly connected to the supply chain. Suppliers had problems, orders did not go on time, and Dedoles had to contract everything sixty to ninety days earlier. These problems complicated the sales of the summer collection, and the company had to postpone the marketing campaigns. In addition, costs increased, so Dedoles lost around a million euros in margins. [7]

These were the main causes of this unpleasant situation, many of them arose from managerial decisions which did not reflect the current global situation and the importance of adapting all internal processes to the speed of the growth. Ambitions need the corresponding and appropriate changes and different scenarios preparation. Strategical thinking plays a key role here, especially when the company grows too fast. Great managers need to think ahead. On the other hand, the development was indeed affected by a global macroeconomic situation, which was something nobody could be prepared for enough. Maybe, with the consideration of external factors, the growth plan should not be as ambitious as it was in this company. It is an example of how fragile rapid growth is. One day it can turn high speed, and on the other, growth can stop and even slow down.

Dedoles tries to solve the problem by selling out the inventory and trying to find new sales channels. The company sees another solution in considering opportunities for various forms of franchises or wholesale collaborations.

Chrapko admits that he was too ambitious but having an ambitious plan in his point of view would be fine if the company had external capital. Now Dedoles is looking for an investor, and Chrapko thinks that if the company had thought about it sooner, it might have avoided today's problems. [18] In 2021 the founder of Dedoles said that he did not see a potential investor in the Slovak Republic. He would only consider the investor who would help the company become a global brand through the penetration of the Asian and American markets. [12] Since the company did not have external capital, it decided to find a partner who would help the company grow with new capital. Dedoles needs to cover long-term commitments.

Jaroslav Chrapko admits that Dedoles faces a challenge. There is a necessary need for organizational changes and managerial changes. Dedoles has suffered on morale, the people inside are under pressure and no one is comfortable with it. It all happened so fast. The company is also undergoing a reorganization, Dedoles is in the middle of an investment process and under pressure from suppliers. [14]

Finally, with the deteriorating situation, Dedoles has prepared a recovery plan and asked for permission to reschedule. Chrapko acknowledges that the company has eroded the trust of the creditors and has had to take appropriate action. The company itself has applied to the court for protection from creditors, which should give it

sufficient time to rehabilitate the company. [25] In the recovery plan, Dedoles drastically reduces both expected sales and investments. The plan is aimed at actively selling and improving the cash flow of the company. [8]

## **6 Conclusion**

Managing business growth is an entrepreneurial dilemma. The entrepreneur should consider if he would like to achieve slow, systematical business growth and let some of the opportunities go or to achieve fast growth. It is a balance of advantages and disadvantages, and each balance can be insured. In this case, the insurance is the investor. Having an investor or not is another entrepreneurial dilemma that depends on the entrepreneur's character.

The entrepreneur of Dedoles was ambitious, he chose the fast growth and the exploitation of all opportunities, but alone, without an external investor. Dedoles' sales plan was dimensioned for higher growth. The company did not expect sales to slow down due to external factors such as war, inflation, or rising energy prices. The company did not adjust the number of inventories and investments accordingly.

To sum up, I would like to use Jaroslav Chrapko's words about the complexity of business success and growth. He once said that every business is a problem in a positive sense. If there are no challenges in it, there is something wrong. As he claims, you are still doing something new in your business, and when you do something new, you overcome the problem. However, following this path, the company develops, and the team becomes stronger.

Dedoles is now an example of how hard scaling up a business toward growth can be. It shows us that business growth affects all business processes, and there is an important and necessary need for strategic managerial decisions. This example emphasizes the need for risk-balanced capital adequacy. Through the company example, we can see that even with huge growth ambitions, not every single opportunity should be taken. There is an important need for a well-prepared business growth plan with strategic consideration of internal factors, and external factors.

Hopefully, entrepreneurs and managers will learn from Dedoles' rapid growth development, and I hope that Dedoles will handle this situation, and as a result, will build a more stable company in the future.

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# Bankruptcy Prediction Models in Prešov Region of the Slovak Republic

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**Abstract.** The current business environment, not only in the Slovak Republic, is characterized by the very frequent existence of crises of business entities. It is no different even during the pandemic, which was characterized by various measures or restrictions affecting the smooth running of companies.

If the company can adapt to the constant changes in the market and thus survive, it needs to know in which financial condition it is and what is its perspective in the market. Companies can use financial analysis, which monitors not only the company's management in the past period, but also with a view to the future. As a result, financial analysis becomes a strategic tool for company management and, with the help of indicators, represents a quantitative expression of the company's financial status. To predict the future state of the company, it performs an ex-ante analysis that uses several methods, among which we include prediction models, especially creditworthiness and bankruptcy models or models based on artificial intelligence.

The contribution is focused on predictive bankruptcy models with the aim of pointing out the financial situation and prosperity of businesses in the Prešov region carrying out their entrepreneurial activity according to SK NACE 56300 – hospitality services during the Corona virus pandemic. Emphasis is placed on the informative value of selected models applied to a selected sample of 204 companies operating in 13 districts of the Prešov Region of the Slovak Republic.

**Keywords:** Bankruptcy Prediction models, Altman model, Taffler model, Bonita Index

**JEL classification:** C38, G33, M41

## 1 Literary researcher

The origins of prediction models date back to the 1930s, when studies using ratios to predict future bankruptcy began to develop. One of the earliest works in this vein was P. J. Fitzpatrick's paper on identifying significant differences between successful and unsuccessful industrial businesses. This work inspired several papers into the mid-1960s. [1]

All studies up to the mid-1960s focused only on single-factor analysis. Generally, the most widespread and most widely accepted is the single-factor study by Beaver. In the study, the author used financial ratios for the first time to predict the failure of business entities. Beaver proved [2] that financial ratio can be successfully used in predicting the difficulties of business entities. He also pointed out that not all ratios have the same predictive ability. However, the use of only selected simple ratio ratios as predictors of failure has been widely questioned in practice because these can be significantly biased by managerial decisions and thus provide a distorted view of the future of the business entity. To remedy the above problem, Beaver proposed the use of the so-called dichotomous classification test. Using this method, multiple indicators with the highest predictive ability are selected and ultimately used as a single predictor with multiple degrees of freedom. [2]

It was Altman who introduced one of the multivariate methods, namely multivariate discriminant analysis, based on the ideas of Fisher (1936). Using this analysis, firms can be divided into two groups, bankrupt and non-bankrupt, based on a linear combination of characteristics that best differentiates the two groups.

Depending on how many and what factors and methods are used in the calculation of a given model to consider, there is a wide range of prediction models. Altman's (1968) model uses a 5-factor discriminant analysis, while Boritz and Kennedy's (1955) model use 14 factors. The range of factors used in the models is from one factor to 57 factors. Altman's Z-score is one of the most widely used models, and this is because its predictive accuracy is high, up to 95% one year ahead. The accuracy of the model dropped to only 72% and 49% accuracy two and five years prior to the company's bankruptcy, respectively, and 29% accuracy three and five years prior to the bankruptcy. [3]

Altman simultaneously with the development of the methodology of prediction models also investigated its reliability or error rate. He divided the erroneous assessments into two types. Error  $\alpha$  - Error type I, in which non-prosperous firms are classified as prosperous, and Error  $\beta$  - Error type II, in which prosperous firms are classified as non-prosperous. [3]

Thus, Altman could be termed as the father of prediction models because after his studies and research, there were further developments and not only USA but also globally. Many other researchers have applied similar methods such as Deakin (1972), Springate (1978), Marais (1979), Taffler (1982).

The application of different prediction methods to the conditions of the Slovak Republic may be questionable, and this is because different models of financial health prediction were developed in different time and space. The question is basically whether a model created based on data characterizing enterprises of one country can be



successfully used to predict the financial situation of enterprises of other countries. It is also necessary to consider the classification or focus of the enterprises for which the model was developed. In fact, the accuracy of prediction models is significantly reduced if the model is used in a different industry, time, or business environment than the one in which the data used to derive the model was obtained [4]

Within the Slovak Republic, models have been developed focusing on one area of the national economy, namely agriculture. These are the Chi-index models of Chrastinova (1998) and the G-index of Gurčík (2002). A model predicting the future bankruptcy of commercial companies operating in the Slovak Republic was developed by Gulka (2016) through logistic regression, where all business entities based in the Slovak Republic were examined except for the financial sector. This method is based on finding the dependence of the logistic variable (0 - non-bankrupt business and 1 - bankrupt business) on several independent variables, i.e. financial ratios.

The aim of the present paper is to evaluate the financial situation and prosperity of enterprises during the period of the Coronavirus pandemic, which disrupted the normal operation of companies due to the impact of various measures and restrictions.

## 2 Methodology

To achieve the set goal, universal methods were used, such as the analysis of available theoretical knowledge obtained through the study of professional literature and the subsequent synthesis of the acquired knowledge. The comparison method was used to solve the problem based on the criteria set by the Commercial Code and the results of the monitored prediction models. To verify the predictive ability of the monitored models, we used ROC analysis, which is a statistical procedure for evaluating signals of correct and false positivity and correct and false negativity. ROC curve analysis describes the relationship between sensitivity and specificity at different values of the discrimination level.

In the paper, we wanted to apply a prediction model to determine the economic impact of the corona crisis on the businesses of the Prešov region and thereby determine the prosperity of the businesses of the mentioned region, which carry out their business activities according to SK NACE 56300 – hospitality services. According to the Finstat database, before the corona crisis in 2019, there were a total of 432 businesses in the hospitality sector in 13 districts of the Prešov region. Based on statistical calculations, we determined the size of the sample, on which we subsequently applied the calculations of prediction models. The sample size corresponded to 204 enterprises. We selected the corresponding number of businesses for each district of the Prešov region.

The source of data for the predictive analysis itself was the financial statements for the accounting period 2020, where it was already possible to monitor the effects of the corona crisis.

**Table 1.** Matrix of change

District	Actual count	Sample
Prešov district	131	62

Poprad district	100	47
Bardejov district	41	19
Vranov nad Topľou district	35	17
Humenné district	33	16
Kežmarok district	20	9
Sabinov district	20	9
Svidník district	14	7
Snina district	16	8
Stará Ľubovňa district	10	5
Levoča district	5	2
Stropkov district	5	2
Medzilaborce district	2	1
$\Sigma$	<b>432</b>	<b>204</b>

Source: Finstat.sk

To perform predictive analysis and evaluate the financial health of 204 companies, we chose 3 bankruptcy models: Altman's, Taffler's and Bonita Index. We specify the methodology of each model in more detail.

## 2.1 Altman index

Altman was the first to quantify the multivariate discriminant function. The Altman index is also called the Z-score. It is based on a discriminant analysis carried out in 1966 on a sample of 66 randomly selected firms, 33 of which had gone through bankruptcy proceedings in the last twenty years and 33 of which had not yet gone through bankruptcy proceedings. This model was originally designed for publicly traded companies. Under the pressure of the needs of economic practice, the index was gradually supplemented with models for joint stock companies without publicly traded shares and for nonmanufacturing companies. [5]

The basic relationship for expressing the financial situation of a company according to the Altman model:

$$Z = 1,2x_1 + 1,4x_2 + 3,3x_3 + 0,6x_4 + 1,0x_5 \quad (1)$$

$$x_1 = \frac{\text{working capital}}{\text{total assets}} \quad (2)$$

$$x_2 = \frac{\text{retained earnings}}{\text{total assets}} \quad (3)$$

$$x_3 = \frac{\text{EBIT}}{\text{total assets}} \quad (4)$$

$$x_4 = \frac{\text{market value of equity}}{\text{total liabilities}} \quad (5)$$

$$x_5 = \frac{\text{sales}}{\text{total assets}} \quad (6)$$

Altman identified the boundaries of the bands by which the future is predicted. [3]  
If:

- $Z > 2.99$  the firm's financial position is predicted to be good
- $1.81 < Z < 2.99$  an area of indeterminate results (grey zone), bankruptcy is possible,
- $Z < 1.81$  financial situation is critical, bankruptcy very likely

## 2.2 Taffler model

Taffler's bankruptcy model (1977) is based on scoring approach and represents the linear regression model with four financial coefficients for the assessment of financial stability of 46 UK companies that default and 46 companies that are stable during the period between 1969 and 1975. Taffler's model incorporate the ratios that are easily defined and reflect the most significant links to the solvency of companies. [13]

Taffler's bankruptcy model consists of 4 factors and is given by the relationship:

$$T = 0,53R_1 + 0,13R_2 + 0,18R_3 + 0,16R_4 \quad (7)$$

$$R_1 = \frac{EBT}{\text{current liabilities}} \quad (8)$$

$$R_2 = \frac{\text{current assets}}{\text{total liabilities}} \quad (9)$$

$$R_3 = \frac{\text{current liabilities}}{\text{total assets}} \quad (10)$$

$$R_4 = \frac{\text{Revenue}}{\text{Total Assets}} \quad (11)$$

If the calculated  $T > 0.3$ , these are firms with a small probability of bankruptcy. If the calculated  $T < 0.2$ , bankruptcy can be expected with a higher probability. [6]

## 2.3 Bonita Index

In the German-speaking economic area of Europe, the Bonita index below is very often used. The discriminant function quantifying the Bonita index B has the form:

$$B = 1,5x_1 + 0,08x_2 + 10x_3 + 5x_4 + 0,3x_5 + 0,1x_6 \quad (12)$$

$$x_1 = \frac{\text{cash flow}}{\text{debts}} \quad (13)$$

$$x_2 = \frac{\text{total capital}}{\text{debts}} \quad (14)$$

$$x_3 = \frac{EBT}{\text{total capital}} \quad (15)$$

$$x_4 = \frac{\text{EBT}}{\text{total revenues}} \quad (16)$$

$$x_5 = \frac{\text{stocks}}{\text{total assets}} \quad (17)$$

$$x_6 = \frac{\text{total revenues}}{\text{total capital}} \quad (18)$$

The result of the Bonita index can be interpreted as follows:

- $-3 < B < -2$  .....the financial situation of the company is extremely bad
- $-2 < B < -1$  .....the company's financial situation is very bad
- $-1 < B < 0$  .....the company's financial situation is bad
- $0 < B < 1$  .....the company is definitely in trouble
- $1 < B < 2$  .....the financial situation of the company is good
- $2 < B < 3$  .....the financial situation of the company is very good
- $B > 3$  .....the financial situation of the enterprise is extremely good

The creditworthiness of an enterprise is higher the higher the Bonita index B.

Part of the survey was also the classification of enterprises into the group of prosperous or non-prosperous enterprises, while we were based on the current legislation of the Slovak Republic, which defines when an enterprise is in bankruptcy, or when it is threatened with bankruptcy. Furthermore, we have added to the criteria the fact that a non-prosperous enterprise has significant problems with liquidity and making a profit. We have thus identified four criteria:

- Total liquidity indicator,
- The financial autonomy indicator,
- Negative equity,
- Negative operating result.

Total Liquidity Ratio L3 is a ratio indicator of liquidity analysis, which expresses how much € of current assets excluding long-term receivables cover € 1 of short-term foreign funds. The recommended value of this ratio according to several literatures is 1.5-2.5. To our analysis, we considered firms to be illiquid if they had L3 values  $< 1$ . [14]

The financial autonomy ratio is an indicator from the group of debt ratio indicators. It expresses how many € of equity are attributable to € 1 of liabilities of the enterprise. The higher its value is above 1, the more stable the enterprise is because it finances its activities through equity. If it is less than 1, the enterprise uses more foreign capital to finance its activities. According to Act No. 513/1991 Coll., the Commercial Code has introduced the concept of a company in crisis since 1 January 2016, where it is the ratio of equity to liabilities that can reveal the reality of the crisis. Currently, after the amendment of this law, this ratio is, as of 2018, 8 to 100. [9]

Negative equity  $VI < 0$  is the third decisive criterion for classifying a company as non-viable. According to Section 3(3) of the Bankruptcy and Restructuring Act, such an enterprise is designated as a going concern. [10]

The last criterion is the ability to hit profits. If an enterprise is unable to make a profit, it may not be able to pay its obligations, leading to insolvency.

The application of the selected prediction models in the database of Slovak enterprises allows us to compare the obtained classification of the enterprise with real data and thus verify the predictive ability of the models. The assessment of the classification and prediction ability of the observed models is performed using a ROC curve, which shows the relationship between sensitivity and 1-specificity. This is the relationship between true positivity and false positivity, which is given by the change matrix. [8]

**Table 2.** Matrix of change

Actual	Predicted		
		Negative	Positive
	Negative	True Negative (TN)	False Positive (FP)
Positive	False Negative (FN)	True Positive (TP)	

Source: Klepáč, H., Hampel, D. 2016.

The table of changes classifies businesses into thriving and non-thriving, considering four situations [8]:

1. True Positives (TP) - this is a positive match, i.e., how many thriving businesses have been correctly classified as thriving,
2. False Positives (FP) - false positive results, i.e., how many failing businesses were misclassified as thriving, also referred to as first type error.
3. False Negatives (FN) - the results of false negatives, i.e., how many thriving businesses were misclassified as failing, this is referred to as an error of the second kind.
4. True Negatives (TN) - these are negative matches, i.e., how many failing businesses were correctly classified as failing.

For an overall assessment of the models, it is necessary to consider [8]:

- Overall model accuracy, which is defined as the ratio of correctly classified entities to all entities, i.e.  $(TP + TN) / (TP + FP + FN + TN)$ .
- sensitivity, which is given by the ratio of true positive cases to all positive cases, i.e.,  $TP / (TP + FN)$ .
- specificity, determined by the ratio of true negative cases to all negative cases, i.e.,  $TN / (TN + FP)$

Based on the calculated sensitivity and specificity values, an ROC curve can be constructed and then the classification accuracy of the models under study can be evaluated using the area under the ROC curve (denoted as AUC) as follows [8]:

- values between 0.5 and 0.75 = acceptable classification ability,
- values between 0.75 and 0.92 = good classification ability,
- values from 0,92 to 0,97 = very good classification ability,
- values between 0.97 and 1.0 = perfect classification ability of the prediction model

### 3 Results

Considering the criteria that divide businesses into prosperous and non-prosperous according to the current legislation of the Slovak Republic, we have selected a sample of businesses divided into 70 businesses that are prosperous and 134 that are not prosperous.

We performed an ex-ante analysis using selected predictive bankruptcy models. Bankruptcy models classified by companies as average, i.e., into the gray zone, it was only necessary to divide them into two groups to be able to determine their ability to speak. According to the final value of the specific model, which was achieved by each enterprise in the gray zone, we classified it between prosperous and non-prosperous according to the threshold values, whether it was closer to which group.

**Table 3** Result of prediction models

	<b>Altman model</b>	<b>Taffler model</b>	<b>Bonity Index</b>	<b>Actual</b>
<b>Negative</b>	150	140	76	134
<b>Positive</b>	54	64	128	70
$\Sigma$	204	204	204	204

Source: own processing

#### 3.1 Altman model

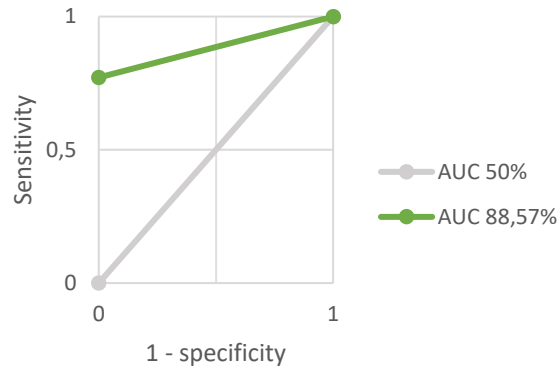
The Altman model applied to the sample of selected enterprises under study ranked the enterprises as follows:

**Table 4** Result of Altman model

	<b>Predicted</b>			
		Negative	Positive	
<b>Actual</b>	Negative	134	0	134
	Positive	16	54	70
				204

Source: own processing

Altman's model correctly classified the non-prosperous enterprises among the non-prosperous, which means that the type I error is equal to 0%. He classified 16 enterprises defined as prosperous among non-prosperous ones, and thus the model committed error II. kind at the level of 22.86%. The proportion of truly positive to all positive observations expressed by sensitivity reached the value of 77.14%, and the proportion of truly negative observations to all negative observations expressed by specificity is 100%. Using the sensitivity and 1-specificity relationship, we constructed an ROC curve.



**Fig. 1.** ROC curve of the Altman model.  
Source: own processing.

Fig 1. shows the ROC outcry of the Altman model of a selected sample of surveyed businesses. The area under the ROC curve of AUC is 88.57%. According to the AUC classification, the model acquired a good classification ability of the prediction model. The AUC 50% curve on the graph shows a straight line to which acceptable classification ability belongs.

### 3.2 Taffler model

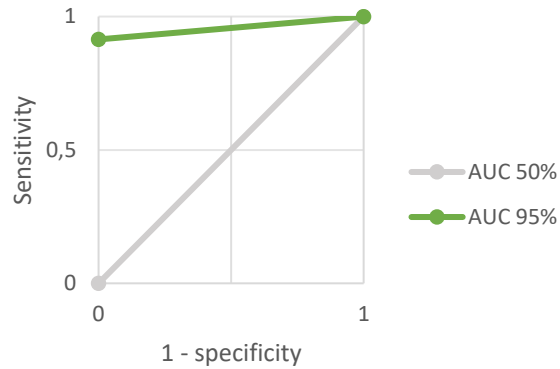
Taffler model applied to the research sample of selected enterprises ranked the enterprises as follows:

**Table 5** Result of Taffler model

		Predicted		
		Negative	Positive	
Actual	Negative	134	0	134
	Positive	6	64	70
				204

Source: own processing

Taffler model correctly classified 134 businesses as non-prosperous. What caused us to make a Type I error at the 0% level. The high accuracy of the model is also evident in the case of classifying enterprises in the group of prosperous ones, where up to 64 enterprises were correctly classified. The model committed 8.57% error II. kind, by wrongly classifying 6 enterprises in the non-prosperous group. The proportion of truly positive to all positive observations reached a value of 91.43%. The proportion of truly negative observations to all negative observations expressed by specificity reached a value of 100%. Using the sensitivity and 1-specificity relationship, we constructed an ROC curve.



**Fig. 2.** ROC curve of the Taffler model  
Source: own processing

Fig. 2 shows the ROC outcry of the Taffler model of a selected sample of surveyed businesses. The area under the ROC curve of the AUC is 95.72%, which means that the model has acquired a very good classification ability.

### 3.3 Bonita Index

The last model (Bonita Index) applied to the research sample of selected enterprises classified the enterprises as follows:

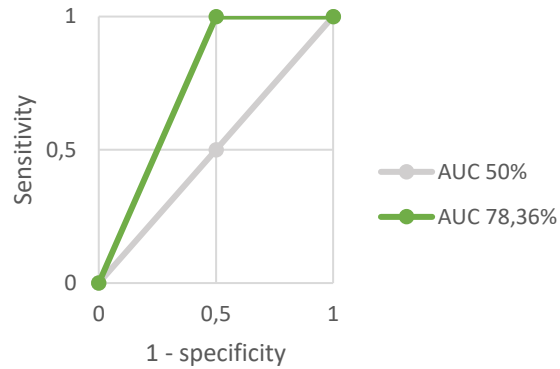
**Table 6** Result of Bonita Index model

		Predicted		
		Negative	Positive	
Actual	Negative	76	58	134
	Positive	0	70	70
				204

Source: own processing

Based on the above table, significant imperfections are identified. The model correctly identified only 76 businesses that are among the non-prosperous. Which is reflected in the high level of Type I error (43.28%) compared to previous models. What we cannot criticize the model for is the correct determination of the number of enterprises that meet the criteria of prosperous enterprises, of which there are 70. Type I error is thus at the level of 0%. The sensitivity of this model is at the level of 100%, which expresses the proportion of truly positive to all positive observations. The specificity indicator of this model is at the level of 56.72%.





**Fig. 3** ROC curve of the Bonita Index model  
Source: own processing

The figure shows the ROC curve of the Credit Index model of a selected sample of surveyed companies. The area under the ROC curve of the AUC takes on a value of 78.36%, so we can conclude that the classification ability of the prediction model is good.

#### 4 Conclusion

In the presented contribution, we focused on predictive models for businesses in the Prešov region applied to a researched sample of 204 businesses in 13 districts of this region, which conduct their business activities according to SK NACE 56300 – hospitality services. For predictive analysis, we used 3 models of Altman, Taffler and Credit Index, which led us to the following conclusion. All three used models achieved a fairly high level of reporting ability. The Credit Index model has the lowest reporting ability at 74.45%. The Taffler model has the highest reporting ability, and thus, according to the AUC classification, the model is included in the category of very good classification ability of the prediction model, which corresponds to 95.72%.

**Table 7** Results of each model

Model	Sensitivity	Specificity	Type I Error	Type II Error	AUC
Altman	95.12%	100%	0.00%	4.88%	88.57%
Taffler	100.00%	48.89%	51.11%	0.00%	95,72%
Bonita Index	82.93%	100.00%	0.00%	17.07%	78,360%

Source: own processing

The contribution was focused on predictive bankruptcy models with the aim of pointing out the financial situation and prosperity of companies during the Corona virus pandemic with an emphasis on the informative value of selected models applied to a selected sample of companies operating in the Prešov region of the Slovak Republic. The subject of further research, which would supplement the current contribution, is the analysis of subsidies that were provided to companies with a significant delay to mitigate the impact of the crisis. Based on the current results, we have concluded that with the help of selected prediction models such as Taffler's and Altman's model, we can predict the financial situation of companies operating in the industry we are investigating with a very good predictive ability.

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# Environmental Aspects in Production in the Context of Industry 5.0

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**Abstract** The paper is focused on comparing the elements of the industrial revolution Industry 4.0 and Industry 5.0. It mainly focuses on one of the elements of Industry 5.0, namely sustainability, or environmental protection using the elements and technologies of the fourth industrial revolution. The main goal is a theoretical analysis of the concept of Industry 5.0 in comparison with the elements of the fourth industrial revolution with a focus on environmental aspects in production. Based on the theoretical analysis, we selected two environmental aspects of production for research, the level of implementation of which we compared between the V4 countries. One aspect was the production rate of zero-emission vehicles and the second aspect was the level of waste production. As a result of the research, we found that Hungary, as one of the V4 countries, achieves the best results in both selected environmental aspects based on data from the EU Statistical Office. Based on the theoretical analysis, we also found that the new concept of the industrial revolution Industry 5.0 complements the elements of Industry 4.0 and thus there is a certain synergy between the machine, man and nature. Therefore, the new concept of Industry 5.0 is important for future studies, especially from the point of view of increasing awareness of environmental protection.

**Keywords:** Industry 5.0, Environmental Aspects, Sustainability.

**JEL classification:** O32, Q55

## 1 Introduction

The trend of sustainability, greening, the implementation of green elements in production and the overall emphasis on environmental protection have become one of the most important and most frequently discussed topics in recent years. It is not just a whim, but above all a growing, even alarming, situation regarding the need to protect the environment. The large amount of emissions, the increasing waste in landfills, the misuse of natural resources, the reduction of biodiversity, climate change and many

others are resulting in the deterioration of our planet and the emergence of a problem of a global nature.

It is precisely the negative changes in climate on a global scale that have raised the interest of both consumers and producers to ensure sustainability of production or environmental protection (Leong et al., 2019). Many countries and international institutions have the same interest, support, in this so-called green trend. Several countries have, for example, developed specific plans and programs within the framework of the European Union's environmental policy. They regulate the level of environmental pollution or promote the use of ecological innovations and solutions in the processes of greening (Wysocki, 2021).

As a result of the current environmental challenges, many companies are beginning to address the environmental impacts of their products and production processes in addition to economic considerations (Linke et al., 2012). The implementation of green features and eco-innovations not only results in the mitigation or elimination of environmental pollution for companies, but also in gaining a certain competitive advantage. In the same way, consumers are becoming increasingly responsible and considering the wider impacts of their purchases. Thus, eco-innovations represent an ideal solution to help businesses meet both economic and environmental goals (Wysocki, 2021).

### **1.1 Current status of the issue at home and abroad**

The growth in the level of automation and digitization of business areas, or the implementation of elements and dynamic development of technology as a result of the Fourth Industrial Revolution, has led to a certain dehumanization of industry - from the perspective of man and nature. This is also why there has been an increased interest and awareness of the aspects of industrial humanization and sustainability (Grabowska et al., 2022).

Industry 4.0 is, above all, about automation and streamlining processes related to real-time information exchange, new technologies, cloud solutions, smart factory and many more. Its focus is therefore on effective process improvement, including the mass use of machines, but this inadvertently ignores the human costs of process optimization. The world, too, has seen a huge increase in environmental pollution in recent years. Unfortunately, Industry 4.0 does not make environmental protection a priority, nor is it the primary goal to create technologies that focus on improving the environmental sustainability of the Earth. (Nahavandi, 2019)

As a result of the continuous development of industry and technology in the context of Industry 4.0, individual methods and ways of progress are later analyzed retrospectively and examined scientifically. Any shortcomings in the development to date are revealed, or mistakes are made which, if eliminated, can be used to increase overall prosperity and sustainable production. In the context of the new concept of development, Industry 5.0 highlights the significant advances brought about by the Fourth Industrial Revolution, in the form of automation, digitalization or robotization, focusing on those activities that support economic growth, sustainable development or climate strategies in the form of environmental protection (Majerník et al., 2022).

Dautaj and Rossi (2022) state that Industry 5.0 is more focused on human quality of life. The primary goal of Industry 5.0 is to achieve a kind of synergy (cooperation, compatibility) between man, machine, robot and nature, i.e. the environment, with an emphasis also on the social side, through the elements of smart industry and elements of Industry 4.0 (Majerník et al., 2022). We could say that Industry 4.0 is technology-based, whereas Industry 5.0 is more value-based (Xu et al., 2021).

Thus, Industry 5.0 could be defined as an environment that complements, complements the concept of Industry 4.0. Within this environment, all activities are interconnected and contain a human-centred perspective. As mentioned above, Industry 4.0 is characterized by the depiction of the factory, which does not attach much importance to the role of the human worker, but predominantly to machines. Industry 5.0, on the other hand, is more focused on humans and their contribution to the whole industrial process, including the highlighting of human creativity. Its main task is to increase efficiency, focus on sustainability and involve humans more in the production process, which on the one hand will foster the creativity of each human individual and in the same way will move from mass production to mass personalization (Dautaj & Rossi, 2022).

One of the main challenges of Industry 5.0 is to design smart environments that are human-centric. This is a challenge where human well-being is prioritized, but in such a way that production efficiency is also maintained. This is the so-called collaboration of robots and humans who will work together to achieve the same, common goals and share the same space (Coronado et al., 2022).

The rising trend of robotization into business processes under the influence of the fourth industrial revolution (Industry 4.0), confirms the fact that investments in industrial robots are on the rise. This claim was made by the International Federation of Robotics (Heer, 2018) on its website, based on a study where, compared to 2013 and 2017, the global sales of robots increased by up to twice as much. The International Federation of Robotics (IFR) highlights many cutting-edge technologies, such as the very concept of human-machine collaboration (we refer to the term collaborative robots) or simple programming, which can help to optimize and improve the productivity of production. It is robotic automation, in the concept of collaborative robots, that IFR believes is good in that robots work with human workers instead of replacing them. Thus, we could say that collaborative robots represent a certain concept that incorporates both an element of the so-called "human touch" and, at the same time, a high quality of the production process is ensured.

The new development concept of Industry 5.0 includes the challenge of creating highly developed systems that are efficient for all participants in society and thus help to provide optimal solutions in the human-nature-machine relationship. That people would be at the center of each transformation, along with technological development, while taking care of sustainability (De Felice & Travaglioni & Petrillo, 2021).

As stated by the European Parliament Portal (2005) in its resolutions on the environmental aspects of sustainable development, there is a need to innovate and invest in innovations in technologies that are more environmentally friendly. It also stresses that innovation in environmental technologies is an important driver for sustainable development.

It is sustainability, as one of the elements of Industry 5.0, that is important for environmental protection. Industry 5.0 is about building more sustainable technological workplaces and processes through elements of the Fourth Industrial Revolution such as digitalization, robotics, artificial intelligence. A key element, as well, is the environmentalization of the economy through the implementation of technologies and best practices that are environmentally friendly or the creation of products that are environmentally friendly (Majerník et al., 2022).

Based on the above findings, we could conclude that the new concept of Industry 5.0 in a way develops Industry 4.0, which is mainly based on technological innovation, smart factories and so on. The various elements of Industry 4.0, such as digitalization, virtual reality, Big Data, Internet of Things and so on (Alvarez-Aros & Bernal-Torres, 2021), are developed by the fifth industrial revolution, complemented and, through them, strive to meet the environmental objectives set. This is due to the increase in the need to protect the environment. It also focuses on people, human labor and human creativity. It focuses on the overall humanization of industry, and also on how humans (as a human factor) can enrich the various elements of Industry 4.0 in meeting corporate objectives.

## **1.2 Aim of the paper and methods used**

The main aim of the paper was a theoretical analysis of the concept of Industry 5.0 in comparison with the elements of the fourth industrial revolution with a focus on environmental aspects in manufacturing. As a result, two environmental aspects in manufacturing were selected and the degree of their implementation was compared among the V4 countries in the context of Industry 5.0. The V4 (Visegrad 4) countries include Slovakia, the Czech Republic, Hungary and Poland.

In order to meet the main aim we have chosen the following sub-aims:

1. To analyze the information and knowledge of the authors concerning the concepts of Industry 4.0 and Industry 5.0, their mutual comparison with a focus on the environmental aspect of Industry 5.0.
2. To specify and characterize the environmental aspects of manufacturing in the context of Industry 5.0 in the V4 countries based on data from the statistical office.
3. To summarize and interpret the findings on individual environmental aspects in manufacturing in the V4 countries, to compare them and then to formulate conclusions.

The process of elaboration of the paper consisted in a detailed analysis and formulation of the main objective and then the definition of individual sub-objectives, which are based on the main objective and condition its fulfilment. Within the scope of the studied issue regarding the Industrial Revolution Industry 5.0, we have processed a sufficient amount of information from the latest available scientific impact journals (WoS and SCOPUS), electronic sources from several authors and data from statistical offices. We analyzed the information in detail and later synthetically linked it into a coherent paper. The next step was to determine the research methods we used in the paper to achieve the main objective. In the final part of the paper, we chose two environmental aspects in manufacturing whose level and degree of implementation we compared in the V4 countries. We summarized the obtained results in the end and

formulated some conclusions based on the theoretical study carried out and the results found.

In order to obtain, concretize, summarize and interpret the latest knowledge on the concept of Industry 5.0 and environmental aspects in manufacturing, we used the following theoretical methods, such as synthesis method, analysis method, induction, comparison and visualization. Through the analysis method, we have thoroughly researched the issue at hand and collected sufficient domestic and foreign literature from various authors to gain an extended overview of the subject. We have defined key concepts and synthetically combined the findings into a coherent whole. In the final section, we compared the collected data and information with each other and combined them into a coherent whole through the method of induction. The method of visualization was used in the graphical processing of the data obtained from the available databases of the statistical offices.

## **2 Research results and discussion**

In terms of the theoretical analysis carried out on Industry 5.0, we can conclude that one of the main areas addressed by the concept of the fifth industrial revolution is the creation of a cleaner environment in the form of environmental protection. That goal can be achieved through the creation of a symbiosis between nature and technological development (Coronado, 2022). As a result of environmental protection and the introduction of greener principles into businesses, we often come across the term - environmental aspect.

Environmental aspects are defined by the ISO 14001 standard as the different parts of activities, products or services that are generated in a company and also affect the environment. However, their impact can be either positive or negative, depending on the extent of their environmental impact. As the iso-tsu.sk portal states, most of the time, or it is assumed that the impact will be negative. In an enterprise, it is necessary for the management to define the individual environmental aspects, their degree and their impacts on the environment. Among the environmental aspects we can include, for example, unwanted products in processes, various accidents disasters, suppliers, complaints and many others.

In order to compare the results of the analytical study, we have chosen the following two environmental aspects in manufacturing:

1. Production of zero emission vehicles.
2. Waste production.

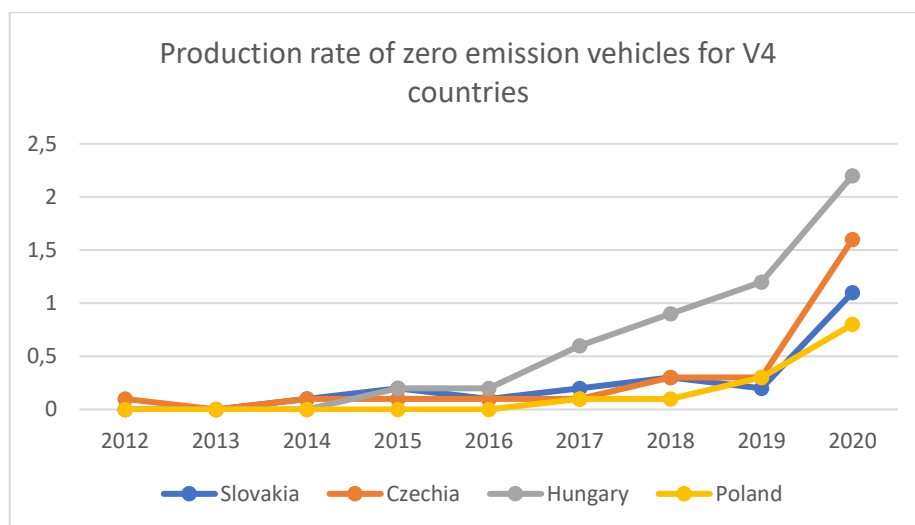
### **2.1 Production of zero emission vehicles**

As a first environmental aspect in production, we have mentioned the production of zero-emission vehicles for the V4 countries.

The EU statistics office, Eurostat.eu, lists this aspect as one of the indicators of the share of zero-emission vehicles in newly registered passenger cars. Zero-emission cars

thus do not release any direct exhaust gases into the air, thus saving the environment. This category includes hydrogen fuel cell vehicles and also battery electric vehicles.

Based on the data available in the Eurostat statistical databases, we have produced the graph shown in Figure 1, which presents the production rate of zero-emission vehicles in the V4 countries. The input data are given in percentage increments of newly registered passenger cars.



**Fig. 1** Production rate of zero emission vehicles for V4 countries as a percentage of vehicles sold.

Figure 1 presents the rate of newly registered zero-emission vehicles. As can be seen, among the V4 countries, Hungary has the largest share, with a vehicle production rate that increased by up to 2.2% in 2020, which represents the largest increase among the V4 countries over the period under review. On the other hand, Poland had the smallest percentage, with 0.8%, a difference of up to 1.4% compared to Hungary.

The increasing trend of this environmental aspect is also confirmed by a study carried out on the 2030 Agenda published by the Statistical Office of the Slovak Republic (2019), which shows that the number of CO<sub>2</sub> emissions produced by new passenger cars has decreased compared to 2007. This is even in all V4 countries, including Poland. As for the biggest decrease, it was recorded in the Czech Republic, where the decrease was up to 19.4%, followed by Hungary with a decrease of 18.1% and finally Poland and Slovakia.

The rate of production of zero-emission vehicles, and the associated decline in CO<sub>2</sub> emissions produced from new passenger cars, confirms the concern for environmental protection. New technologies for vehicle production can contribute to sustainable development and production.



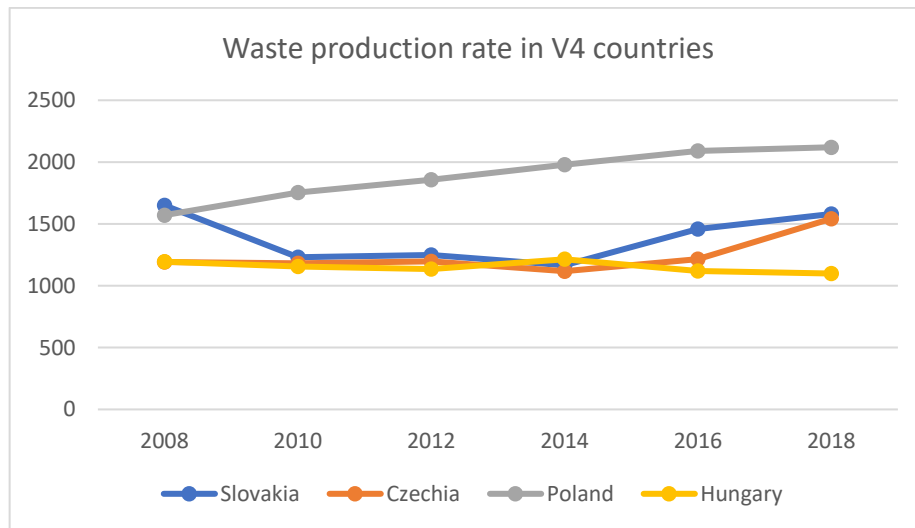
## 2.2 Waste production

The second environmental aspect of production in the context of Industry 5.0 was the level of waste production in the V4 countries.

In the framework of the 2030 Agenda for Sustainable Development, which was developed by all UN member states, representatives of the business community, the civil sector and members of the academic community, one of the targets or indicators is the production of waste, excluding mineral waste. In order to ensure sustainable production and consumption, it is necessary to create fundamental changes in waste management, since it is the amount of waste produced that represents a significant loss of resources in the form of materials and energy.

As stated by Eurostat (2020), waste disposal can cause serious impacts and environmental problems. As an example, they cite landfill, where it takes up a large amount of space and can therefore cause pollution of soil, water and air, and at the same time, the burning of waste can introduce harmful emissions into the air. It is also a long-term policy objective to reduce the amount of waste generated and to achieve higher levels of waste recycling.

Based on the available statistical data on waste generation in the European Union countries, as reported by Eurostat, we have produced the graph shown in Figure 2. Specifically, we have selected only data relating to the V4 countries. The input figures are given in kilograms per capita. The Eurostat collects the data every two years. The present graph presents the evolution of waste generation for each V4 country individually between 2008 and 2018.



**Fig. 2** Waste production rate in kilograms

Based on Figure 2 above, we could conclude that the environmental aspect, the waste generation rate, has a predominantly upward trend, which in this case is not a very good indicator. The only country within the V4 countries whose curve has a decreasing

character is again Hungary. We can see that compared to 2014 the waste generation rate has decreased, namely by 115 kilograms. We can also see that the waste generation rate in Poland was already high right at the beginning of the period under review, namely in 2008. For Slovakia, we can see a significant decrease in waste generation right at the beginning of the period under study, namely from 2008 to 2010, when it dropped from a production of 1650 kg to 1230 kg.

The results achieved in the research are confirmed by the study conducted on the 2030 Agenda published by the headquarters of the Statistical Office of the Slovak Republic (2019), which states that as of 2016, an increase in waste generation was recorded in two V4 countries, Poland and the Czech Republic, and in Poland even by 33%. However, in terms of waste recycling rates, we can observe the highest increase since 2010 in the Czech Republic, where it has increased by up to 10 percentage points.

### **2.3 Analysis of research results in the context of Industry 5.0 and discussion**

On the basis of the above results, we could conclude that among the V4 countries, Hungary achieved the best results. Compared to the other three countries, it achieved the highest values in our selected environmental aspects. As regards the production rate of zero-emission vehicles, there was an increase of up to 2.2% compared to the previous year. In terms of waste production, it had a decrease of 420 kg per capita compared to the previous year.

The action plan for the circular economy, presented by the European Commission in Brussels in March 2020, also speaks of the need to introduce new sustainable and more ecologically acceptable solutions. It represents one of the main pillars of the European Green Deal - the new European program for sustainable growth. It represents several measures throughout the entire life cycle of products and focuses on an ecological future. One of the measures is to reduce the production of waste in electronics and ICT. The emphasis is on extending the life of products through the modernization of individual components or reusability.

As the portal GX Solutions (2021) reports, technologies that bring automation and electronization have also entered waste management. The transfer of data and technologies to waste collection increases the efficiency of waste management and the quality of services provided. The essence of mass collection is that the consumer only pays for what he throws away. And that motivates people to environmental behavior. Digitization of containers, electronic waste collection, monitoring and planning are possible through GPS and RFID technologies.

We also meet ecological goals in the automotive industry. Many car companies have developed production programs and plans aimed at reducing or eliminating CO2 emissions. For example, Toyota is one of the pioneers for zero-emission vehicles. It has developed a strategy for when it wants to achieve climate neutrality by 2050. The goal of this strategy is to help customers choose technologies that are more environmentally friendly (touchIT, 2022).

Based on the data obtained from the EU Statistical Office, we could conclude that the environmental aspect we investigated, the production of vehicles with zero emissions, had an upward trend in all V4 member states. This means that interest in

environmental protection is growing, which is also supported by automobile companies with their ecological plans regarding the production of vehicles with zero emissions.

Worse results in terms of environmental protection among the V4 member states were achieved in the second investigated environmental aspect – waste production. The curve should have a downward trend. However, only the waste production curve in Hungary had a decreasing character. This may be due to the fact that the strategic plans of car companies regarding the protection of the environment were developed before the plans for the elimination of waste.

### **3 Conclusion**

Within the framework of the Industry 5.0 concept, we have focused on one of the main elements that differentiate it from, or complement, Industry 4.0, and that is environmental protection. Not only the V4 Member States, but also other countries are affected by the need to introduce eco-friendly and sustainable innovations. The level of implementation of ecological elements in business processes is certainly influenced by the legislation and developed programs of each country within the framework of the Sustainable Development Goals (Wysocki, 2021).

Industry 5.0 is a relatively new concept of industry, which complements and develops elements of Industry 4.0, such as digitalization, automation, smart factory, Big Data, etc., In cooperation with them, it is mainly oriented towards environmental protection, environmental innovation and value creation in the form of social orientation, focusing on people, their needs, creativity. The main objective is to create sustainable principles in production and development using elements of technological development.

The concept of the fifth industrial revolution represents a kind of synergy between machine (technology), man and nature. While Industry 4.0 could be described as technological, Industry 5.0 is more value-based. These are values, such as economic growth, sustainable development or climate strategies in the form of environmental protection, as well as the social side, the orientation towards the humanization of industry and the emphasis on the value of humans in achieving corporate goals in collaboration with technology.

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# The Level of Smart Mobility in V4 – Comparison of Capital Cities

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**Abstract.** Digitization and the development of the use of technology are becoming more and more a part of our daily lives. One of the current topics at the moment is sustainability. These two issues need to be able to come together. The use of digital technologies is important in order to improve the usability of resources and the functioning of processes throughout society. Through this article, we want to point out the current situation and level of the Smart Cities in V4 (Czech Republic, Hungary, Poland and Slovak Republic). We focus on the level of smart mobility in the capitals of the mentioned countries and then we compare them with each other. The aim of the first theoretical part of the contribution is to define the goals of Smart Cities and Smart Mobility and define their importance for the future. In the second analytical part, the aim is to compare the four capitals in Central Europe, belonging to the V4 and specify possibilities for the development of Smart Mobility in these cities.

**Keywords:** Smart City, Smart Mobility, digitization

**JEL classification:** O39, Q56, R11

## 1 Introduction

Sustainability is the theme of the 21<sup>st</sup> century. It concerns every single country, every city and basically every one of us. One of the areas that is constantly being taken over and examined in terms of sustainability is transport. Currently, there is a trend of living in suburban areas outside the city center, which causes people more and more to use means of transport to travel to work, school, acquaintances, etc. The goal of the future is to increase the sustainability of cities through the constant development of technology. To this a separate Smart City concept was created, which focuses on the application of technological innovations to the functioning of processes in the city. One of the important areas of the transition to Smart City is solving traffic problems in the city. Specifically, the so-called Smart Mobility Strategy. Putting it into practice is a

relatively demanding and lengthy process, but it is important that large cities in particular draw up a plan to put Smart Mobility into practice. We express how this works in practice in the article by identifying the situation in the field of Smart Mobility in four capital cities – Bratislava, Budapest, Prague and Warsaw.

## **2 Definition of Smart City and Smart Mobility**

Smart city concept is currently an increasingly accepted issue, which is dealt with not only by experts but also by metropolises of individual countries of the world. This issue is associated with the development of digital technologies and their usability in practice. There are several definitions of the term Smart City and it is quite difficult to define it clearly, as it consists of several sub-elements. According to the European Commission, Smart City is a place where traditional networks and services are made more efficient with the use of digital solutions for the benefit of its inhabitants and business. [8] Professor M. R. Wade defines Smart City as an urban area that has become more efficient and/or more environmentally friendly and/or more socially inclusive through the use of digital technologies. [29] The issue of Smart City was already addressed in 2000, when Hall stated in his article that Smart City can be considered a winning strategy of the city, which uses technology to increase the quality of life in urban areas and consequently increase the quality of the environment through better services. [9]

As we have already mentioned, Smart City is a concept composed of several elements. One of these elements is Smart Mobility. Defining Smart Mobility is also not easy, as it is an issue that is relatively young and still under investigation. Albino et al. define in their article Smart Mobility as the use of modern information and communication technologies in order to improve urban transport. [28] A similar view is shared by Chun and Lee, who say that Smart Mobility is a concept of comprehensive smart services used in combination with smart technologies aimed at future transport systems. [6] The last definition we give is from Vanola, who says that Smart Mobility represents the availability of ICT in relation to modern, sustainable and safe transport systems. [1]

Based on the above definitions and opinions of experts, we can state that the concept of Smart City, as well as the concept of Smart Mobility is influenced by the level of use of modern technologies in the normal functioning of the city and transport. The speed of adaptation of individual cities to new available technologies varies, which we also analyze in the analytical part of this article, specifically in the four capital cities within the Visegrad Group.

## **3 Aim and methodology**

The aim of this article is to identify the level of Smart Cities in the V4 capital cities and then compare them with each other, focusing on the level of Smart Mobility. As part of literature review, we defined the basic terminology related to Smart City and Smart Mobility. We based on several opinions of professional authors, which allowed us to

summarize the current situation in the theoretical basis of Smart Mobility issues. In the practical part of the article, we compared the level of transformation of the V4 capital cities to Smart Cities through the implemented index – Smart City Index 2021. As SCI is relatively large, we focus our attention on the Mobility factor.

The main method used in writing the article was a comparison of four capital cities – Bratislava, Warsaw, Prague and Budapest. The comparison was based on the Smart City Index (SCI), which is constructed by the IMD World Competitiveness Center (IMD) and the Singapore University of Technology and Design (SUTD).

SCI methodology [13]:

1. SCI takes into account the views of the city's concerns on issues related to the technological applications available to them in the city.

2. The first edition of the SCI ranks 102 cities worldwide by capturing the perceptions of 120 residents in each city.

3. The index consists of two pillars: the Structure Pillar, which refers to urban infrastructure, and the Technology Pillar, which assesses the level of technological measures and services available to the population.

4. Each pillar is evaluated over five key areas: health and safety, mobility, activities, opportunities and governance.

5. The cities are distributed on the UN Human Development Index (HDI) score of the economy they are part of.

6. Within each HDI group, cities are assigned a 'rating scale' (AAA to D) based on the perceptions-score of a given city compared to the scores of all other cities within the same group.

7. The final results are presented in two forms:

- overall ranking (1 to 118),
- individually by pillars.

Furthermore, in the contribution, we used analysis (used in the examination of the data obtained from SCI), for the interpretation of the results we mainly used graphic representation in the form of bar graphs. At the end, we applied the method of summarization, through which we specified the conclusions based on performed analysis.

### **3.1 Object of research**

We focused our analysis on the capitals of Central European countries, which together form the Visegrad Group (V4). It is the capital of the Slovak Republic – Bratislava, the capital of the Czech Republic – Prague, the capital of Poland – Warsaw and the capital of Hungary – Budapest.

#### **Bratislava**

The capital city of the Slovak Republic has less than 440 000 inhabitants [31]. HDI is growing slightly year-on-year (specifically between 2018/2019 by 0,003 points). GNP per capita in PPP in dollars is also growing (an increase of 1 441 dollars). [10]

### **Prague**

The capital of the Czech Republic has around 1 300 000 inhabitants [32]. HDI is growing slightly year-on-year (specifically between 2018/2019 by 0,009 points). GNP per capita in PPP in dollars is also growing (an increase of 6 512 dollars). [13]

### **Warsaw**

The capital of Poland has around 1 700 000 inhabitants [33]. HDI is growing slightly year-on-year (specifically between 2018/2019 by 0,008 points). GNP per capita in PPP in dollars is also growing (an increase of 3 997 dollars). [14]

### **Budapest**

The capital of Hungary has around 1 750 000 inhabitants [30]. HDI is growing slightly year-on-year (specifically between 2018/2019 by 0,009 points). GNP per capita in PPP in dollars is also growing (an increase of 4 185 dollars). [11]

## **4 Results**

Based on theoretical background, it is clear that the development of technology is promoted in all areas of the society. A prerequisite for the future is the development of smart technologies into the functioning of cities. The speed of technology transfer and digitization is different. There are cities that are already almost fully digitized and we can call them Smart Cities. However, some cities are just embarking on a wave of digitization and technology advancement. In the practical part of the article, we therefore focus on comparing the level of smart in V4 capital cities. Specifically, we focus on one analyzed factor – Mobility, through which we determine the level of transition to Smart Mobility.

Among the cities that we can call Smart City, we can include Singapore, Zurich and Oslo, which in the SCI index ranked the first three highest ranks in 2021. Singapore thus defended its first place in 2020.

When we focus on the mentioned V4 capital cities, the best position was occupied by Warsaw. Out of a total of 118 countries, Warsaw ranked 75<sup>th</sup> in 2021. Compared to the previous year, Warsaw fell by 20 positions. In comparison, Bratislava occupied the 96<sup>th</sup> position in 2021, and the position also deteriorated by 20 places. The third analyzed city – Budapest, occupied the position just behind Bratislava (97<sup>th</sup>) in 2021. Even in this case, there was a year-on-year drop of 20 places. The largest drop was recorded in the capital of the Czech Republic (Prague), which occupied the 78<sup>th</sup> position, which represented a drop of 44 places.

We summarize the overall evaluation in Table 1. <sup>1</sup>

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<sup>1</sup> Specific results in the individual factors analyzed are available on the IMD website: <https://www.imd.org/smart-city-observatory/home/>.



**Table 1.** SCI 2021 and 2020 for V4 capital cities [13].

City	Smart city Rating 2021	Structure 2021	Technology 2021	Smart City Rank 2021	Smart City Rank 2020	Change 21/20
Bratislava	CC	CC	CC	<b>96</b>	76	- 20
Budapest	CC	CC	CC	<b>97</b>	77	- 20
Prague	CCC	B	CCC	<b>78</b>	44	- 34
Warsaw	CCC	CCC	CCC	<b>75</b>	55	- 20

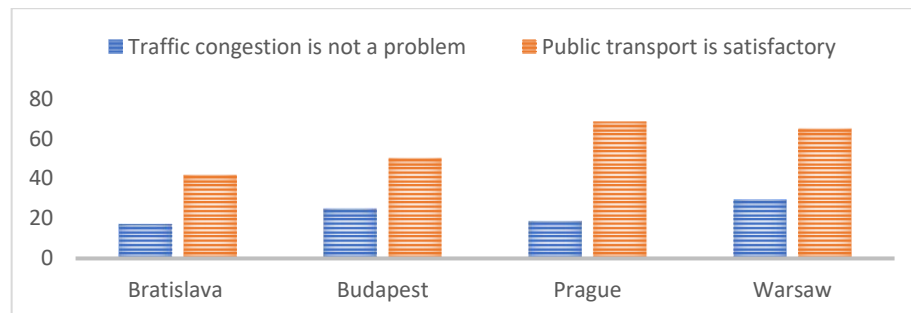
Source: IMD website: <https://www.imd.org/smart-city-observatory/home/> [accessed 25.06.2022]

Based on the above table, we can state that the transition to Smart City is at a comparable level in all 4 cities. A significant negative is the fact that all analyzed cities have significantly deteriorated year-on-year. It is therefore clear that none of the major V4 cities have managed to embark on a wave of digitization and the transition to smart technologies in cities.

We analyze the shortcomings of individual cities in separate subchapters.

#### 4.1 SCI factor Mobility in the first pillar Structures

SCI is divided into two pillars, both of which analyze the Mobility factor, which significantly affects the creation of Smart City. When we focus on the first pillar of SCI, we analyze mobility in terms of structure. Figure 1 shows the achieved values for mobility issues for the four cities analyzed in 2021.



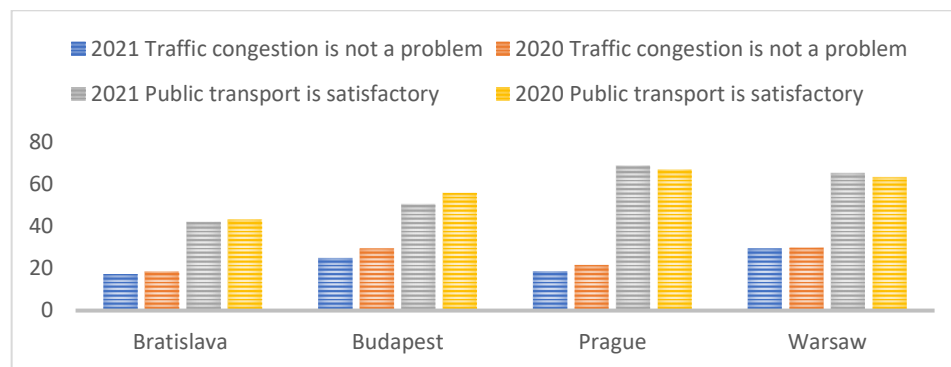
**Fig. 1.** Mobility in the pillar Structures 2021 in analyzed cities.

Source: own processing according to IMD World Competitiveness Center: Bratislava, Budapest, Prague, Warsaw.

It can be seen from Figure 1 that traffic congestion is a problem for analyzed cities. Budapest and Warsaw are at the average level of all analyzed cities on this issue. Bratislava and Prague are significantly below average. On the positive side, the inhabitants of all four cities are satisfied with public transport and the achieved values

of this indicator are above average. We can therefore deduce that the solution to this situation is to increase the use of public transport in cities. The conditions according to the SCI results are created enough for this, it is only necessary for people to realize the need to use them and thus facilitate transport in the city center.

When we compare 2021 and 2020, the mobility indicators did not show significant changes. A slight drop was recorded in Budapest, where satisfaction with public transport as well as with traffic congestion deteriorated.



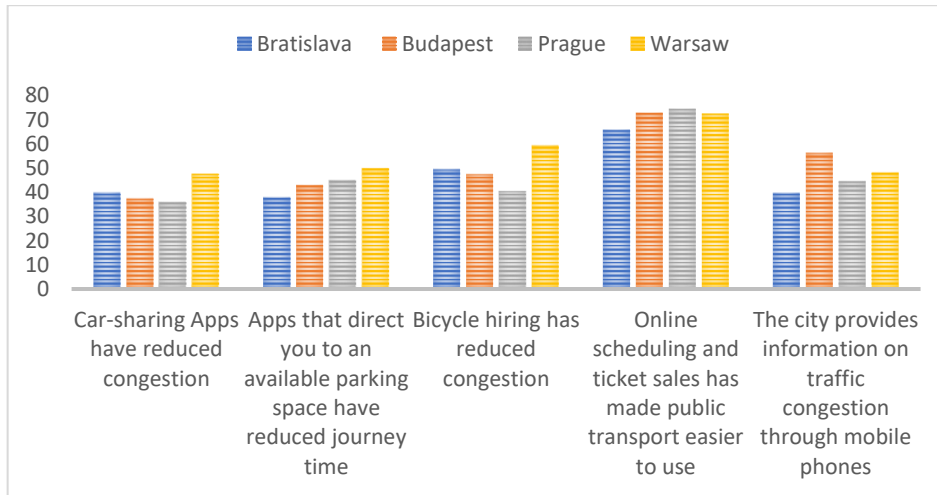
**Fig. 2.** Mobility in the pillar Structures 2021 and 2020 in the cities analyzed.

*Source: own processing according to IMD World Competitiveness Center: Bratislava, Budapest, Prague, Warsaw.*

The situation did not improve year-on-year in any of the analyzed cities. It is therefore necessary for cities to focus more on promoting the use of public transport and improve the transition to Smart Mobility.

#### 4.2 SCI factor Mobility in the second pillar Technologies

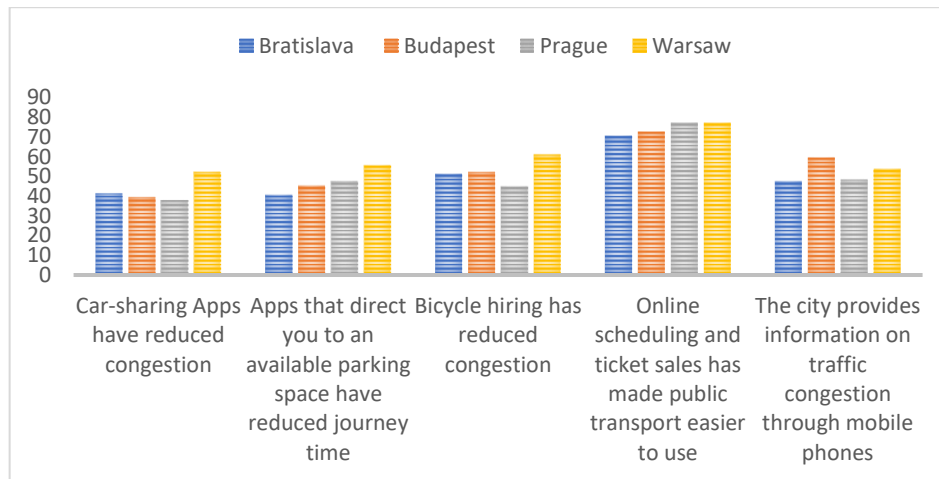
In this section we will focus on the analysis of the results of the SCI factor Mobility in terms of technology. Figure 3 shows the values for each Mobility indicator for 2021.



**Fig. 3.** Mobility in the pillar Technologies 2021 in the cities analyzed.  
*Source: own processing according to IMD World Competitiveness Center: Bratislava, Budapest, Prague, Warsaw.*

In terms of analyzed technologies, a different area is problematic for each city. In Bratislava, the problem is the application related to parking and information about traffic congestion via mobile phone. Other indicators are at the level of the average. In Budapest, the possibility of reducing congestion through car-sharing apps as well as parking-related applications is particularly problematic. The possibility of online scheduling and ticket sales within the use of public transport is the most perceived positively. In Prague, car-sharing applications are not perceived as a tool to reduce traffic congestion. The only indicator that reached above-average values is online scheduling and ticket sales in public transport. Warsaw ranked best in the analyzed indicators. The only slightly below-average result is the indicator “the city provides information on traffic congestion through mobile phones”. Other indicators achieved either average or above-average results.

Figure 4 shows the year 2020 for the Mobility indicators in the Technology Pillar.



**Fig. 4.** Mobility in the pillar Technologies 2020 in the cities analyzed.  
*Source: own processing according to IMD World Competitiveness Center: Bratislava, Budapest, Prague, Warsaw.*

All countries recorded a decrease in the analyzed indicators. This is not a significant decline, but all indicators deteriorated slightly year-on-year. The most significant decreases occurred in the indicator “the city provides information on traffic congestion through mobile phone”, the smallest decrease was recorded by the indicator “car-sharing apps have reduced congestion”.

### 4.3 Future of Smart Mobility in analyzed cities

Based on the results of the SCI, it is clear that the four cities analyzed have certain mobility shortcomings that need to be improved in the coming years. Each of these cities has a goal of gradual transformation into a Smart City as part of its development strategy.

Bratislava has a creative concept called Bratislava Reasonable City 2030 [3], the aim of which is to turn Bratislava into a so-called Smart City by 2030 through the development of several areas. One of these areas is also mobility. The strategic goal of Bratislava is sustainable and efficient traffic management, including the collection, analysis and use of integrated traffic data in the city. It wants to achieve this goal through several tools. The aim is to increase the supply and attractiveness of passenger transport by public transport and thus increase the quality of public space. Emphasis is also placed on the sustainability of environmental quality. The achievement of the sub-targets is measured through several clearly defined indicators. These include a reduction in the share of motorized individual transport to 35% in 2025, 25% in 2030 and less than 20% in 2040, an increase in the length of cycle paths built in Bratislava, a reduction in emissions from transport, etc. The following projects are currently underway in Bratislava, the aim of which is to improve the level of mobility in the city:

- Informatization of public transport in Bratislava, which focuses, inter alia, on the fitting of information boards using position data obtained from GNSS equipment in means of transport stops [7],

- Bikesharing, which is the largest in Slovakia in Bratislava and aims to develop cycling [2],

- Urban-E, which aims to develop electromobility and support the expansion of charging station infrastructure [21],

- Up! City, which focused on electric car sharing, is currently inactive [18].

We can state that Bratislava is trying to accelerate the process of transformation to Smart City through several projects.

Like Bratislava, Budapest has a strategy for becoming a Smart City. In particular, the Smart Budapest concept [22], which focuses on regional development, the environment, society and the economy. One of the goals is to ensure sustainable transport and proactive transport management in the city. In Budapest, they want to focus on increasing the use of public transport by 2030. Specifically the aim is to achieve that by 5% point growth in public transport half of all city traveling. [22] One of the goals is, of course, to increase the use of electric cars in the city. In order to achieve this goal, it is necessary to build a sufficient infrastructure in the city with enough charging stations. Proactive transport management is management that aims to increase traffic safety and reduce congestion through efficient urban logistics and intelligent mobility in Budapest. In Budapest, They focus on the development of Smart Mobility through several projects and strategies:

- The Mobility Plan in Budapest, which aims to improve Budapest's competitiveness and transport, as well as to improve the manageability of the city and surrounding areas on the basis of sustainability standards. [5]

- Budapest for All is a strategy that aims to protect the city's environment and habitability. [15]

- The Budapest Integrated Settlement Development Strategy is a comprehensive plan that sets out development trends and priorities in the city of Budapest. [20]

- Climate Strategy and Sustainable Energy and Climate Action plan [10].

- MOL Bubi is a bicycle sharing service. [17]

Budapest is set for a gradual transformation to smart using a variety of tools and paths.

Prague also has a concept for the development of smart elements in the city, specifically the concept of Smart Prague 2030 [19]. The concept is based on the use of state-of-the-art technologies to transform the metropolis into a more pleasant place to live. Of course, this concept also focuses on mobility in the city. Its challenges lie in air and noise pollution, traffic jams, the age of the vehicle fleet, the use of public transport and parking problems. The aim is for mobility in Prague to be clean, shared, intelligent, mobile and self-managing. Several projects are being implemented to develop mobility in the city:

- Intermodal route planner, which will contribute to the flow of traffic and reduce the environmental burden caused by car traffic in Prague. [25]

- Maas App – Single registration and single payment for mobility services [26].

- Multi-channel check-in system for public transport, which enables a comfortable and modern way of handling public transport passengers. [27]
- Data integration of P+R car parks in the catchment area of Prague, the aim of which is to reduce the burden in Prague through car parks outside the city limits. [23]
- E-carsharing, which creates space for a system of public car sharing. [24]

As in the previous two cities, the goal in Prague is to improve the level of Smart Mobility in the city.

Warsaw also has a concept focused on the development of the city towards Smart City, specifically Warsaw and Smart City. [16] This concept is divided into 6 key areas of development. One of them is mobility in the city, which aims to expand the use of public transport, make public transport more efficient and use new technologies in order to find sustainable solutions in transport. In Warsaw, there is so-called Veturilo project. It is one of the largest urban cycling systems in Europe. Thanks to this project, there is a total of 500 km long network of cycle paths in Warsaw. Furthermore, mobile applications are widely used in Warsaw, which are used to purchase tickets, parking tickets, timetables and the current location of public transport. Car-sharing, which has been operating since 2017, is a matter of course in this city. It is planned to put more than 140 electric buses into use in the future. The aim is for the city to use only electric cars in the future, while it is necessary to ensure, in particular, an increase in the number of charging stations. Another important project that will move Warsaw towards Smart Mobility is VaVel. This project uses big data from public transport and the Veturilo bike system. The result is the creation of an intelligent route planner, with the application designing the optimal route.

## 5 Conclusion

The future of our planet is in our responsible approach to daily activities. One such activity is travel and use of means of transport. The solution to traffic problems in cities is the Smart Mobility concept.

It turned out that in the capitals of the V4, the level of development of Smart Mobility is still in its infancy. All four cities still have several important challenges ahead of them, which they are elaborating on specific strategies focused on the built Smart City. In the article, we focused primarily on analyzing the position of the four main cities in the SCI. We focused our attention on the part of this index that examines the level of mobility in the city. Overall, the city of Warsaw has the best position in the SCI, ranking 75<sup>th</sup>. As 118 cities were analyzed, all four V4 capitals will not be ranked until the second half of the evaluation. The negative is that there was a significant year-on-year decrease of up to 20 or more places in all four cities. It is therefore necessary for these cities to focus on the gradual development of smart elements, as the cities of developed countries are starting to flee more significantly.

As far as mobility is concerned, in the analyzed cities there are problems comparable in several cases. Traffic congestion and the associated solution are a big problem. The topic of parking and related applications is also problematic. One of the goals in all four cities is to increase the attractiveness of public transport and reduce the traffic load. On

the positive side, all four cities have developed a development concept towards Smart City, which also includes a separate section focused on elements of Smart Mobility. The advantage is that individual cities are part of several projects aimed at streamlining transport in the city.

The conclusion is that cities are theoretically ready for the transition to Smart City, but in practical terms there is still a long way to go to real transformation. One of the important factors influencing the level of Smart Mobility in the city is, of course, the people whose efforts should be focused on using the new elements that the city offers them. Only by consensus of the city's activities and the activities of its inhabitants can the Smart City strategy be successfully implemented.

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# Reskilling and Upskilling of Managers: People Management in the Digital Era

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**Abstract.** Trends in business management caused by Industry 4.0 implementation and related COVID-19 restrictions brought up new challenges. Consequently, increasing digitalization triggered a modern concept of people management accelerating digital leadership. Newly arisen job positions require new strategies in training, reskilling, and upskilling. The role of businesses is to ensure appropriate applicable training of digital skills for their employees and mainly managers which are the main actors of organizational changes and act as digital leaders. Currently, enterprises employ number of employees with a set of skills but to fully digitalize the business process it is necessary to have more or different skills which were the subject of our research, The aim is to create a model representing new set of managerial skills necessary for digital leadership and to identify a gap in the current and desired skills of the examined enterprises and moreover to suggest a procedure of the reskilling and upskilling program implementation to ensure managerial efficiency.

**Keywords:** reskilling, upskilling, digitalization

**JEL classification:** J24, J28, M54

## 1 Introduction

Nowadays Industry 4.0 is often discussed in the context of digitalization on the business management level and influence all industries and each enterprise in the world. Industry 4.0 platform has arisen from a project of German government in 2011 and since then it is present in all countries. As a consequence of its implementation to the business process, the way of managing people, business culture and job positions has significantly changed [1].

One of the most important challenges of the business transformation process is the training of employees and managers. Human capital is the key actor of business processes, and it is essential for them to adjust skills and competencies in accordance with the digital revolution. It can be deduced that the newly arisen state requires reevaluation of the traditional competencies' concepts on the existing positions. Digital competencies of managers and equally their subordinates have become more important than ever. Therefore, managerial skills are the main subject of our research. All these challenges are more actual for the reason of digital revolution on the labor market. [2]

All the identified adjustments were accelerated in the early 2020 due to the COVID-19 spread which has caused even bigger changes. It has affected all departments of businesses, mainly HR and top management. Digital era is characterized by exponential usage of technologies, and it covers the entire industries, sectors, and regions. Concept of virtual teams and cloud systems need to be even more examined and create an easier way for changes implementation [3].

Our examination is oriented on reskilling and upskilling of managers as this topic is very up-to-date due to many authors. These concepts should help enterprises to provide their managers with necessary skills. The future of management is developing towards leadership, and therefore in this paper we focus on the trend of leadership skills development.

## **2 Literature Review**

People management nowadays along with reskilling and upskilling concept of traditional skills is one of the most important components of HRM and one of the most discussed topics in the management field. Many authors mention the need for skills transformation due to digitalization. Moreover, as we mentioned before, the main actors of business turning into digital process are managers who act as leaders of the change and are those who needs to be upskilled and reskilled first.

### **2.1 Reskilling and upskilling: skills of digital era**

In the context of managerial positions there are many studies identifying skills perceived as the key reflection of the digitalization era. Initially, there have been identified critical thinking, ability to solve problems, networking, collaboration, agility, adaptability, effective oral and written communication, evaluation, and analyses of information (analytical thinking or so-called information literacy), creativity and imagination [4,5,6].

Further research of Industry 4.0 done by numerous authors recognizes that new skills are needed, mainly digital literacy focusing on the ICT skills. Entrepreneurial skills along with the mentioned digital ones are accompanied by communication and teamwork ability. Furthermore, specifically for the HR departments strategic thinking is commonly cited by researchers [1,7].

Study of the author Manakhova points out the relevancy of life-long learning which should be an essential part of society 4.0. High turnover, as a consequence of

digitalization, and cost-savings should be made use of in a form of higher investments in the reskilling and professional training programs. The requirement for continuing education is acknowledged also by WEF. The basic skills essential for current job positions have rapidly changed and furthermore, more than 133 million of new positions has arisen. [8,9].

Additionally, authors mention effective handling of impersonal meetings and online communication due to COVID-19 and social distancing. The topic of upskilling and reskilling is often discussed in relation with the coronavirus restrictions. Businesses need to take into account that new training should be implemented to the business policies [10]. Because of the social and physical distance, it is necessary to learn how to work in an online space and add creativity and soft skills to the training of employees. In the context of remote work, employees are recommended to be trained in online platforms. Other stated skills include agility of learning and in the instances of managers, systematic future planning is likewise cited [11,12].

Even the biggest companies such as Henkel, L'Oréal, Voith, PwC and Amazon launched upskilling programs to ensure new skills and thus prepare themselves for the digital future. We anticipate that this trend applies on the employees as well as managers [13]. The key activity and turning point of the digital transformation is primarily education and training of employees [14].

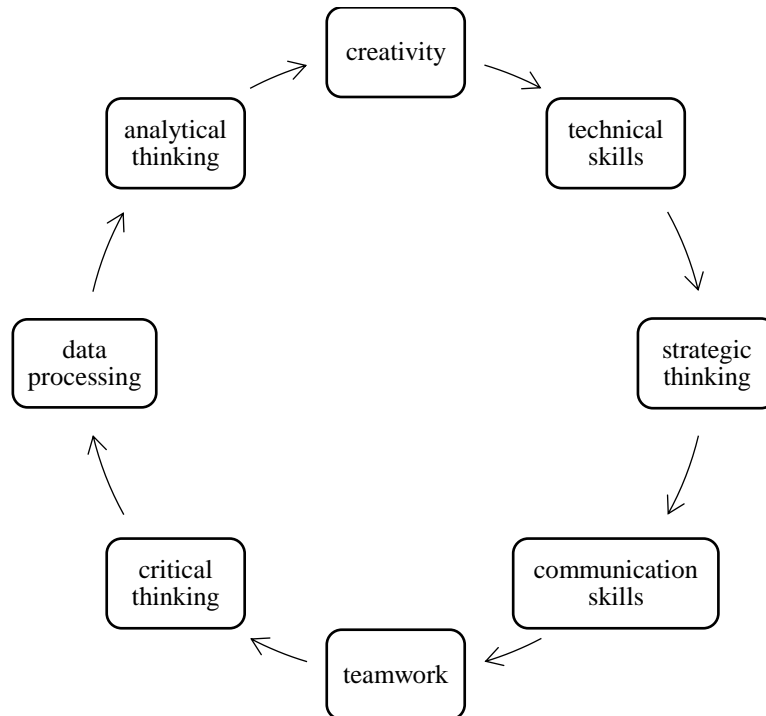
## **2.2 Digital Era Leader**

As previously mentioned, currently the skills in general should be changed or updated not only of the staff but mainly of the managers who are the leaders of change. Fully developed HR department oriented towards innovations and new trends is a precondition for leadership development. That is why this chapter focuses on leaders who manage people in digital era.

Leaders can help the transformation in three ways. The first factor is sharing their experience with employees. Secondly, continuing learning and clearly articulated vision to make sure new leaders have the ability to learn from their own mistakes. The research of author Kane [15] was oriented on skills for leading people in digital era. The mostly mentioned were transformation vision, orientation for the future, and openness for the changes.

Considering the reconstructed management of staff, the leadership styles have overcome notable metamorphoses compared to the traditional forms. Before the start of Industry 4.0 transactional leadership was predominantly enforced and now authors highlight transformational management. Similarly, as with employees, managers should be digitally literate and in addition have a clear digital vision. New-found skills include quick failure skill which represents the ability fail, admit a mistake, and learn from it. Moreover, managing diverse teams and connecting opportunities with individual employees through immediate communication are mentioned [16, 17].

In the figure 1, we illustrate a summary of managerial skills for successful implementation of digitalization according to the gathered information from authors.



**Fig. 1.** Summary of Industry 4.0 managerial skills  
Source: own processing

Handling digital leadership is a complex task requiring numerous competencies and is efficient with upskilled and reskilled managers. Author created digital leadership excellence framework which shows the skills of digital leader in four of his roles. These include reflexive leader, independent creator of changes, digital curator, intelligent decision-maker [18].

Authors mention individual tools and activities which should be done by the management. From those that were not mentioned before we can include tracking the competencies and the necessity of employees' development, diversity management, supporting learning and trainings, mentoring, flexibility, and talent management [19].

### 3 Methods

In this paper we used compilation for the purpose of data collection of information about the researched topic from various authors. This includes knowledge about the Industry 4.0 concept which is closely linked to digitalization which is currently a very discussed topic. Moreover, COVID-19 spread caused huge changes and accelerated the digitalization process and therefore it is important to examine this phenomenon, too. In terms of these trends the need of reskilling and upskilling started to be significant in the context of newly needed skills. Identification of these skills was the base of our

research. This basically creates the theoretical part of our paper. In order to identify the key set of information about reskilling and upskilling of managers we used induction and deduction methods.

For gathering the data about the mentioned skills needed for the second part of this paper, we used a short survey in which we asked managers about the skills which they use for their managerial function and then about the way they perceive the examined skills in accordance to their future importance.

In terms of methodology, we used thesis in order to validate and compare the existing gaps in skills of managers with their importance for the future of the enterprises.

In the results and discussion part of this paper we aimed to analyze the obtained data from database of enterprises which were given the survey we explained previously. Moreover, we used comparison of the current state of skills on the contrary to the desired status in the enterprises.

Research question of this paper is: Are existing skills of managers in the examined enterprises reflecting the digital transformation? How should the enterprises implement reskilling and upskilling program?

The aim of this paper is to determine a model of skills which should be upskilled or reskilled in examined enterprises. Moreover, with a partial objective we added the value to the main one by suggesting a model of a reskilling and upskilling process for the examined enterprises in the Slovak republic.

The subject of our research were 841 enterprises from all Slovak regions. 256 of them are micro sized, 174 small sized, 176 medium sized and finally, 235 enterprises were large sized. According to the business sector, 272 enterprises are from production sector, 403 of them provide services and 166 belongs to other sectors. From the point of view of ownership 540 enterprises are domestic and remaining 301 are foreign origin.

## **4 Results and discussion**

As we previously mentioned, authors state various competencies and skills of managers which allow digitalization of enterprises. Considering that, we constructed a model of managerial skills required for successful implementation of Industry 4.0 along with the tendencies of the COVID-19 crises. In order to verify the theoretical knowledge of researchers we examined enterprises in Slovak republic.

In the questionnaire we asked about two circumstances. Firstly, we examined the current skills of managers which are perceived as already developed and used by managers. Secondly, we asked about the same skills but in the context of their relevance for the future of the enterprise. In this way, we were able to apprise of the discrepancies in the current status in comparison with their importance for the future. Consequently, we could examine the gap in the skills which needs to be added and empowered.

In the survey, respondents could choose from a scale from 1-5. In the first question where we examined the real state in the given enterprise, 1 means that managers in the company do not apply the skill to 5 which means complete application of the given skill. In the second question where we asked about the future importance, 1 means that

the skill is not essential and meanwhile 5 represents important skill. Below this text table of the gather data is enclosed showing the results of the survey.

**Table 1.** Real and future skills of managers

SKILLS OF THE MANAGERS	REAL APPLICATION IN THE ENTERPRISES					IMPORTANCE FOR THE FUTURE OF THE ENTERPRISE				
	1	2	3	4	5	1	2	3	4	5
<b>Data processing</b>	8,32	9,5	20,1	29,1	32	7,37	5,23	18,19	27,23	39,83
<b>Critical thinking</b>	3,92	6,78	22,95	36,15	29,6	2,62	4,76	17,7	30,56	42,69
<b>Creativity</b>	2,97	6,54	24,6	32,2	32,8	2,85	5,11	16,5	30,44	43,28
<b>Analytical thinking</b>	1,3	3,92	17,95	34	41,97	1,55	2,97	13,3	24	56
<b>Stategic thinking</b>	3,69	6,42	18,9	31,63	38,6	3,09	4,04	13,08	24,85	53,03
<b>Technical skills</b>	6,66	9,5	18,9	28,66	35,31	6,9	6,18	15,7	25,2	44
<b>Teamwork</b>	2,26	4,64	1,66	34,13	41,38	1,78	2,73	12,6	25,68	54,93
<b>Communication skills</b>	2,38	6,42	20	33	38	2,02	4,52	13,2	27	51,25

Source: own processing

We expected differences occurring because we are aware that not all enterprises are ready for the implementation of Industry 4.0. Moreover, the concept is relatively new and not all enterprises invested money to reskilling and upskilling. Furthermore, employees in Slovakia could be resistant to changes which would result into insufficient skills level important for digitalization. In the table below we show the differences considering only the scale 4 and 5 because they have the biggest relevance.

**Table 2.** Gaps in the real and future skills

SKILLS OF THE MANAGERS	DIFFERENCES (GAPS) IN THE REAL AND FUTURE SKILLS		
	Scale 5	Scale 4	Scale 4 and 5
<b>Data processing</b>	7,83	-1,87	5,96
<b>Critical thinking</b>	13,09	-5,59	7,50
<b>Creativity</b>	10,48	-1,78	8,72
<b>Analytical thinking</b>	14,03	-10,00	4,03
<b>Stategic thinking</b>	14,43	-6,78	7,65
<b>Technical skills</b>	8,69	-3,46	5,23
<b>Teamwork</b>	13,55	-8,45	5,10
<b>Communication skills</b>	13,25	-6,00	7,25

Source: own processing

The comparison and evaluation of the given data confirmed discrepancies between the two variables. With this finding we can conclude that in the examined enterprises in Slovak republic there is a need for change and improvement. Therefore, we recommend to the examined enterprises to focus on reskilling and upskilling programs for managers.

If we rank all skills in the context of the positive differences, they can be placed in this order from the most important one: 1. creativity, 2. strategic thinking, 3. critical thinking, 4. communication skills, 5. data processing, 6. technical skills 7. teamwork and 8. analytical thinking. As the research was done in the Slovak republic the application can only be applied to Slovak business environment. Other countries might reach different results. Another limitation of the research is that we examined less than 1000 enterprises and the research can only be valid in the context of managers.

Creativity as a skill can be perceived very helpful tool for managers. This particular ability can be boosted by each person individually not only at the workplace but in personal life, too, mainly by maintaining physical or creative activities in free time. There are many workshops and courses to give the space for a person to become creative and awaken them. However, many authors mention that creative workplace might help in reaching better job performance in general.

Analytical, critical, and strategic thinking are predominantly inborn ability of an individual. These traits nevertheless can be learned by trainings and hard work and along with data processing could be improved by numerous tasks or role plays. We consider the skill of teamwork as an important part of new set of skills for Manager 4.0 and perceive this ability to be empowered only by a lot of practice and applying this type of work into the work process.

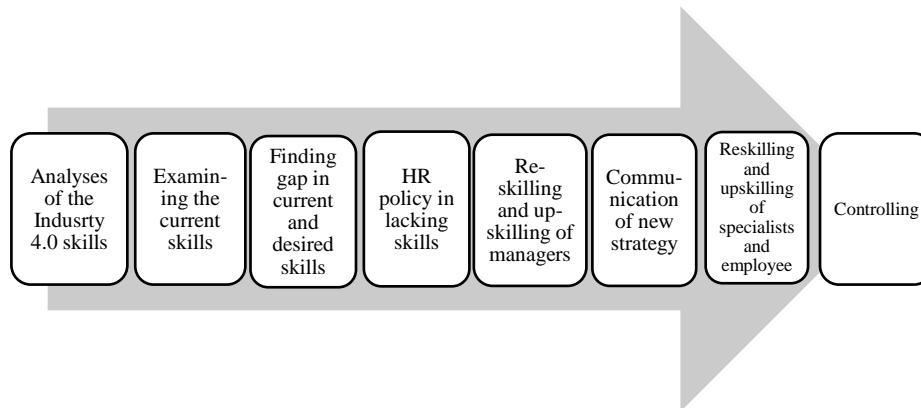
Another skill mentioned and examined in the enterprises is communication. In the current period we face many challenges in this area as a lot of communication process takes place online, so the face-to-face form starts to disappear, and it becomes less personal. It can be challenging for managers as well and that is why there is a need to not only learn how to communicate properly but to manage impersonal communication via the Internet and various media, including social media. Technical skills should be upgraded mostly by professional trainings or courses based on the specific type of task it is required for.

Open communication from the top management can be a great tool for handling this situation. Other significant factor is that managers are the role models for their employees and leadership in HR is also very important factor as its increasing in relevancy. Only when the managers are skilled enough and properly, they can lead their way for the employees. Managers act also as employees' helpers on the road to better digital literacy.

Human resources are the most valuable asset of all enterprises worldwide and they should be given the most attention. The skills of the employees and mostly managers are very important when executing a certain profession and function in the company. When gaps exist management should undertake several steps to make sure all requirements and expectations are met correctly.

Based on the research and stated facts we suggest a model of reskilling and upskilling in the organizations due to the digitalization phenomenon along with COVID-19 existence. The model of the steps is illustrated in the Figure 2.





**Fig. 2** Reskilling and upskilling procedure

Source: own processing

The limitation of the survey is that it was done in 2020 when COVID-19 has already been spread but the restrictions started only in March. Knowing this trend, we can assume that the acceleration of digitalization then was just in the beginning and the situation could have changed until now. Remote work concept has been implemented to the strategies of many businesses which caused companies to train managers in the mentioned skills which would lead to an improved level of them. Meanwhile, the situation in the examined enterprises might have changed slightly or enormously. Sometimes even a small change in the business strategy of HR department can reduce the discrepancies in skills of their employees.

All skills play significant role in people management, but we need to add that they vary according to various countries and specific organizations. Some of the enterprises are very individual when we look at them from the point of view of the sector in which they operate. For instance, the results might be different in services which are generally more digitalized and have higher potential to digitize their processes in comparison with agriculture. This is just one of the examples. Slight differences can also be observed in smaller versus larger enterprises as larger ones usually have more financial resources to finance the investments into digital business transformation.

## Conclusion

In conclusion, we can say that the platform Industry 4.0 became part of our lives. Socio-economic trends caused significant shift from the world we knew before digitalization started. The pandemic influenced the development as well and according to specialists it not only had negative but also positive effects such as acceleration of digital transformation. Both these circumstances affected enterprises on various levels.

As most of the businesses have overcome changes vague skills need to be revised. Given the stated knowledge and previously mentioned facts from this paper it is clear that there are still gaps present in the managerial skills which they possess and those they will need for the future to perform an improved managerial role 4.0.

In this paper we provided a closer look to why reskilling and upskilling of workforce and mainly managers are relevant and desired. We did this by examining these practices on a theoretical level and their perception of foreign authors.

In addition, we examined enterprises from various sectors, regions and of different sizes. We determined the existing gaps in the skills which should be considered in the future. Lastly, we suggested a model of possible actions that would be appropriate for the enterprises in the reskilling and upskilling programs.

We fulfilled the aim of this paper by finding the gaps between the skills that are still insufficient or need further attention. By constructing a model of the differences, we provided a closer look and suggestion on which skills the examined enterprises in Slovakia should focus more. Moreover, we enriched this model with a complementary procedural scheme suggesting a managerial implication of how they should deal with the discrepancies. This could be done by numerous steps including reskilling and upskilling model to their business policies in the HR management field.

### **Acknowledgement**

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# Correlation between Car Sales and the GDP in EU Countries with Focus on the Impact of Covid Pandemics

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**Abstract.** The present paper deals with the sales of passenger cars and light utility vehicles in relationship to the GDP of EU countries. This relationship is evaluated with the correlation coefficient. A maximum period of up to 20 years is considered at first stage. In the second step the correlation is evaluated over a 10-year period prior to the Covid pandemics. The pandemics hit the EU countries in 2020. Therefore, the correlation is finally evaluated over a 10-year period including the year 2020. This paper studies the impact of a major external negative factor on the evolution of car sales across EU countries while considering their GDP.

**Keywords:** car sales, passenger cars, light utility vehicles, correlation, pandemics, Covid-19

**JEL classification:** *M21, L25, L21*

## 1 Introduction

Car sales represent an important part of the global economy, and they maintain their importance on the EU market. During the financial crisis in 2008, incentives were put in place across the EU countries to support their sales and to maintain the automotive industry in good shape. This paper focuses on the correlation between the car sales and the Gross Domestic Product of EU countries. The objective is to study the link between the two indicators in relationship to a negative external influence represented by the Covid-19 pandemics that hit the EU first in 2020.

The link between the car sales and the GDP is evaluated with the correlation coefficient. The EU countries represent an economic group with various internal performances. Therefore, it's likely that the car sales evolve differently in reaction to an external factor such as the pandemics. The present paper will monitor this evolution and look for findings that can be used for managerial actions.

## 2 Methodology

Data from several sources were processed to achieve an overview of the car sales and the economic performance in terms of GDP in EU countries.

At the first stage the data on the Gross domestic product (GDP) were processed. The GDP was considered at market prices. It is the result of the production activity of resident producer units. It is defined as the value of all goods and services produced less the value of any goods or services used in their creation. The ESA 2010 (European System of Accounts) regulation may be referred to for more specific explanations on methodology. Data are presented in million units of national currency. No conversion to a single currency such as Euro was done. Institutional source of the data analysed in this paper is Eurostat. The data is presented on annual basis. [15]

Countries considered: Belgium, Bulgaria, Czechia, Denmark, Germany (until 1990 former territory of the FRG), Estonia, Ireland, Greece, Spain, France, Croatia, Italy, Cyprus, Latvia, Lithuania, Luxembourg, Hungary, Malta, Netherlands, Austria, Poland, Portugal, Romania, Slovenia, Slovakia, Finland, Sweden. The data was downloaded from the database located at [ec.europa.eu/eurostat/databrowser](http://ec.europa.eu/eurostat/databrowser).

Data used for analysing the car sales in the mentioned countries were sourced at a database located on [carsalesbase.com](http://carsalesbase.com). [14] Information regarding total passenger and light utility vehicles are present over a period starting frequently from the year 1995. Data on Cyprus, Estonia and Malta were not present in a complete manner suitable for the present paper. Therefore, these countries were excluded from this overview. The data from Eurostat were not used as they didn't reach up to the year 2020 at the time of the creation of this paper. The data obtained from the above source is used throughout this paper.

The correlation coefficient is a numerical value of correlation. It means a statistical relationship between two variables. The variables may be two columns of a given data set of observations, or two components of a multivariate random variable with a known distribution. [17]

Several types of correlation coefficient exist. They all assume values in the range from  $-1$  to  $+1$ . The value  $\pm 1$  indicates the strongest possible agreement.  $0$  represents the strongest possible disagreement. As tools of analysis, correlation coefficients present certain problems. Correlation should not be incorrectly interpreted as it does not imply causation. [17]

As much as the correlation coefficient is closer to  $+1$  or  $-1$ , it indicates positive ( $+1$ ) or negative ( $-1$ ) correlation between the arrays analysed. Positive correlation means that if the values in one array are increasing, the values in the other array increase as well. [16] The equation for the correlation coefficient is:

Equation

$$\text{Correl}(X, Y) = \frac{\sum (x - \bar{x})(y - \bar{y})}{\sqrt{\sum (x - \bar{x})^2 \sum (y - \bar{y})^2}}$$

**Fig. 1.** Formula of the correlation coefficient [16]

In this formula  $\bar{x}$  and  $\bar{y}$  are the sample means average of array1 and average of array2 respectively.

There is no clear definition of correlation values that define the strength of a correlation. Only the extreme values of -1, 0 and 1 are given. For the purposes of this article a strong correlation is the one with absolute value over 0,75. A weak medium correlation is between 0,25 and 0,75. A weak correlation is below 0,25. Data in the present paper are evaluated accordingly. The positive correlation is valid for values over 0 and negative below 0.

**Table 1.** Interpretation of absolute correlation values for purposes of the present paper

From	To	Correlation type
1	0,75	Strong
0,75	0,25	Medium
0,25	0	Weak

**Table 2.** Interpretation of correlation values

From	To	Correlation type
1	0	positive
0	0	no correlation
0	-1	negative

### 3 Results and Discussion

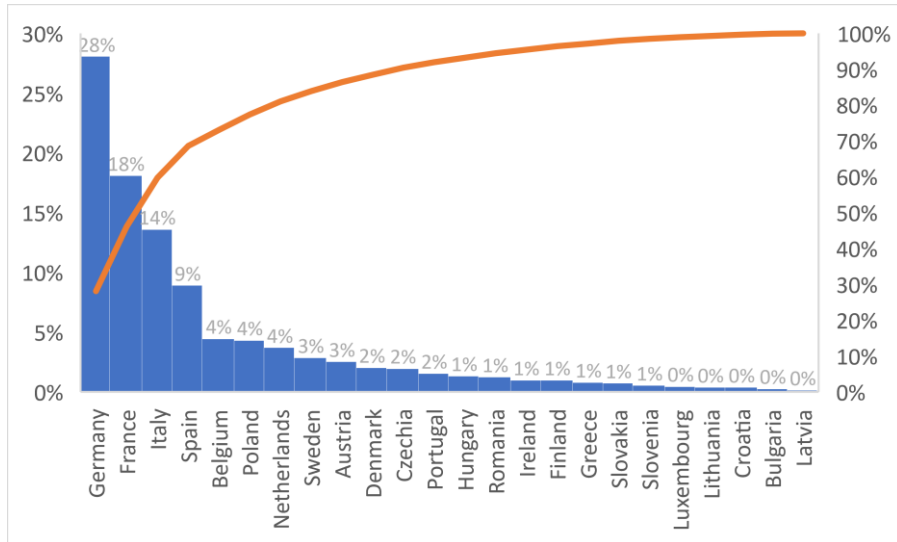
In the first stage a general overview show how car sales (passenger cars and light commercial vehicles) were changed between 2019 and 2020. This is shown in the following table.

**Table 3.** Volume of car sales before the pandemics and in its first year

Year	Passenger Cars	Light Commercial	Sales
2019	12990239	1743145	14733384
2020	9913698	1434561	11348259
Change	76%	82%	77%

A drop in volumes is visible between these 2 years. The impact was stronger on the passenger cars and weaker on the light commercial vehicles. It must be noted that the utility vehicles represent a much smaller volume in unitary sales. Therefore, their overall impact on the total sales of these two groups is relatively smaller. In most economies the total car sales closely follow the sales of passenger cars.

The EU market is composed of 27 countries. 24 of them were subject to analysis. A pareto analysis of share of each member country in the total volume of car sales shows the dominance of Germany, France, and Italy as the largest markets. Further markets are smaller while half of the countries analysed represent less than 2% of the total market.



**Fig. 2.** Pareto analysis of the EU car sales volumes in 2020

The following overview shows how the cars sales and the GDP changed between 2019 and 2020.

**Table 4.** Change of car sales and GDP per country at the in 2020 compared to 2019

Country	Passenger Cars	Light Commercial Veh.	Sales	GDP
Austria	76%	84%	77%	95%
Belgium	78%	88%	80%	96%
Bulgaria	63%	85%	66%	100%
Croatia	57%	76%	59%	92%
Czechia	81%	84%	81%	98%
Denmark	88%	94%	89%	100%
Finland	84%	87%	85%	99%
France	75%	84%	76%	95%
Germany	81%	88%	81%	97%
Greece	71%	87%	72%	90%
Hungary	81%	84%	82%	102%
Ireland	75%	86%	77%	105%

Country	Passenger Cars	Light Commercial Veh.	Sales	GDP
Italy	72%	85%	73%	92%
Latvia	76%	78%	76%	96%
Lithuania	87%	66%	85%	101%
Luxembourg	82%	87%	83%	102%
Netherlands	80%	79%	80%	98%
Poland	77%	85%	78%	102%
Portugal	65%	72%	66%	93%
Romania	78%	81%	78%	100%
Slovakia	75%	75%	75%	98%
Slovenia	73%	60%	71%	97%
Spain	68%	74%	69%	90%
Sweden	82%	58%	79%	100%

The market of Passenger Cars was the least impacted in Denmark where it reached 0,88 of 2019 sales. This market was the most impacted in Croatia where it reached 0,57 of 2019 sales.

The market of Light Commercial Vehicles was the least impacted in Denmark where it reached 0,94 of 2019 sales. This market was the most impacted in Sweden where it reached 0,58 of 2019 sales.

The market of Total Car Sales was the least impacted in Denmark where it reached 0,89 of 2019 sales. This market was the most impacted in Croatia where it reached 0,59 of 2019 sales.

The GDP was the least impacted in Ireland where it reached 1,05 of its 2019 value. The GDP was the most impacted in Spain where it reached 0,9 of its 2019 value.

A more detailed analysis is carried out on these countries in the central European region. Austria, Czech Republic (addressed by the Eurostat as Czechia), Slovakia, Poland and Hungary. These markets have different properties. While the Polish market is relatively large, the Austrian market has more history without a centrally managed economy. Czech, Slovak, and Hungarian markets are small however they behave differently.

### 3.1 Austria

The correlation between the GDP and sales of Passenger Cars in Austria in the pre-pandemic years between 2019 and 2000 can be described as positive with medium strength with a correlation at the level of 0,66. For the Light Commercial vehicles in the same period the correlation is positive with strong strength and a correlation of 0,89. The total car sales in Austria during this period have strong and positive correlation at the level of 0,76.

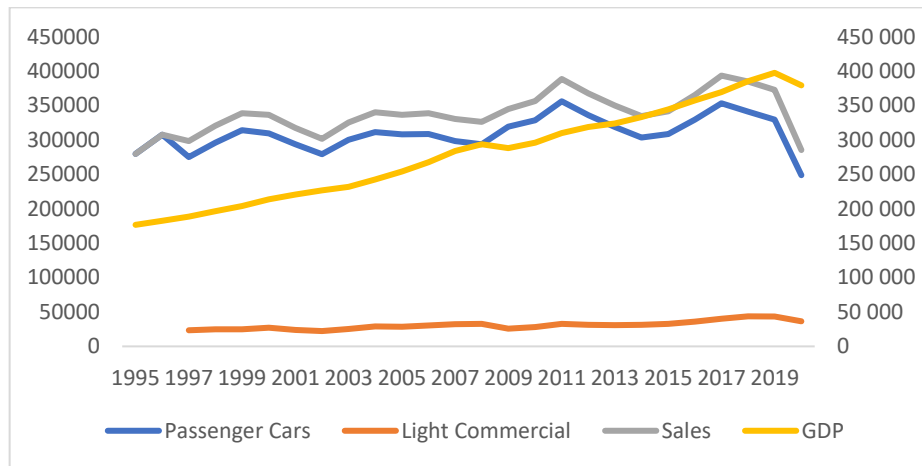
A more specific analysis of the correlation between the GDP and car sales is done in the period of 10 years prior to the Covid pandemics. During this timeframe Passenger Cars had a positive and weak correlation with value of 0,11. The Light Commercial



vehicles had a positive and strong correlation at the level of 0,95. The car sales in Austria had a in general a positive and medium correlation at the level of 0,35.

A third step of the analysis focuses on the correlation between sales and the GDP in a 10-year period while the last year of that period is 2020 i.e., the first year of the Covid 19 pandemics. This adjusted period shows the following results. For Passenger Cars the correlation is weak and negative at the level of -0,21. Regarding the Light Commercial vehicles, the correlation is positive and strong with value of 0,91. Total car sales in relationship with the GDP had a negative and weak correlation with a value of -0,06.

Including the first year of Covid pandemics had the following impact on the correlation between car sales and GDP: Passenger Cars changed by -0,32, the Light Commercial vehicle sales by -0,05 and the total sales by -0,42.



**Fig. 3.** Evolution of car sales and GDP in Austria

### 3.2 Czechia

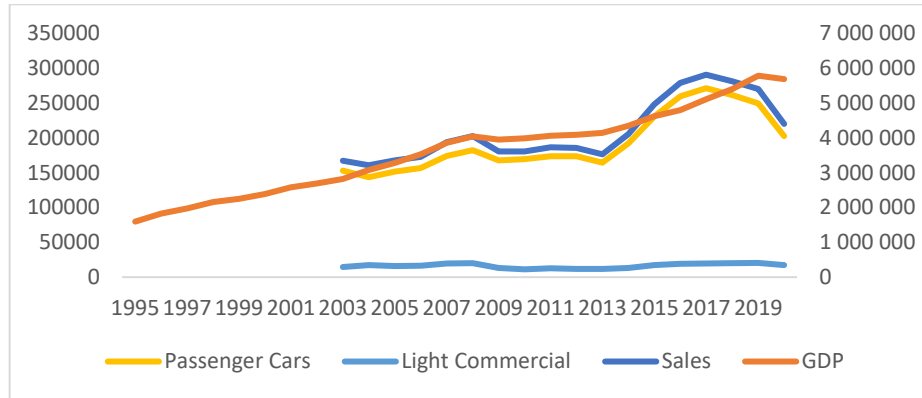
The correlation between the GDP and sales of Passenger Cars in Czechia in the pre-pandemic years between 2019 and 2003 can be described as positive with strong strength with a correlation at the level of 0,9. For the Light Commercial vehicles in the same period the correlation is positive with medium strength and a correlation of 0,44. The total car sales in Czechia during this period have strong and positive correlation at the level of 0,89.

A more specific analysis of the correlation between the GDP and car sales is done in the period of 10 years prior to the Covid pandemics. During this timeframe Passenger Cars had a positive and strong correlation with value of 0,87. The Light Commercial vehicles had a positive and strong correlation at the level of 0,93. The car sales in Czechia had a in general a positive and strong correlation at the level of 0,88.

A third step of the analysis focuses on the correlation between sales and the GDP in a 10-year period while the last year of that period is 2020 i.e., the first year of the Covid 19 pandemics. This adjusted period shows the following results. For Passenger Cars the correlation is medium and positive at the level of 0,69. Regarding the Light Commercial

vehicles, the correlation is positive and strong with value of 0,85. Total car sales in relationship with the GDP had a positive and medium correlation with a value of 0,7.

Including the first year of Covid pandemics had the following impact on the correlation between car sales and GDP: Passenger Cars changed by -0,19, the Light Commercial vehicle sales by -0,08 and the total sales by -0,18.



**Fig. 4.** Evolution of car sales and GDP in Czechia

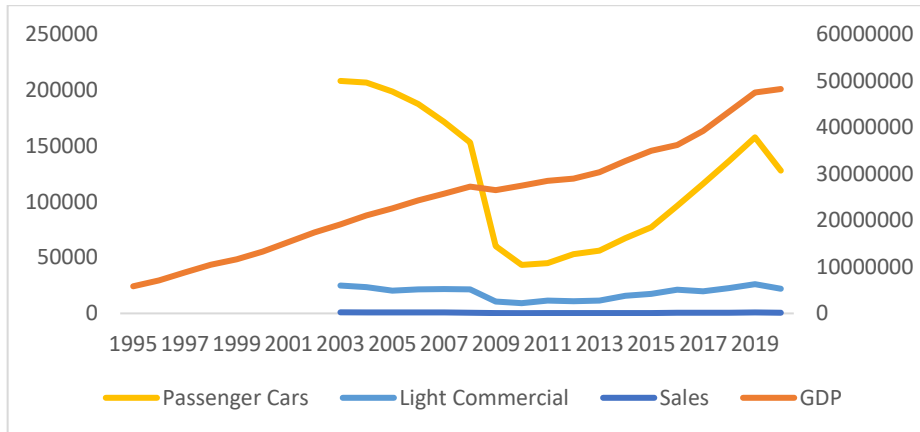
### 3.3 Hungary

The correlation between the GDP and sales of Passenger Cars in Hungary in the pre-pandemic years between 2019 and 2003 can be described as negative with medium strength with a correlation at the level of -0,28. For the Light Commercial vehicles in the same period the correlation is positive with weak strength and a correlation of 0,15. The total car sales in Hungary during this period have weak and negative correlation at the level of 0,24.

A more specific analysis of the correlation between the GDP and car sales is done in the period of 10 years prior to the Covid pandemics. During this timeframe Passenger Cars had a positive and strong correlation with value of 0,99. The Light Commercial vehicles had a positive and strong correlation at the level of 0,96. The car sales in Hungary had a in general a positive and strong correlation at the level of 1.

A third step of the analysis focuses on the correlation between sales and the GDP in a 10-year period while the last year of that period is 2020 i.e., the first year of the Covid 19 pandemics. This adjusted period shows the following results. For Passenger Cars the correlation is strong and positive at the level of 0,96. Regarding the Light Commercial vehicles, the correlation is positive and strong with value of 0,92. Total car sales in relationship with the GDP had a positive and strong correlation with a value of 0,96.

Including the first year of Covid pandemics had the following impact on the correlation between car sales and GDP: Passenger Cars changed by -0,03, the Light Commercial vehicle sales by -0,04 and the total sales by -0,03.



**Fig. 5.** Evolution of car sales and GDP in Hungary

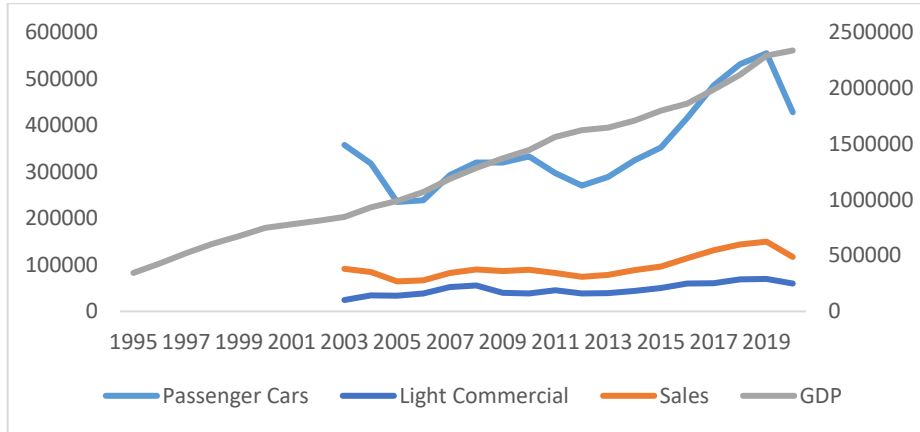
### 3.4 Poland

The correlation between the GDP and sales of Passenger Cars in Poland in the pre-pandemic years between 2019 and 2003 can be described as positive with strong strength with a correlation at the level of 0,75. For the Light Commercial vehicles in the same period the correlation is positive with strong strength and a correlation of 0,82. The total car sales in Poland during this period have strong and positive correlation at the level of 0,78.

A more specific analysis of the correlation between the GDP and car sales is done in the period of 10 years prior to the Covid pandemics. During this timeframe Passenger Cars had a positive and strong correlation with value of 0,93. The Light Commercial vehicles had a positive and strong correlation at the level of 0,94. The car sales in Poland had a in general a positive and strong correlation at the level of 0,93.

A third step of the analysis focuses on the correlation between sales and the GDP in a 10-year period while the last year of that period is 2020 i.e., the first year of the Covid 19 pandemics. This adjusted period shows the following results. For Passenger Cars the correlation is strong and positive at the level of 0,87. Regarding the Light Commercial vehicles, the correlation is positive and strong with value of 0,87. Total car sales in relationship with the GDP had a positive and strong correlation with a value of 0,87.

Including the first year of Covid pandemics had the following impact on the correlation between car sales and GDP: Passenger Cars changed by -0,06, the Light Commercial vehicle sales by -0,08 and the total sales by -0,06.



**Fig. 6.** Evolution of car sales and GDP in Poland

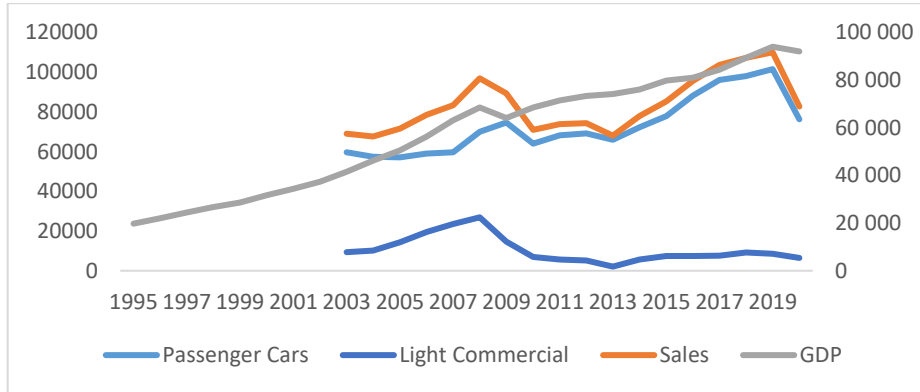
### 3.5 Slovakia

The correlation between the GDP and sales of Passenger Cars in Slovakia in the pre-pandemic years between 2019 and 2003 can be described as positive with strong strength with a correlation at the level of 0,87. For the Light Commercial vehicles in the same period the correlation is negative with medium strength and a correlation of 0,35. The total car sales in Slovakia during this period have medium and positive correlation at the level of 0,73.

A more specific analysis of the correlation between the GDP and car sales is done in the period of 10 years prior to the Covid pandemics. During this timeframe Passenger Cars had a positive and strong correlation with value of 0,96. The Light Commercial vehicles had a positive and medium correlation at the level of 0,67. The car sales in Slovakia had a in general a positive and strong correlation at the level of 0,95.

A third step of the analysis focuses on the correlation between sales and the GDP in a 10-year period while the last year of that period is 2020 i.e., the first year of the Covid 19 pandemics. This adjusted period shows the following results. For Passenger Cars the correlation is strong and positive at the level of 0,78. Regarding the Light Commercial vehicles, the correlation is positive and medium with value of 0,69. Total car sales in relationship with the GDP had a positive and strong correlation with a value of 0,79.

Including the first year of Covid pandemics had the following impact on the correlation between car sales and GDP: Passenger Cars changed by -0,18, the Light Commercial vehicle sales by 0,02 and the total sales by -0,16.



**Fig. 7.** Evolution of car sales and GDP in Poland

The following overview shows mostly positive correlation between the GDP and the car sales. In Hungary the correlation is quite weak. In Slovakia there seems to be some anomaly on the market.

**Table 5.** Correlation between GDP and car sales over 20 years before the Covid pandemics for Austria, over a 17-year period for remaining countries

Country	Passenger Cars	Light Commercial	Sales
Austria	0,66	0,89	0,76
Czechia	0,90	0,44	0,89
Hungary	0,09	-0,06	0,09
Poland	0,75	0,82	0,78
Slovakia	0,87	-0,35	0,73

During a shorter, 10 years period prior to the Covid pandemics the correlations evolve. They seem rather strong for passenger cars and fluctuate more for passenger cars.

**Table 6.** Correlation between GDP and car sales over 10 years before the Covid pandemics

Country	Passenger Cars	Light Commercial	Sales
Austria	0,11	0,95	0,35
Czechia	0,87	0,93	0,88
Hungary	-0,49	-0,19	-0,51
Poland	0,93	0,94	0,93
Slovakia	0,96	0,67	0,95

**Table 6.** Correlation between GDP and car sales over 10 years including the first year of the Covid pandemics

Country	Passenger Cars	Light Commercial	Sales
Austria	-0,21	0,91	-0,06
Czechia	0,69	0,85	0,70
Hungary	-0,64	0,92	-0,63
Poland	0,87	0,87	0,87
Slovakia	0,78	0,69	0,79

**Table 6.** Comparison of a 10-year correlation before and including pandemics

Country	Passenger Cars	Light Commercial	Sales
Austria	-0,32	-0,05	-0,42
Czechia	-0,19	-0,08	-0,18
Hungary	-0,14	1,11	-0,11
Poland	-0,06	-0,08	-0,06
Slovakia	-0,18	0,02	-0,16

When the pandemics are considered, the correlation decreases in Austria, Czech Republic, and Poland. The lowest drop can be found on the light commercial vehicles. The correlation of at passenger cars and subsequently on total car sales is faces a much stronger drop in its value. Only Hungary is an exception where the correlation rises for commercial vehicles. On the other hand, it reaches a value that is more in line with the other countries.

The group of light commercial vehicles shows a stronger correlation with the GDP compared to the passenger cars.

## 4 Conclusion

The objective of this paper is to study the correlation between the car sales and the GDP in the EU countries in relationship to a negative external influence represented by the Covid-19 pandemics that hit the EU first in 2020.

Data analysis shows that passenger car sales are weaker correlated to the GDP in the reaction to an external negative influence presented by the Covid pandemics. On the other hand, the light commercial or light utility vehicles seem to have a much stronger correlation to the GDP in case of an external impact.

The present conclusions can be a base for a further analysis to show the causality between the car sales and the GDP. It must be reminded that the correlation does not imply causality only a link between two datasets. The direction of influence needs to be studied differently.

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# Which Factors Most Affect Life Satisfaction in the Developed and Developing Countries in 2019?

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## Abstract.

In this article, we focused on the economy of happiness. In the introduction, we discuss why it is important to deal with the economics of happiness as part of economic theory. We then looked at Easterlin's paradox. In the next part, we briefly characterized which factors can affect happiness and satisfaction with life. In the second part we deal with research that had an impact on satisfaction with life. As a sample, we took the countries of the world, which we divided according to the Human Development Index (HDI) into developing and developed (limit 0.8 points HDI). We drew on satisfaction with life from the World Happiness Report. All data are for the year 2019. In conclusion, we looked at which of the selected indicators are significant and have an impact on life satisfaction, whether in developing or developed countries.

**Keywords:** Life satisfaction, happiness, developing and developed countries.

**JEL classification:** B55, I31

## 1 The economics of happiness

Happiness is a word that attracts immediate attention. This explains why many social and economic scientists use the term 'happiness', even though it often means 'life satisfaction' or 'subjective well-being'. Happiness is just one of many emotions that people experience at any given moment. It differs from evaluations of a person's life in general or job satisfaction, for example (Nikolova and Graham 2020).

The economics of happiness is the theoretical, qualitative, and quantitative study of happiness and quality of life, well-being and life satisfaction. It is usually

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associated with economics and other social sciences such as sociology and psychology. Proponents of the economics of happiness consider subjective indicators related to happiness as more objective indicators of quality of life, rather than wealth, income or profit. The field has grown substantially since the late 20th century, for example, with the development of methods, surveys, and indices to measure happiness and related concepts, as well as quality of life. Findings on happiness have been described as a challenge to the theory and practice of economics (Layard, 2006).

For example, research shows that migration improves both the income and subjective well-being of migrants who have moved from post-socialist countries to the West (Nikolova and Graham, 2015). This example illustrates that looking beyond income and employment and incorporating subjective measures into economic policymakers' analyses can reveal additional benefits or costs of particular decisions that can help policymakers and individuals act proactively and, in a welfare-enhancing direction, either for the individual or across the country.

The economics of happiness approach has several advantages that make it of interest to policy makers, academics, civil society organisations and lay people alike. However, applying these measures in political and economic analysis requires a thorough understanding of their challenges.

In recent years, a growing consensus has emerged in academia and policy circles about the urgent need to broaden the conceptual and empirical analysis against which well-being is defined and measured. Objective measures of welfare, such as income or employment, are often not indicative of how well people are doing in life and whether certain policies are having a positive impact on this. As the OECD (2011, p. 265) states, "Subjective well-being reflects the notion that how people experience a set of circumstances is as important as the circumstances themselves, and that people are the best judges of how their own lives are."

According to Kovanda, when it comes to happiness, it is important not to overestimate material goods. He considers governments' measurement of "Gross National Happiness" inappropriate because it may give governments too much power over people, and therefore governments should only create space for happy people with the help of democracy and decentralization. (Kovanda, 2014)

Richard Easterlin became famous in the economics of happiness, especially for the famous "Easterlin's paradox", which he published in 1974. Easterlin found that increasing everyone's income would not increase everyone's happiness, because with increasing income, people's material conditions would increase, according to which they judge their own happiness. (Easterlin, 1995)

A variety of explanations have been proposed for the Easterlin Paradox. For example, the relative income hypothesis states that an individual's happiness depends on his/her relative income rather than the absolute level of income (Ferrer-i-Carbonell 2005, Clark et al. 2007, Easterlin 1994). This may help explain why an increase in incomes of all individuals does not result in an increase in the average happiness level.

Another explanation by Easterlin (2001) stresses the role of individuals' aspirations and expectations in determination of happiness levels. He suggests that individuals' aspirations and expectations (regarding the goods and services) rise with income level. Therefore, even though the individual's income level rises over time which helps her satisfy her previous aspirations, she wants to consume more to be as happy as she thought she would be when her previous expectations were satisfied.

Clark (2012) sought to clarify the paradox that has arisen over the last 40 years, with a decline in perceptions of life satisfaction: "income inequality is increasing while the proportion of very dissatisfied and very satisfied people is declining." that poor people have better access to basic needs and that rich people do not bring extreme wealth. If income inequality is not high, then increasing the income of all people will not increase overall happiness but will reduce the gap between happy and unhappy people.

Individuals income are one of the most common areas of research in the economics of happiness, and it is assumed that the feeling of subjective happiness is an increasing function of income, but the marginal usefulness of income decreases with its amount. (Inglehart 2000, Easterlin 2001, Deaton 2008).

The following factors can also affect happiness:

- mental and physical health (Clark, 2017),
- marriage and social contacts (Stutzer 2006, Laaksonen 2018),
- education (Hayo 2003, Scitovsky 1976),
- institutional factors - economic freedom in poor countries and in rich countries it is political and personal freedom (Veenhoven 2000, Graafland 2012)
- unemployment (DiTella 2001, Clark 1994),
- divorce and parental divorce (Clark 1994, Blanchflower 2000),
- inflation (DiTella, 2001),
- discrimination (Blanchflower, 2000).
- gender (DiTella, 2001, Frey 2000, Blanchflower 2000),
- economic progress and development (Easterlin 1974, Blanchflower 2000, Clark 2012)

## **2 Life satisfaction in developing and developed countries**

Borrowing the idea of shift in preferences from psychology literature, we propose that non-materialistic goods contribute to the happiness of individuals in rich countries, but the materialistic goods don't. Similarly, materialistic goods should have

an influence on happiness of poor countries' residents while non-materialistic goods should not. In the context of non-materialistic goods (and higher order needs), we analyze the institutional characteristics of a country such as the extent of democracy and civil rights and lack of corruption. The democracy and civil rights indices we employ measure the extent to which citizens of a country are involved in decision making and the degree of personal liberties in the country, respectively. Corruption index is determined by the degree of misuse of entrusted power for private gain in a country. Rich and poor countries have dissimilarities in these institutional characteristics and the preferences of individuals over these characteristics in rich and poor countries may be different.

For example, people in rich countries may value institutional characteristics (such as the prevalence and protection of civil rights) of the country more than they value the level of development or GDP, and for individuals in poor countries the opposite may be true. In that case, an increase in a rich country's GDP may not affect the happiness of its citizens, but a poor country's residents would be happier when that country's GDP increases.

## 2.1 Methodology

The estimation if there some effects on subjective well-being (SWB) provided by Jalal El ouardighi and Francis Munier tell us there is a strongly significant effect of GDP per capita growth rates and unemployment on SWB. (Jalal El ouardighi and Francis Munier, 2019)

To estimate the effects on SWB Jalal El ouardighi and Francis Munier use model with Fixedeffect.

In our estimation we will try to estimate effects of log GDP per capita growth rate, social support, health life expectancy, freedom to make life choices and perception of corruption on life satisfaction. We have just cross-sectional data, so we used OLS regression.

Using World Happiness Report (WHR) data to find out levels of life satisfaction worldwide. In the survey from WHR, respondents should evaluate their lives: "Imagine a ladder, with steps numbered from 0 at the bottom to 10 at the top. The upper part of the ladder represents the best possible life and the lower part of the ladder represents the worst possible life for you. On which step of the ladder would you say that you personally feel that you are standing at the moment?"

Here we examine the dependence of life satisfaction (dependent variable -  $y$ ) on the logarithm of GDP per capita, expected corruption, social support, freedom of choice, life expectancy and generosity, which were used in the model as explanatory (independent) variables ( $x$ ).

$$SL_{it} = b_0 + b_1 (\log HDP/p.c.it.) + b_2 CP_{it} + b_3 SS_{it} + b_4 G_{it} + b_5 (LE) + u_{it} \quad (1)$$

We have examined this addiction in 125 World countries which are divided into developed (51) and developing (74) according to HDI, we set 0.8 points as a critical limit, all countries below 0.8 points HDI are characterized as developing countries (less developed, LD2019) and countries with over 0.8 points HDI are characterized as developed countries (well developed, WD 2019).

We used sources from the World Happiness Report 2021 and the Human Development Reports 2021. We used Stata software to calculate the regression (worldhappines.report 2021, hdr.undp.org 2021).

## 2.2 Results

**Table 1.** descriptive statistics

VARIABLES	(1) N	(2) mean	(3) sd	(4) min	(5) max
LifeLadder	139	5.575	1.118	2.375	7.780
LogGDPpercapita	136	9.481	1.151	6.966	11.65
Socialsupport	139	0.816	0.120	0.420	0.982
Healthylifeexpectancyatbirth	138	65.10	6.570	48.70	77.10
Freedomtomakelifechoices	138	0.797	0.117	0.385	0.970
Generosity	135	-0.0206	0.153	-0.289	0.561
Perceptionsofcorruption	131	0.721	0.188	0.0696	0.963

In table number 1 we can see the descriptive statistics of the variables that we used. There are between 131 and 139 observations for the variables because of data availability. We tried to get all the necessary data for each country that we have included in the model.

N- means the number of observations,

Mean- the mean value,

Sd- the standard deviation,

min- means the minimum value,

max- means the maximum value.

**Table 2.** OLS regressions

VARIABLES	(1) WD2019	(2) LD2019
LogGDPpercapita	0.240 (0.208)	-0.151 (0.159)
Socialsupport	3.936*** (1.111)	3.538*** (1.062)
Healthylifeexpectancyatbirth	0.0398 (0.0271)	0.0641*** (0.0208)
Freedomtomakelifecoices	1.360 (0.877)	0.946 (0.867)
Generosity	0.509 (0.528)	-0.253 (0.517)
Perceptionsofcorruption	-0.846** (0.382)	0.525 (0.710)
Constant	-4.448** (2.156)	-4.013*** (1.354)
Observations	51	74
R-squared	0.784	0.573

Standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

From our regression we can see that the LogGDP per capita is non-significant explanatory variable for both regressions. That means the relationship between life satisfaction and GDP per capita in our sample is not occurred. For the LogGDPpercapita variable, we expected that this variable would be negligible for developed countries, but for countries that are characterized as less developed countries, we expected that the value would be positive and significant. According to the literature, we expected that in less developed countries LogGDPpercapita would have an effect on life satisfaction, but this was not confirmed in our model.

Social support is significant explanatory variable for both observations. We can see that the social support has highest impact on life satisfaction regardless of whether it is a developed or developing countries. Social support means if individuals are having someone to count on in times of trouble. From these two particular regressions we can say that for life satisfaction regardless of whether it is a developed or developing country the most important thing is to have someone who can helps you whenever you need. Currently, we see that even less developed countries reach a certain standard and thus have the opportunity to ensure a sufficient standard of living and

satisfy the basic needs of life. Considering the difference of cultures in the world and in our observation, we can say that social support is one of the most important factors that can influence life satisfaction. We can also see that if social support changes by one unit, life satisfaction increases by almost 4 units when we are talking about more developed countries, and in less developed countries, life satisfaction increases by 3.5 units.

In developed countries variable healthy life expectancies at birth is non-significant and this is because in most developed countries healthy life expectation at birth is obvious. For less developed or developing countries is expectation of healthy life at birth is not obvious and has a significant positive impact on life satisfaction. If in less developed countries the expected length of healthy life increases by one year, the satisfaction with life in the given countries increases by 0.06 units

Freedom to make choices and generosity in our sample are non-significant explanatory variables for both regressions.

Perceptions of corruption is significant variable just for developed countries and have a negative effect. In more developed countries, the population is more concerned with the political situation, and therefore we can see that if there is a higher rate of perception of corruption in the country, people's satisfaction with life decreases. If the perception of corruption in the country increases by one unit in developed countries, it will cause a decrease in satisfaction with life by almost one unit (0.85 points).

## 2.3 Conclusion

From the literature, we would assume that for less developed countries, GDP per capita growth should have a positive effect on life satisfaction, and for developed countries, non-material things and the functioning of institutions should have a positive effect.

The first assumption was not confirmed from our research, we cannot say that the growth of GDP per capita has an impact on life satisfaction for either developed or developing countries.

From our research, we can say that social support had the greatest positive impact for both observed groups, and therefore we can say that even for the less developed countries, non-economic aspects have a greater impact on life satisfaction.

We also confirmed the assumption that countries that are more developed are more concerned with the political situation and therefore a higher perception of corruption has a negative effect on life satisfaction.

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# Influence of Factors on the Formation of Reputation in Insurance Companies

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**Abstract:** The aim of this work is to identify important factors that insurance companies consider important for their reputation and at the same time to assess their weighting. Based on the results of an extensive literature review, the six factors that are held responsible for the formation of reputation were derived. These factors served as the basis for structured expert interviews, which were conducted with experts from the insurance industry following the literature research. The evaluation of the interviews shows that, due to the regulatory nature of the insurance industry, special conditions apply here for the formation of reputation. In particular, the area of services should be considered separately from the product factor, as this is where insurers have the best opportunities to create their own profile and differentiate themselves from the competition. The survey also shows that the responsible handling of corporate values and the emotional appeal to stakeholders are regarded as important factors by the experts. While the interviewees indicated that they ascribe growing importance to social media, at the same time there is still room for improvement in insurers' use of these channels.

**Keywords:** reputation, insurance, reputation management

**JEL classification:** G22, D91, L14

## 1 Introduction

Building a good reputation is an undertaking that must be understood as a long-term investment. Companies that have a positive reputation are assumed by stakeholders to be above-average performers. At the same time, the strategic competitive position improves, making it easier for the company to achieve higher prices, strengthen the loyalty of customers and suppliers, and reduce transaction costs. A high reputation also reduces susceptibility to crises and economic fluctuations.

As valuable as a positive reputation is for the company, it is also fragile. Reputations built up over the long term can be destroyed within a few moments and turn into the opposite. Once a previously good reputation has been destroyed, it is only possible to regain the good values in the long term and at great expense. To prevent this from happening in the first place, the company needs targeted reputation management.

For a company to be able to manage its reputation in a targeted manner, it must first determine which factors have any influence at all on perceived performance. Massive investments in reputation-building measures only pay off if the company's management assesses the importance of the individual factors in the same way as the stakeholders.

The discussion about reputation management is gaining additional momentum as a result of advancing digitization. The weight of customer reviews in online portals and social media is steadily increasing, since on many platforms the user has the floor. User reviews are highly significant, as their opinions are considered neutral by other users. Reputation also takes place online and companies need to find a way to monitor and analyze their customers' online feedback.

## **2 Identification of the most important factors**

A company's reputation among its stakeholders is a valuable asset and one of its most valuable success factors (Pollák et al., 2021). Viewed from the stakeholder perspective, a company's reputation provides an assessment basis for estimating the company's contribution to its own and the common good (Helm, 2007). Specific performance characteristics of individual companies are increasingly easily and quickly copied by competitors, whereas reputation as an intangible value can only be taken over by competitors with difficulty (Kirstein, 2009).

There is a wide spectrum in the literature about what exactly reputation is. The consensus of all descriptions is that reputation as an intangible corporate asset is an extremely fragile element that every organization has to offer. A company's positive reputation has an impact on numerous areas of the corporate environment. For example, it contributes to the company being valued, respected, and perceived positively by customers, investors, suppliers, and employees alike (Farooq, 2016; Fearnley, 1993). At the same time, a high reputation reduces vulnerability in economic crises, such as the 2008 financial crisis. Raising the company's profile makes it easier for firms to differentiate themselves from competitors in the perception of customers and to create unique selling points (Ternés, 2015).

The battle for young talent has long since begun in the insurance industry. When choosing an employer, the reputation of the company is increasingly becoming a decisive criterion in addition to the question of remuneration. Pride in the company, in the work performed, and in corporate values lived is an essential element of self-

expression for many employees (Ternés, 2015). By recruiting well-qualified and motivated employees, business results and brand value are increased in the medium term (Ternés, 2015).

In the scientific literature, there are differentiated approaches to defining the term reputation. At the beginning of the 1990s, various authors formulated their different definition approaches. Hall (1992), for example, described that in his view the emotions and knowledge of individuals determine the reputation of companies. For Dozier (1993), reputation arises from the direct experiences of stakeholders on the one hand, but also from a continuous communication process on the other. While Hall and Dozier thus draw on both affective and cognitive perspectives to define reputation, Fombrun (1996) restricts himself to a primarily affective perspective. A few years later, he published his approach, according to which reputation is the overall assessment of a company by its stakeholders, consisting of the total affective reactions of customers, investors, employees and the public. In contrast, Gray and Balmer (1998) take a different approach to the definition. For them, corporate reputation is more an evaluation of corporate attributes. Accordingly, this view does not take the affective components into account, but focuses on the conscious perception by stakeholders.

Reputation is understood as a collective term referring to the view of all stakeholders on corporate reputation, including identity and image (Davies et al., 2001). Partial views of corporate reputation can be found in psychology, sociology, philosophy, economics, marketing and other fields of science (Pollák et al., 2021). From a sociological perspective, Fombrun and van Riel (1997) describe corporate reputation as an aggregate assessment of firm performance, relative to the expectations and norms of stakeholders in an institutional field.

In the specialist literature, there are various approaches and views on which factors of reputation should be recorded for the most accurate measurement possible. Different authors place different emphases and weightings on the items in their studies and investigations. Table 1 provides an overview of the six most influential factors in the formation of reputation.

**Table 1.** Categories derived from the state of research

<b>Categories</b>	<b>Sources</b>
<p><b>General management quality</b></p> <ul style="list-style-type: none"> <li>• Qualified employees</li> <li>• Presentable as an employer</li> <li>• employee orientation</li> <li>• Appearance pleases</li> </ul>	<p>Fombrun (2000); Fryxell (1994); Schwaiger (2004)</p>
<p><b>Responsibility in dealing with society and nature (social responsibility/ environmental orientation)</b></p> <ul style="list-style-type: none"> <li>• Ethical behavior</li> <li>• Not only profit-oriented</li> <li>• Social responsibility</li> <li>• Environmental commitment</li> <li>• Transparency and openness</li> <li>• Social Responsibility</li> <li>• Support for good causes</li> </ul>	<p>Fombrun (2000); Fryxell (1994); Schwaiger (2004)</p>
<p><b>Perception of the quality of products and services</b></p> <ul style="list-style-type: none"> <li>• Price/performance ratio</li> <li>• Quality</li> <li>• Innovative strength</li> <li>• Customer orientation</li> </ul>	<p>Fombrun (2000); Fryxell (1994); Schwaiger (2004)</p>
<p><b>Earnings and financial strength</b></p> <ul style="list-style-type: none"> <li>• Value as a long-term investment</li> <li>• Growth momentum</li> <li>• Outperforms competitors</li> <li>• Low-risk investment</li> <li>• Market leadership</li> <li>• Ability to go global, internationalization</li> </ul>	<p>Fombrun (2000); Fryxell (1994); Schwaiger (2004)</p>
<p><b>Responsible approach to corporate values</b></p> <ul style="list-style-type: none"> <li>• Inspiring vision</li> <li>• Leadership</li> <li>• Clear values</li> <li>• Fair pay</li> <li>• Attractive workplace</li> <li>• Pleasant working environment</li> <li>• Independence</li> </ul>	<p>Fombrun (2000); Fryxell (1994); Schwaiger (2004)</p>
<p><b>Emotional appeal to stakeholders</b></p> <ul style="list-style-type: none"> <li>• High level of identification with the company</li> <li>• Greater regret in case of loss</li> <li>• Trust</li> <li>• Admiration and respect</li> <li>• Reliability</li> <li>• Credibility</li> <li>• Communication performance</li> </ul>	<p>Fombrun (2000); Schwaiger (2004)</p>

### **3 Aim and methodology**

The goal of this paper is to identify important factors that insurers rank as important to their reputation and to determine how these factors are weighted.

The starting point of the research is a consideration of the current state of knowledge through a literature review, which is one of the qualitative research methods. The approach aims at illuminating and comparing the different scientific perspectives. The research is based on scientific articles, studies, conference papers and reference books. Within the framework of the systematic literature research, the three phases of literature search, literature acquisition, and literature utilization were followed (Okoli, 2010).

In a further step, 12 structured expert interviews were conducted to obtain practice-relevant data. The interviews were conducted with experts and managers from the insurance industry. The contacts to the interview partners were established from the author's professional environment. A guideline geared to the topic with defined categories served as the survey instrument and was previously verified with the help of a pretest. The various experts answered the questions orally, independently of each other, in individual interviews. The guideline was not used as a standardized process in order to take into account unexpected topic extensions that arose in the course of the interviews. This ensured that any unexpected aspects would find their place in the investigation. The guideline for the expert interviews serves to structure the topic area and the investigation and thus has a central orientation function. It takes into account the principles of qualitative research, in particular the principle of openness. The approaches of qualitative content analysis according to Mayring served as orientation for the evaluation of the interview recordings.

### **4 Results and discussion**

In the twelve interviews conducted, the interviewees were asked to give their assessment of the importance of the six key factors for corporate reputation in insurance companies.

#### **4.1 General management quality**

Most of the interviewees believe that good management should be far-sighted and stand for continuity. It provides clear structures and exemplifies what it expects from its employees. Management must ensure that employees do their jobs as well as possible on their own. An important point that was mentioned again and again during the discussions is the further training of employees, which, in addition to improving quality, also serves as protection against exogenous shocks. The interviewees agreed that customers directly sense whether an insurance company's employees are well qualified, which definitely has an impact on the perception of its reputation.

#### **4.2 Responsibility in dealing with society and nature (social responsibility/ environmental orientation)**

In assessing this factor, the interviews gave a mixed picture. While some interviewees consider this point to be very important, the other part does not consider the topic of sustainability to be as relevant as it is often seen in public, since customers often do not question whether an insurance company is sustainable. Some interviewees say that it is important for companies to talk about CSR activities, while others see more of a risk of greenwashing here. For these individuals, sustainability is more of a hygiene factor that only becomes important when the company is not behaving sustainably. According to the interview participants, many customers nowadays expect companies to go as paperless as possible. Companies are happy to take this up, as it can generate major cost savings at the same time.

#### **4.3 Perception of the quality of products and services**

Whereas in the literature the areas of products and services are always considered uniformly, the evaluation of the interviews showed that this does not apply to those of the insurance industry. There is a clear distinction from other industries, which is justified by the fact that government regulation makes it virtually impossible for groups to differentiate themselves by products. The guidelines for product development are so narrowly defined that the products of the individual insurance groups differ only in nuances. Only in the event of a claim does the intangible product of the insurance company materialize. For this reason, the interviewees see it as very important that the insurance terms and conditions must be written in a comprehensible way and that it must be clear to customers what is insured and what is not.

When looking at services, the most important aspect mentioned by all interviewees was the speed with which customer questions are answered and the length of time it takes to process them. Here, the interview participants call for more creativity in optimizing processes. Innovation does not always refer only to products, because improving existing products alone is not yet innovation. Insurers must ensure that customers have a positive experience with their insurer even without a claim. This can include, for example, actively promoting preventive measures so that a claim does not occur in the first place. The expectation of digitized processes is that they will become faster and simpler and increase convenience.

#### **4.4 Earnings and financial strength**

The importance of an insurer's earnings and financial strength in building reputation depends on the type of insurance the customer is interested in. When taking out a motor vehicle liability insurance policy, it makes virtually no difference how well the insurer is positioned financially. That's why there are always new companies in this area that offer their services completely digitally and cost-optimized on the Internet. When taking out endowment or pension insurance, on the other hand, this factor becomes

more important. These insurance lines require a long-term commitment to the company with high annual premiums. Customers have an interest in ensuring that the company will still exist in twenty years' time and that the accumulated credit balances can be paid out on time. At the same time, large insurers can better exploit economies of scale and, according to the interviewees, have higher customer acceptance at the same time.

#### **4.5 Responsible approach to corporate values**

The interviewees agreed that it is essential to breathe life into the corporate values. It is also necessary that these values are lived with the same intensity from the top of the company to the employees. On the other hand, corporate values that are not lived can lead to a poor reputation. Vision plays a subordinate role in the insurance industry due to regulation. Unlike tech companies, customers do not expect visionary ideas in the eyes of the interviewees, but rather continuity and reliability. While in other industries, such as delivery services or even warehouse workers at Amazon, employee pay repeatedly causes negative reputations, this is not the case in the insurance industry. Since the image of the industry is often negatively tainted, it is occasionally heard from the customer side after negative experiences that the payment of the insurance sales force is rather too high than too low.

#### **4.6 Emotional appeal to stakeholders**

The argument that communication with customers must take place at eye level and that each target group needs to be addressed individually was mentioned again and again. For some of the customers, the interviewees noted an increasing need for personal contacts with increasing digitization. Ethical behavior on the part of companies is also relevant to their own employees, because employee satisfaction is also noticeable to customers. Answers were mixed when asked about the importance of a modern workplace. On the one hand, it was noted that customers were not interested in whether employees' workplaces were modern. On the other hand, according to the interviewees, customers expect insurers to have good technical equipment.

Some of the respondents said that the importance of comparison portals will continue to increase when buying insurance. Here, in addition to the familiar comparison calculators on which the products of the individual insurers compete with each other, rating platforms on which customers share their experiences with each other were also mentioned. The use of social media by insurers is viewed rather cautiously by the interviewees. Here, a large proportion is of the opinion that insurers have not yet understood social media. They believe that social media is about facts, figures and data, but this is not the case in reality. At most, business initiations take place via social media, but no direct sales. Nevertheless, the professional use of social media is imperative in order to make contact with the younger generations.

#### 4.7 Weighting of the individual factors by the interviewees

Following the interview, the interviewees were asked to rate the importance of the respective factor on a scale of 1 (fully agree) to 6 (not at all agree). Of the six factors queried, the quality of products and services factor was rated as the most important. The factors responsibility for society and nature and financial power and strength, on the other hand, were rated as least important by the respondents.

*Table 2. Weighting of the individual factors*

<b>Factor</b>	<b>Average Value</b>	<b>Standard Variation</b>
General management quality	2,17	0,30
Responsibility in dealing with society and nature (social responsibility/ environmental orientation)	3,00	1,50
Perception of the quality of products and services	1,50	0,73
Earnings and financial strength	2,83	0,56
Responsible approach to corporate values	1,92	4,26
Emotional appeal to stakeholders	1,92	0,90

The standard deviation for the factor Responsible handling of corporate values is particularly striking. It was rated 1 five times, but also 5 five times.

## 5 Conclusion

With the help of extensive literary research, the six most important factors that are held responsible for the formation of reputation were identified. These factors were previously considered universal for all industries, although different industries have different prerequisites. The aim of this paper is to examine whether these factors are also applicable to reputation in the insurance industry. In the next step, experts and managers from the insurance industry were interviewed in structured expert interviews to obtain data relevant to practice.

The survey showed that not all factors are considered equally important and that there are different weightings from the respondents' point of view. While in theory products and services are combined into one factor, in the insurance industry they have to be considered separately. Due to strong regulatory requirements, it is hardly possible to distinguish insurers by products alone. The opportunity to stand out from the competition exists primarily by using the services around the products to distinguish oneself to the customers. This point was seen by the interviewees as the most important factor in building a corporate reputation.

Second and third place were taken by the factors responsible handling of corporate values and emotional appeal to stakeholders. The way in which the company



communicates with customers and its use of social media are the main focus here and were rated as equally important by the interviewees. When assessing general management quality, the terms continuity and reliability in particular were mentioned again and again as being important for customers, but also for employees. On the other hand, the financial strength of insurers and the responsible treatment of society and nature were ranked fifth and sixth in the evaluation of the six factors. The study showed that industry-specific characteristics must be taken into account when determining the factors for building reputation.

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# The Impact of Financial Literacy on Debt Behavior of Households: Evidence from Micro Data

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**Abstract.** While several papers have focused on the effect of financial literacy on household retirement savings or investment choices, this paper is devoted to its impact on households' debt behavior. We utilize Slovak household finance and consumer survey (HFCS) microdata to analyze the impact of the objective level of financial literacy on Slovak households' debt behavior. We find that Slovak households display different debt behavior with respect to varying levels of financial literacy. We focus on high-cost credit products and find that a household's financial literacy does not have a statistically significant impact on the probability of having an outstanding balance of non-mortgage or credit debt. However, we find that younger households with higher incomes dispose of a higher probability of having an outstanding balance of non-mortgage or credit debt while being more credit-constrained and less able to save from their monthly income compared to more financially literate households. Thus, we may consider households with an outstanding balance of non-mortgage or credit debt to be more financially vulnerable, as they are more frequently engaging with high-cost credit products with a lower ability to save and with a higher probability of being credit constrained. This behavior may lead to a significant decrease in their ability to face unexpected internal or external adverse shocks.

**Keywords:** Financial Literacy, Debt Behavior, Microdata.

**JEL classification:** G51, G53, D10

## 1 Introduction

In many countries, rising household indebtedness is becoming an essential issue. Slovak households belonged for almost a decade (2010 – 2020) among households with the highest annual credit growth rate within the EU and Central and Eastern European (CEE) region while having relatively low financial assets. One of the measures of expressing the level of household indebtedness is the Debt-to-Income ratio (DTI). DTI ratio of Slovak households in the last ten years went from approximately 39% in 2010

to 72% in 2020, and household debt to GDP went from 26% in 2010 to 47% in 2020.<sup>1</sup> Such a development in household indebtedness was supported mainly by a favorable macroeconomic development and historically low-interest rates. From the perspective of economic theory, the financial behavior and situation of households are primarily connected to selected relevant socio-economic, behavioral, and demographic factors. However, in our study, we examine the impact of financial literacy on households' debt behavior, whereas financial literacy is becoming more essential in a world with the increasing complexity of different financial products. It is vital that households dispose of the necessary level of financial literacy not just to understand various financial products and services but also to be able to evaluate the level of risk connected with them. Generally, the financial literacy of Slovak households is low, which is also demonstrated within the HFCS data. Only 17% of respondents were able to correctly answer all questions regarding financial literacy. Meanwhile, 50% of respondents in Germany and 36% of respondents in Finland were able to answer similar questions all correctly. These findings have motivated us to examine more closely the impact of financial literacy on the debt behavior of Slovak households.

Several studies investigated the impact of financial literacy on household retirement saving and planning (Lusardi & Mitchell, 2007; Van Rooij et al., 2012; Pastorakova et al., 2017; Cupák et al., 2019) and stock market participation (Van Rooij et al., 2011; Cupák et al., 2020; Xia et al., 2014; Chu et al., 2017). However, less attention has been devoted to the impact of financial literacy on households' debt behavior. Available studies concerning the examination of the impact of financial literacy on debt behavior and indebtedness found that a low level of financial literacy has a negative impact on debt behavior which is reflected in the high-cost credit choices and in the amount of accumulated debt. (Lusardi & Tufalo, 2015; Disney & Gathergood, 2012; Gathergood, 2011; Allgood & Walstad, 2012). To better understand the determinants of the Slovak household's debt behavior and its relation to financial literacy we utilized the Slovak HFCS microdata from 2017 assembled by the National Bank of Slovakia (NBS). The HFCS data contains questions regarding financial literacy from which we can derive the financial literacy index and the database contains detailed information regarding different debt products as well. This allows us to measure objective financial literacy and its impact on households' debt behavior. Based on the reviewed literature we will focus mainly on low financially literate households with an outstanding balance of non-mortgage or credit debt, whereas our underlying hypothesis is that households with a lower level of financial literacy are more likely to use high-cost credit and more likely to have an outstanding balance of non-mortgage or credit debt.

The paper is structured as follows. The second section contains reviewed previous literature and related theoretical background. The data and variables are described in the third section and the fourth section presents preliminary results from our descriptive analysis. Finally, section five concludes our findings and contains ideas for further research on this topic.

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<sup>1</sup> Source.: Eurostat

## 2 Previous literature and theoretical background

Financial literacy by the most base definition is typically connected to a person's competency and the ability for managing money (David L. Remund, 2010). Moreover, financial literacy is the individual's ability to use knowledge, experiences, and skills of basic financial concepts, products, and services to appropriately manage personal financial resources in short-term decision-making and most importantly in long-term financial planning with the aim to achieve a lifetime of financial security and well-being (Hung et al., 2009). Although there is a number of definition of financial literacy in the academic literature, however, there is no standardized definition and measurement of financial literacy, which is commonly used in research studies. Therefore economists in research studies usually adjust the definition of financial literacy with the respect to chosen research areas and research questions. For example, researchers have also shown that there is a negative correlation between wealth, planning for retirement, and financial literacy. Individuals who are less financially knowledgeable are less likely to have thought about retirement and are less likely to know about interest compounding calculation and do not know about inflation and risk diversification, which is critical for an effective savings plan for retirement. (Lusardi & Mitchell, 2007; Lusardi & Mitchell, 2017). Another study focuses on the effect of financial literacy and willingness to participate in the voluntary private pension scheme in Slovakia. The study indicates a strong positive association between an individual's financial literacy and propensity to save for retirement (Cupák et al., 2019). The different research papers focusing on Slovak household participation in voluntary retirement savings found that social factors like gender, marital status, and dependent children are not significant determinants influencing their participation in voluntary retirement savings. (Pastorakova et al., 2017). Therefore authors suggest that *“standard motivational tools used in countries with a long tradition of participation in voluntary retirement saving may not be effective in our conditions”*<sup>2</sup>. Different directions of the literature is focusing on the impact of financial literacy and stock market participation and portfolio diversification (Van Rooij et al., 2011). This study examines on a sample of Dutch households the role of financial literacy on stock market participation. To better understand financial literacy they created questions that measured basic financial literacy related to the basic numerical ability, compound interest rate, and understanding of inflation. Questions to measure more advanced financial literacy were related to different financial instruments such as stocks, bonds, and mutual funds. The study found that only 23,8% of Dutch households own stock or mutual funds and households which display higher levels of “advanced financial literacy” are more likely to participate in the stock market and hold stocks or mutual funds. The mentioned studies have focused on the assets side of the household balance sheet. However, financial literacy should have a positive impact on individuals' ability to effectively manage and plan their personal finances including debt decisions and management. The recent development in household debt behavior in Slovakia has motivated us to look at

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<sup>2</sup> Pastoráková, E., Brokešová, Z., Peliová, J.: (2017). Proaktívny prístup k tvorbe súkromných dôchodkových úspor: kľúčové determinant. Politická Ekonomie, 65(6), 709-727

the liability side of the household balance sheet and examine the effect of financial literacy on households' debt behavior.

Due to the rapid development of different debt-related financial instruments in recent years in line with the "democratization" of the banking sector, loans and regulations regarding consumer debt loads, have caused loans to become financial products easily available to many individuals in different financial situations. Slovakia was among the countries with the fastest increase in household indebtedness in Central and Eastern European (CEE). The driving behind such an increase in household indebtedness can be related to rising living standards due to a favorable macroeconomic environment, low-interest, and rising property prices. Besides macro-economic factors of rising household indebtedness, we have to consider micro-economic factors such as disposable income, amount of savings, expenditure, social status, age, education, family size, and the level of financial literacy. In this paper, we will focus on the impact of financial literacy on household debt behavior.

## **2.1 Financial literacy and debt behavior**

The previous section focused on financial literacy linked with individual and household assets. In this section, the focus will be concentrated on the studies examining the effect of financial literacy on individual and household debt and borrowing. The low level of financial literacy may negatively contribute to a level of household indebtedness. The study, (Lusardi & Tufalo, 2015) found that debt literacy (consisting of questions regarding interest compounding, working of credit card debt, and ability to choose the most advantageous means of payment) was particularly low among women, the elderly, minorities, and those who are divorced. The same results concerning the relationship between credit card behavior, gender, and financial literacy were confirmed by (Mottola, 2013). The study revealed that women with a lower level of financial literacy were more likely to have costly credit card behaviors like paying late or over-the-limit fees and higher interest rates on their credit cards than men with lower financial literacy. Moreover, a study (Lusardi & Tufalo, 2015) shows, that only one-third of respondents in the population can apply concepts of interest rate compounding in everyday situations or understand how credit cards work. They used cluster analysis to create four clusters with respect to their demographic characteristics and debt literacy. Those who had a lower level of debt literacy and reported lower self-assessed financial literacy levels as well were much more likely to have reported difficulties with their debt burden, were unable to assess their debt position and were characterized by high-cost borrowing. Moreover, less financially literate individuals pay a larger fraction of fees and finance charges on credit cards compared to the more financially literate individuals, due to lack of knowledge. Allgood & Walstad, 2012 investigated the effects of actual and perceived financial literacy on a wide range of financial behaviors. One of the investigated financial topics was related to the usage of credit cards and paying credit card bills. The results showed that respondents with high actual and perceived financial literacy are 16% less likely not to always pay their credit card balance in full each month than respondents with low actual and perceived financial literacy. Furthermore, respondents with high actual and perceived financial literacy were 13% less likely to carry a credit card balance, 11% less likely to be charged a late

fee for late payment, and 6% less likely to be charged an over-the-limit fee for exceeding their credit limit. From these results, we can derive the importance of financial literacy in the relation to individuals' level of indebtedness. Furthermore, individuals who engage in the consumer credit market display on average poorer levels of financial literacy and own consumer credit portfolios with higher costs in comparison with individuals who are not engaged in this market. (Disney & Gathergood, 2012). Moreover, households with a lower level of financial literacy are associated with the use of high-cost credit such as store cards, mail order catalogs, customs union loans, and payday loans, have lower net worth, and are more likely to report problems with paying their debts (Disney & Gathergood, 2011).

While most of the studies which analyzed the link between financial literacy and indebtedness were focusing on North America (U.S) and West Europe (UK, Sweden) region. To the best of our knowledge, there is no study concerning the relationship between financial literacy and household debt behavior for CEE countries using microdata. Households and individuals in the CEE region had different economic, social, and political development compared to households in more developed western countries. Therefore, the aim of this study is to investigate the overall level of objective financial literacy among Slovak households. First, according to selected relevant socio-economic and demographic characteristics and subsequently, examine the relationship between the level of financial literacy and household debt behavior. For this purpose, we use data from Household Finance and Consumption Survey collected in 2017.

### **3 Data & Methodology**

We used the latest publicly available wave of Slovak Household Finance and Consumption Survey (HFCS) data collected by the National Bank of Slovakia in 2017. HFCS data contains information regarding households' financial situation and their balance sheets such as households' assets, liabilities, income, and expenditures. Moreover, the HFCS data contains detailed information regarding individual household demographic characteristics, gender, education, employment status, and marital status. The HFCS database is a probability sample of households, meaning that there is always a weight connected to each sampled household. Therefore it is necessary during the computation of different statistics outcomes to take into account the final sample weights, which confirms the representativeness of the sample at the country level. The final sample of the Slovak HFCS data from 2017 consists of 2178 households with 10 895 observations. Questions regarding financial literacy were answered only by the reference persons of households. Even though we can only evaluate the financial literacy of the reference persons, we consider their answers as the answer of the households, as we assume that those individuals were the most competent member of the household to answer questions related to financial literacy.

To analyze the relationship between the ownership of outstanding balance of non-mortgage or credit debt and the level of financial literacy and other socioeconomic variables we used the descriptive statistic method cross-tabulation. First, we focused on the overall portion of households with or without an outstanding balance of non-mortgage or credit debt and their level of financial literacy, demographic and

socioeconomic characteristics. Subsequently, we focused specifically on the characteristics of households that exhibited low financial literacy with an outstanding balance of non-mortgage or credit debt.

To predict the influence of financial literacy and other selected control variables on the outstanding balance of non-mortgage and credit debt we created a dichotomous dependent variable. Our dependent binary variable reaches the value 1 in the case when a household has an outstanding balance of non-mortgage or credit debt and 0 otherwise. In the proposed logistic regression model the dependent binary variable is the probability of having an outstanding balance of non-mortgage or credit debt, while we applied several categorical variables as independent variables.

The baseline model in this study is given as follows:

$$P(Y) = \frac{1}{1 + e^{-(\beta_0 + \beta_1 Fin.lit_1 + \beta_2 Gen.2 + \beta_3 Age_3 + \beta_4 QInc_4 + \beta_5 Doabletsave_5 + \beta_6 docredit_6 + \epsilon_i)}} \quad (1)$$

For the interpretation of parameter estimates after logistic regression, we used average marginal effects. Marginal effects refer to the impact of independent variables on a dependent variable as a discrete change from the from the baseline level.

### 3.1 Financial literacy and debt behavior

According to the literature, we found that authors distinguish between objective (actual) and subjective (perceived) financial literacy. The subjective (perceived) financial literacy is measured with the help of self-assessment of the level of financial literacy by individuals mainly across the different ranges of the Likert scale (Allgood & Walstad, 2012). The objective financial literacy is measured by the set of questions concerning financial literacy and is based on a number of correct and incorrect answers to test questions. The first who tried to measure the objective financial literacy of the US population was Lusardi and Mitchell (2006) who created a module that contained three questions “Big Three” regarding financial literacy for the 2004 US Health and Retirement Study (HRS). These questions were formulated with the aim to test basic financial knowledge associated with the working of interest compounding, the effects of inflation, and risk diversification. However, some studies wanted to provide a more comprehensive view of financial literacy in connection with specific areas such as retirement savings, stock market participation, and debt management. Therefore they have adjusted the questions related to financial literacy in line with the examined topic. With these adjustments, they were able to specifically measure the impact of the level of debt literacy on indebtedness (Lusardi & Tufalo, 2015). Others created questions regarding financial literacy with different difficulties to examine the possible effect on stock market participation (Van Rooij et al., 2011).

The Slovak HFCS data 2017 contains four questions regarding financial literacy in order to discover the ability of reference persons (households) to understand the basic concepts of personal finance including interest rates, inflation, the riskiness of financial products, and portfolio diversification. The difficulty level of those questions increased



gradually. In order to create our financial literacy index, we measured financial literacy as a sum of binary variables. If the reference person answered the financial literacy question correctly the value is 1 and 0 otherwise. Thus, for each household, the financial literacy index ranges between 0 and 4. The average value of the number of correct answers across households was 2.38 which means that most of the households were able to correctly answer more than 2 questions out of 4 questions related to financial literacy. However, only 12% of households were able to correctly answer all four financial literacy questions which suggests low financial literacy among Slovak households in comparison with other countries. While more than 50% of respondents in Germany and 36% (Koenen & Lusardi, 2011; Kalmi & Ruuskanen 2017) of respondents in Finland were able to correctly answer all four similar financial literacy questions. The distribution of answers across different individual characteristics was the following. The lowest financial literacy we could observe among households with low income, unemployed status and older age categories. On the other hand, the highest financial literacy was observed among middle age, high-income households, having an employment or self-employment status. In the following section, we will take a closer look at the characteristics of households with low financial literacy with an outstanding balance of non-mortgage or credit debt. This part includes a descriptive analysis of the percentage of households with or without an outstanding balance of non-mortgage or credit debt in relation to the relevant characteristics.

## **4 Results**

After we examined households' overall financial literacy level and socio-demographic characteristics, we will focus on their debt behavior. We will mainly focus on the portion of households with an outstanding balance of non-mortgage or credit debt. We will look closely at households with low financial literacy with an outstanding balance of non-mortgage or credit debt. First, we created a binary variable to distinguish between households with or without an outstanding balance of non-mortgage or credit debt. Table 2 shows us that only 18% of households hold an outstanding balance of non-mortgage or credit debt. Further, we find that those who have outstanding balance of non-mortgage or credit debt balances are more likely to be households who exhibit lower levels of financial literacy. Approximately 60% of those households could answer no more than two financial literacy questions correctly. The results from cross-tabulation suggest that a higher share of households with a lower level of financial literacy are using debt instruments associated with higher costs. In terms of socio-demographic characteristics, the higher share of households with an outstanding balance of non-mortgage or credit debt are employed, young, or middle age males with secondary education. Further, we examine in more detail the category of households with low financial literacy (no more than two correct answers out of four) with an outstanding balance of non-mortgage or credit debt.

From our survey analysis, we may consider that 53% of households with an outstanding balance of non-mortgage or credit debt have low financial literacy. However, almost 80% of the low financially literate households were able to answer 2 questions concerning financial literacy correctly. The age structure of households suggests that

the share of low-literate households with outstanding balance non-mortgage or credit debt is declining with age. This can be explained by Modigliani and Brumberg's life-cycle hypothesis, where younger households report higher expenditure and often consumption financed through debt by the assumption of increasing incomes over the course of their lifetime and subsequent gradual reduction of debt financing among older households. Regarding the working status of households, we can observe a higher share of economically active individuals with an outstanding balance of non-mortgage or credit debt. Meanwhile, the most often achieved education is secondary education in this category. Households that perform lower levels of financial literacy tend to have a lower average value of income and assets than households with higher levels of financial literacy. Although households with low financial literacy with an outstanding balance of non-mortgage or credit debt have higher median income value than households without an outstanding balance of non-mortgage or credit debt. On the other hand, we can observe a higher share of households with an outstanding balance of non-mortgage or credit debt are not able to save from their monthly income and are more likely to be credit-constrained households. These observations may have two implications. First, is that these households may have self-control problems and make disproportionate use of quick-access credit products which facilitate impulse-driven purchases and leads to higher indebtedness. The second implication is that these households are more financially vulnerable in case of the occurrence of internal or external adverse events.

Table 1 presents the results of the logistic regression. The dependent variable is the probability of households having an outstanding balance of non-mortgage or credit debt. Compare to a cross-tabulation analysis, this approach is more appropriate for differentiating the characteristics of households with and without an outstanding balance of non-mortgage or credit debt. Especially, it allows us to better understand the variables influencing the characteristics of households with an outstanding balance of non-mortgage or credit debt. We calculated the average marginal effects from the logistic regression analysis, which are useful for the interpretation of parameter estimates after the nonlinear regression model. The first column in Table 1 contains the odds ratio and the second column contains marginal effects interpreted as a discrete change from the baseline level.

Marginal effects of low financial literacy (according to our definition) did not have a statistically significant effect on the probability of having an outstanding balance of non-mortgage or credit debt. The result of the regression did not confirm our hypothesis that households with a lower level of financial literacy are more likely to use high-cost credit and more likely to have an outstanding balance of non-mortgage or credit debt. This could be attributed to several factors, the usage of non-mortgage or credit debt is not as common in Slovakia as in western countries with more developed financial markets and higher financial literacy among citizens. We may assume that households who are using such debt instruments in Slovakia are households with higher income, which allows them to be more likely to obtain access to these debt instruments. This assumption is confirmed by the data when the marginal effect of the Income quintiles independent variable was statistically significant. Each additional income quintile (higher household income) is associated on average with a 3 percentage point increase in the probability of having an outstanding balance of non-mortgage or credit debt. In

terms of age, on average each additional age category (older household) is associated with a 5 percentage point decrease in the probability of having outstanding non-mortgage or credit debt. Further, households with outstanding non-mortgage or credit debt are on average 15 percentage points less likely to be able to save and 12 percentage points more likely to be credit constrained. Thus, we may consider households with outstanding non-mortgage or credit debt to be more financially vulnerable, as this behavior may significantly decrease their ability to face unexpected internal or external adverse shocks.

**Table 1:** Logistic regression results for the probability of having an outstanding balance of non-mortgage or credit debt

VARIABLES	(1) Odds ratio	(2) Marginal effects
Non-Mortgage or Credit debt dummy		
Low Financial Literacy	0.866 (0.129)	-0.02 (0.024)
Gender (Female)	1.435** (0.230)	0.06** (0.025)
Age categories	0.711*** (0.0374)	-0.05*** (0.008)
Income quintiles	1.202*** (0.0665)	0.03*** (0.009)
Do able to save	0.388*** (0.0715)	-0.15*** (0.028)
Credit constrained	2.094*** (0.509)	0.12*** (0.038)
Constant	0.562** (0.163)	
Observations	10,510	10,510

Standard errors in parentheses  
 \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Source: Own calculations based on the Household Finance and Consumption Survey 2017

## 5 Conclusion

This study has examined the relationship between the level of financial literacy and outstanding non-mortgage or credit debt using Slovak HFCS 2017 survey data. Slovak households were among the households with the fastest increase in household indebtedness in the Central and Eastern European (CEE) region. Such an increase in household indebtedness was supported by a favorable macroeconomic development combined with historically low-interest rates. More affordable loans may lead to excessive indebtedness which represents an important problem that may threaten the financial well-being of many individuals and households. Therefore, understanding the factors that influence individual or household debt behavior is crucial for regulators, policymakers, and financial institutions. In this study, we focused on financial literacy specifically on households with a low level of financial literacy as one of the factors that may influence their debt behavior on the credit market.

The preliminary finding of this research suggests that households present different debt behavior with respect to varying levels of financial literacy. The cross-tabulation analysis showed that only 18% of households have an outstanding balance of non-mortgage or credit debt. Subsequently, we discovered that a higher share of households with a lower level of financial literacy (according to our definition) has an outstanding balance of non-mortgage or credit debt. Therefore, we took a closer look at the characteristics of a specific group of individuals who displayed low financial literacy with an outstanding balance of non-mortgage or credit debt. The socio-economic characteristics suggest that these households are most likely to be employed with the highest achieved secondary education. However, from our regression analysis, we were not able to prove our hypothesis that households with a lower level of financial literacy display a higher probability of having an outstanding balance of non-mortgage or credit debt, as the marginal effects of low financial literacy independent variable did not have a statistically significant effect. This could be attributed to the factor, that the majority of Slovak households are generally not using non-mortgage or credit debt. Those households who decided to have an outstanding balance of non-mortgage or credit debt were not affected by their level of financial literacy. Although, we found a statistically significant association between income quintiles and age categories on the probability of having an outstanding balance of on non-mortgage or credit debt. Younger households with higher income display a higher probability of having an outstanding balance of non-mortgage or credit debt, which is in line with the life-cycle hypothesis, which describes the financial behavior of agents over their lifetime.

Furthermore, we discovered that households with an outstanding balance of non-mortgage or credit debt are on average 15 percentage points less likely to be able to save and 12 percentage points more likely to be credit constrained than households without an outstanding balance of non-mortgage or credit debt. Households with these characteristics may present a self-control problem connected with impulsive purchasing behavior by using quick access but higher-cost credit. We may consider those households more financially vulnerable when they are hit by unexpected internal or external negative shocks and carry higher debt loads combined with a lower ability to save, which might lead to credit constraints and the inability to borrow to overcome unexpected adverse shocks.

In further research on this topic, we will more closely examine the impact of financial literacy on the level of indebtedness among younger households by calculating the different debt indicators as debt to income ratio (DTI), debt service to income ratio (DSTI), and loan to value ratio (LTV) and by regression model examine the relationships and estimate the probability of how the level of financial literacy influence the households level of indebtedness.

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## Appendix

**Table 2.** Individuals with/without an outstanding balance of non-mortgage or credit debt & low financial literate individuals with an outstanding balance non-mortgage or credit debt

	Has an outstanding balance of non-mortgage or credit debt	Don't have an outstanding balance non-mortgage or credit debt	Low financial literate individuals with an outstanding balance of non-mortgage or credit debt
<b>Overall</b>	0.18	0.82	0.53
<b>Financial Literacy</b>			
0 or 1 correct	0.17	0.16	0.29
2 correct	0.42	0.45	0.71
3 correct	0.29	0.28	NA
4 correct	0.12	0.11	NA
<b>Gender</b>			
Male	0.64	0.60	0.56
Female	0.36	0.40	0.44
<b>Age group</b>			
Under 35	0.10	0.05	0.16
35-44	0.24	0.11	0.30
45-54	0.26	0.15	0.20
55-64	0.26	0.27	0.22
65- and over	0.14	0.42	0.12
<b>Working Status</b>			
Employee	0.53	0.33	0.55
Self-employed	0.11	0.12	0.12
Unemployed	0.11	0.05	0.10
Retired	0.25	0.50	0.23
<b>Education</b>			
Secondary	0.78	0.79	0.80
Tertiary	0.22	0.21	0.20
<b>Income</b>			
Median	17.424€	14.357€	15.940€
<b>Assets</b>			
Median	60.100€	69.000€	52.000€
<b>Able to save</b>			
No	0.80	0.64	0.85
Yes	0.20	0.36	0.15
<b>Credit constrained</b>			
No	0.88	0.95	0.84
Yes	0.12	0.05	0.16

**Source:** Own calculations based on the Household Finance and Consumption Survey 2017

# Impact of Basel III Agreement on the European Union 's Banking Sector

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**Abstract.** The aim of this article is to analyze the impact of the Basel III agreement on the European Union's banking sector. This article is divided into three parts. The first part is introductory, which describes the basics of the mortgage crisis in the USA, the causes of its beginning and its development into the global financial crisis. The second part deals with the reaction of the G20 countries to the financial crisis itself in the form of the implementation of the Basel III Agreement and the impact of this agreement on the European banking sector. This chapter then deals with quantitative cash release and negative interest rates, as it is a consequence of the Basel III Agreement. The Basel III Agreement had a significant impact on the monetary policy of the European Central Bank and its impact on business in the countries of the European Union. We deal with this issue at the end of this section. In the third part of this article, in its conclusion, we summarized the key findings of this article and defined the impact of the Basel III Agreement on the European banking sector.

**Keywords:** Basel III, mortgage crisis, banking sector

**JEL classification:** E58

## Introduction

The financial crisis that started in the USA in 2007 quickly spread and affected many countries. This crisis began as a real estate crisis that erupted as a result of providing mortgages to people with a lower standard of living. Banks offered them mortgages with low interest rates, which this group of people had trouble repaying. When approving loans to risky clients, not only banks but also rating agencies failed. As a result of the outbreak of this crisis, discussions began in the banks about why this crisis happened, what were the reasons and what measures should be taken in the future to reduce the risk of a financial crisis of this magnitude. One of the results of these discussions was the introduction of the Basel III agreement by the G20. The purpose of

this agreement was to increase the level of capital in banks and reduce risky banking operations. However, this significantly influenced the European banking sector. The financial crisis hit financial markets all over the world, affecting the banking and finance sector. Banks began to experience problems in the area of liquidity and capital adequacy. As it turned out, the capital adequacy introduced by Basel II were not sufficient. Therefore, the Basel Committee issued the new Basel III rules, detailing compliance with the regulatory standards of bank capital adequacy and liquidity. The new rules established higher and better capital for banks, better coverage of risks, introduced a leverage ratio, measures to support the building of capital that they could draw on in crisis periods, and introduced global liquidity standards, namely the short-term liquidity cover indicator and the net stable funding indicator. At the same time, established requirements for higher and better quality capital and conditions for better coverage of risks.

The financial crisis began in 2007 as real estate crisis in the USA. Banks in the USA wanted to maximize their profits and began lending to low-solvent clients. In addition to banks, some credit rating agencies, whose role was to assess the solvency of future borrowers, also played a significant role in this crisis. From those with the AAA / Aaa designation to the insolvent ones, which were included in Group D. "However, it was not a problem to obtain proof of the required income from the rating company for a bribe" (Financial Crisis, 2016). Banks were too light-hearted about such assessments and relied on rating results, while no longer verifying client data. It was not long before interest rates began to rise, with debtors no longer able to repay these higher interest rates. This situation quickly resulted in a sharp drop in property prices and banks found themselves in a situation where the value of the property they lent to clients a few months ago was significantly lower than the amount borrowed by the bank. In the following chart we can see how big the price drop was.

**Graph 1** Market value of median-priced homes, adjusted for inflation, 1970 to 2014



Source: Lessons from the financial crisis: The central importance of a sustainable, affordable and inclusive housing market (Calhoun, 2018)



The economies of European countries avoided the first wave of the financial crisis without major consequences, but financial institutions, their products and rating agencies began to lose their reputation and the European Commission began to criticize them for negligent investment practices, risky liquidity management and irresponsible lending. The impact of this financial crisis began to show itself in the EU in the first quarter of 2008 and the global economy began to slow down. There are several causes for this crisis, but "the core of the crisis has been unsustainable housing mortgages combined with general undercapitalisation and insufficient guarantees in the financial system" (Calhoun, 2018).

## **1. Methodology of work**

The purpose of this article is to review the implementation of Basel III agreement and its impact on the EU banking sector. To achieve this goal, several theoretical methods were used, which were used in the form of general methods (synthesis, analysis, induction, deduction and comparison). Graphical representations were used to make interest rate data clearer. In the part where we deal with the characteristics of the Impact of the Basel III agreement on the EU banking sector, the method of synthesis will be used, which combines information about the economic situation. The method of induction and deduction will be used to draw conclusions about the importance and opportunities of this agreement for EU countries.

## **2. Results and discussion**

However, over time, as the crisis weakened, there was more and more talk in the banking community about the need for some changes in the functioning of the banking system, as this crisis revealed significant shortcomings in the banking business. Basically, we could highlight three primary shortcomings in the way banking works:

1. many banks had insufficient capital,
2. some banks have artificially increased their capital balance sheets in an effort to comply with capital adequacy conditions,
3. Banks usually had short-term resources invested in long-term assets, which made them weakly liquid.

For these reasons, the Basel Accords had to be changed. The G20 approved the Basel III agreement at the Seoul summit in 2010. The changes compared to the previous two Basel Accords have been significant, such as:

- higher and better quality capital, while creating the conditions for better risk coverage, namely the ratio of assets in the balance sheet and off-balance sheet to capital,
- support for capital that would be drawn primarily in times of crisis,
- the introduction of two liquidity standards that would operate at a global level,

coverage and an indicator of net stable funding, which secured less risky mortgage lending by banks.

In addition to the capital rules, the Basel III agreement contains other measures such as:

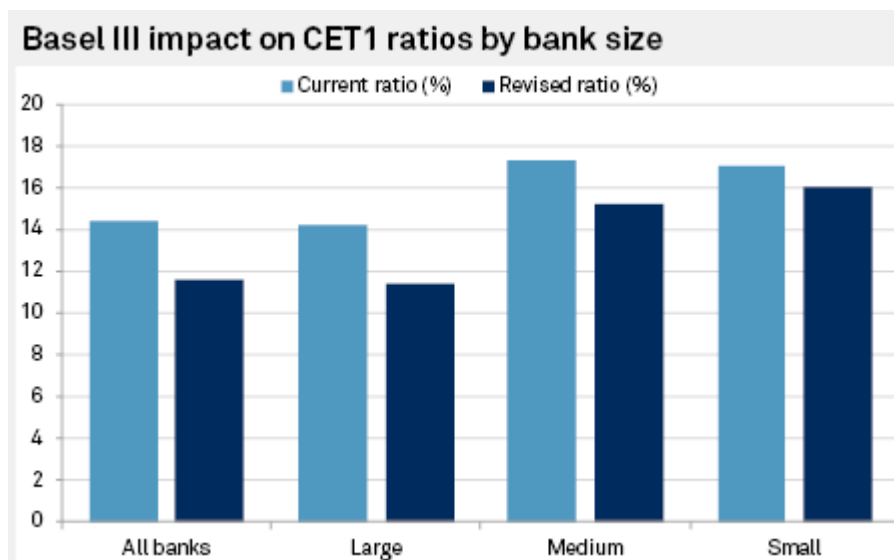
- increased G20 financial supervision of systemic risk at local and global level,
- standardization of derivatives trading,
- the obligation for hedge funds from a certain size to include restrictions for non-EU fund managers,
- common global accounting rules,
- credit rating agencies must be registered and supervised by European Union.

### 2.1 The effects of Basel III on the European Union's banking sector

These measures have reduced banks' incentives to take excessive risks and are a prerequisite for a lower probability of financial crises. "The Basel III framework was introduced in the wake of the global financial crisis as a way to strengthen risk management and regulation in the banking sector" (Damyanova, 2020).

For example, the average CET1 ratio, which means the degree of solvency of banks that measure the bank's capital against its assets, in the case of European banks fell to 11.5% from 14.4%, as the following chart shows.

**Graph 2** Impact of Basel III on CET 1 ratio by bank size:



Source: EU at risk of missing 2022 deadline for final Basel III capital rules (Damyanova, 2020)

Common Equity Tier 1 (CET1) is a component of Tier 1 capital that is mostly common stock held by a bank or other financial institution. It is a capital measure introduced in 2014 as a precautionary means to protect the economy from a financial crisis, largely in the context of the European banking system. It is expected that all Eurozone banks should meet the minimum required CET1 ratio of 15.1% of risk-weighted assets in 2022, up from 14.9% in 2021. Following financial crisis, the Basel Committee formulated a reformed set of international standards to review and monitor banks' capital adequacy. These standards, collectively called Basel III agreement, compare a bank's assets with its capital to determine if the bank could stand the test of a crisis. Capital is required by banks to absorb unexpected losses that arise during the normal bank's operations. The Basel III agreement framework tightens the capital requirements by limiting the type of capital that a bank may include in its different capital tiers and structures. A bank's capital structure consists of Tier 2 capital, Tier 1 capital, and common equity Tier 1 capital. Tier 1 capital is calculated as CET1 capital plus additional Tier 1 capital. Common equity Tier 1 comprises a bank's core capital and includes common shares, stock surpluses resulting from the issue of common shares, retained earnings, common shares issued by subsidiaries and held by third parties, and accumulated other comprehensive income. CET1 ratio measures a bank's capital against its assets. Because not all assets have the same risk, the assets acquired by a bank are weighted based on the credit risk and market risk that each asset presents. For example, a government bond may be characterized as a no-risk asset and given a zero percent risk weighting. On the other hand, a subprime mortgage may be classified as a high-risk asset and weighted 65%. According to Basel III agreement capital and liquidity rules, all banks must have a minimum CET1 to risk-weighted assets ratio of 4.5%. A bank's capital structure consists of Lower Tier 2, Upper Tier 1, and CET1. CET1 is at the bottom of the capital structure, which means that any losses incurred are first deducted from this tier in the event of a crisis. If the deduction results in the CET1 ratio dropping below its regulatory minimum, the bank must build its capital ratio back to the required level or risk being overtaken or shut down by regulators. During the rebuilding phase, regulators may prevent the bank from paying dividends or employee bonuses. In the case of insolvency, the equity holders bear the losses first followed by the bondholders and then Tier 2 capital.

The Basel III agreement has a significant impact on the European banking sector, which by 2019 needed around 1,1 trillion € in additional short-term liquidity capital and around 2,3 trillion € in long-term financing.

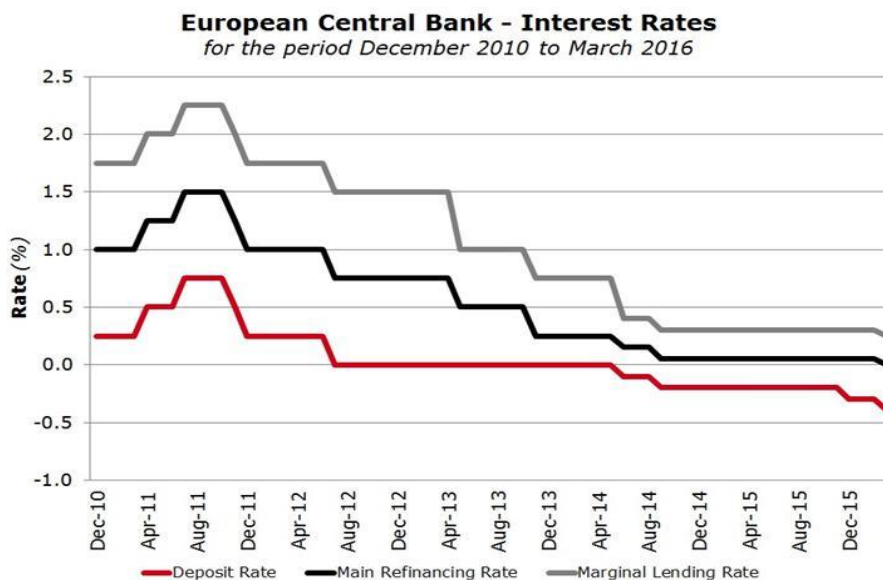
Thus, the banks were forced to obtain a huge amount of capital that they did not need before. If we wanted to interpret this very simply, the Basel III agreement limited banks' profits but increased the security of the banking sector. Although banks also had additional costs, they also had opportunities to seek additional capital in the form of cost reductions, product revaluations, improved capital adequacy management and asset and liability restructuring. The retail, corporate and investment banking segments were affected in different ways. The impact of Basel III on retail banks was minimal, but corporate banks limited Basel III in structured finance and trade finance. Investment banks operating in the capital markets were more severely affected than retail and corporate banks, as many had problems with capital adequacy, such as covering short-

term loans with short-term resources for some banks. As far as Slovak banks are concerned, the Basel III agreement has had an impact on the management of long-term resources. As they became more expensive, which had an impact on the price of long-term loans to clients. However, as a whole, we can evaluate the Slovak banking sector in such a way that it is in good condition and has managed to adapt to the Basel III agreement.

## **2.2 Quantitative cash release and negative interest rates as one of the consequences of the Basel III agreement**

Another indirect consequence of the Basel III agreement was the situation when “in March 2015, the ECB began purchasing assets from commercial banks as part of its non-standard monetary policy measures. These asset purchases, also known as quantitative easing, support economic growth in the euro area and help us bring inflation back to below but close to 2% ”(European Central Bank, 2014). The European Central Bank has begun quantitative easing in a way it has not preferred for a long time, following the example of the US Federal Reserve. Subsequently, in the winter of 2015, it expanded this quantitative easing and thus made it possible, for example, not only to buy government bonds, but also to give central banks the opportunity to buy regional bonds. That is, the bonds of the regions of the Member States. Subsequently, there was a further expansion of quantitative easing, when national central banks could also buy corporate bonds, which meant that they could directly buy so-called high-quality corporate debt. The following chart shows how the European Central Bank has been cutting interest rates over several years.

**Graph 3** European Central Bank interest rates for the period December 2010 to March 2016



Source: Towards a Redesign of Fiscal Consolidation For a Consistent Policy Mix in Euro Area, Progressive Economy, Annual Forum 2016 (Researchgate, 2016)

### 2.3 The impact of the European Central Bank's monetary policy on EU business

The European Central Bank's monetary policy is based on two pillars that help maintain price stability. These pillars of monetary policy are monetary and economic analysis. In order to maintain price stability, the European Central Bank observes the direction in which the money is moving in the economy and the outlook for the macroeconomic trend and its impact on inflation in the future. The European Central Bank's monetary policy has an impact on the economy through various channels, such as the interest rate channel, the credit channel, the exchange rate channel and the wealth channel using monetary policy instruments. A change in market interest rates in the short term will set in motion several mechanisms. This change affects the development of economic variables such as product or price. When the amount of money in the economy changes, the change is reflected at the level of the general price level. However, it will not cause a permanent change in variables such as product or unemployment. Income or the level of unemployment in the long run are determined by factors such as the development of technology and population growth. "The most important instruments of the ECB's standard monetary policy are open market operations and the maintenance of minimum reserves" (Verbeken, Rakić, Paternoster, 2019).

## Conclusion

In 2007, the mortgage crisis began in the USA, which subsequently grew into a global financial crisis. Banks in the US wanted to maximize their profits and started lending to less solvent clients. In addition to banks, some rating agencies also played a role in this crisis, whose task was to assess the solvency of future borrowers. However, it was a common practice that a better rating could be easily obtained, for example by a bribe. However, soon a large number of low-solvency clients began to have problems repaying such loans. This situation quickly resulted in a sharp drop in real estate prices, and the banks found themselves in a situation where the value of the property they had lent to clients a few months earlier was significantly lower than the amount the bank had lent them. Subsequently, the mortgage market in the USA began to collapse and the global financial crisis broke out.

Developed countries realized that it is necessary to modify the way the banking sector functions in order to reduce the risk of such financial crises in the future. It was therefore necessary to change the Basel Agreements. The G20 approved the Basel III agreement at the Seoul summit in 2010. And the changes compared to the previous two Basel agreements were significant.

Higher quality capital was increased, creating conditions for better risk coverage, creating capital support that would primarily be drawn on in times of crisis, and setting global liquidity standards and net stable funding ratios that secured less risky mortgage lending by bank. Another indirect consequence of the Basel III agreement was the situation when the European Central Bank started using negative interest rates and quantitative easing.

The requirements of the Basel III agreement had a significant impact on the European banking sector. By 2019, the banking sector needed about 1,1 trillion € of additional Tier 1 capital, 1,3 trillion € of short-term liquidity and about 2,3 trillion € of long-term financing. The return on equity ratio of European banks decreased by approximately 4 percentage points. Banks prevented a possible decrease in profitability, for example, by reducing costs, repricing products, increasing capital by improving capital adequacy and liquidity management, or restructuring assets and liabilities. The retail, corporate and investment banking segments were affected in different ways. Retail banks were minimally affected, while this segment is significantly represented in the Slovak banking sector. Corporate banks are limited by the Basel III agreement in structured financing and trade financing. Investment banks active in trading on the capital markets were hit the hardest. Slovak banks do not have problems with capital adequacy and have a capital adequacy ratio above the threshold of 10,5%. For Slovak banks, the Basel III agreement has the strongest impact on the management of long-term resources, because they have become more expensive due to the adjustments necessary for the introduction of the Basel III agreement. In general, however, we can consider the Slovak banking sector to be healthy.

The new rules will force banking institutions to increase their capital by hundreds of billions € over the next ten years. In an effort to mitigate the impact on the banking sector and financial markets, regulatory authorities have given financial institutions time to comply with the new rules.

The impact of Basel III on the banking sector of the European Union is great. Profits for banks have decreased, but on the other hand, the risk of repeating the financial crisis of 2007-2009 due to the irresponsible behavior of the banking sector has significantly decreased.

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# Examining the Relationship between Foreign Direct Investment and Export in the Region of Selected Central and Eastern European Countries

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**Abstract.** The In today's globalized world, both foreign direct investment and exports of goods and services are an indicator of the level of competitiveness of the economy and play an important role in economic growth. It is also the same in the countries of Central and Eastern Europe. The aim of the presented scientific article is to use scientific methods to examine the relationship between the inflow of foreign direct investment and exports within the region of selected Central and Eastern European countries. Many scientific studies have looked at the relationship between FDI and economic growth, but fewer describe the long-term or short-term relationship between investment and export value. In the following article, we will deal with the mutual relationship between them within selected eleven countries of Central and Eastern Europe.

**Keywords:** foreign direct investment, export, CEE, panel data

**JEL classification:** *F10, F14, F20*

## 1 Introduction

The sharp rise in foreign direct investment (FDI) and international trade flows in recent decades, given the current instability of their flows following the global economic crisis, has prompted an interest in examining their relationship, as evidenced by growing theoretical and empirical literature in this area. Countries are currently fully aware of the potential benefits of foreign direct investment. Therefore, governments are increasingly trying to attract them, while offering significant incentives to motivate investors to invest in a given country. However, evidence of the export effects of foreign direct investment remains ambiguous, as does the validity of the host country's policies. The theory predicts the positive or negative effects of foreign direct investment on export values. Theoretical controversy and whether governments' interest in attracting investment is justified leads to a proliferation of empirical studies examining



this problem. So far, we have seen several attempts to evaluate the state of the existing empirical literature examining the relationship between foreign direct investment and exports.

The importance of foreign direct investment in the countries of Central and Eastern Europe, especially with regard to the process of transformation of their economies, is invaluable. In the CEE countries in particular, FDI has a significant positive impact on their economic growth. According to Ferenčíková and Dudáš (2010), we can talk about foreign investment on two levels of positive effects - the ability to supplement the missing domestic resources that are needed in process of economic transformation and to bring other positive secondary effects. This is the common denominator in the efforts of the aforementioned CEE countries to attract new foreign direct investment. Economic theory does not clearly identify the relationship between FDI and exports. In his seminar paper, Mundell (1957) examined this relationship on the assumptions of the neoclassical Heckscher-Ohlin-Samuelson theory, where foreign direct investment flows depend on differences in factor prices and factor subsidies between countries. With the growing mobility of international factors, these disparities are narrowing. The conclusion of his research was that the mobility of capital driven by foreign direct investment is a perfect substitute for exports. The so-called export learning is a closely related concept, which is important to mention at the beginning of the research and the subsequent explanation of the impact of foreign direct investment on the export of the host country. Firms decide for themselves whether to become exporters, deriving their decision from their production performance (Clerides et al., 1998). By gaining experience associated with the implementation of export operations, they improve their export competitiveness in foreign markets. This particularly emphasizes the importance of providing strong export support to domestic firms in order to improve their efficiency. Empirical evidence of export learning has been examined in a meta-analysis conducted by Martins and Yang (2009), which suggests that exports generally have a positive effect on productivity and that this effect is more pronounced in developing countries.

Helpman et al. (2003) point out that the complementary and substitutive relationship between investment and export needs to be taken into account. This is a question related to the type of individual FDI. Most macroeconomic models are based on general equilibrium models, so the relationship between the two variables can be analysed from the perspective of both the home and host countries (Kojima, 1973; Mundell, 1957). Based on the results of empirical studies, the complementary relationship shows a rather positive impact of investment on the host country's exports, while the substitution relationship speaks of no or rather a negative impact.

Zhang and Song (2000) examined the impact of FDI inflows on Chinese exports during the period 1986-1997. Based on their calculations, they concluded that FDI inflows undoubtedly play an important role in supporting Chinese exports. When calculating the correlation coefficient using a simple regression model, they found a strong dependence between the given quantities. Specifically, in their published output, it was found that the 1 % change in FDI levels in the previous year is associated with a 0.29 % increase in exports next year in the Chinese economy. Using a bivariate Granger causality test, Fabry (2001) examined the causal relationship between FDI and exports

in a group of 10 countries from the Central and Eastern European region. Based on this test, he pointed out that the relationship between FDI and exports was not found, on the other hand, there was a relationship between FDI and economic growth. In contrast, the Pacheco López (2004) study showed a two-way causal link between foreign direct investment and exports in Mexico, where it has been found that exports stimulate FDI and FDI, on the contrary, supports exports. Dritsaki C. and Dritsaki M. (2012) examined the causal link between foreign direct investment and exports of the twelve EU countries between 1995 and 2010 using the Granger causality methodology. The findings support the presence of a bilateral causal relationship between foreign direct investment and exports, both in the short and long term, for this group of countries. One of the main conclusions of this study is that exports and FDI are two important factors in economic growth. For these countries, promoting exports and attracting new foreign investors are crucial. For non-euro area countries, the devaluation of the currency may be the first step. Export promotion, combined with FDI and a stable exchange rate, can create a favourable environment for sustainable growth. Zamrazilová (2006) examined the relationship between FDI and exports in the neighbouring Czech Republic. The result of her study is that foreign investors not only brought funds to the Czech Republic, but their entry improved foreign-controlled companies' access to world markets and increased their adaptation to the changing conditions of demand in developed markets. The strong export orientation and performance of companies under foreign control contributed to a gradual increase in the country's export performance.

An important aspect of the relationship examined is the level of economic development of the host country. This is a particularly important issue in predicting the potential for side effects in the host country (Görg & Greenaway, 2016). The lower level of development of the country presumes greater opportunities for new and rapidly developing technological innovations than side effects within foreign investment. This theory has been extended to the problem of export effects of foreign direct investment, which are more positive in a less developed host country (Brouthers, Werner, & Wilkinson, 1996).

Compared to foreign direct investment, basic export data are observed from an ex-post perspective, while foreign direct investment data is continuously monitored and evaluated to ensure value added. FDI is therefore constantly examined, especially from an ex-ante point of view. This is due to the fact that FDI represents the investor's interest in the form of a complex investment, which can be modified at the time of management of the relevant business entity. Therefore, foreign direct investment is much more difficult to research and predict.

The above literature review suggests that the theory alone cannot give a clear answer as to whether the impact of foreign direct investment on host country exports is positive, negative, or non-existent. The relationship examined is therefore essentially an empirical problem, which has also been examined by various empirical studies. The results are diverse, which is the motivation for our quantitative analysis in other parts of this paper.

## 2 Model

The aim of the scientific article is to use scientific methods to examine the relationship between the inflow of foreign direct investment and exports within the region of selected countries of Central and Eastern Europe. To achieve our goal, several research methods were used, namely the method of selection, analysis, induction, deduction, and comparison. Above all, we worked using mathematical and statistical methods. The analysis pointed out the development of the inflow of foreign direct investment, the position of foreign trade, its importance. The paper used mostly secondary sources of information provided by relevant economic organizations such as UNCTAD. Due to the rapid development of the world economy, in addition to the extensive publications of leading economists, up-to-date Internet resources were used to examine the issue.

As the scope of the researched issue is relatively extensive, relevant information was selected using the selection method to achieve the goal. In the first part, we focused our attention on the description of the position of foreign trade in the economies of Central and Eastern Europe, the inflow of FDI and the current FDI stock. Induction and deduction methods were applied to evaluate the given state of the examined attributes and competitiveness of the economy. Mathematical-statistical methods were used in the quantification of the obtained data, in which we used a graphical representation for clarity. A descriptive analysis is used in the paper to explain the charts and figures, which provided a comprehensive picture of the researched issue through comments and verbal descriptions.

To assess the causality between exports and the inflow of foreign direct investment, we decided to perform a correlation-regression analysis. The dependent variable (Y) is represented by export values. The independent variable (X) represents the inflow of foreign direct investment. The coefficient of determination (R<sup>2</sup>) expresses what percentage of the variation in the value of the dependent variable Y is due to the variation of the independent variables X.

Since we have many variables in our model, we decided to work with panel data - panel regression. Panel data includes a cross-sectional and a time component. In this case, it is a combination of observations of cross-sectional export data and the foreign direct investment stock in 11 countries over a period of 28 years. We chose a model with fixed effects, which, in contrast to the pooled regression model, assumes different absolute terms for the individual cross-sectional units:

$$(1) \quad Y_{it} = \alpha_i + \beta_1 X_{it1} + \dots + \beta_k X_{itk} + U_{it}.$$

*Where:*

*Y* is the real export,

*X* is the stock of foreign direct investment,

$\alpha_i$  is the specific constant for each cross-sectional unit. In our case, this can be the so-called other, unspecified effects,

*index i* is the cross - sectional component  $i = 1, \dots, N$ , which we use to monitor *N* objects (countries),

*index t* is the time component  $t = 1, \dots, T$ , by which we observe  $T$  time periods,  $Y_{it}$  will denote the value of the object variable  $Y$  at time  $t$ ,  $\beta$  is the vector  $K \times 1$ ,  $X_{it}$  is the  $i$ -th observation of the explanatory variables,  $U_{it}$  is a random component.

In addition to the fact that panel data allow us to compile and test more complex models, their advantage is that they also solve selected econometric problems that often occur in empirical work. One of them is the problem with immeasurable variables, which affect the explanatory variable, but since they cannot be measured, we cannot include them in the selected model. Panel data make it possible to eliminate this problem by using the first difference, while we get:

$$(2) \quad Y_{it} - Y_{it-1} = \alpha_i + \beta_1(X_{it1} - X_{it1-1}) + \dots + \beta_k(X_{itk} - X_{itk-1}) + (U_{it} - U_{it-1})$$

### 3 Results and discussion

The inflow of foreign direct investment also played an important role in terms of the economic transformation of the countries of Central and Eastern Europe (CEE)<sup>1</sup> in the early 1990s. Until 1989, the CEE countries were centrally planned, with export and import trade operations being conducted exclusively through state trading enterprises, which had a monopoly on foreign trade. At that time, foreign trade was characterized by strong concentration within the Council for Mutual Economic Assistance (CMEA)<sup>2</sup>. The liberalization of national economies in the CEE countries has led to a huge inflow of FDI into the region, and by joining the EU, FDI inflows have intensified. The integration process, which the CEE countries completed in three waves<sup>3</sup>, opened up the EU market and brought new export opportunities, which was also reflected in the dynamics of export growth, especially in the V4 countries.

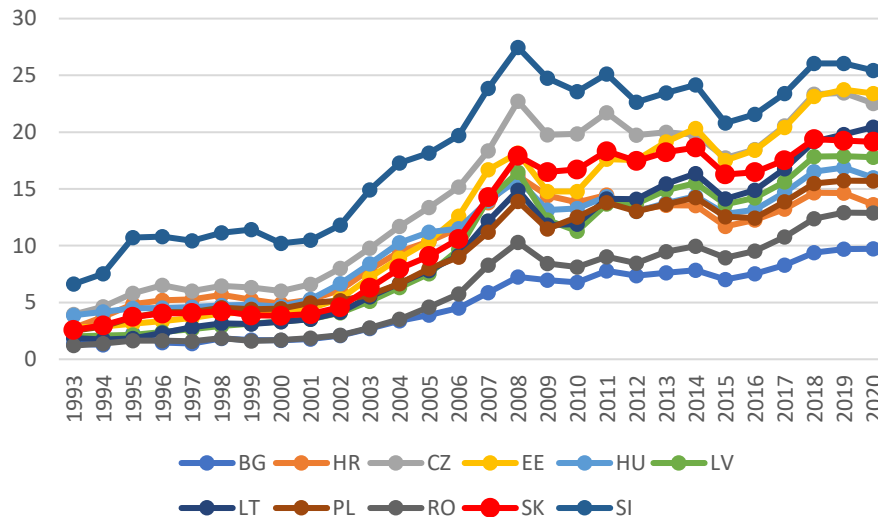
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<sup>1</sup> CEE countries that are members of the EU: Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Lithuania, Latvia, Poland, Romania, Slovak Republic, Slovenia.

<sup>2</sup> All the above-mentioned CEE countries were members of the CMEA, except Yugoslavia (Croatia also belonged to Yugoslavia in the past), which had observer status.

<sup>3</sup> The largest enlargement of the EU took place in 2004, with 10 countries becoming members: Cyprus, Czech Republic, Estonia, Lithuania, Latvia, Hungary, Malta, Poland, Slovak Republic and Slovenia. Romania and Bulgaria became members of the EU in 2007, and the last enlargement took place in 2013, when Croatia became a member.

**Fig. 1.** GDP growth p.c. in CEE countries in 1993 - 2020 (in thousands of USD)

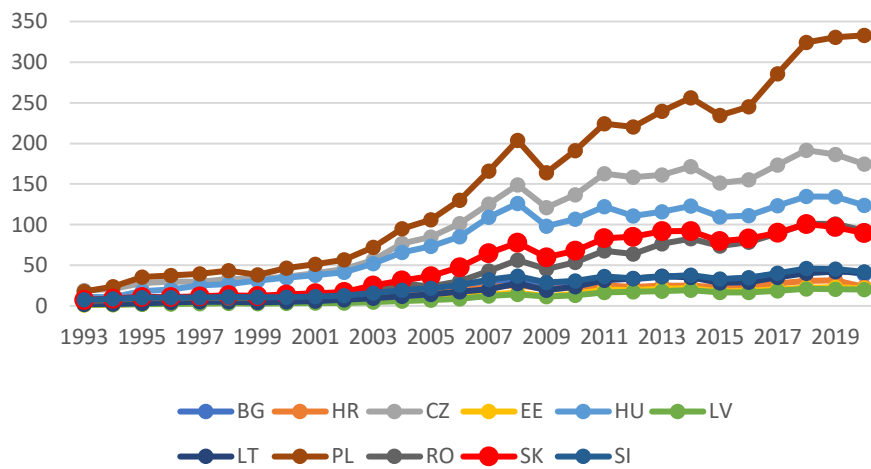


If we look at Fig 1, which describes the overall economic condition of the national economies of the CEE region, we see that the highest GDP per capita within the CEE countries in 2020 is in Slovenia at USD 25,444; Estonia at USD 23,399 and the Czech Republic at USD 22,535. The Slovak Republic, as the most open and export-efficient economy in the CEE region, produced the 4th largest GDP per capita in 2020, amounting to USD 19,156. GDP per capita of Poland reached USD 15,706 and the lowest GDP from CEE countries in 2020 was recorded by the national economies of Croatia (USD 13,634), Romania (USD 12,875) and Bulgaria (USD 9,726).

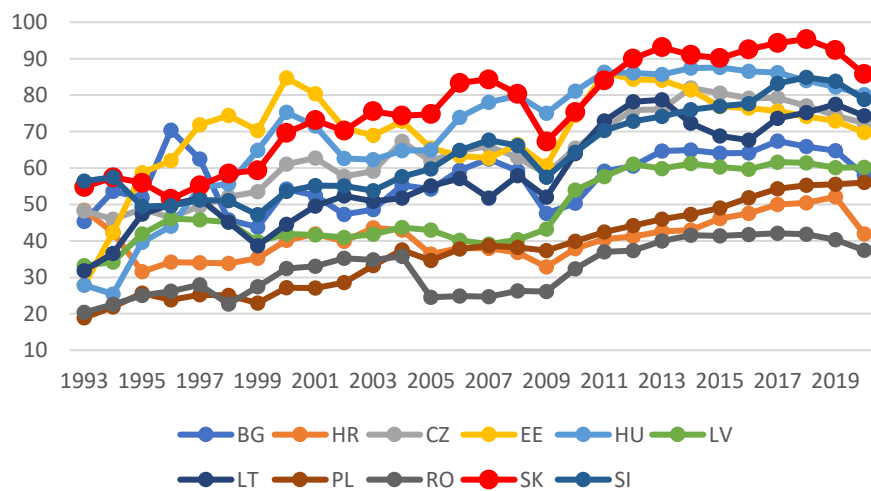
In terms of export volume, we can divide the development in the CEE countries into the period before and after the integration into the EU i.e., from 2004. From Fig. 2 we can observe that a significant increase in exports after 2004 is characteristic especially for the group of V4 countries within which Poland's exports grew the most dynamically until 2020, namely by USD 238.1 billion, Czech exports by USD 97.9 billion, Hungary's exports by USD 57.7 billion and exports of the Slovak Republic by USD 58.3 billion. Outside the V4 countries, Romania is the only country in the CEE region with the largest volume of exported goods and services, but as we can see in the following Fig 3, the Romanian economy achieves this volume only in absolute terms, while its export performance is the lowest in the overall comparison of the CEE region and amounts to only 37.5 % of GDP. Other countries have long maintained a stable trajectory of the development of the volume of exported goods and services, which in a mutual comparison does not exceed the value of USD 50 billion. The lowest exports within the CEE region in 2020 is in Latvia at USD 20.2 billion, Estonia at USD 21.7

billion, Croatia at USD 23.5 billion, Bulgaria at USD 39.2 billion and Lithuania at USD 41.4 billion. At the same time, it should be noted that the exports of goods and services of the remaining economies of the CEE region in absolute terms do not reach a value comparable to the V4 countries.

**Fig. 2.** Exports of goods and services of CEE countries in 1993 - 2020 (in billions of USD)



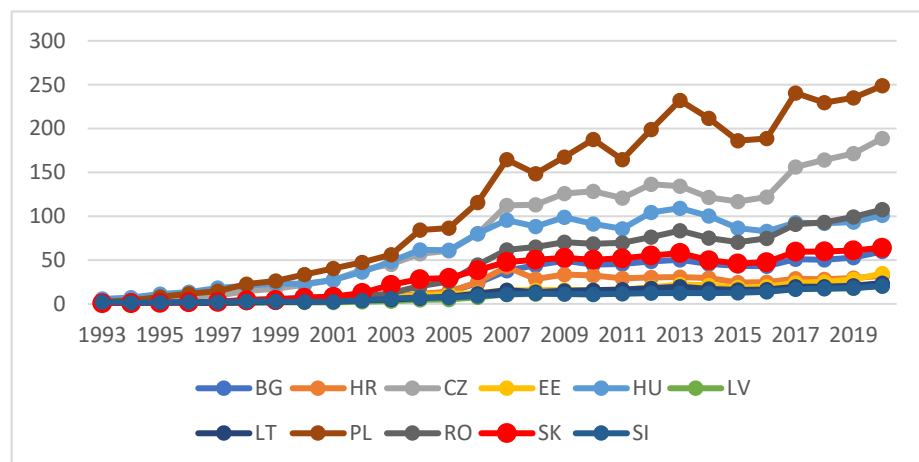
**Fig. 3.** Export performance of CEE countries in 1993 - 2020 (in % of GDP)



As the volume of exports in absolute terms cannot provide us with a more balanced view of the export potential of CEE countries, in the following section we decided to use the export performance indicator, through which we can express the percentage of the final value of exports in relation to the nominal value of GDP. This comparison does not disadvantage any country in terms of market size and domestic production. Export performance can be considered one of the key indicators in the analysis of foreign or global trade.

In the long run, the most export-efficient economy within the CEE region as well as within the V4 is the Slovak Republic, whose exports of goods and services accounted for 85.7 % of GDP in 2020. The highest level of export performance was achieved by the Slovak economy in 2018, when up to 95.4 % of GDP was produced by goods and services located on foreign markets. From the crisis year 2009 to 2019, the increase in export performance in the Slovak Republic represented 25.1 %, but the global pandemic caused a subsequent year-on-year decrease of 6.6%. The decline in export performance caused by the Covid-19 pandemic has affected almost all CEE countries in the range of around 2 - 10%, with the exception of Latvia and Poland, which have remained stable. Export performance in Croatia fell the most, by as much as 10 %.

**Fig. 4.** FDI stock in CEE countries in 1993 - 2020 (in billions of USD)



The development of the FDI stock in the CEE region largely copies the development trend of exports of goods and services. As we can see from Chart 4, the inflow of FDI into these countries also began to gain momentum after integration into European structures in 2004 and 2007 respectively, when the V4 countries in particular were able to attract the largest amount of foreign capital in the form of FDI in the following years. The largest concentration of FDI is in Poland, where the total increase in the volume of FDI since 2004 is approximately 33.8 %, in absolute terms, FDI stock in Poland amounts to USD 248.7 billion. It is important to point out that Poland, as the

country with the highest volume of FDI in the economy amounting to USD 248.7 billion, managed to create up to the 8th highest gross domestic product per capita within the CEE countries according to the previous Fig. 1. The second most attractive territory within the CEE region is the Czech Republic with a value of FDI stock of USD 188.8 billion, followed by Romania with a FDI stock of USD 107.5 billion and Hungary with a FDI stock of USD 101 billion. Within the CEE region, the Slovak Republic is the country with the 5th largest accumulated foreign capital in the form of FDI with a value of approximately USD 64 billion in 2020, while in 1993 the volume of FDI in the Slovak economy was only USD 641.9 million. In 2004 – 2009, FDI stock in the Slovak Republic increased by 86.4 %, in 2009 - 2014 decreased by 5.8 % and in 2014 – 2020 increased again by 28.7 %. The lowest accumulation of FDI in the CEE region is in Slovenia, where the FDI stock is only USD 20.4 billion, followed by Latvia with a FDI stock of USD 20.5 billion, Lithuania with a FDI stock of USD 23.7 billion and Croatia with a FDI stock of USD 32.1 billion.

As we stated in previous sections of this scientific article, we decided to perform a panel regression to assess the relationship between foreign direct investment and exports. From the first observation of the results according to Table 1, it is clear that the observation is of statistical significance. The coefficient "fdistock" has a value of 1.08951, which means that with an increase in FDI by USD 1 million, we can expect exports to increase by an average of USD 1.08951 million. The value of R2, the correlation determinant, is at the level of 92.5 %. However, the low value of the Durbin-Watson statistic of 0.873658 is alarming, which signals an obvious autocorrelation i.e., a serial dependence of random faults or residues. The Durbin-Watson test is the best-known test for error autocorrelation testing in linear regression models.

**Table 1** Relationship test between FDI and exports in selected CEE countries

Included 11 cross-sectional units				
Time-series length = 28				
Dependent variable: export				
	coefficient	std. error	t-ratio	p-value
const	6082.21	960.698	6.331	9.01e-10 ***
fdiStock	1.08951	0.0179279	60.77	3.18e-169 ***
Mean dependent var	48320.59	S.D. dependent var	59863.27	
Sum squared resid	4.01e+10	S.E. of regression	11639.59	
LSDV R-squared	0.963549	Within R-squared	0.925800	
LSDV F(11, 296)	711.3205	P-value(F)	1.4e-205	
Log-likelihood	-3314.461	Akaike criterion	6652.921	
Schwarz criterion	6697.682	Hannan-Quinn	6670.819	
rho	0.563784	Durbin-Watson	0.873658	
Joint test on named regressors -				
Test statistic: F(1, 296) = 3693.2				
with p-value = P(F(1, 296) > 3693.2) = 3.18113e-169				
Test for differing group intercepts -				
Null hypothesis: The groups have a common intercept				
Test statistic: F(10, 296) = 15.349				
with p-value = P(F(10, 296) > 15.349) = 4.31169e-22				



When estimating the relationship between two nonstationary variables using the least squares method, we can find an estimated relationship, even if there is no real relationship between them. For example, if both time series are increasing, which is also our case, they may be correlated, although the cause of their growth is different. Such regression is characterized by a high R2 value and a low Durbin-Watson statistic value. And that is exactly what happened in our measurement.

Therefore, we proceeded to control the residuals i.e., the differences between the expected, hypothetical value and the actual value of the variables. After performing the ADF - GLS residual test, the p-values for each country deviated from the required value  $< 0.05$ . We decided to solve the problem using the first difference and repeat the test.

**Table 2** Relationship test between FDI and exports in selected CEE countries (first difference)

Included 11 cross-sectional units				
Time-series length = 27				
Dependent variable: d_export				
	coefficient	std. error	t-ratio	p-value
const	2622.54	515.137	5.091	6.48e-07 ***
d_fdiStock	0.155961	0.0625019	2.495	0.0132 **
Mean dependent var	3087.590	S.D. dependent var	8791.683	
Sum squared resid	1.95e+10	S.E. of regression	8276.325	
LSDV R-squared	0.146734	Within R-squared	0.021380	
LSDV F(11, 285)	4.455537	P-value(F)	3.33e-06	
Log-likelihood	-3094.583	Akaike criterion	6213.166	
Schwarz criterion	6257.491	Hannan-Quinn	6230.911	
rho	-0.119592	Durbin-Watson	2.162617	
Joint test on named regressors -				
Test statistic: F(1, 285) = 6.22649				
with p-value = P(F(1, 285) > 6.22649) = 0.0131511				
Test for differing group intercepts -				
Null hypothesis: The groups have a common intercept				
Test statistic: F(10, 285) = 2.98044				
with p-value = P(F(10, 285) > 2.98044) = 0.00137271				

After repeating the test, the "d\_fdistock" coefficient is 0.155961, which means that with an increase in FDI of USD 1 million, we can expect exports to increase by only USD 0.155961 million on average (see Table 2 above). The value of R2, the correlation determinant, dropped to a level of only 0.02 %, which is a very low value. However, we know from theory that the value of the correlation determinant in panel regression is often very low. It is therefore not significant for a given model. However, if we look at the value of the Durbin-Watson statistic, it shows that we have eliminated autocorrelation i.e., the presence of random faults, because its value is around the number 2. It is this value that is required and signals zero autocorrelation.

As the measured value of dependence is lower in this case, we decided to postpone the measurement of the impact of FDI on the economies of the countries concerned by one year. Nevertheless, we have to reckon with the so-called delays in the effects of foreign direct investment. We did the test again.

**Table 3** Relationship test between FDI and exports in selected CEE countries (first difference + lag1)

Included 11 cross-sectional units				
Time-series length = 26				
Dependent variable: d_export				
	coefficient	std. error	t-ratio	p-value
const	1394.39	436.906	3.192	0.0016 ***
d_fdiStock_1	0.621103	0.0527864	11.77	3.83e-26 ***
Mean dependent var	3156.184	S.D. dependent var	8946.927	
Sum squared resid	1.32e+10	S.E. of regression	6941.293	
LSDV R-squared	0.421320	Within R-squared	0.335671	
LSDV F(11, 274)	18.13557	P-value(F)	5.24e-27	
Log-likelihood	-2929.426	Akaike criterion	5882.853	
Schwarz criterion	5926.725	Hannan-Quinn	5900.438	
rho	0.014957	Durbin-Watson	1.889827	
Joint test on named regressors -				
Test statistic: F(1, 274) = 138.446				
with p-value = P(F(1, 274) > 138.446) = 3.82932e-26				
Test for differing group intercepts -				
Null hypothesis: The groups have a common intercept				
Test statistic: F(10, 274) = 1.64772				
with p-value = P(F(10, 274) > 1.64772) = 0.0931717				

After the retest, we can see from Table 3 that the value of "d\_fdistock\_1" has increased. With an increase in FDI by USD 1 million, we can expect exports to increase by an average of USD 0.621103 million. The determination coefficient is approximately 33 %. Durbin-Watson statistics did not show the occurrence of autocorrelation. Thus, it has been shown that FDI, taking into account the year needed to adapt to a given economy and to start the production, has a more significant impact on the export of the economy in the host country.

## 4 Conclusion

Each country seeks to promote exports, and one of the main tools of pro-export policy is to support the inflow of foreign direct investment. FDI can help channel foreign capital to sectors that have the potential to compete internationally, while the global ties of multinational companies can facilitate their access to foreign markets. In addition to direct support, there is also indirect support for exports through new strategies, procedures and distribution channels. Our observations document the fact that significant investments have been made in Central and Eastern Europe in recent years. The inflow of foreign direct investment also played an important role in terms of the economic transformation of the countries of Central and Eastern Europe (CEE)<sup>4</sup> in the early 1990s. The subsequent integration process, which the CEE countries completed in three waves, opened up the EU market and brought new export

<sup>4</sup> CEE countries that are members of the EU: Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Lithuania, Latvia, Poland, Romania, Slovak Republic, Slovenia.

opportunities, which was also reflected in the dynamics of export growth, with the V4 countries at the forefront.

Although foreign direct investment in terms of data is not a variable that can be easily estimated, according to our panel regression, there is a significant, statistically significant dependence of foreign direct investment in Central and Eastern Europe on the export of goods and services of these countries. In our observations, we conclude that the most intense measured relationship between foreign direct investment and exports is when we take into account the delay in FDI effects. In the case of a one-year shift, we found that with an increase in FDI of USD 1 million, we can expect exports in CEE countries to increase by an average of USD 0.621103 million, based on the results of measured values. Our analysis thus showed that the aforementioned investments during the observed period 1993 - 2020 helped to increase the export of goods and services in selected countries of Central and Eastern Europe.

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# Investigation of Procrastination Prevalence among Employees in Small and Medium Enterprises in Slovakia

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**Abstract.** As in other developed countries, small and medium-sized enterprises in Slovakia are the most widespread type of business. In this context, leadership is key to the sustainable management and support of employees, and especially those employees who are more prone to negative work habits, such as procrastination in the performance of work tasks. The paper focuses on how work procrastination is a negative behavior linked to unpleasant cognitive experiences that causes significant losses in both individual and organizational growth. Those findings are then put in connection with the understanding the causes of employees' work procrastination helps to reduce the frequency with which it occurs. Our assumptions are supported by research which was carried out by CAWI – computer assisted web interviewing. Slovak office workers in SMEs were taken as sample and the questionnaire were administered to capture the data. This quantitative approach added to our understanding of work procrastination and provided practical suggestions for avoiding its negative impacts. The main findings presented in this article show a significant frequency of online procrastination in the areas of Instant messaging and social media surfing during working hours in terms of office workers in small and medium enterprises. According to the data online procrastination also appears to be frequent regarding the daily reading of online news during working hours.

**Keywords:** procrastination, cyberslacking, small and medium enterprises

**JEL classification:** M12, M21, L20

## 1 Introduction

Small and medium-sized enterprises are the driving force of the European economy, as they contribute to job creation and economic growth and ensure social stability. From a quantitative point of view, the term small and medium-sized enterprise covers all sectors if it does not exceed a certain size. Since words suggesting size are used to name small and medium businesses, economists choose to categorize them based on

quantitative measurable indicators. The number of employees is the most frequent criterion used to distinguish between businesses (Hatten, 2011). As in any other type of business, in SMEs the key to dynamism are people. It requires their engagement, activity and a specific leadership which is fueled by creative work, flexibility, and effective time management. However, according to various research data procrastination as the opposite of effective time management is dominant not only in the academic, but also in a professional field. Therefore, we can conclude that procrastination is specific in individual areas of life and should be approached in this way (Klingsieck, 2013). Procrastination is sometimes also referred to as the disease of the era, with a prevalence rate of 20–25 percent in the general population. Office workers postpone for roughly 1.3 hours each day, which is likely an underestimate (D'Abate and Eddy, 2007). Workplace procrastination refers to the deliberate postponing of work activities that must be completed, which has far-reaching consequences for employees' lives and organizational development. Exploring the causes of work procrastination behavior is critical since it provides theoretical insights and practical advice on how to effectively avoid these issues (Bolden and Fillauer, 2019).

Therefore, the main goal of this article is to provide an insight to the frequency of online procrastination regarding office workers in small and medium enterprises, which especially important for managers who should choose the most specific tools in the fight against pro-procrastination behavior, focusing on the specifics of procrastinators.

## 2 Literature review

Procrastination affects basically all professions and therefore the mentioned types of procrastinators can be found in all social groups. Based on the research data, we can conclude that there is no significant difference between the procrastination behavior of men and women, and the types of procrastinators apply to both genders. On the other hand, if we focus on age, older age groups are less prone to procrastination than younger age groups (Gupta, 2012). Chu and Choi (2005) introduced the terms “active and passive procrastination” from the following perspective.

- **Active procrastinators** postpone their responsibilities deliberately, thus applying the subsequent strong motivation under time pressure, when they can complete tasks just before the deadlines and achieve satisfactory results.
- **Passive procrastinators** are traditional procrastinators who postpone their tasks until the last minute with feelings of guilt and depression, making them more likely to fail to complete the tasks.

In this context, according to their theory, active procrastinators differ from passive procrastinators in the cognitive, affective, and behavioral dimensions. The suggestion of differences between them was supported by findings in several studies. Based on them, it was found that passive and active procrastinators differ from each other in:

- their relationship to the goal they are avoiding;

- in terms of time efficiency and perceived time control;
- self-efficacy rates;
- average overall benefit;
- levels of stress and depression;

The level of self-regulation skills, including - elaboration, organization, critical thinking, task value, testing anxiety, time management and effort control is very important (Chu and Choi, 2005).

However, procrastination is nowadays also caused by modern phenomena, such as the digital overload of employees, the so-called digital distraction or technostress. **Technostress** is a psychophysiological condition characterized by high levels of stress-sensitive hormones as well as cognitive symptoms such as poor concentration, irritability, and memory impairment. There is evidence that information overload from the use of mobile phones and other devices can increase negative emotions such as anger and anxiety (Torre et al., 2020).

**Digital distraction**, or disturbance is related to today's modern, digital age which is also influential at the workplace. Options such as home-office, i.e., work from home are gaining in popularity. Today, most organizations are transforming into an organization that has all the digital conveniences at its disposal. They are undergoing a massive digital transformation to catch up with the rapidly changing and technologically interconnected world. According to the Information Overload Research Group, a quarter of our business day will be lost due to online information overload. However, it takes up to 23 minutes and 15 seconds to return to the original task we are doing. Distraction, which occurs because of a single message on Facebook or reading a short blog article, is therefore not only the time spent on it, but also the time that is wasted after the act. These distractions derail the mind for a long time, which damages productivity. Every time you switch the focus from one thing to another, there are certain costs, called "change costs". According to neuroscientists from the University of California, the constant bombardment by electronic stimuli is forcing our brains to work extra. Digital overload causes the brain to remain in an unfocused hyper stage even when we are not near the device. It leads to stress and affects our lives (Priyanshi et al., 2017).

Procrastination as a prevalent behavior at work is influenced by the very characteristics of the job and the personality of the employee, and procrastination can also affect mood and performance. In addition, high levels of stress and boredom are associated with increased procrastination at work and are also associated with reduced work exposure. More than 95% of procrastinators want to get rid of this harmful behavior at work. Given the high costs and negative effects of procrastination, understanding this behavior will help us face it in the work environment (Metin, 2016). Available studies suggest that procrastination is the predominant behavior at work, influenced by personality factors such as high neuroticism and low conscientiousness, and situational factors such as limited role relevance, limited autonomy, and non-constructive feedback. In addition, it is associated with high levels of stress and boredom, reduced workload, and performance (Metin, 2018).

Procrastination in the workplace is characterized by two dimensions, namely soldiering and cyberslacking:



1. Soldiering is a type of procrastination in the workplace that hinders work-related activities by prioritizing non-work tasks without any harmful intent. Long coffee breaks, avoidance of planning and vigilant dreaming of employees during working hours are common examples of soldiering. However, with the advent of the use of mobile technologies, a new way of procrastination in the workplace has also emerged.
2. Cyberslacking is the use of the Internet or mobile devices for personal purposes during working hours. Although the Internet often allows employees to perform their work faster and more securely than before, it also makes it easier for them to use the Internet for personal purposes, leading to high financial costs associated with shorter time spent working. Cyberslacking is difficult to observe, and measure compared to soldiering, as employees may appear to be working (sitting in an office and looking at a computer screen), when they are actually busy with non-work activities (e.g., using instant messaging tools for personal communication), or checking social networks and websites (Vitak, 2011).

Workplace cyberslacking can be minor and only take a few minutes (e.g., checking and handling personal e-mails and shopping online), or it can involve much more time (e.g., playing games of chance, watching movies, and constantly chatting on social networking platforms), which can significantly reduce employee productivity. According to research, the rate of cyberslacking in the workplace is about 60-80%, which leads to about 30-40% decline in productivity. Previous research has examined the factors that cause cyberslacking in the workplace, including poor organization and information overload. Similarly, the negative effects of cyberslacking in the workplace, such as wasted time, lost productivity, distraction from work-related activities, breaches of organizational standards and culture, and threats to the security of e-mail systems and networks, were examined (Nusrat, 2021).

From a managerial point of view, however, it is important to perceive a certain paradox that has arisen. Digital tools in the workplace, such as e-mail, instant messaging, and collaboration software, have accelerated the pace of work communication, but they also pose significant barriers to work. A recent survey of 3,750 employees by Workfront, a work management software company, found that employees are interrupted by an average of almost 14 times a day by email, instant messaging, and other digital distractions. Another survey from Adobe found that the average employee in a U.S. office spends more than three hours each day trying to keep up with a work email. And an analysis of data from 50,000 employees collected by Rescue Time, a Seattle-based company that monitors digital activities, shows that the average employee checks their communication devices on average every six minutes (Maurer, 2019).

### **3 Methodology**

The presented study was conducted on employees, specifically office workers, in small and medium enterprises in Slovakia. As a survey method, we used an online method of questionnaire data collection CAWI - computer assisted web interviewing. The aim of the questionnaire was to find out the prevalence of cyberslacking (online procrastination) and soldiering (offline procrastination) among employees in small and medium enterprises during the working hours. An electronic questionnaire was sent to 112 employees. The sample of respondents included 68 women and 44 men between the age of 20 and 60. The freely available Google Forms application for the distribution and processing of questionnaire answers was used for the analysis of the results, the computer program and Excel was used to create graphic presentations.

The procrastination of respondents in the work environment was measured using a 12-item standardized work procrastination scale (PAWS; Metin et al., 2016). The original English version of the questionnaire was translated into Slovak language by the back translation method. This method is also called reverse translation and covers the process of re-translating content from the target language back to its source language in literal terms and compared with the original. The Procrastination at work scale (PAWS) consists of two dimensions, namely soldiering (deliberately slowing down the job so that the employee avoids all day work, e.g., longer coffee breaks) and cyberslacking (using the Internet or mobile devices for personal purposes during working hours). The dimension of soldiering is evaluated by 8 items in the scale of work procrastination as "I take a long coffee break at work". The cyberslacking dimension is measured by 3 items, such as "I do online shopping during business hours". Since the aim is to investigate the cyberslacking (online procrastination) we further present the data related to those items.

According to these methodologies the stated research question is – What is the prevalence of online procrastination regarding the office workers in small and medium enterprises in Slovakia and what kind of tools does the literature offer to managers to minimize the prevalence of online procrastination and procrastination at work in general.

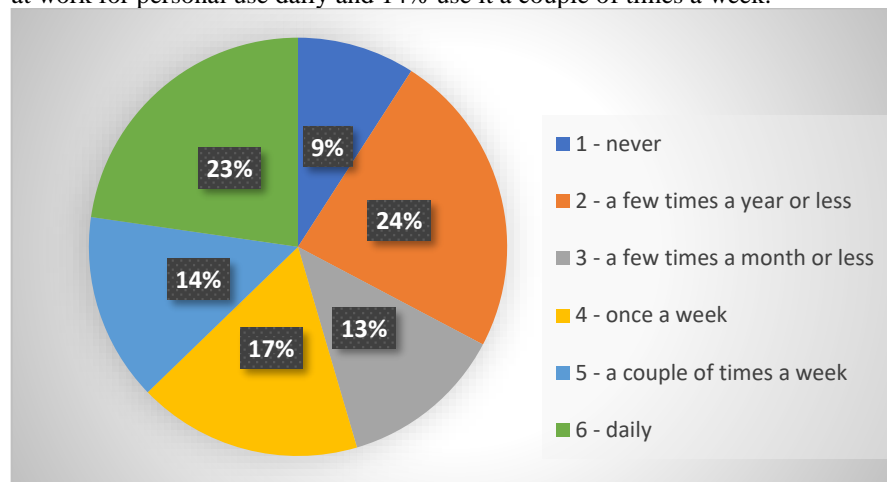
### **4 Results and discussion**

Cyberslacking is an online off-task behavior that includes things like reading blogs for personal enjoyment. It became popular as technology became more widely used at work. Because cyberslacking can appear to be work—employees need only sit in front of a computer and click a mouse—more it's difficult to quantify than soldiering. The Internet has improved corporate efficiency by enhancing employee productivity, reducing time and space constraints in doing business, and enabling better consumer interactions. However, there is a downside to using the Internet. In today's office, surfing the web during work hours, exchanging instant messaging, and spending time on non-job-related activities are all commonplace. Employees squander time and are

less engaged in their work because of cyberslacking, which reduces productivity (Malachowski, 2005).

Our goal is to provide a more complete and balanced view of procrastination by including conceptualizations from extant literature that highlight negative aspects of online procrastination and data gain from quantitative research. Therefore, we present the data regarding questions which are related to the online procrastination.

During the data analysis a significant frequency of Instant messaging during working hours was noticed (Fig.1). 23% of employees in SMEs stated that use Instant Messaging at work for personal use daily and 14% use it a couple of times a week.



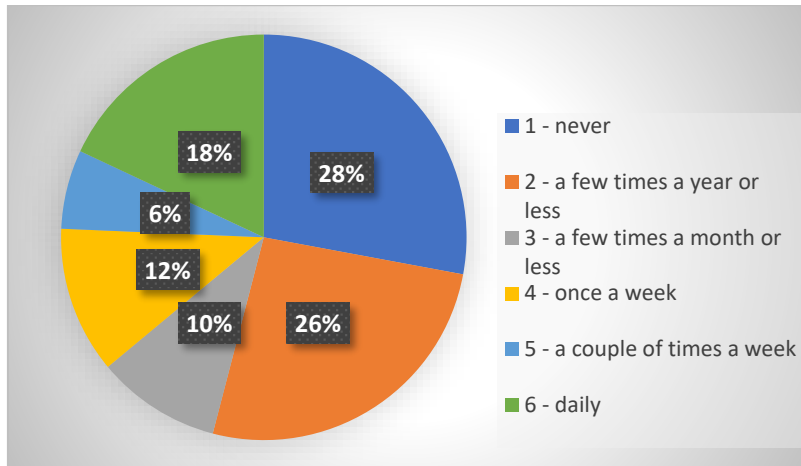
Source: (Own research, 2022).

**Fig. 1.** The prevalence of Instant Messaging at work

These results can be compared with One of the rare studies on cyberslacking where according to Garrett and Danziger (2008b), 80% of the employees in their sample admitted to engaging in at least one of the two cyberslacking activities (sending personal emails or texts and surfing the internet for purposes unrelated to work).

Moreover, a recent study on cellphones found that 85.04% more time was spent on non-work-related activities on phones than on work-related activities during all hours. The study employed log data gathered from 18 subjects over the course of 72 hours. Only during office hours, however, was the proportion of work-related activities 38.16% higher than that of non-work-related activities. Although they were utilized for work, most smartphone use during work hours was comparable to cyberslacking. Consequently, it was impossible to draw the conclusion that smartphone use was primarily for one reason (Youngchan, 2019).

Regarding the use of social network sites as Facebook, Instagram, and Twitter, 18% of respondents stated that they use them daily. Another 6% of employees in SMEs use it a couple of times a week (Fig. 2).

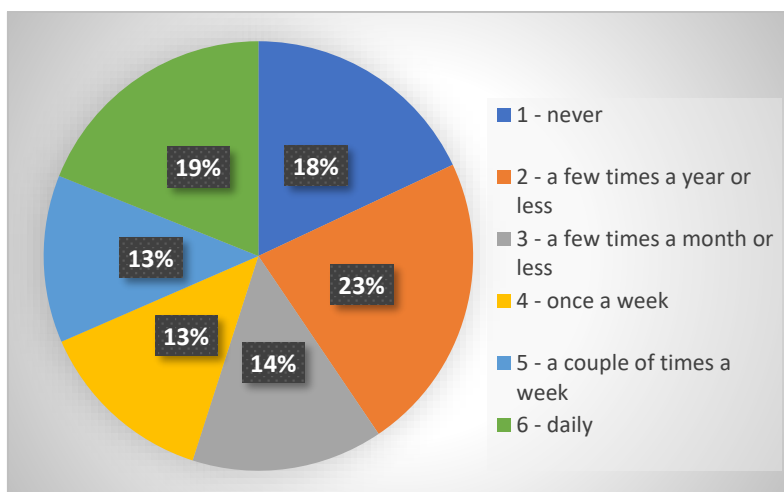


Source: (Own research, 2022).

**Fig. 2.** The prevalence of social network site using at work - (own research, 2022).

Another form of online procrastination at work is reading news online which also appears to be frequent. 19% of respondent stated that they read news online a daily basis. Another 13% stated that they read online news a couple of times a week.

This habit can be explained by the term “escapism”, which is explained by M. Griffiths (2000) as a behavior, which can occur when a person uses social media to escape from anxiety, despair, and other difficulties in real life. Such escape can occasionally be linked to procrastination. Some people tend to put off or postpone dealing with problems like money, loneliness, or anxiety by posing as an alternative, frequently fictitious, environment online (Warmelink, et. al., 2009).



Source: (Own research, 2022).

**Fig. 3.** The prevalence of reading news online at work - (own research, 2022).

The use of the Internet for personal purposes at work cannot be viewed as an a priori bad occurrence that results in financial losses for the employer, a loss of productivity, a security concern, or even legal ramifications. Another point of view suggests that minimizing anxiety when working on a computer is a type of stress relief, or that using a business phone for personal purposes is an advantage. Many firms, on the other hand, lack clear policies regarding internet access and e-mail usage. Employee views are thus used to determine what constitutes acceptable and undesirable use of the Internet for personal purposes, as well as realistic utilization rates.

By analyzing this prevalence, we agree, that as a prevention against online procrastination at work, recommendations stated by Breck (2000) should be followed. We assume, that those including for example - examining the things that need to be done, evaluating the rationality of the excuses, encouraging oneself, creating a to-do list, deciding on priorities, breaking the task into manageable pieces, managing time, displaying a positive attitude, organizing the work environment, coping with stress, starting work, rewarding oneself when small goals are achieved, reflecting on the completed work, and celebrating the task's completion can be used as tools for managers to minimize and eliminate the procrastination at work. Therefore, they should serve as main pillars in further research in this topic.

Employees and companies both benefit from understanding and improving procrastination at work. In reality, the current findings provide a tool and some evidence for the use of this metric in the Slovak context. Managers and employees may find it useful to measure the amount of procrastination at work for themselves. The findings of this study imply that two aspects of procrastination at work are distinct.

Managers can utilize Procrastination at work scale - PAWS to assess and understand their employees' procrastination at work, allowing them to more effectively target specific aspects of the employee's work design and task progress that need to be followed up on and improved (Prem et al., 2018).

Employees that use this assessment tool may be able to better manage their time at work and create a work schedule. Employees who are cyberslacking, for example, should consider shutting off their cell phones or disconnecting their desktops from the Internet during work hours. There were various limitations in this study. Because of the small sample size, future research will need to replicate these findings in bigger groups to ensure generalization of the results.

## **5 Conclusion**

According to the overall results it can be stated that leaders, managers, and executives should, in particular, pay comprehensive attention to the implementation of their own standards of conduct, provide employees with effective supervision and establish formal organizational platforms or reliable channels to mediate employee requests or complaints to increase their motivation. In addition, interpersonal care should be promoted in the workplace in exchange for the gratitude and trust of employees. This will increase their pro-organizational motivation, dedication, and

willingness to fulfill their responsibilities and eliminate undesirable pro-procrastination behavior.

In conclusion, it is important to note that the research sample may not be applicable to the majority of SME employees in Slovakia. Despite this, we believe that the respondents were able to answer the questions sufficiently and the information obtained from the presented survey should be used as a basis for further investigation of the online cyberslacking frequency and procrastination behavior of employees in small and medium-sized enterprises in Slovakia and abroad. Further research should focus on the stated recommendations how to eliminate this negative behavior at workplace and what kind of company policy works the best in terms of small and medium enterprises in Slovakia.

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# The Risk of Investing in the Construction of a Recreational Facility during a Pandemic

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**Abstract.** The potential success of the hotel business in Slovakia has been associated with a relatively high degree of uncertainty over the last two years. Slovak Government Guideline No. 4/DzPaÚ/2019/MÚ on recreation allowances introduced an obligation for larger employers to reimburse employees for part of their recreation expenses from 2019, creating increased demand for Slovak recreational facilities. On the other hand, the same government, through various restrictions issued in connection with the COVID-19 pandemic, has caused recreational operators problems during this period, not infrequently even existential ones. In this situation, investment in the construction of new hotel-type leisure facilities is burdened by the impact of various factors in the external business environment. The present paper is devoted to the estimation of the risks associated with the construction of hotel-type recreational facilities in the conditions of the ongoing COVID-19 pandemic in Slovakia. The present estimation is performed using the Analytic Hierarchy Process (AHP) method implemented under the assumption of three possible scenarios of development of the external economic environment in the period of the pandemic. Relevant pairwise comparisons forming the input to the AHP method for each alternative are the result of expert assessment of the impact of selected factors.

**Keywords:** risk, pandemic, investment, recreational facility, AHP method

**JEL classification:** D810, Z32

## 1 Introduction

The hotel industry is now characterized as an essential part of tourism services. It is an entity that we can offer in the market, which can satisfy the needs of customers, their



wishes or demands [1] [2]. A hotel product can be food, accommodation and ancillary services as a complex and we call it a service package. It should meet several requirements such as attractiveness, image, accessibility, price, satisfying customer (guest) needs, etc. [3].

Tourism is an industry that, as we know it today, began to take shape in the late 19th and early 20th centuries. Tourism began in the period of the first industrial revolution and today tourism is interdisciplinary. It is an industry providing products and services to customers who spend time away from their place of residence. The industry is divided into three groups namely accommodation services, food services and other tourism [4] [5].

It is generally known that Slovakia offers beautiful nature, geographical location, various historical monuments and cultural heritage for tourism development, but it does not use these resources enough [6].

From the development of foreign tourism we get negative information such as low share of tourists from Western European countries, higher share of low solvent tourists who have low average expenses, higher share of tourists from former socialist countries, etc. [7]. Other problems and shortcomings of the hotel industry in Slovakia are unconnected and incomplete services, improper infrastructure (transport, etc.), unqualified staff in services, low level of knowledge of foreign languages, low level of services that do not correspond to the level of prices, lack of information or promotion, the relationship between staff and hotel guests, cleanliness or hygiene [8].

The hotel investment is treated as a cost item of the investment property. Its payback period is generally very long term, which is approximately 12-15 years. Nowadays, in some locations even 15-18 years must be taken into account. It mainly depends on what type of investment we have used, what is the location of the hotel, what are the financing parameters, etc. [9]. If it is a qualified investment, we can generally take it as a relatively safe investment based on the overall view, with the hotel market being taken as stable in the long run [10].

If we look at the period of the last economic crisis, the volume of investments in hotels in Europe between 2006 and 2007 was at a record high (about 19 billion Euros), but in 2008 the values dropped significantly [11]. Furthermore, due to the recession of European economies, or the decline in RevPAR (Revenue per Available Room), as well as the suspension of bank loans, the volume of realized investments in hotels in 2009 dropped significantly by up to 50%, which amounted to about EUR 3 billion. This implies a decrease of 85% compared to 2007 [12]. The economic crisis has had a significant impact on the hotel industry, tourism and also hotel investments. We have to note that in our neighbours (Austria, Hungary) the economic crisis had a more significant impact on classic city hotels than on hotels providing wellness& spa (an increase of wellness hotels even during the economic crisis was registered by 3 to 9%) [13].

When planning new hotels or accommodation facilities, in addition to monitoring the growth of rooms in the selected location, we must also take into account the development of the number of guests staying in the hotel. In order for hotel investments to take off in the market and to provide good conditions for guests, it is important that

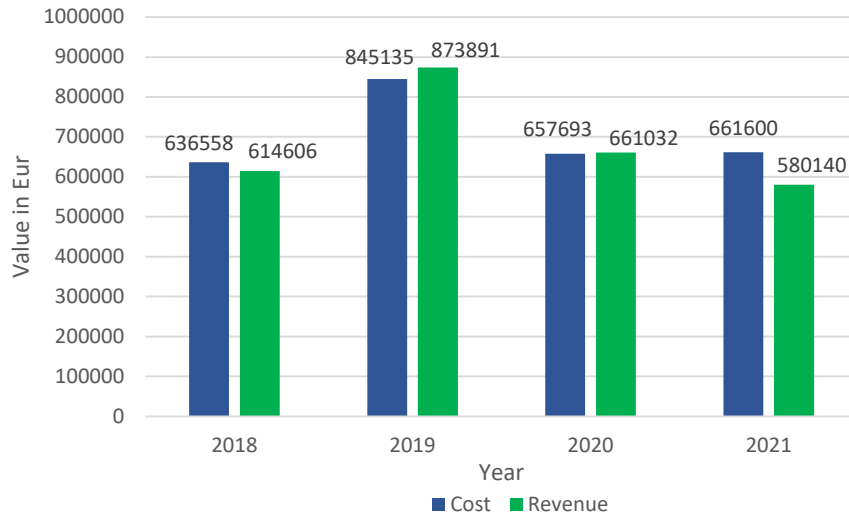
the number of guests with their accommodation grows faster than the number of new accommodation facilities opened [14] [15].

## **2 Aim and Methodology**

On the example of a specific investment project of building a hotel-type recreational facility located in a lucrative recreational location in eastern Slovakia, we will show the possibility of practical implementation of the AHP method oriented to investment risk estimation [16]. The economic evaluation of the investment activities of the company in connection with the project of building an apartment house is based on the situational analysis, which was developed in connection with the implementation of the project of the completion of the building. The present analysis is the basis for supporting the investor's decision-making to decide on the further course of the construction. A description of all parts of the above-mentioned situational analysis would exceed the scope of this paper by an order of magnitude. Moreover, the disclosure of sensitive economic data could have a negative impact not only on the apartment building, but on the entire hotel complex. We will only show the development of costs and revenues over the last four years (see Fig.1.). The figure shows that the COVID-19 pandemic has an impact on the hotel complex's business operations, where the costs and revenues from 2020 and 2021 were close to the situation in 2018. During the pandemic, the government adopted a package regarding allowances to support the tourism business. The allowances relate to support for investment activities and non-investment activities. The hotel took advantage of this assistance for entrepreneurs and submitted an application. For the year 2021, it received the following allowances:

- for wages 71 366, - EUR,
- for rent 3 450,- Eur,
- on a decrease in sales of 64 935,- Eur.

In the following, we briefly describe the basic inputs needed to implement the AHP method. In this context, we will recapitulate some of the input data.



**Fig. 1.** Development of costs and revenues.

The project is financially about halfway through its implementation. Some of the building modifications have not been completed and the internal equipment has not been purchased or installed. If the project were to stop completely, no revenue could be expected and the cost of preserving the existing condition would be minimal. In addition to the principal, the cost of the funds already spent in connection with the construction would consist of interest on the bank loan plus transaction costs in connection with the negotiation of the extension of the maturity period. The present situation would have a negative impact on the adjusted net investment value as well as on the future value.

If the project were to proceed at the planned pace without any restrictions, the apartment building could be ready to provide services from the beginning of Q3 2022. In the event of a positive development in Q3 and Q4 2022, it would be possible to assume (given the expected increase in demand) almost 100% utilisation of the entire facility in the second half of 2022. In such a case, the revenues would substantially exceed the expected costs. The return on investment and other parameters of the economic evaluation of the investor's investment activities would likely exceed the investor's expectations forecasted before the project commenced. Both the adjusted net present value of the investment and the future value would show a positive increase.

In the event of negative developments (another wave of pandemic, government-mandated lockdown, insufficient and late support from the state), minimal returns can be expected and thus costs will play an important role in the economic evaluation of the investment. If the former is considered an optimistic state of development, the latter is clearly pessimistic. The economic value of the investment in question is obviously heavily dependent on a combination of what scenario is actually realised and what measures are taken by the investor. As a multi-criteria decision-making method

applicable to support the investor's decision-making in the project of apartment building completion, we used the AHP method described in the previous part of the thesis. We developed this method for three possible development scenarios:

1. Optimistic scenario.
2. Average scenario.
3. Pessimistic scenario.

We have identified the following as possible alternatives to the investor's decision:

*Alternative 1 - Full Operation* - This alternative contemplates the continuation of construction without any restrictions. In this alternative, there is no problem to meet all the deadlines related to the bank loan. This alternative and timing means that the entire apartment building will be fully available for hotel guests throughout the 2022 mid-year period.

*Alternative 2 - 3/4 Funding* - Represents the completion of the building, landscaping the surrounding area with the understanding that the construction time on the second floor would be made inaccessible to customers. The "streamlining" given would represent a savings of approximately 1/8 of the total expected project cost. In the architect's opinion, the solution in question would pass the approval process without any problems. The accommodation capacity would be reduced by less than 1/4 in terms of square metres of accommodation area, but more than 1/4 in terms of rooms.

*Alternative 3 - 1/2 Funding* - Represents making only the ground floor of the structure available to customers. Capacity-wise, this represents 1/2 of the building in terms of square footage; in terms of rooms, it is less than 1/2 of the rooms originally designed. Financially, this would represent an additional investment of approximately 1/4 of the total amount.

*Alternative 4 - 1/4 Funding* - Represents the opening up of two ground floor apartment rooms. These rooms have direct individual access from the beach and therefore the original entrance would not need to be addressed with this option. Financially this represents a saving of 3/8 of the total project.

*Alternative 5 - Stop Funding* - In this option we consider stopping funding altogether, which represents a saving of 1/2 of the total expected cost. Under this option, preservation work would take place, construction would be completely halted, and the apartment building would not be available to guests during the entire summer and winter 2022 season.

AHP's multi-criteria decision-making method is based on predetermined criteria to select the most appropriate alternative. Due to the nature of the decision problem being addressed, we adopted cost, revenue, investment value and customer loyalty as the basic criteria.

Each of these criteria consists of three sub-criteria, which use a weighting system to determine in more detail the selection of a suitable alternative. These sub-criteria are as follows:

- *Costs* - investment, operating, other costs.
- *Revenues* - sales, subsidies, other revenues.
- *Investment value* - net investment value, adjusted net investment value, future investment value.

- *Customer loyalty* - long-term stays (loyalty of customers preferring long-term stays in the past), weekend stays (loyalty of customers preferring weekend stays in the past), business stays (loyalty of organisers of conferences, corporate events, etc.).

The forecasting of the first three criteria was derived directly from the books of the hotel next door. Similarly, the last criterion "customer loyalty" was based on the experience of the hotel. During the previous periods, it has been shown that different government interventions can only affect certain types of customers. For example, long-term stays tied more to sports and wellness activities may be restricted (if wellness is banned), while customers who visit the hotel on business may enjoy it to the full.

The specific quantification of individual indicators for all combinations, development scenarios and alternatives in terms of all sub-criteria would exceed the scope of this paper by an order of magnitude. The above mentioned data formed the basis of the expert assessment, which the team of experts (consisting of the hotel owner, the construction contractor and the architect) developed as a basis for the implementation of the AHP method in deciding on the future fate of the apartment building. Pairwise comparisons were made between the four criteria, but assuming a negative development (pessimistic scenario), a positive development (optimistic scenario) and between these two developments (average scenario). All results are outputs from the XLSTAT statistical software.

### 3 Results

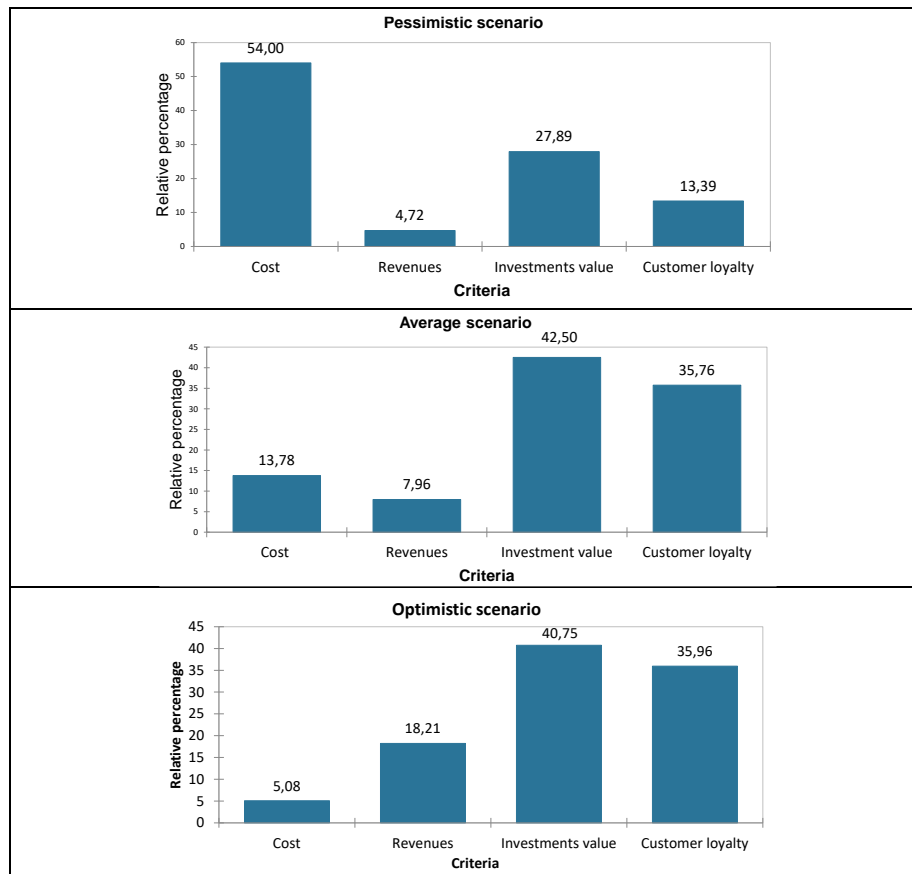
Based on the examination of the current state of the hotel industry in Slovakia, we have identified above a number of problems and shortcomings that hinder the development of this sector.

These problems can be solved as follows:

- Legislative measures from the government - creation of new laws, support related to tourism development, establishment of tourism management bodies, etc.
- making prices for services available,
- developing agro-tourism and making tourism services more attractive,
- the use of support programmes for the development of tourism and the hotel industry, e.g. from foreign funds,
- capitalizing on franchising in the hotel industry,
- creating a good image,
- investment of funds in advertising, effective promotion of Slovakia abroad, especially to emphasize the strengths such as nature, monuments, folklore, etc.

In this paper we present the results of the AHP method comprehensively (see Fig. 2), based on all assessments for all three development scenarios.

Fig. 2. Individual scenarios.



The figure shows the percentage impact of each criterion for all three scenarios based on the evaluation of all previous weights. It is clear from the figure that the most important criterion in the pessimistic scenario is cost. In the average scenario, it is the value of the investment, closely followed by customer loyalty. And it turns out that this situation is maintained even in the optimistic scenario.

The second most important is the value of the business (investment). The criterion with the lowest weighting is revenue. The obtained results can be interpreted by the weight of the estimation of each criterion. The net investment value, the adjusted investment value as well as the future value are of great importance. They lose it only if the investment produces almost no returns.

The result of the evaluation of the AHP method for each scenario is a matrix (see Table 1, 2 and 3). This is an overall evaluation of the individual weights. The rows of the matrix represent the individual criteria and sub-criteria and the columns of the matrix represent the individual alternatives - the options depending on the investor's decision. The last row presents the column sum of the individual weights. The column with the highest numerical value represents the recommended decision for a given estimate of each parameter. In the pessimistic scenario, according to the AHP method

and the estimation of the weights made by the expert group, the best option is to stop financing the project (Table 1).

**Table 1.** Pessimistic scenario.

Crit./Alt.	Full range	3/4 funding	1/2 funding	1/4 funding	suspension of funding
Cost	2,42	4,49	7,96	13,60	25,53
Investment	1,09	2,76	5,36	9,73	20,42
Operational	0,14	0,23	0,44	0,82	1,33
Other costs	1,19	1,50	2,16	3,05	3,77
Revenue	0,71	0,58	0,66	0,98	1,78
Revenue	0,10	0,21	0,42	0,82	1,67
Subsidies	0,53	0,30	0,17	0,10	0,05
Other income	0,08	0,07	0,07	0,06	0,05
Value of the investment	1,48	2,53	4,29	7,23	12,37
Net investment value NPV	1,17	1,94	3,17	5,17	8,49
Adjusted net present value of the CU	0,25	0,46	0,88	1,62	3,00
Future value	0,06	0,13	0,24	0,43	0,88
Customer loyalty	2,67	2,00	1,88	2,59	4,26
Long-term stays	0,28	0,55	1,09	2,12	4,09
Weekend stays	1,78	1,14	0,63	0,39	0,13
Business stays	0,60	0,31	0,16	0,08	0,04
	14,55	19,19	29,59	48,80	87,87

Even in the average scenario, as in the previous scenario, the AHP method recommends stopping funding (Table 2). In the optimistic scenario, the full scope of works option is clearly the most appropriate option for the continuation of the apartment building project (Table 3).

As a result of the overall assessment under all options, scenarios as well as from the perspective of all criteria, the recommended option based on the implementation of the AHP method is to stop financing the investment project (Table 4). This recommendation can be interpreted as a weighted assessment of the fact that the revenues from the operation of the apartment building are insufficient at the proposed prices of the accommodation facility as well as the expected customer spending in relation to the expected costs.

**Table 2.** Average scenario.

Crit./Alt.	Full range	3/4 funding	1/2 funding	1/4 funding	Suspension of funding
Cost	6,02	3,29	2,33	1,23	0,91
Investment	4,16	1,93	1,33	0,56	0,39
Operational	1,51	0,98	0,65	0,37	0,24
Other costs	0,35	0,38	0,34	0,30	0,28
Revenue	2,67	1,67	1,22	1,12	1,28
Revenue	2,09	1,08	0,59	0,39	0,25
Subsidies	0,05	0,10	0,19	0,34	0,68
Other income	0,53	0,50	0,44	0,39	0,35
Value of the investment	7,55	7,21	8,27	9,21	10,26
Net investment value NPV	5,32	4,81	5,49	6,09	6,56
Adjusted net present value of the CU	1,49	1,62	1,92	2,16	2,62
Future value	0,74	0,77	0,87	0,96	1,07
Customer loyalty	2,34	3,62	5,65	9,57	14,59
Long-term stays	0,90	1,60	3,03	5,67	10,12
Weekend stays	0,32	1,39	2,07	3,45	4,17
Business stays	1,11	0,63	0,55	0,45	0,29
	37,15	31,59	34,94	42,25	54,06

**Table 3.** Optimistic scenario.

Crit./Alt.	Full range	3/4 funding	1/2 funding	1/4 funding	Suspension of funding
Cost	2,19	1,29	0,75	0,48	0,36
Investment	1,70	0,97	0,52	0,28	0,16
Operational	0,47	0,30	0,19	0,12	0,06
Other costs	0,01	0,02	0,04	0,09	0,15
Revenue	7,91	3,85	2,54	1,95	1,97
Revenue	6,62	2,86	1,61	0,85	0,37
Subsidies	0,16	0,28	0,48	0,83	1,43
Other income	1,13	0,71	0,44	0,27	0,17
Value of the investment	20,39	10,63	5,50	2,78	1,44
Net investment value NPV	1,30	0,75	0,40	0,21	0,12
Adjusted net present value of the CU	5,05	2,61	1,35	0,68	0,35
Future value	14,04	7,27	3,75	1,89	0,97
Customer loyalty	17,38	9,55	5,08	2,64	1,31
Long-term stays	12,74	6,59	3,40	1,72	0,88
Weekend stays	3,74	2,39	1,33	0,70	0,32
Business stays	0,90	0,57	0,35	0,22	0,11
	95,73	50,64	27,75	15,72	10,16

**Table 4.** Overall assessment.

Crit./Alt.	Full range	3/4 funding	1/2 funding	1/4 funding	Suspension of funding
Cost	3,54	3,02	3,68	5,11	8,93
Investment	2,32	1,89	2,41	3,52	6,99
Operational	0,71	0,50	0,43	0,44	0,54
Other income	0,52	0,63	0,85	1,15	1,40
Revenue	3,76	2,03	1,47	1,35	1,67
Revenue	2,94	1,38	0,88	0,69	0,76
Subsidies	0,25	0,23	0,28	0,42	0,72
Other costs	0,58	0,43	0,31	0,24	0,19
Value of the investment	9,81	6,79	6,02	6,41	8,02
Net investment value NPV	2,60	2,50	3,02	3,82	5,06
Adjusted net present value of the CU	2,26	1,57	1,38	1,49	1,99
Future value	4,94	2,72	1,62	1,10	0,97
Customer loyalty	7,46	5,06	4,20	4,93	6,72
Long-term stays	4,64	2,92	2,51	3,17	5,03
Weekend stays	1,94	1,64	1,34	1,51	1,54
Business stays	0,87	0,50	0,35	0,25	0,15
	49,14	33,81	30,76	35,59	50,70

On the other hand, it should be noted that the column sum of the weights for the "stop financing" option is only 3% greater than the column sum representing the option of completing the project without any constraints. A subsequent sensitivity analysis of the method based on an insignificant increase in the price of accommodation might find a very different result for the AHP method, i.e. full implementation of the project, but also with only a small variation. The AHP method has shown that there are only two options in play. Either to complete the project fully or to stop funding altogether.

## 4 Conclusion

Until recently, tourism development has been growing globally, but also in Slovakia. Although tourism in Slovakia has had many shortcomings, it is an important part of the Slovak economy, providing many jobs. The extension by the Slovak Government of the employer's obligation to contribute to an employee's Slovak recreation has substantially improved conditions, especially for those enterprises providing hotel



services. This favourable situation has also translated into a certain investment optimism in the sector.

Using the specific case of a hotelier who, prior to the pandemic period, had invested a significant amount of funds in the construction of a new facility near his existing hotel, we have shown how the selected multi-criteria AHP method can be used to support his decision making on how to exit the investment project. The investment project in question is currently in the middle of its implementation and the hotelier in question is faced with the decision whether to stop the project, continue it without restrictions, or take some restrictive measures. However, the AHP multi-criteria decision making method needs input data to build the model, not all of which were available to the decision making team. The aforementioned decision-making team consisted of the investor (hotel owner), the developer and the architect who designed the building. The uncertainty of this team's decision-making was partly eliminated by constructing three scenarios which, in a way, projected the possibilities of future development both in terms of regional development and in terms of possible restrictive measures by the government.

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# The Financial Situation of Entrepreneurs in the Slovak Republic and their Application of Tax Relief for R&D

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**Abstract.** Since 2015, companies in Slovakia have had a very effective tool for financing innovation: deduction of research and development expenses. It is an indirect support for research and development, which is provided to the company through a tax credit for expenses incurred for research and development activities. The amount of supercomputing gradually increased during the first years. The year 2018 was a breakthrough in the application of supercomputing, as the rate increased to 100% compared to previous years, when entrepreneurs could claim only 25% of expenditure (costs) on research and development. Thanks to R&D, taxpayers can therefore apply a reduction in the tax base (tax relief) and a precisely defined amount in addition to their normal business activities, regardless of whether R&D activities are the core of their business or are only ancillary to their main business activities. These options apply to all tax entities investing in development activities, regardless of whether they are natural persons (entrepreneurs), small legal entities or large multinational corporations. The aim of this paper is to analyze the application of supercomputing to research and development by entrepreneurs in the context of the financial situation of companies in the Slovak Republic in 2018 using financial and statistical indicators.

**Keywords:** development, financial situation of entrepreneurs, research, tax relief, R&D

**JEL classification:** O30, F63, H25

## 1 Introduction

R&D support exists in different forms in the countries of the European Union. Innovation is clearly part of R&D. Innovation is a process that has gone through the whole technological cycle from the birth of the idea, its technological development and documentation to the necessary business practices to enter the market in the form of a product, service or technology (Slobodnyak, etc., 2020). The decisive objective and

objective of using different forms of indirect R&D support is to motivate the business sphere to carry out R&D more, including their financial support (Turečková, 2016). Companies' investments in R&D are one of the factors that stimulate economic growth and innovation performance of both companies and the state (MacGregor Pelikánová, 2019), both nationally and regionally (Majerová, 2018). Governments around the world use different types of R&D support tools (Turečková, Nevima, 2020). Support may take a direct or indirect form. Direct types of support include the provision of public financial assistance in the form of grants and subsidies. Indirect types of support for R&D, especially in the business environment, can be described as tax incentives in the form of an additional deduction of expenses incurred in the form of a tax credit, tax saving or preferential treatment for R&D companies. The benefits of R&D include royalties or revenues from the sale of research - related assets or patents and development, and resulting innovations can also affect the efficiency, efficiency and economy of the costs incurred with efficiency gains.

The purpose of financial analysis is to provide information to financial managers and analysts so that they can make thorough decisions about their business (Hasanaj, Kuqi, 2019). The analysis of financial reporting plays an important role in deciding on the resources needed to increase the efficiency of the enterprise and maximize profitability by increasing production with minimal labour and capital costs. To ensure the accuracy and transparency of reporting, it is important to carry out an analysis, including the main financial indicators. Based on the decision of the management of companies in financial and economic aspects, companies can prevent various risk situations (Sroka et. al., 2020). The financial analysis is of particular importance to external stakeholders as it is based on available financial statements, which are the main source of information for all who need to take decisions (Laitinen, 2018).

The contribution focuses on R&D in the Slovak Republic in 2018. Theoretical interpretations of R&D in legislative standards at transnational and national level are defined in the first part of the contribution. Theoretical background is important from the point of view of understanding R&D in the conditions of the Slovak Republic. In research, the processed data are collected and published by the Financial Administration of the Slovak Republic, which, under the leadership of the Ministry of Finance, oversees, among other things, compliance with generally binding legal regulations, EU regulations and international treaties that ensure the implementation of trade policy, customs policy, tax policy. It manages the collection of taxes, and its main mission is to effectively collect and manage customs duties and taxes to meet the revenue part of the state budget of the Slovak Republic and the budget of the European Union (EU), the protection of the economic interests of the state and the protection of the expenditure part of the state budget of the Slovak Republic (Financial Administration, 2022a).

The aim of the contribution is to analyze the application of the super deduction of R&D costs by entrepreneurs in the context of their financial situation in Slovakia for 2018 using a statistical evaluation of selected financial indicators of companies applying the super-deduction in 2018, namely revenues, profit before tax, after tax, super-deduction of R&D costs, income tax payable, ROA and ROE.)

## 1.1 Theory background

R&D plays an important role in economic growth (Blanco et al., 2020). Although government R&D subsidies prevail in several countries, which could presume market failures as they distort the market incentive mechanism and reduce the efficiency of the market mechanism (Chen & Yang, 2016), in some situations R&D subsidies may even reduce R&D investments due to the so-called extrusion effect (Acemoglu, etc., 2018). Government R&D subsidy should not only encourage businesses to increase investment in R&D, but also improve the efficiency of R&D of enterprises (Xiong, 2011). So far, however, there is still no consensus on the impact of government subsidies on R&D on business R&D efficiency (Wan-Shu Wu & Kai Zhao, 2021). Based on the documented results of private enterprises, it is confirmed that government subsidies for R&D can effectively increase investment in R&D, but do not have a significant impact on the efficiency of R&D of enterprises (Zheng, 2016). The government tends to support high productivity businesses. The efficiency of enterprises will improve significantly after receiving a R&D grant (Guo et. al., 2018). On the other hand, the authors Yan and Huang found through their research that government subsidies for R&D do not have a significant impact on the effectiveness of R&D of enterprises. However, they may aggravate the overcapacity of businesses. The inconsistency of existing research affects the possible complex relationship between the government's R&D grant and R&D efficiency, which is often influenced by multidimensional factors such as industry, entrepreneurship, the region and other key factors from different perspectives (Yan Huang, 2020).

Frascati's manual defines R&D as "*creative work done systematically to increase the pool of knowledge, including knowledge of man, culture and society, and to use this pool of knowledge to design new applications.*" (OECD Frascati Manual, 2015)

R&D is the generation of new knowledge. In a business context, it is an activity that companies undertake to develop new products, processes, or services or to improve those that already exist. Businesses often face risks in carrying out R&D. This is because there are uncertainties as to whether what they are trying to do is technologically feasible or, more often, they do not know how they will achieve their objectives in practical terms (ForrestBrown, 2019). There are two main types of research in R&D – basic research and applied research.

*1. Basic research is about acquiring knowledge and using it to build understanding and intelligence that a business can use to its advantage. This knowledge can be the basis for other R&D projects and can feed on strategic business decisions. It is often part of the scientific research activities of universities and research organizations. Less often it is carried out by business entities.*

*2. Applied research is much more defined and often seeks to achieve a specific goal. This could be the use of new technology, the achievement of a new market, improved safety, or cost reductions. Applied research is often what leads to the development phase. This type of research is carried out by business entities with the most.*

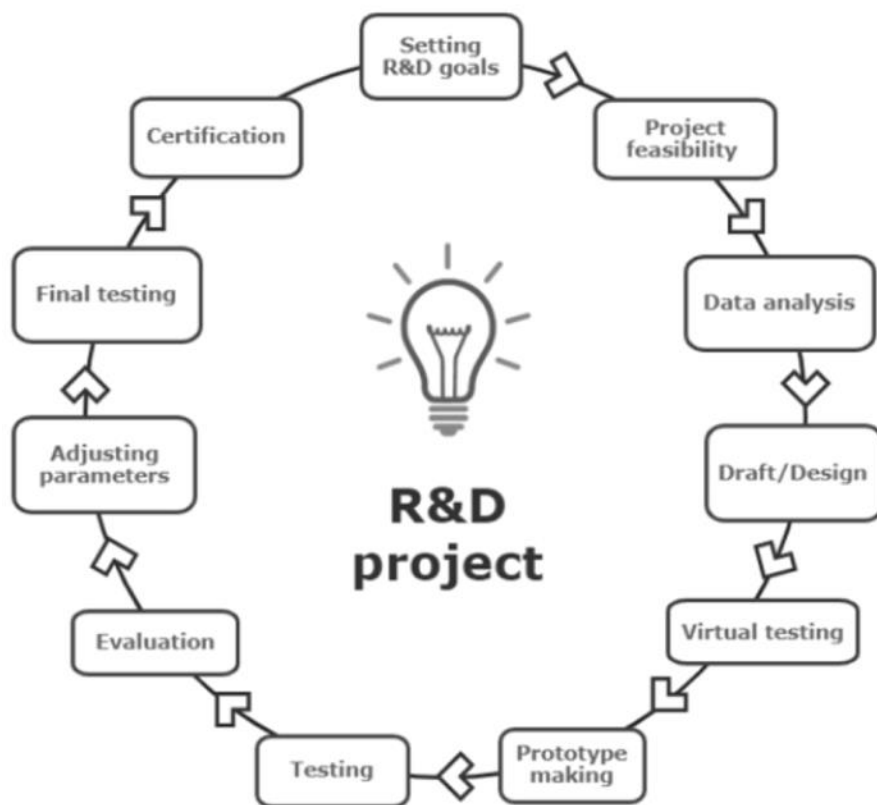
To motivate companies to invest more in R&D, create more jobs for professionals, as well as increase competitiveness, the Slovak Republic introduced a super-deduction as a tool to support R&D - a special tax regime allowing additional deduction of R&D

costs from the income tax base (Sario, 2021). Until 2015, companies in the Slovak Republic could benefit from support only in the form of subsidies or tax breaks. Since 2015, the conditions of the Slovak Republic apply a tax super-deduction of costs/expenses. The base rate for 2015-2017 was 25% of R&D expenditure(s). Since 01 January 2018, the deduction of R&D expenditure (costs) has increased from 25 % to 100 % of R&D expenditure(s) and the method of calculating the deduction of R&D expenditure has also changed (Financial Administration, 2018).

Super deduction for R&D in the Slovak Republic: (Sario, 2021)

- provides for the possibility of additional deduction of R&D - related costs.
- is automatically claimed in the tax return for the tax period.
- does not require any application and is not subject to approval by any authority.
- there are no sector restrictions.
- applies throughout the territory of the Slovak Republic, without any differences.

In the following Figure 1 we present the phases of the project/project cycle in the company that decides to implement research and development.



**Fig. 1.** R&D Project phases/Project cycle

All the above steps in Figure 1 are necessary to develop the R&D project that the company needs to develop to apply the super-deduction to R&D. The length of each stage depends on the type and form of research and development.

## 2 Data and Methodology

We draw all information about companies that apply super-deduction of R&D costs in the Slovak Republic in 2018 from the current lists published on the Financial Administration of the Slovak Republic (2022b). The Financial Administration of the Slovak Republic collects data on enterprises from completed and filed tax returns, in which companies indicate the number of projects, the objectives of individual projects and the amount of the super deduction they applied in the tax period. Table 1 presents statistics on the number of enterprises by legal form that have applied a super deduction in 2018, the financial indicators of which will be subject to further analysis.

**Table 1.** Overview of enterprises by legal form of business in 2018.

<b>Enterprises according to legal form</b>	<b>Total number of entities</b>	<b>Number of subjects analyzed</b>
Limited Liability Company	197	181
Joint Stock Company	49	43
Limited Partnership	3	3
Self-employed	14	0
Contributory organization	1	0
<b>Total</b>	<b>264</b>	<b>227</b>

Source: own processing

Our research contains data for the Slovak Republic for 2018, when complete data are available to us. Of the 264 companies, we have financial data for 246 companies from the official source of the Register of Financial Statements in Slovakia, which are obtained from the finstat.sk (2021) in the processed form of the dataset. The analysis shall be carried out on entities accounting in the double-entry accounting system which have a uniform form of financial statements and are corporate taxpayers. Financial data were not available for 18 entities – 14 self-employed persons, as they are not obliged to publish their financial statements in the register of financial statements, the data of 1 contributory organization, 1 limited liability company and 2 public limited companies were not disclosed. Of the 246 financial data disclosed, 10 entities must prepare IFRS financial statements that do not have a uniform structure; therefore, these entities will also be excluded from the following analysis. Since the super-deduction can only be used for a positive tax base, we have exempted from a more detailed analysis 5 entities with negative management results before tax and 4 entities with negative equity, which

implies an unfavorable financial situation and do not give meaningful results for the ratios used. After the filtering is indicated, 227 business units belong to the analyzed enterprise group (Table 1).

Before starting a more detailed examination of financial indicators, we subjected the dataset to a formal check, i.e., whether the balance sheet equation Assets = Equity + Liabilities applies in the analyzed financial statements and thus the financial data do not show signs of inaccuracies. All data from the analyzed dataset without signs of formal errors passed through this check.

In the following Table 2 we provide descriptive statistics of basic indicators for R&D enterprises in 2018. We will list sales, assets, and equity as the basic financial indicators of the group of enterprises examined. The arithmetic means and median in all three indicators show that half of the entities achieve above-average values of financial indicators, as the arithmetic mean is always significantly (several times) above the median.

**Table 2.** Descriptive statistics of the surveyed enterprises for the year 2018 (in EUR).

	<b>Sales</b>	<b>Property</b>	<b>Equity</b>
<b>Min</b>	0.00	11,424.00	7,425.00
<b>Max</b>	485,483,065.00	158,677,861.00	139,698,627.00
<b>Arithmetic mean</b>	15,648,851.36	9,966,003.89	4,876,224.86
<b>Median</b>	3,538,224.00	2,753,224.00	1,150,912.00

Source: own processing

The aim of the contribution is to analyze the application of the super-deduction by entrepreneurs in the context of the financial situation of companies applying the super-deduction for R&D in Slovakia for 2018 using statistical indicators. We use several financial and statistical indicators to assess the financial situation of companies, namely: Profit or loss before tax (EBT); Super-deduction of R&D costs, Income tax payable, Profit after tax; EBIT (Profit before tax and interest); Arithmetic mean of Assets; ROA – Return on Assets, ROE – Return on Equity.

From the ratio indicators we will use ROA and ROE. ROA is an indicator of how profitable a company is relative to its total assets. ROA gives a manager, investor, or analyst an idea as to how efficient a company's management is at using its assets to generate earnings. ROA is displayed as a percentage; the higher the ROA the better (Investopedia, 2021a). According to expert recommendations, the profitability of total assets should exceed the interest rate on long-term loans. The higher the value of the asset profitability indicator, the better.

$$ROA = \frac{\text{clear profit}}{\text{assets}} \times 100\%$$

The result can be interpreted: How many monetary units of net profit were generated by one monetary unit of total assets. From the point of view of the balance sheet



equation, this also applies in derived to the unit of total capital, total equity and liabilities.

The ROE is used to determine the yield of one equity unit. Return on Equity (ROE) is a measure of financial performance calculated by dividing net income by shareholders' equity. Because shareholders' equity is equal to a company's assets minus its debt, ROE is considered the return on net assets. ROE is considered a measure of the profitability of a corporation in relation to stockholders' equity (Investopedia, 2021b). The return on equity should be at least the interest rate of banks on deposits, since only in this case is it more advantageous to do business than to value free capital through interest-bearing deposits with a bank. ROE growth dynamics should be higher than roa growth dynamics.

$$\text{ROE} = \frac{\text{clear profit}}{\text{equity}} \times 100\%$$

The following hypotheses have been established for research purposes:

- 1) Hypothesis – If an entity has achieved a positive profit or loss, its tax due will be greater than zero for most enterprises. It can then be assumed that most businesses have managed to benefit from all the tax breaks and do not pass on part of the super-deduction for years to come.
- 2) Hypothesis – Most businesses value equity (ROE) at more than 10%, which is higher than the appreciation of deposits with banks in 2018.
- 3) Hypothesis - Most enterprises value total capital (ROA) at more than 10%.

In the next part of our contribution, we will use a statistical analysis of financial indicators of entities that apply tax super deduction of R&D costs in the Slovak Republic in 2018 through descriptive statistical indicators of the surveyed group of enterprises. We will then analyze the obtained values and present the results obtained by us in tables and graphs.

### **3 Analysis of the financial situation in companies applying the super-deduction for 2018**

Based on the available financial statements, we can calculate other financial indicators examined and subject them to statistical examination. For selected financial indicators, statistical indicators such as min, max, arithmetic mean, variation range, standard deviation, median, upper quartile, lower quartile, and interquartile deviation were selected. The statistical indicators of the financial indicators examined by us are shown in Table 3 and 4.

**Table 3.** Analysis of selected financial indicators in 2018.

	<b>Profit or loss before tax (in €)</b>	<b>Profit or loss after tax (in €)</b>	<b>Income tax payable (in €)</b>	<b>EBIT (in €)</b>
<b>MIN</b>	296.00	296.00	0.00	938.00
<b>MAX</b>	85,480,108.00	68,137,938.00	17,599,404.00	85,480,108.00
<b>Arithmetic mean</b>	1,363,342.04	1,128,253.38	279,081.38	1,390,584.31
<b>Coefficient range</b>	85,479,812.00	68,137,642.00	17,599,404.00	85,479,170.00
<b>Deviation</b>	6,047,927.34	4,834,538.13	1,326,091.49	6,055,396.35
<b>Median</b>	260,244.00	243,914.00	36,962.00	294,533.00
<b>Upper quartile</b>	869,630.00	782,579.50	147,085.50	965,939.00
<b>Lower quartile</b>	58,439.50	59,353.50	5,728.00	77,193.25
<b>Interquartile deviation</b>	811,190.50	723,226.00	141,357.50	888,745.75

Source: own processing

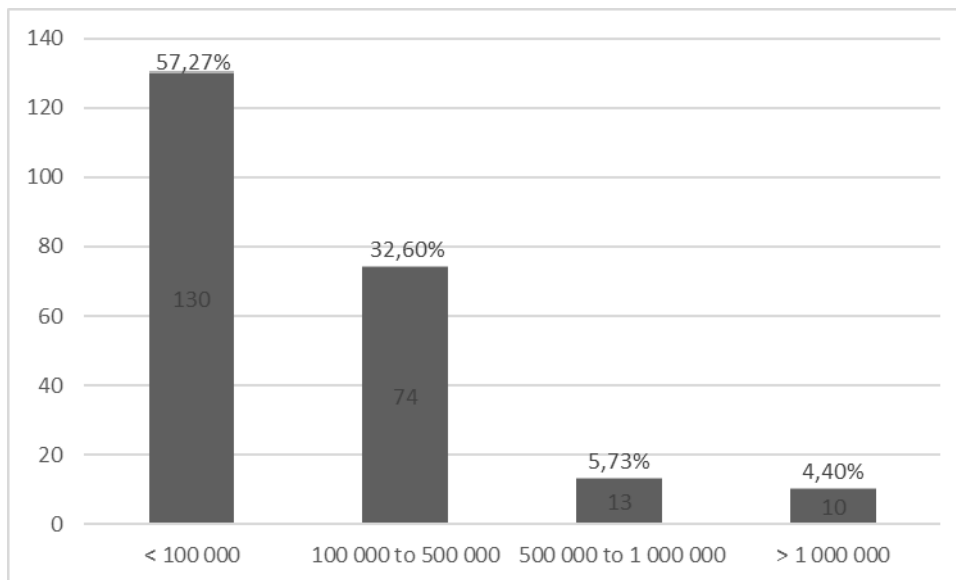
**Table 4.** Analysis of selected financial indicators in 2018.

	<b>Arithmetic means of assets (in €)</b>	<b>ROA (in %)</b>	<b>ROE (in %)</b>
<b>MIN</b>	6265.00	0.05	0.26
<b>MAX</b>	140,672,150.00	113.97	658.72
<b>Arithmetic mean</b>	9,831,367.94	18.58	42.15
<b>Coefficient range</b>	140,665,885.00	113.92	658.46
<b>Deviation</b>	20,004,713.18	20.50	55.26
<b>Median</b>	2,192,606.50	11.11	28.43
<b>Upper quartile</b>	8,756,677.25	24.50	54.62
<b>Lower quartile</b>	585,189.75	4.61	11.43
<b>Interquartile deviation</b>	8,171,487.50	19.89	43.19

Source: own processing

The statistical analysis shows that in all the indicators examined, the arithmetic mean is greater than the median, which means that half of the entities achieve significantly above average values of the indicators examined expressing their economic stability. The positive financial situation of the group of undertakings examined is also confirmed by the upper quartile, which indicates above average values for the ROA and ROE ratios, which means that a quarter of the enterprises make a return on the capital invested for total capital of 24.5 % (ROA) and for equity capital. 54.62% (ROE), which is more than the average of the entire enterprise group at 18.58% (ROA) and 42.15% (ROE), and up to half of enterprises reach 11.11% (ROA) and 28.43% (ROE). At the lower quartile of 4.61 (ROA) and 11.43% (ROE), a much higher rate of appreciation of the capital employed across the group of enterprises examined can be observed compared to interest on deposits with banks in 2018. Based on these indicators, it can be concluded that more than 75 % of the undertakings examined achieve an excellent appreciation of capital.

For the other absolute financial indicators analyzed, on the other analyzed, the arithmetic average is greater than the upper quartile, indicating the distribution of the group of enterprises, where a quarter of enterprises achieve the highest financial indicators, which are above and below their arithmetic average. This means that the highest values of financial indicators are for a smaller group of enterprises than the upper quartile. This situation is also described by financial indicators, which we have also assessed based on basic descriptive statistics. The same conclusion applies to the applied amount of the R&D cost super deduction, where the top quartile is 211,796.23 € close to the arithmetic average of 230,224.36 €. This means that only a small number of enterprises apply large amounts of super deduction and most claim the super deduction in low amounts, as confirmed by the Figure 2.



**Fig. 2.** Overview of the categories of enterprises applying for super-deduction in 2018

The threshold for the lower quartile for the after-tax profit figure was set at 59,353.50 € and the threshold for the upper quartile is 782,579.50 €. Enterprises are profitable, their financial situation is good, which is also helped by the possibility of deducting expenditure on R&D carried out, i.e., super deduction of costs and thus lower loss of equity in the payment of income tax. The undertakings examined by us do not lead to critical situations, are not at risk of bankruptcy and their financial situation is positive, as evidenced by the EBIT indicators, where the minimum of the group of undertakings examined is 938,00 €.

The ROA and ROE indicators were positive across all enterprises. We calculated the lowest ROA value at 0.05% for AXYZ - CNC s.r.o. If we focus more closely on its other financial indicators in this case, the profit before and after tax was €296 and the tax due was 0 €. Conversely, we calculated the highest ROA value at 113.97% in Čavojský & Partners, a. s. In this case, the company reported a pre-tax profit of 849,371 € and payable tax of 97,060 €. For the ROE indicator, we calculated 0.26% in INSEKO a.s. as the lowest, with a pre-tax profit of 2.625 € and a tax due of 1,120 €. On the other hand, we are the highest ROE in the company HD elektronika SK, s.r.o.. calculated at 658,72 %, with a pre-tax profit of 142,078 € and a tax due of 960 €. We can conclude that, for the most part, the higher the ROA and ROE, the higher the value of the profit or loss after tax and the lower the ROA or ROE, the lower the profit after tax or the tax due was low or zero.

According to the financial statements data found, the tax due was zero for 31 entities, with two enterprises reporting a profit before tax higher than the profit or loss after tax and, after a closer inspection of the financial statements, we found that the balance sheet line 'income tax due' had been incorrectly filled in and the incorrect line 'deferred income tax' was filled in. We have therefore included only 29 enterprises listed in Table 5 in the further analysis. All the entities examined reported a positive profit-to-profit result and managed to eliminate the full amount of their income tax liability up to 0.

**Table 5.** Businesses with zero tax due in 2018.

<b>Company</b>	<b>P/L before tax (in €)</b>	<b>P/L after tax (in €)</b>	<b>Super- deduction in 2018 (in €)</b>	<b>ROA</b>	<b>ROE</b>
<i>AMIDIA s.r.o.</i>	4,683	4,683	5,073.25	1,83%	3,30%
<i>Ardaco, a.s.</i>	253,035	253,035	187,253.86	9,37%	12,46%
<i>AXYZ - CNC s.r.o.</i>	296	296	243.70	0,05%	0,42%
<i>Bel Power Solutions, s.r.o.</i>	43,859	56,813	320,601.35	0,24%	0,77%
<i>Bizzcom s.r.o.</i>	362,620	362,628	398,499.69	8,54%	66,30%
<i>Blumenbecker Slovakia s.r.o.</i>	167,061	167,061	195,264.63	6,10%	11,28%
<i>CASPRO s.r.o.</i>	216,035	216,035	209,598.42	18,78%	77,39%
<i>CELM SLOVAKIA</i>	37,443	37,443	1,859.75	49,96%	78,72%
<i>CLEVERSOFT, s.r.o.</i>	37,443	37,443	40,561.40	49,96%	78,72%
<i>develogics k. s.</i>	49,300	49,300	56,607.38	24,09%	51,56%

<i>Ecoland s. r. o.</i>	51,646	51,646	11,265.25	3,60%	15,37%
<i>EkoWatt s.r.o.</i>	17,366	17,366	10,888.79	9,47%	26,91%
<i>ELRON s.r.o.</i>	63,051	63,051	66,191.98	17,29%	45,88%
<i>EXENT s.r.o.</i>	938	938	3,735.38	0,83%	6,64%
<i>GEORGANICS s.r.o.</i>	28,108	28,108	28,169,23	11,75%	30,80%
<i>G-Performance EU, s.r.o.</i>	1,481	1,481	13,388.94	5,73%	16,52%
<i>GRADIENT ECM s. r. o.</i>	99,296	99,296	100,972.26	5,84%	9,41%
<i>KFB Control s.r.o.</i>	57,599	57,599	25,094.49	5,54%	11,44%
<i>Krone Consulting s. r. o.</i>	27,544	27,544	43,012.08	10,65%	24,23%
<i>LKT, s. r. o.</i>	33,423	40,567	3,264.23	2,71%	88,66%
<i>Manufacturing s.r.o.</i>	40,614	40,614	46,071.88	24,28%	103,81%
<i>METRUM servis, s.r.o.</i>	160,721	160,721	161,727.33	30,42%	48,31%
<i>MYMEDIA, s.r.o.</i>	2,604	2,604	5,887.22	3,31%	9,92%
<i>R-DAS, s. r. o.</i>	213,624	213,624	213,994.04	4,45%	6,10%
<i>Relco Technology s.r.o.</i>	8,604	8,604	7,219.12	52,03%	67,00%
<i>robotec, s.r.o.</i>	79,698	79,698	107,224.31	2,24%	9,43%
<i>Rossum Integration s. r. o.</i>	39,816	39,816	42,242.64	24,06%	155,38%
<i>SEWEX, s. r. o.</i>	58,121	58,121	58,459.69	16,80%	31,69%
<i>VAS Systém, spol. s r.o.</i>	168,265	168,265	178,170.40	9,33%	23,69%

Source: own processing

In 2018, 29 companies correctly report income tax due, or no tax, in the financial statements, which accounts for just under 13% of all businesses surveyed. We anticipate that in the following accounting periods, as the super-deduction rate increases, the number of entities that will be able to eliminate the tax burden on the State altogether and to keep the capital generated by the profit in the company for further business activities will also increase.

Of these 29 entities, the highest ROA has 52.03% company Relco Technology s.r.o., whose applied super deduction was 7,219.12 € and the lowest ROA .005 % company XYZ - CNC s.r.o. with a super deduction of 243.70 €, the highest ROE was 155.38% for Rossum Integration s.r.o., whose super deduction was 42,242.64 € and lowest ROE 0.42 % enterprise XYZ - CNC s.r.o. with applied super deduction 243.70 € and it can be deduced that they have managed to take advantage of all available tax breaks involving a super-deduction for R&D. Some businesses may have benefited from other tax breaks, including tax breaks or various subsidies and incentives that we did not analyse in this research. All these enterprises have a positive economic result and carry out R&D, so we assume that thanks, they have managed to eliminate the payment of the tax due to zero. The lowest profit before tax is reported by XYZ – CNC s.r.o. only in

the amount of 296.00 € with a super-deduction of 243.70 € and on the other hand the highest company Bizzcom s.r.o. in the amount of 362,620 € with a super deduction of 398,499.69 €. The average value of profit before tax was 80,148.07 €. Several enterprises report a profit after tax higher than before tax, which may be due to the application of deduction of the tax license paid from previous years or higher paid advances on income tax.

Of the other 197 entities, the lowest income tax was paid by V O N S C H spol. s r. o. in the amount of 4.00 €, for super-deduction of R&D costs in the amount of 25,249.24 € and the highest tax liability was reported by ESET, spol. s r. o. in the amount of 17.599.404 € for super-deduction of R&D costs in the amount of 3,595,889.56 €.

## **4 Conclusion**

Based on our analysis, the financial situation of R&D superemployment companies is good, most of them value the capital contributed above average and therefore the use of research results in enterprises can be assumed in the future, applying the continuity of the continuation of the activities of the 227 enterprises examined. It can also be assumed that such support in the form of income tax reductions promotes the maintenance of a good financial situation and stability of. The group of investigated entities showed 29 that reported zero tax due and showed a positive economic result, which may mean that this is due to the application of a super-deduction of R&D costs. However, most enterprises reported a positive value of the tax due, which means that even after applying the super-deduction in full, the income tax was positive, which means that the financial performance of the enterprises is good. This is confirmed by the statistical evaluation of the financial indicators examined.

We have confirmed all 3 hypotheses with research. We confirmed hypothesis 1 because 196 enterprises reported income tax due of more than 0 €, which is 86 % (out of 227 enterprises). It can therefore be assumed that most businesses have managed to benefit from all tax breaks and do not pass on part of the super deduction to subsequent years. The hypothesis 2 that most businesses value equity (ROE) at more than 10%, which is higher than the appreciation of deposits with banks in 2018, has been confirmed as the median is 28.43%, i.e., more than half of businesses have a ROE greater than this value. Also confirmed is the hypothesis 3 that most businesses value total capital (ROA) at more than 10%, which is higher than the appreciation of deposits with banks in 2018, when the median ROA is 11.11%.

All selected enterprises have potential for the future, their situation is stable, although we can see high differences in them, e.g., in the amount of assets, sales or equity. The undertakings examined are in a positive financial situation and their activities do not lead to critical situations or bankruptcy. It is true that we have analyzed the available data for 2018 and we can assume that in 2020 there may be some financial problems due to the ongoing Covid19 pandemic. The financial incentive to apply the super deduction is gradually increasing, which can help even in the period after the covid-19 pandemic. That's why future research will look at the impact of super-deduction

percentage growth, financial analysis of businesses during and after the Covid-19 pandemic.

At the beginning of the research, we eliminated different groups of enterprises from the original group, either enterprises for which we did not have financial data or were published under IFRS. We have excluded some entities based on negative indicators, since only an entity whose tax base has been positive and the ROA and ROE ratios for negative indicators (equity and profit or loss) can claim a super calculation of R&D expenditure does not give meaningful results for evaluation.

There were also those entities that showed negative equity (4) and negative profit or loss (5) that were excluded from this research. For these entities, we see the potential for writing additional contributions to track their financial situation from the start of the super deduction.

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# Impact of the Trade Defence Measures on EU-Russia Foreign Trade Relations

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**Abstract.** The EU trade defence measures against products from a given country depend on the potential injury that imports of these products would cause. The groups of goods from the Russian Federation, which are mainly subject to antidumping measures, are no exception. The aim of the article is to determine the impact of the EU trade defence measures implemented against Russian products on their foreign trade relations pointing out the effectiveness of these measures. The article will also deal with the new technique of antidumping measures implementation, to which the Russian Federation is subject, and the article also concludes the perspectives of trade defence instruments in the EU-Russia foreign trade relations in connection with the current military conflict between Russia and Ukraine.

**Keywords:** Trade Defence Measures, European Union, Russia, Foreign Trade, Dumping

**JEL classification:** F13, F19

## 1 Introduction

Over time, Russian Federation has become a major trading partner of the EU, as evidenced by the fact that in 2021, Russia was in fifth place among all trading partners in EU exports (4.1%), while in EU imports, the country reached third place (7.5%) (Eurostat, 2022).

However, as part of imports from the Russian Federation, there are product groups which the EU has assessed as potentially dangerous for domestic producers based on investigations and suggestions. These products are subject to trade defence measures which should restrict their imports and reduce the potential risk of economic injury to European producers. The EU is currently taking trade defence measures against goods from the Russian Federation in the form of antidumping (AD) duties. These duties will be the issue of our article.

Theoretically, if the Russian company exports the product at a price lower than the price normally charged on its own domestic market, this is dumping. A specific entity located in Russia does so when it seeks to export a product on the EU market at a lower price than its selling price on the domestic market. Ultimately, therefore, the subjects with dumping behavior seek to push domestic producers or small firms out of the market by short-term price reductions, while the level of these reduced prices is below the sum of their cost of production and a reasonable profit. In such a case, the intervention of the European Commission and the Council, which will issue an opinion, is required. The EU thus seeks to protect the market from the dumping behavior of foreign companies, respectively, large global chains (European Court of Auditors, 2020; Baláz et al., 2019).

### **1.1 Literature Review**

Foreign trade relations between the EU and the Russian Federation are the subject of long-term research by the authors of the scientific community. As part of the review of existing scientific publications, we focused on resources from the Current Contents Connect database. Authors such as Kašťáková and Baumgartner, 2017 or Krasilnikova, et al., 2019 deal with macroeconomic and trade statistical indicators that illustrate the development of trade in these two territories using one-factor indicators of foreign trade evaluation or econometric models. Drieniková, 2014 or Romanova, 2013 deal with the issue of Russia's accession to the WTO and the resulting challenges for the EU, considering the evaluation of the strategic partnership or prospects for the future. Isachenko and Medvedkova, 2019 deal with the issue of trade barriers and regulations, which, according to the authors, significantly affect bilateral relations between the Russian Federation and the EU, taking into account political issues or issues of economic sanctions. Savelyev and Khetagurova, 2016 deal with the issue of antidumping measures imposed on Russian goods in general and making recommendations that Russian exporters can defend themselves in the WTO. They also consider the cooperation of Russian entities with the investigating authority to be very important and beneficial in relation to the issue of dumped goods. Wustenberg, 2019 deals with EU antidumping measures against Russian products, analyzing EU practices. As the analysis of antidumping measures against Russian products from a practical point of view is not represented in detail in the publications Current Contents Connect, we see the space for processing this issue.

## **2 Methodology**

The aim of the article is to determine the impact of the EU trade defence measures implemented against Russian products on their foreign trade relations pointing out also the effectiveness of these measures.

The research was divided in two stages, while the first involves the searching of information within the relevant books and journals that are indexed in the Current Contents Connect database. We have also used the information from the official

documents published by European Commission. The second stage includes the dealing with the practical statistical data obtained within the relevant databases, including Eurostat, International Trade Centre, etc.

While preparing the paper, we used the empirical methods of scientific research. We have defined the basic concepts by analysis and synthesis combined also with abstraction. The practical results are illustrated by the method of mathematical and statistical methods with the help of graphic illustrations for better understanding. The method of comparison was used when identifying the impact of trade defence measures on foreign trade relations between countries examined within the observed period of last 10 years and when evaluating the effectiveness of trade defence measures. When evaluating neuromarketing methods, we used the method of comparison. Methods of induction and deduction helped us to determine the conclusions of the research within our article. Within the process of identifying the impact of measures mentioned above, we also used the indicator of mutual trade intensity – Trade Intensity Index.

## 2.1 Trade intensity index

The potential for mutual trade between the countries observed can be expressed through the intensity of mutual trade, which is calculated through the Trade Intensity Index (TII). We use this index to determine whether the volumes of mutual trade between the two selected countries reach greater or lesser values than expected given their position in the world economy. The index can be expressed as the ratio of the share of exports of country  $i$  to country  $j$  to the total exports of country  $i$  and the share of exports to country  $j$  to the value of total world exports. The formula for its calculation is as follows (World Bank, 2010):

$$TII_{ij} = (x_{ij}/X_{it}) / (x_{wj}/X_{wt}); \quad (1)$$

where:

$x_{ij}$  – value of exports of country  $i$  to country  $j$ ;

$X_{it}$  – the value of total exports of the country  $i$  to the whole world;

$x_{wj}$  – value of the world exports to country  $j$ ;

$X_{wt}$  – total value of world exports.

The results of this calculation can be interpreted as follows (World Bank, 2010):

- if  $TII = 1$  - this is indicated by the fact that the exporting country  $i$  exports to country  $j$  the same ratio as belongs to country  $j$  in relation to its share of world imports;
- if  $TII > 1$  - in this case it is the fact that country  $j$  exports to country  $j$  in a larger proportion than to the whole world. In other words, trade flows are higher than expected given the position and importance of countries in the world economy. It is therefore an intensive trade between the countries concerned;

- if  $TII < 1$  - this result indicates a low trade between the studied countries, resp. at a lower level than expected.

The value of the Trade Intensity Index is therefore dependent on several factors, including trade barriers or trade defence instruments. Based on the development of the trade intensity index, it is possible to assess the change in the trade intensity of the surveyed entities during the observed period. In our case, it is an examination of the intensity of trade between Russia and the EU (vice versa). The source of data in this analysis is the ITC Trade Map database.

### **3 EU antidumping policy against Russia**

The European Union is currently investigating nine antidumping measures against imports from the Russian Federation. Since 2017, the European Union has been using a new dumping methodology to assess market distortions in third countries. The main objective of this methodology is to detect and correct market distortions resulting from state intervention in third countries, while the dumping calculation algorithm itself is based on the rules set out in the WTO Anti-Dumping Agreement (The Council of the EU, 2017).

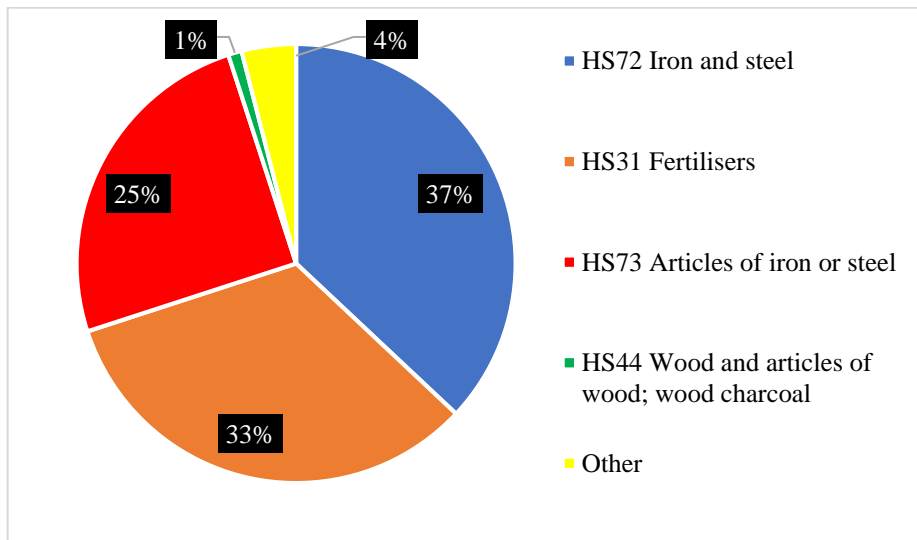
Should a serious market distortion in the exporting country be found, the European Commission has the right to correct the prices, as these prices do not provide a relevant basis for comparison with the export price in a distorted market. According to this methodology, other benchmarks must be used in similar cases, which reflect undistorted production and sales costs. This correction therefore consists in determining the price of a given product either on the basis of production costs and sales prices in another country at a similar level of economic development or on the basis of appropriate undistorted costs and prices at international level (European Commission, 2017; The Council of the EU, 2017).

One of the reports of significant market distortions in third countries is also the report concerning the Russian Federation. It is the result of European research and provides facts and important evidence on several aspects of the Russian economy that may be relevant to the decision-making process in antidumping investigations. The Commission's working document on the significant economic distortions of the Russian Federation for the purposes of trade defense investigations (2020) therefore speaks of the problems which, according to the EU, have caused market distortions, from which we list selected points:

- a higher level of state intervention in the economy at the regional level, with the presence of illegal means of business activity and Russia's poor performance in the fight against corruption;
- in many sectors, state-owned enterprises are a tool for potential intervention in regulated markets (eg the banking sector);
- preferential treatment of state-owned enterprises in government procurement;

- the level of corruption in the procurement sector is well above the level of OECD economies;
- unclear temporary import substitution policy with a large set of measures to replace imports by domestic production in many sectors;
- the impact of sanctions imposed on Russia (uncertainty, reduction of investment, etc.);
- high levels of state participation and high levels of market concentration in many strategic sectors (energy, defense) and natural monopolies (electricity, gas, water, and rail);
- the absence of policies that would lead to a systematic overestimation or underestimation of the value of the soil, environmental aspects are not considered either;
- monopoly rights and state-regulated prices;
- excessive reduction of transport costs by regulated and subsidized railway tariffs creates an advantage only for selected sectors;
- still prevailing export duties on selected goods, e.g. wood industry;
- limited influence of trade unions on wage policy and working conditions, low level of real bargaining.

The goods subject to antidumping defence duties, with accordance to the new methodology come from several product groups, which are shown in the following Figure 1.



**Fig. 1.** Commodity structure of EU antidumping measures investigating against Russia (author's own processing according to European Commission, 2022).

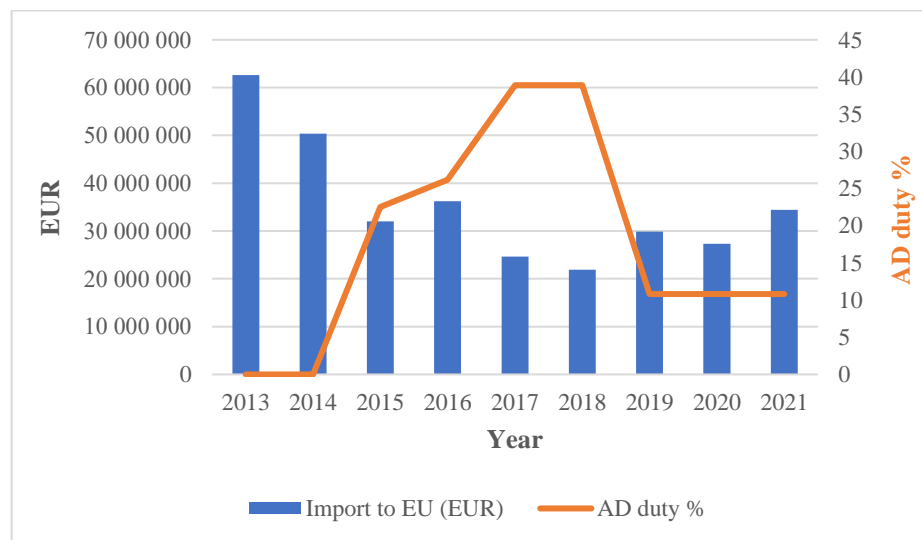
Figure 1 shows us the commodity structure of EU antidumping measures that are currently being investigated against Russian products. According to the HS2 product

groups, the most represented group is HS72 – Iron and steel with the share of 37% to the total dumped goods. The second group is HS31 – Fertilisers, with the 37% share. The next with the share of 25% is the product group HS73 – Articles of iron and steel. We can illustrate the fact that this group, together with group HS72, which has similar characteristics, constitutes more than 60% of the products subject to antidumping measures in the form of duties. The product group HS44 – Wood and articles of wood; wood charcoal has the lowest share, with only 1%. The other groups of Russian products subject to antidumping duties, the amount of which was negligible compared to the groups already contained, were combined into one value called Other, which makes up a total of 4% share.

Selected products within the commodity groups in first 3 places included in the Figure 1 will be the subject of research into the effectiveness of EU antidumping defence measures investigated against Russia. We illustrate here the development of the value of products imported within the chosen HS group together with the development of AD duty in % that have been in force. We have also involved the years before the implementation of AD duty, for comparison and better understanding.

### 3.1 Effectiveness of EU antidumping defence measures against products from Russia within the group HS72 – Iron and steel

According to the EU official database, we have chosen the particular commodity from the HS72 group, that is subject to antidumping duties. To be more specific, the commodity observed is HS6 - 72251100 - Flat-rolled products of other alloy steel, of a width of 600 mm or more, of silicon-electrical steel of a thickness exceeding 0,16 mm.

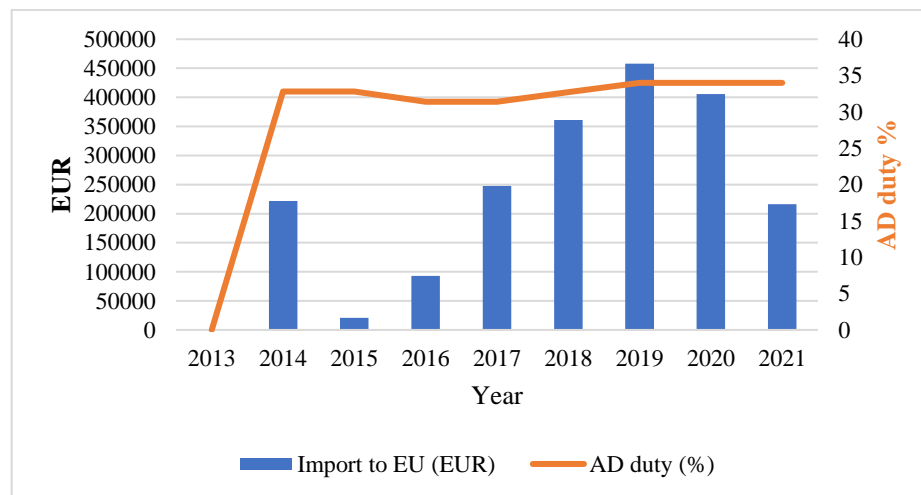


**Fig. 2** Development of imports and antidumping duty on HS72251100 commodity from the Russian Federation to the EU in 2013 – 2021 (author’s own processing according to European Commission, 2022 and Eurostat, 2022).

Firstly, we analyzed products from group HS72251100. Figure 2 shows the development of the value of imported goods in EUR in individual years and the development of the antidumping duty in %. The AD duty was imposed on these products in 2015, starting at 22.5%. In this case, we observe a significant reduction in imports of goods. Subsequently, in 2016, 2017 and 2018, the value of the antidumping duty increased to 38.9% and the imports decreased. The duty dropped sharply to 10.8% in 2019 and this value remains unchanged. At the same time, during the duty reduction, the volume of imported goods increased slightly. Based on the analysis of this figure, we can conclude that the imposition of an antidumping duty on these products was effective during the period of application of the higher duty, as imports of products showed a declining trend after the duty imposition. After the reduction of duty, imports increased in 2019, then decreased again in 2020. In the last monitored year, however, we see a slight increase in imports, which evokes a slight defect in the effectiveness of AD duties. Accordingly, we can conclude that the imposition of duties has eliminated the existence of dumping prices in this product sector. This decrease may mean that the domestic market has been protected from imports of goods at prices below their selling price on EU market. However, it is necessary to focus on the management of AD duties in recent years due to the mentioned slight increase.

### 3.2 Effectiveness of EU antidumping defence measures against products from Russia within the group HS31 – Fertilisers

The analysis of the AD duty within the product group HS73 was implemented on the products from HS31026000 - Double salts and mixtures of calcium nitrate and ammonium nitrate.

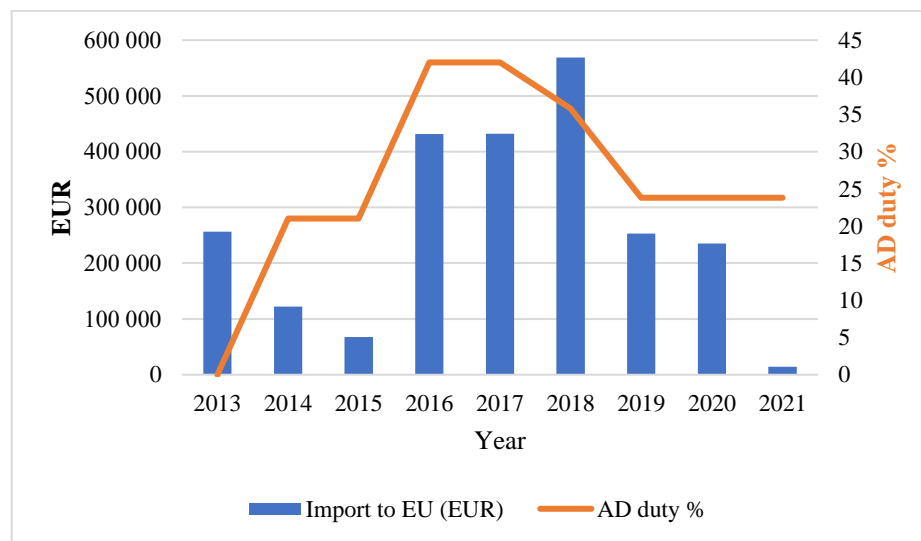


**Fig. 3** Development of imports and antidumping duty on HS31026000 commodity from the Russian Federation to the EU in 2013 – 2021 (author’s own processing according to European Commission, 2022 and Eurostat, 2022).

Figure 3 shows that the AD duty was imposed on these goods in 2014, when it was 32.8%. In 2015, we recorded a significant decrease in the value of imports and even though the value of customs duties did not change, the value of imports fell. In the following year, the value of the duty decreased to 31.4%, while this value persisted in 2017. Next years, there was a slight increase in the values of imports. We recorded the highest value of imports in 2019, and at the same time a definitive duty of 34% was implemented that year. In the last 2 years, however, we can see a decline in import values. In this case, we can evaluate the effectiveness of the imposed duty positively, as we recorded a declining trend of imports after the first implementation of the duty - in 2015 and 2016 and also after re-implementation of the definitive duty - in 2020 and 2021.

### 3.3 Effectiveness of EU antidumping defence measures against products from Russia within the group HS73 – Articles of iron and steel

The effectiveness of AD duty within the last group, HS73 will be analyzed by the example of import of HS73079311 - Tube or pipe fittings of iron or steel - Elbows and bends.



**Fig. 4** Development of imports and antidumping duty on HS73079311 commodity from the Russian Federation to the EU in 2013 – 2021 (author's own processing according to European Commission, 2022 and Eurostat, 2022).

In the case of these goods, the AD duty was imposed in 2014 when it was 21%. At the same time, after the imposition of the duty, the value of imports for the products concerned decreased by about half, followed by the same decrease in 2015, while the value of the duty remained unchanged. As the value of import started to rise significantly in 2016, the new AD duty reached the value of 42% and stopped the rising trend, which stayed unchanged. In 2018, the AD duty was reduced to 35.8%, and the

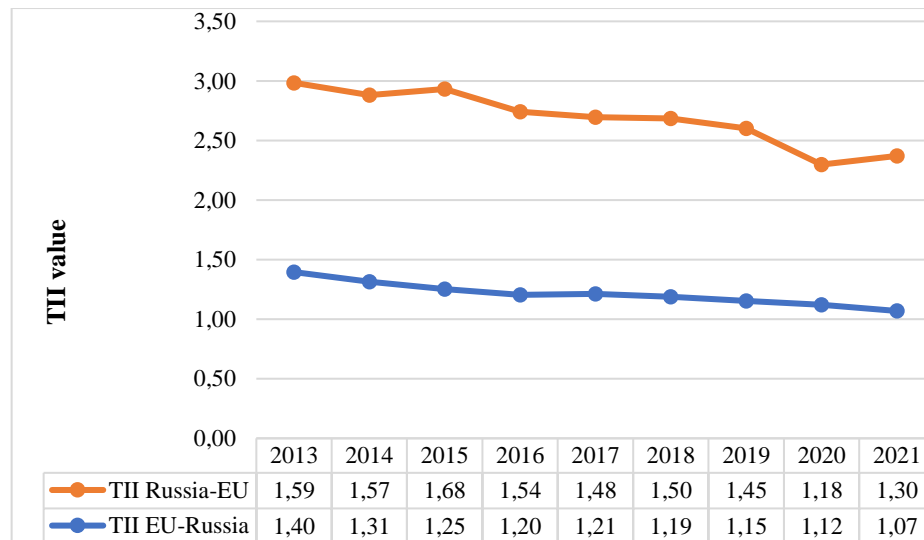


import increased rapidly. However, AD duty was subsequently reduced more, to 23.8% in 2019, where we can see also the decrease in Russian imports. Compared to 2018, we have seen a significant drop in import values by about half, even the AD duty is lower which is a paradox. In 2021, the value of imports fell rapidly to the lowest value so far, based on which we can assess the antidumping duty as effective.

The next part of the article illustrates the impact of the AD duties on mutual trade intensity between Russia and the EU.

### 3.4 EU trade defence measures and trade intensity of the mutual trade EU-Russia

In following analysis we measured the data obtained from ITC Trade Map by using the formula (1) we have already mentioned in chapter 2. We dealt with the period starting in 2013, the same year as the previous Figures. The results are as follows.



**Fig. 5** Development of trade intensity between Russia and the EU (vice versa) in the years 2013 to 2021 based on the TII index (author's own processing according to ITC Trade Map, 2022).

The results in Figure 5 shows that trade flows are higher than might be expected given the importance of Russia in the world economy, so Russia exports in proportion more goods to the EU than to the rest of the world. However, even though the trade intensity was at the level more than 1, so the intensity was high, within the observed decade, after imposing the AD duty, the index has decreasing trend, even in 2021 the trend started to increase. All things considered, the AD duties could be one of the factors that negatively influenced the trade intensity between Russia and the EU. For the illustration, we have also involved the trade intensity from the EU point of view. The results are the same, higher than 1, but the index trend have been also decreasing.

## 4 Conclusion

The article dealt with the EU trade defence measures and their impact on foreign trade relations between the EU and Russian Federation. This country must face the antidumping duty defence from the EU, followed by new updated methodology taking into account the trade distortions.

Within the research, we have found that the product groups facing the AD duties the most are HS72, HS31 and HS73. Particular commodities from these HS groups were subjects to examining the effectiveness of AD duties imposed by the EU. Even the small abnormalities or paradoxes, the effectiveness of EU AD duties imposed on particular products from mentioned groups was proved in the whole. However, it is important to manage the trade defence policy more precious, as there was small increase in last period observed within HS72 commodity.

The analysis of mutual trade intensity also proved the fact, that implementation of AD duties could be the reason for decreasing trend of trade intensity index between Russia and the EU, even the trade is still intensive, because the values were higher than 1.

The development of trade defence measures by the EU against Russia has been influenced since 2017 by a new methodology, which includes market distortions. However, the Russian Federation is currently facing sanctions around the world due to military aggression in Ukraine. This fact may also significantly affect the mentioned methodology of EU trade defense instruments in the near future, as these factories are also considered to be distortions in the report mentioned in our article. At present, we can almost certainly expect changes in this policy on the part of the EU in connection with the events of recent days, so the issue needs to be further monitored and analyzed in detail.

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# Analysis of Network Analysis Tools Possibilities in Area of International Taxation

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**Abstract.** In modern era of globalization, we face every day to new business models, technologies and way of enterprises achieve their revenues and gain profits. Under these conditions is quite harder to tax internationally operating businesses when we realize that actual network created of bilateral and multilateral treaties in not so perfect as we would assume. From these facts arises the research question. Is actual network of bilateral tax treaties perfect? If no, where the weak parts are? And finally, and most importantly, how can we measure it? In our research paper we analyze which tools of social network analysis can be used to measure and examine nature of bilateral tax treaties network. By understanding answer to this research question, in future we would be able to fully use all the SNA tools, that are most suitable for network of bilateral tax treaties and treaties like them. Furthermore, we can predict which tools are on the other hand not suitable for this type of network.

**Keywords:** Bilateral tax treaties, Network, Taxation, Social network analysis

**JEL classification:** H20, D85, L14

## 1 Introduction

When studying such global entity as network of bilateral tax treaties (from here only BTT), it is needed to use tools that meet the needs and copies features of this entity. If we want to observe how network works or need to predict how subjects in this network may act in future, we must precisely choose specific tools to successfully achieve our aims. (Kubicová J. , 2021) Network analysis is one of the youngest analysis methods that is nowadays available to use. In this part of work we analyze, in which areas and how social network analysis (from here only SNA) has been used until now and how it has evolved from the original theory of graphs. Then Graph theory was born in solving a puzzle about the so-called " Seven Bridges of Königsberg ", when in 1736 the mathematician Leonhard Euler first mentioned the possibility of solving the puzzle using a graph. (Sporns, 2022) (Ławniczak, a iní, 2020)

The advantages of solving problems with the help of the graph are that the graphs are easier for the recipients to visually perceive than the mathematical formulation of the problem. By use of graph theory, it is possible to search for the shortest paths connecting different points on the graph, search for possible connections between people, suggestions for friendships on social networks, monitoring the spread of viruses, GPS, studying molecules, links between them and the like. Graph theories are unique because they can connect nodes / entities through the relationships that connect them.

In many studies, we also come across the term Social Network Analysis. Using this method, it is a process of examining social structures using networks and graph theory. SNA is one of the ways to examine networks of nodes connected by certain relationships using graph theory. In SNA, the edges of graphs capture, for example: information transfer, connections (relationships) between entities or even business networks, which multinational companies create by their mutual interactions, ownership interests in subsidiaries and the like. The concept of social network analysis is first mentioned in history in connection with the sociologist George Simmel or Émile Durkheim. (Hollstein, 2021) The advantage of the SNA approach in the field of international business and taxation is the similarity, between social networks, and networks of companies or countries connected through relations. The relationship between graph theory and SNA is very close. It is possible to say that SNA is more technically advanced, but it builds on graph theory. The difference between SNAs is that it is possible to examine the network using graph theory, but it is possible to attribute certain properties to nodes as well as edges that affect their position and importance in the network.

From the above-mentioned circumstances, it follows that the SNA method is an ideal method for examining contractual relations between countries in international treaties network. One of the examples can be the examination of bilateral or multilateral contractual network relations between nationals in the field of international taxation. The network of contractual relations between countries is a complex entity with a complicated and dynamically changing structure. As we have recently been witnessing the trend of international treaties abuse in the field of international taxation by companies, we perceive the need to choose a suitable research theory, which in our opinion is SNA. This methodology can capture important characteristics of international networks such as double taxation treaty networks. On the other side SNA is flexible enough to absorb and promptly react to changes in the real network of international treaties.

## **2 Overview of basic terms of SNA**

A graph is a set of vertices / nodes and edges that are connected in one whole. The term node can represent various objects, countries, territories, entities, persons, and the like. Edges can connect nodes in any way. When describing the nature of graphs, it is necessary to distinguish between the term "tree" and "graph". While the tree has a so-called node, which can be considered as the starting point, and the other nodes are connected to it, and each other node creates a single link to its parent's node, this is not the case with the graph. (Carrington, Scott, & Wasserman, 2005) Based on the

properties of the edges, we can distinguish between edges with and without direction. For graphs where the edges have the direction of the trajectory to be performed when moving between nodes, we distinguish between the origin node and the destination node. (Cordeiro, Sarmiento, Brazdil, & Gama, 2018) While at the edges without direction, a two-sided shift is possible both from node A to B and vice versa. This difference between the edges then gives a precondition for the emergence of different types of graphs. If we have edges indicating the direction in the graph, it is a diagram, graph with edges indicating only one-way movement between nodes and vice versa, a graph where two-sided movement is possible is called a multigraph. (Camacho, Panizo-Lledot, Bello-Orgaz, Gonzalez-Pardo, & Cambria, 2020)

The edges of the graph can also be assigned a weight. The weight of an edge can express different circumstances of the relationship between two nodes, such as: cost, the amount of transmission of a certain unit across a given edge per unit of time, the distance between two nodes, and the like. In general, we can perceive the evaluation of edges as: distance, time, cost, capacity (or in other words edge permeability). The expression of how the vertices are connected to each other is called incidence, it can be written in various ways, such as: incidence table, matrix, or in the form of a graph diagram. (Zulehner, Hillmich, & Wille, 2019) Incidence matrices can describe both evaluated graphs when the edges of the graphs have different weights, and unevaluated, when the edges of the graphs are equivalent without weights. The incident matrix in the case of a non-oriented graph, a graph without edges with a given direction, also called a multigraph, has a specific shape in that around the main diagonal of the matrix the elements of the matrix are arranged in a mirror image. This representation is since the route from node A to node B carries a certain value that applies reciprocally in both directions, since the path of movement between points does not have a specified strict direction. In the case of an oriented graph or otherwise called an orgraph, the incidence matrix is not symmetric.

One of the tasks that can be easily solved using graph theory is to find the path between the nodes and optimize the path between the two nodes. However, if we request a path, it is necessary to determine the appropriate condition that the path should meet. It is possible to require finding the shortest route between country / node A tax haven / node X. However, the most beautiful route, in terms of the smallest number of countries involved in transferring profits, may not be characterized by the lowest costs of transferring such company profits from country / node A to X. When searching for a path between monitored nodes, it is therefore necessary to determine the correct criteria that the path should meet.

In general, when working with network analysis, we may encounter the following basic concepts:

**Open network** - In the context of international tax avoidance treaties, we consider a network of countries linked by contractual relations as a model of an open network. (Kurt & Kurt, 2020) In this model, there is room for the emergence of structural holes, which we observe, in the case of real application of bilateral agreements. If there is a structural hole in the system of nodes connected by edges, it is possible to get from node A to node C, where the existence of a direct path A-C is not necessary, just through node B, which forms a structural hole. We also face a similar problem with companies that are shifting profits between jurisdictions with a view to reducing their tax base. In doing so, they use a network of international double taxation treaties to their advantage.

If the transfer were made directly between jurisdictions that do not have a double taxation treaty, the situation could lead to double taxation of the same income. However, companies want to avoid this, which leads them to abuse tax avoidance treaties by exploiting a structural hole - a third country that has a contractual relationship with both original nodes - countries. It is therefore important to see peripheral, peripheral countries that are not contractually linked to more countries, while monitoring countries that have a wide network of international double taxation treaties that can be used as bridges between countries on the periphery of the network with countries in core network. (Kubicová J. , 2011) (Kubicová J. , 2017) It is precisely these nodes, which are structural holes, that are characterized by the fact that they lie mostly between different areas of higher density than they are located just inside the cluster of nodes, and thus in areas of high density. (Walker, Kogut, & Shan, 1997) Further research confirms that when companies are in a system reminiscent of an open network, their strategies are more independent and have more freedom. (Walker, Kogut, & Shan, 1997)

**Network structure with closed core and peripherals** - In this case, it is a network structure where the nodes in the core of the network are closely interconnected, but outside the core, individual nodes not connected to the rest are connected to the peripheral nodes. (Camacho, Panizo-LLedot, Bello-Organ, Gonzalez-Pardo, & Cambria, 2020) Such a structure may also reflect a network of countries linked by bilateral tax treaties.

**Closed network** - All individual nodes are interconnected with all other nodes. This model is not a suitable model for illustrating a network of bilateral tax treaties, as the treaties are not concluded between all countries. (Burt, Kilduff, & Tasselli, 2013) The advantage if a network of international agreements is a closed network is the absence of structural holes and a perfect flow of information within all the tops of the graph. This allows for greater trust between the various actors in the network. (Burt, Attachment, decay, and social network. , 2001) (Coleman, 1988)

**Node (node; vortex)** - In the conditions of examining the issue of income taxation from cross-border transactions, nodes would be represented by countries.

**Edge** - The edge of the chart could be a suitable carrier of information on the possible existence or non-existence of a bilateral contractual relationship between a given country and a selected other country. (Sathiyarayanan & Pirozzi, 2017)

**Structural hole (bridge hole)** - arises when some nodes connect different areas of the network and form a single, or one of the few, paths that can connect nodes from these parts of the network.

**Degree** - A quantity expressing the number of concluded agreements on the avoidance of taxation of one monitored country with all other countries, which are part of the set of peaks / nodes of the chart.

**Density** - The indicator expresses the ratio of all existing contractual connections of countries to each other, to a value that expresses all possible connections even outside those existing between all countries. The higher the density in the observed graph, the more complex and perfect the network of bilateral tax treaties is, the more room there is for the existence of holes. It is possible to say that with increasing density from an open graph, the graph gradually becomes closed. (Marsden, 1993)

**Node centrality** - This is an indicator that indicates the extent to which a node is the centrality of the entire network. In the context of countries linked by international

agreements, the country with the largest number of counterparties would be considered the most centralized. Central actors have more relationships through which they can obtain resources and are also less dependent on another individual actor. (Sparrowe, Liden, Wayne, & Kraimer, 2001)

**Network centrality** - If the facts indicate that a few countries have a relatively wide network of contractual relations with other countries and the remaining countries in the network do not have such many contracts, we are talking about strong network centrality. (Friedkin, 1991) (Valente, Coronges, Lakon, & Costenbader, 2008 ) In cases where all countries have a relatively equal number of contractual relations with counterparties, let's talk about the low centrality of the system.

### 3 Methodology and data

In this part of work, we take a closer look at the tools that SNA offers for studying of global tax agreements network. Tools that we have focused on in this research are centralities of network, namely: degree centrality; closeness centrality; betweenness centrality; eigenvector centrality. In one step we introduce and describe the tools that SNA offers, and simultaneously analyze if they are suitable for this type of network. Research aim, is to objectively analyze if specific tools are suitable for our purposes of tax treaties network, is done by “SNA tool test of suitability for BTT network analysis “. This test of suitability of SNA tools is divided into five more categories, namely: Suitability for network of BTT; Positive aspects of tool; Shortcomings of tool; Ease of results interpretation; The contribution of the tool to understanding how the network works. How can tools achieve their rating in this test is presented in Table 1). The higher rating tool achieves, the better interpretive power it has. In the results we present tools of SNA from lower to higher ratings achieved by the tools in our test. In results we present also wider description of possible application and interpretations of these tools in case of BTT network. It is needed to be mentioned, that one of possible weakness of this research could be a certain degree of subjectivity caused by the fact that the value of the total rating indicator is calculated from individual points that we, as authors, assigned to individual SNA tools. However, our effort was to approach the enumeration of positive and negative features of the given tools with the greatest possible degree of objectivity.

**Table 1.** Brief overview of “SNA tool test, of suitability for BTT network analysis”

<b>SNA centrality tool</b>	
<b>Short description of tool</b>	
<b>Suitability for network of BTT</b>	<i>(Non -1 point/ week +1 point/ average +2 points /strong +3 points)</i>
<b>Special positive aspects of tool</b>	<i>(Each aspect +1 point)</i>
<b>Shortcomings of tool</b>	<i>(Each aspect -1 point)</i>



<b>Ease of results interpretation</b>	<i>(Bad -1 point/ good + 1 point/ great +2 point)</i>
<b>The contribution of the tool to understanding how the network works</b>	<i>(Bad -1 point/ good + 1point/ great +2 point)</i>

### **TOTAL RATING**

Firstly, test introduce the specific tool by its name and short description of the tool and its value interpretation. Then there are five categories, where tools can reach or loose points that creates their overall rating summarized at the end of the table (see Total rating). Now we introduce each of these categories. First of them there is Suitability of tool for network of BBT. As it is in all other research methods not all the tools that analysis offers can be used in case of the data with different nature. This reason led us to set this criterion as the first one. SNA tools can reach up to 3 points based on their suitability for BTT network analysis. However, if toll is completely not suitable for our purposes, then it can even loose up to 1 point of overall rating. In the phase of data preparation, we understandably tried to avoid completely unsuitable SNA tools. That the reason that neither of selected tools does not loses its total rating at this category. However, even if we have somehow made the firs raw selection of data, we wanted our test to be suitable also for other researchers in future. Thus, we have decided to make ranking of this and other criteria also with possibility of losing their points crating total rating. Next two criterions are aimed at more accurate description and knowledge of the SNA tool, while evaluating its positive and negative aspects. Each positive aspect of the instrument brings one positive point to the overall evaluation, while negative aspects deduct one point from the overall evaluation for each aspect. As we move on it is necessary to be able to interpretate the results of each research. Criterion of results interpretation ease can reward the tools by 1 or 2 points and can lower overall rating by 1 point if results are hard to interpretate. Contribution of the tool to understanding how the network works, rates possibility of tool to tell us how the network looks like, where are the strong and weak parts or nods of network and so on. The scale in the evaluation of this criterion ranges from -1 point to +2 points.

In next part of the work, we present results of our suitability test of SNA for BBT network use.

## **4 Results and discussion**

Results of our SNA tool test of suitability for BTT network analysis may be able to bring this area of research to until now unexplored areas. All of our results can be used both for BTT network analysis and also analysis of any other bilateral or multilateral tax treaty network in field of international taxation. We believe that thanks to this test, in future we can easier choose the right tools to achieve specific aims on our way to examine the international treaty networks. Results of SNA tools test is displayed in Table A) in Appendix of this work.

Results of our test have revealed that out of all four centrality measures, the most suitable for analysis of international treaty networks, is Betweenness centrality. This

tool of SNA has great ability to reveal the most important nodes of network in case of transmitters of income to periphery of network (possible tax heavens) and other countries. Secondly, presence of high values of centrality indicates network imperfections and may be great evidence for a network imperfection. Another benefit is that even if this centrality measure characterizes nodes, it has also ability to describe the network composition. Overall score of this centrality measure is 9 points. In case of suitability for network of international treaty networks test it reaches maximum points, in total 3 out of 3 possible. Similarly, this tool passed the test in following categories: ease of results interpretation and contribution of the tool to understanding how network works.

Closeness centrality and Eigenvector centrality have reached both total score 5 points. In case of Closeness centrality, only 1 point has been devoted for this measure in case of ease of results interpretation and contribution of the tool to understanding how the network works. Positive aspects of closeness centrality results from its ability to not only to describe the properties of the node, but also properties of the entire network, what more it can be used to specify periphery and core of network. Negative aspect of this centrality lies in fact that, not all nodes represented by countries located on periphery of network must be "tax heavens".

Eigenvector centrality describes the point with the highest degree of prestige is characterized by the fact that it is connected by several one-way edges pointing from other nodes towards this node. In case of our type of network, we do not have edges with directive, it is still possible to use this tool to find the most prestige node/country, that may play important role in profit shifting. However, Eigenvector centrality is more suitable for networks with the direction of the interaction, thus it can be replaced by degree centrality at some types of networks.

Finally, the centrality measure, with the lowest total rating is Degree centrality. This SNA tool is very simple, and it describes only nodes. It is useless in describing nodes position in network, its prestige or any another attributes of nodes. According to these facts its total rating has reached only 3 points.

## **5 Conclusion**

Results of our test reveal, that the best tool for analysis of nodes and network of international treaty networks, is Betweenness centrality, with the highest reached rating consisting of 9 points. Another centrality measures as Closeness centrality and Eigenvector centrality have reached 5 points score. Finally, SNA tool with lowest rating is Degree centrality, that has reached only 3 points in total rating. According to these results we can say, that most suitable SNA tool for international treaty networks analysis is Betweenness centrality. With this tool we can identify structural holes that behave as a bridge between countries with no direct connections to tax heavens and tax heavens through intermediary node, or country. Then also suitable tools are Closeness centrality and Eigenvector centrality. From these two we assume that according to their very common interpretation Closeness centrality is more suitable, as far as Eigenvector centrality is more common tool in directed networks.

According to these findings and results, countries, governments may in future use presented SNA centrality tools for their predictions in field of international taxation and

combat thus aggressive tax planning by companies. On the other hand, companies located in other country can use network to help them in decision making, when investing in countries. As far as it is not illegal to use international treaties. However, it is important to mention, that is not legal to abuse them

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# APPENDIX

Table 2) Results of SNA tools test

SNA centrality tool	Short description of tool	Suitability for network of BTT	Special positive aspects of tool	Shortcomings of tool	Ease of results interpretation	The contribution of the tool to understanding how the network works	TOTAL RATING
Degree centrality	It is a relatively simple way to measure the degree of centrality of a node. The CD value is given by the number of bindings that the node in the network acquires. The indicator does not talk about the structure of the network, it only characterizes the node.	(non -1 point/ week +1 point/ average +2 points /strong +3 points)	(Each aspect +1 point)	1) it only describes the properties of the node, not the entire network (-1 point)	great (+ 2 points)	good (+ 1 point)	3 points
Closeness centrality	If a point is located on the periphery of the network, its distance to all other points in the network is greater than for points in the core of the network. The value of closeness centrality is calculated using the reciprocal value of the sum of the distances of the points to a given point, the edge points of the network will have lower values in the denominator due to the larger value. In contrast to the CD indicator, which was focused only on the characteristics of the point, in the case of the CC indicator we can talk both about the characteristics of the point and partly about the characteristics of the network.	average (+ 2 points)	1) it not only describes the properties of the node, but also properties of the entire network (+1 point) ..... 2) it can be used to specify periphery (possible tax heavens) and core of network (+1 point)	1) Not all nodes (countries) located on periphery of network has to be "tax heavens", thus it is needed to special detach real tax heavens from jurisdictions with low connections through BTT to other countries (-1 point)	good (+ 1 point)	good (+ 1 point)	5 points
Betweenness centrality	The CB indicator is a characteristic of a node. The CB expresses the probability of the shortest route between two points leading through the point being monitored. If the monitored node is used less times to create the shortest paths when connecting nodes, the CB value will be closer to zero. Such nodes, which are not located inside the network, but on the contrary on its periphery, will acquire values closer to zero. However, it should be noted that BC differs from the other mentioned methods of centrality measurement in that the larger the CB value of a given node, the more frequent the passage through the given node, while maintaining the assumption of passing the shortest routes.	strong (+ 3 points)	1) tool has great ability to reveal the most important nodes of network in case of transmitters of income to periphery of network (possible tax heavens) and other countries (+1 point) 2) presence of high values of centrality is a great evidence of network imperfections (+1 point)		great (+ 2 points)	great (+ 2 points)	9 points
Eigenvector centrality	The degree of prestige is also determined by SNA, especially in the field of sociology. Prestige is mostly monitored in the case of graphs in which the edges have a given direction. The point with the highest degree of prestige is characterized by the fact that it is connected by a number of one-way edges pointing from other nodes towards this node.	strong (+ 3 points)	1) even if in our type of network, we do not have edges with directive, it is still possible to use this tool to find the most prestige nod/country, that may pay important role in profit shifting (+ 1 point)	1) tool is more suitable for networks with the direction of the interaction, thus it can be replaced by degree centrality at some types of network(- 1 point)	good (+ 1 point)	good (+ 1 point)	5 points

# Impact of Shared Airbnb Accommodation on the Local Population

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**Abstract.** In this paper, we monitor the impact of shared Airbnb accommodation on the local population. The methodological approach is to divide the impacts of this type of hostel into three groups according to the three pillars of sustainability: economic, social and environmental. We obtain primary data using the method of marketing quantitative research by the standardized survey through a structured questionnaire. The survey took place online from 03.11.2021 to 21.11.2021 on a sample of 556 respondents. Among other things, the respondents stated that they anticipate further development of shared accommodation in Slovakia, but we found in our survey a relatively high degree of inability to take a stand on the elements we examined. This means that many people in Slovakia do not even have an opinion on shared accommodation yet, and perhaps it is high time to start forming this opinion right now.

**Keywords:** Sharing economy, Shared accommodation, sustainable tourism

**JEL classification:** L83, Q01

## 1 Introduction

Over the last decade, we have witnessed the growing popularity of the sharing economy, literally on a global scale. Shared accommodation platforms have experienced a particularly strong increase in users and thus occupy a significant place in the sharing economy. Both parties benefit from the P2P (Peer-to-Peer) system of shared accommodation - users can offer their services for a reward, while the platform administrator ensures the functionality of the place of supply and demand, for which he receives a commission. One of the most popular and most frequently discussed examples of this mechanism is Airbnb.

Platforms such as Airbnb allow individuals to take on the role of micro-entrepreneurs and act as hosts offering accommodation to tourism operators for a fee. Visitors, tourists who use this type of accommodation, on the other hand, can benefit

from an exceptional experience of true authenticity of the local population. Sometimes the host even interacts with the guest, which introduces him to local attractions and traditions. What impact does this new phenomenon have on the local population, which does not directly participate in the processes described above? How do local people view shared accommodation in terms of sustainability? These are the questions that prompted us to research this issue.

## 2 Methodology

The main aim of the article is to find out how a selected group of Slovak residents perceives the impacts of shared accommodation in Slovakia within the three pillars of sustainability.

Firstly, to meet the main goal, the study of theoretical resources of the literature was the basis of the compilation of the literature overview. The study of theoretical resources of the literature and the analytical-synthetic method was a process that subsequently helped in building the practical part of this paper.

Secondly, we obtained primary data using the method of marketing quantitative research by the standardized survey through a structured questionnaire. The survey took place online from 03.11.2021 to 21.11.2021 on a sample of 556 respondents. From the total number of respondents, we obtained 553 answers that were complete and suitable for further processing. The survey involved 363 women, 187 men, and 6 respondents refused to state their gender. The average age of the respondents was 26 years, with the youngest being 14 years old and the oldest 65 years old. 385 respondents have been using shared Airbnb accommodation for an average of 3 years, the other 168 respondents have asked for their theoretical views because they have not yet had their own experience with shared accommodation.

To meet our objectives, we used the following research methods:

- comparison and analysis of the source of publications on the chosen topic and synthesis of the identified approaches and theories to understand the interrelationships of the issue,
- a method of scientific abstraction to identify and disclose irrelevant information,
- a method of deduction aimed at formulating the main areas of research,
- collection, critical analysis, and synthesis of collected data from secondary sources,
- the method of marketing quantitative survey by standardized inquiry through a structured questionnaire,
- graphical methods aimed at clarifying the information obtained and basic statistical methods for primary data processing (average):

$$x = \frac{1}{n} \sum_{i=1}^n x_i$$

### **3 Results**

#### **3.1 Literature review**

Today, tourism services include a whole called the "shared economy". The name shared economy implies that the subject of this part of the economy is sharing, ie the use of not fully utilized (Schor and Attwood-Charles, 2017). There are several designations for a shared economy - shared consumption, collaborative economics, collaborative economics, or non-proprietary lifestyles (Wu and Zhi, 2016). Other names follow from the nature and degree of development of access economy, peer economy, platform economy, and digital economy (Görög, 2018).

Most authors define a shared economy in terms of providing temporary access to unused assets to other consumers using a peer-to-peer model (Botsman, 2013; Oxford learners dictionary, 2020; Cambridge dictionary, 2020; European Commission, 2020; Frenken et al. 2015; Grit, 2020). Manifestations of the sharing economy in tourism can therefore be observed mainly in areas such as accommodation (best known are Airbnb or HomeAway), catering (EatWith, BonAppetour, EatFeastly), transport (Uber, Lyft, BlaBlaCar or Bolt), guide services (Vayable, ToursByLocals or WithLocals) (Gajdošíková, 2018) and others. The first Airbnb mentioned is the subject of this contribution.

The term sustainable tourism can be understood as the application of the concept of sustainable development in tourism. At present, however, the term "sustainable tourism" is beginning to replace the new term "responsible tourism", within which active care for the life of the current and future generation in a certain environment is key (Novacká, 2013). Contu et al. (2019) point to several scientific papers that distinguish three main areas (pillars) of sustainability, namely economic, social and environmental sustainability.

Economic sustainability refers to the ability to create prosperity at different levels of society and to address the cost-effectiveness of all economic activities.

Social sustainability is about respecting human rights and equal opportunities for all members of society. Novacká (2013) expands the pillar of social sustainability by three dimensions, namely the dimension of social development of the local population and the positive result of tourism activities in the locality, the dimension of a social approach to company employees and the dimension of social responsibility of the region, association or company.

Environmental sustainability refers to the ability to conserve and manage resources, especially those that are not renewable or valuable in terms of life support.

#### **3.2 Survey results**

In this article, we divide the results of the survey according to the three areas to which the statements related thematically. The methodological starting point is the three pillars of sustainable development.



### **Economic aspects**

We followed respondents' views on the economic aspects of Airbnb through nine statements, to which they were assigned an answer expressing the degree of their identification with the statement.

These were directed mainly to the areas of state economic income, the gray economy, rising real estate prices and rising real estate rental prices. Of the 553 respondents, 240 (43.4%) agreed that shared Airbnb accommodation contributes to the state's economic development (6% of respondents). 163 (29.5%) respondents could not express themselves. As many as 359 (64.9%) respondents agreed or fully agreed that shared Airbnb accommodation contributes to the increase in consumer sales in this area of accommodation and 141 (25.5%) marked the answer "do not know". Furthermore, 280 (50.6%) respondents believe that shared Airbnb accommodation contributes to the development of the gray economy (eg non-taxation of income, non-payment of levies, ...), 203 (36.7%) respondents could not express their opinion and 70 (12.7%) respondents did not hold this opinion. 238 (43.0%) respondents claim that shared Airbnb accommodation contributes to the growth of the price level of real estate in the vicinity of the offer, 199 (36.0%) respondents were neutral, and 116 (21%) respondents disagreed with this statement. When asked whether shared Airbnb accommodation causes an increase in the price level of long-term rental properties around the offer, 231 (41.8%) respondents answered in the affirmative, 216 (39.1%) respondents could not answer and 106 (19.2%) did not agree with the statement. 384 (69.4%) respondents thought that shared Airbnb accommodation is a more attractive source of income for accommodation owners than the long-term rental of the property. As many as 466 (84.3%) respondents are convinced that shared Airbnb accommodation has a positive impact on the development of tourism in Slovakia, and only 66 (11.9%) could not answer, or only 19 respondents (3.8%) claimed the opposite. Similarly, 485 (87.7%) respondents believe that shared Airbnb accommodation increases the possibility of tourism growth in their district. The last statement within the economic aspect of shared accommodation was that shared Airbnb accommodation is experiencing growth and the number of offered accommodation facilities in Slovakia will continue to grow in the future. 404 (73.1%) respondents agreed with this statement, 133 (24.1) respondents took a neutral position and only 16 (2.9%) were against this statement.

### **Social aspects**

As part of the social aspects of the occurrence of shared Airbnb accommodation, we again offered the respondents several statements (a total of thirteen) and they were asked to express the degree of identification with this statement.

First, 367 (66.4%) respondents perceived the opportunity to meet new people due to the presence of Airbnb shared accommodation in their vicinity positively, 165 (29.8%) neutral, 18 (3.3%) negative, and 3 respondents (0.5 %) could not express themselves. 434 (78.5%) respondents would perceive contact with foreign languages due to the potential occurrence of Airbnb shared accommodation in their vicinity positively or very positively, 102 (18.4%) neutral, only one (0.2%) respondent would be negative and 4 (0.7%) cannot assess. Similarly, 419 (75.8%) respondents perceived potential

contact with another culture due to the occurrence of Airbnb shared accommodation in their area positively, 117 (21.2) responded neutrally and only 13 (2.4%) negatively. Four (0.7%) respondents could not assess this statement. As part of the prevention of racial discrimination due to Airbnb's shared accommodation in Slovakia, we recorded a greater degree of uncertainty, as 277 (50.1%) respondents expressed the same opinion, and up to 205 (37.1%) respondents could not confirm or refute this statement and 71 (12, 8%) disagreed with him. 429 (77.6%) respondents would like to introduce Airbnb guests to the local environment, customs and traditions, 99 (17.9%) respondents were unable to take a stand on this statement and only 25 respondents were against such a move. Similarly, as many as 411 (74.3%) respondents to our survey thought that Airbnb shared accommodation in Slovakia supports the convergence of cultures, 108 (19.5%) respondents were neutral and only 34 (6.1%) did not. On the other hand, 421 (76.1%) respondents agreed with the statement that shared accommodation Airbnb in Slovakia supports the presentation of Slovak culture and customs to a greater extent than conventional forms of accommodation (eg hotel), 86 (15.6%) could not answer, and only 46 (8.3%) thought the opposite.

In the second half of the section, we focused our attention on statements with potential equative effects of shared Airbnb accommodation in Slovakia. In the case of the possibility of disturbing their privacy by Airbnb shared accommodation, 270 (49.0%) respondents expressed negative to very negative concerns, 212 (38.3%) took a neutral position and only 34 (6.1%) respondents considered the possibility of disturbing their privacy. considered unlikely or unobtrusive. In connection with the potential occurrence of Airbnb shared accommodation in the vicinity of respondents, 261 (47.2%) would perceive the possibility of a clash with guests staying in shared Airbnb accommodation as neutral, 217 (39.2%) respondents would accept this option, and 69 (12.5%) respondents would like to avoid such situations. In connection with the potential occurrence of Airbnb shared accommodation in the vicinity of the respondents, 279 (50.5%) respondents would consider the possibility of a threat to their safety, and 232 (42.0%) would be neutral or would not feel such a threat. 34 (6.1%) respondents excluded this type of threat. 306 (55.3%) respondents considered the possibility of non-compliance due to the occurrence of shared accommodation as probable and negative to very negative, 183 (33.1%) took a neutral position and only 60 (10.8%) respondents would not be hindered. Similarly, non-compliance with night rest due to the potential occurrence of Airbnb shared accommodation in their vicinity would be perceived by 314 (56.8%) respondents as negative to very negative, 167 (30.2%) neutral and only 68 (12.3%) respondents would not be hindered. 284 (51.4%) respondents feared a threat of lack of parking spaces due to the potential occurrence of Airbnb shared accommodation in the area, 190 (34.4%) respondents took a neutral position and 71 (12.8%) respondents this option was not negative, or likely negative impact on their lives.

### **Environmental aspects**

As in previous cases, we analyzed the respondents' opinion on the environmental aspects of shared Airbnb accommodation in Slovakia through statements (a total of five statements) and the degree of their identification.

331 (59.9%) respondents agreed with the statement that Airbnb shared accommodation in Slovakia is in line with the idea of a sustainable lifestyle, 179 (32.4%) could not answer and 43 (7.8%) did not agree, or completely disagreed. 291 (52.6%) survey respondents thought that Airbnb shared accommodation in Slovakia has a positive impact on the environment (in Slovakia), 212 (38.3%) could not assess and 50 (9.0%) did not hold this opinion. But 337 (60.9%) survey participants thought that Airbnb shared accommodation in Slovakia was more environmentally friendly than its conventional forms (such as a hotel), 169 respondents (30.6%) could not express their opinion on this statement, and only 47 (8.5%) disagreed with him. Furthermore, 327 (59.1%) respondents thought that Airbnb's shared accommodation in Slovakia saved energy in accommodation tourism compared to its conventional forms (such as a hotel), 172 (31.1%) could not assess and 54 (9, 9, 8%) was of the opposite opinion. The last statement of this section was that Airbnb shared accommodation in Slovakia records lower water consumption in accommodation tourism compared to its conventional forms (such as a hotel). 249 (45%) respondents complained about this statement, 232 (42.0%) respondents did not know how to comment, and 72 (13%) participants surveyed had the opposite opinion.

## **4 Discussion**

The shared economy is a relatively frequent topic in Slovakia. In the shadow of shared accommodation, which can be found in almost the entire territory of Slovakia, we can observe its effects on the local population. Locals are aware of this type of accommodation in their area and are partly able to express their views and feelings that this accommodation evokes in them. This encouraged us to examine the effects of shared accommodation in Slovakia on the local population, and we divide these impacts we examine according to the three pillars of sustainability into economic, social and environmental impacts.

Within the economic impacts of shared accommodation in Slovakia, we recorded relatively clear answers both within the monitored benefits and within the potential threats that shared accommodation brings with it. As many as 84.3% of respondents think that shared Airbnb accommodation has a positive impact on the development of tourism in Slovakia and even 87.7% are convinced that shared Airbnb accommodation contributes to the growth of tourism in the district in which occurs. Due to the fact, that this type of accommodation is more popular especially with younger generations, this accommodation can bring a new segment of clientele to Slovakia. Respondents also took a similar view. Furthermore, more than half of the respondents expressed the view that shared accommodation contributes to the economic development of the state and defended these claims both in the case of increasing sales of consumer goods in the area

(50.6%) and in the area of income generation for such accommodation (69.4%). But this can pose threats that respondents are aware of. For example, 50.6% of respondents are concerned about the development of the gray economy in the form of non-taxation of income or non-payment of levies. Thus, shared accommodation also opens the door to micro-entrepreneurs and other less experienced people who want to try to provide accommodation services, but the respondents are also aware of the possibility of growth of the gray economy, which is reducing the state's income. Respondents also expressed concern about the creation of inflationary pressures. 43.0% of respondents are concerned about the growth of the price level of other real estate in the vicinity of the offer and 41.8% of respondents are concerned about the growth of the price level of long-term rental real estate in the vicinity of the offer. On the other hand, residents can also use this real estate price increase for their personal gain. The disappointment was that on average one in four respondents in the section answered "I don't know". This means that respondents are not sure about economic issues or do not have a sufficient overview of the issue and its potential impacts.

The second aspect examined was the social aspect. Respondents were neutral (47.2%) to slightly positive (31.1%) about the possible interaction with the guest accommodated in the shared Airbnb accommodation. It is possible to assume that many respondents have already met some accommodated guests in their vicinity, but they did not notice it themselves. Furthermore, respondents were in favor of meeting new people (66.4%) and contact with foreign languages (78.5%) or contact with another culture (75.8%), which confirms that, in their opinion, Airbnb can be a tool for convergence. cultures (74.3%), they welcome this approach and almost every second (50.1%) thinks that shared Airbnb accommodation in Slovakia helps to prevent racial discrimination. Racial discrimination, interpersonal relationships and a lack of understanding of other cultures are relatively common topics in Slovakia, but respondents are of the opinion that shared accommodation can help eliminate these problems. The presence of authentic tourists from other countries can bring understanding and reduce the negative consequences of the diversity of the population of Slovakia. Regarding the negative social aspects of shared accommodation in Slovakia, respondents were aware of the possibility of disturbing their privacy (49.0%), security threats (50.5%) or disturbing the night (56.8%). In the case of shared housing, 55.3% of respondents were aware of the possibility of non-observance of night rest and 51.4% of respondents feared the possibility of a lack of parking spaces due to the occurrence of shared accommodation in their vicinity. It is a pleasant finding that respondents are also aware of the potential negative consequences of shared accommodation and can comment on them. Slovakia is already facing this problem (eg security threats, lack of parking spaces, etc.) even today, and local governments are already looking for tools to regulate these negative effects. Finally, we made two statements comparing shared and traditional accommodation from a social perspective. Three out of four respondents (76.1%) say that shared Airbnb accommodation in Slovakia supports the presentation of Slovak culture and customs to a greater extent than conventional forms of accommodation (eg hotel) and very similarly, 77.6% of respondents would like to introduce these guests environment, customs and traditions.

The third category was the environmental side of shared accommodation in Slovakia. As in other countries of the European Union, environmental issues are current in Slovakia.

## **5 Conclusion**

Shared tourism services have undergone a transformation from a social to a commercial basis and are experiencing constant growth and development. This was confirmed by our research. In this paper, we examined the perception of the effects of shared Airbnb accommodation on the local population. The methodological approach was to divide the impacts into three groups according to the three pillars of sustainability.

Within the economic aspect, we noted the prevailing view that a shared economy is beneficial for individual subjects of the state, but respondents are also aware of the threats that this type of accommodation brings. Within the social pillar, it can be stated that the inhabitants of Slovakia are inclined to tourists who stay in this type of accommodation and do not resist the idea of sharing customs and traditions with them. However, the inhabitants of Slovakia are also aware of the pitfalls that will need to be regulated through appropriate tools. From the point of view of the environmental pillar, this type of accommodation is more sustainable in the eyes of the inhabitants of Slovakia than its conventional forms (hotel) and brings many benefits.

An interesting finding is that many Slovaks did not have an opinion on many elements of shared Airbnb accommodation in Slovakia, almost one in three reached the answer "I do not know" or "neutral", which means that there is still a high level of unknowns around this issue. However, this will certainly change in the future because most people think that the offer of accommodation facilities in Slovakia will continue to grow in the future and we will encounter this phenomenon more and more often.

## **6 Limitations & Research Extensions**

This paper contains an initial look at the partial results of our survey. The collected data will in the future be subject to econometric analysis, which will result in conclusions for practice. At the same time, we plan to conduct the same survey in another country of the European Union and compare the results of the surveys.

## 7 Acknowledgements

The article was elaborated within Project of young teachers, researches and doctoral students in full-time study No. I-22-101-00 Impacts of the shared economy on the local population in the selected locality.

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# The Future of Retail in City – Centers

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**Abstract.** The dynamically changing retail area can be viewed from several perspectives. The aim of the article is behavioral research. It is aimed at generation Z young people and their consumer behavior in the field of retail in the centers of large cities in Slovakia. In particular, it is possible to place retail in shopping malls, on shopping streets or outside city centers. In this article we apply mainly the quantitative method through a standardized questionnaire. The result will be a comparison of Z generation responses. Finally, we evaluate the advantages and disadvantages of these retail placement options, which will be considered in future research. The results can be used as a basis for future research.

**Keywords:** retail, shopping centres, shopping streets, city centers, generation Z

**JEL classification:** M30, D90

## Introduction

An elementary input to any analysis in the field of retail research is the knowledge of consumer behavior and customer preferences. However, several elements are key indicators. The answer to the question of why research in the field of retail is so common is the ever-changing situation. We are currently living in a time when almost every type of retail has transformed into an online environment. It is important to note that the current world is hit by a global pandemic, which has resulted in a sudden shift to online buying/ selling. Retail needs to monitor market changes and adapt quickly. Particular attention should be paid to the young generation, which feels at home in the online world.

The aim of the article is behavioral research. It is aimed at generation Z young people and their consumer behavior in the field of retail in the centers of large cities in Slovakia. In particular, it is possible to place retail in shopping malls, on shopping streets or outside city centers. The article is created as a basis for future research.

Retailing in city centers is important to explore from a variety of perspectives. Above all, these are large cities where the Z generation moves very often due to the

opportunities that arise here. There can be several jobs as well as study opportunities that occur here. It should also be noted that the world wants to change and be more ecological to the environment. It is therefore important to adapt metropolitan centers to consumer requirements, i.e. to take account of purchasing power and also to take account of the above fact.

## **1 Methodology**

The presented article can be characterized as analytical in terms of the methods used. The methods used correspond to this character, and these are general scientific methods, especially analysis and synthesis at all stages of solving the problem in question. We also use other scientific and philosophical methods such as induction and deduction, the method of abstraction, the method of comparison and others. In this article we apply mainly the quantitative method through a standardized questionnaire.

The aim of the article is behavioral research. It is aimed at generation Z young people and their consumer behavior in the field of retail in the centers of large cities in Slovakia. In particular, it is possible to place retail in shopping malls, on shopping streets or outside city centers.

To achieve the above goal, it is necessary to find answers to the following research questions:

Q1: What types of retail Z generation prefer in city centers?

Q2: Does the Z generation prefer retail either on the main street or in shopping malls?

From the point of view of the nature of the research, it can be stated that it is a primary research. Quantitative data collection includes statistical data, percentages, etc., which are obtained from various surveys, questionnaires or by processing of existing statistics. The effective implementation of quantitative research consists in the systematic collection of data through questionnaires (Fennetteau, 2015). The elaboration of the questionnaire consists in the formulation of a set of questions and the diversity of answers and their arrangement so that the provided answers allow to introduce the relevant results into the study problem after data analysis (Boulan, 2015).

## **2 Results and Discussion**

### **2.1 Literature review**

The retail sector is very important for Europe. Its added value lies mainly in employment. This sector is constantly affected by developments, new trends, digitization as well as changes in consumer preferences and habits, all impact the retail sector. Retail is one of the biggest sectors in Europe in terms of the number of enterprises active and individuals employed. There are nearly 5.5 million enterprises active in the retail and wholesale sectors, which comprises approximately 23% of all non-financial businesses in the EU economy (Snijders, 2019).

Due to the cumulative attractiveness and synergy that various nearby stores create between each other, there is a tendency for retailers to agglomerate in certain



geographic areas (Berman, Evans, 2007). These places can be called “retail agglomerations” (Teller, 2010) and main street retail districts and shopping malls are the two main types that strive to attract consumers. This typology is based on the characteristics of how they are planned and constructed, and consequently how they are managed and integrated in the market as a whole (Parente, 2012).

With the arrival of shopping centers in most cities, the importance of traditional retail districts is declining. However, public policy makers have been attaching renewed importance to these traditional districts as part of the movement to revitalize city centers in various countries, although this is still incipient in the world. (Thomas, Bromley, Tallon, 2006)

Retail - both online and brick-and-mortar- forms the basis for local economies, our workforce and community in the world. The pandemic hit the world in March 2020, and since then trade disruption has accelerated dramatically and the time has come for innovation in the retail sector. City leaders now have a unique opportunity to help shape the retail environment in ways that realize their community's vision for the future (Geraghty, 2021).

The advantage of e-commerce is convenience and time savings, but it lacks physical retail's sense of occasion, which, last but not least, creates experiences, intensive customer service and more. In the future, the key to success is likely to lie in economic and demographic diversity and local character. It is expected that after the pandemic we will be able to see a more significant recovery than expected in the area. The use of retail space will take on a new dimension, although not across the board. Larger cities are well placed to absorb the economic impact, but smaller urban centers may need a long-term, creative approach to stimulating recovery (Turner, 2021).

The Institute for Future Cities is embarking on a 2 years AHRC funded research project to explore the future of cities centres around the world, looking not only at retail but the other changes which are occurring in city centres. Alongside partners at the Universities of Northumbria (UK), Newcastle (Australia), Pretoria (South Africa), and Paraiba (Brazil), the project will explore how to understand the changes in – and pressures on – city centres across the globe (Rogerson, 2020). This initiative is being led by international academic researchers from the UK, Australia, South Africa and Brazil.

## **2.2 Description of the questionnaire**

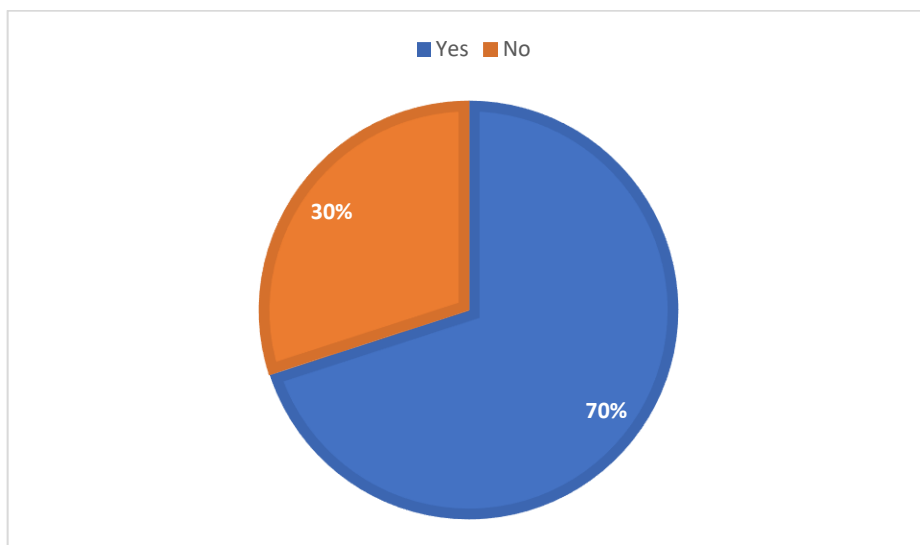
The author of Ortolang defines a questionnaire as a set of written or oral questions to which a person is exposed or to which should be answered, a handwritten or printed document listing a question (Ortolang, 2018). The respondents to the questionnaire are Generation Z (1996 and later), specifically a selected sample of 100 people.

The questionnaire was sent via the website to students of the University of Economics in Bratislava within the subject of business operation, where topics related to research were discussed. The research lasted one month, during the months of October and November 2021. As a result, the mentioned 100 respondents represented a representative sample, mainly it was about young people - Generation Z. This is the

first online generation that has not experienced a world without the Internet. It is seen as the driving force behind economic and innovation in the world. The characteristic word for this generation is multitasking, they do not have enough time and therefore are forced to do several activities at once.

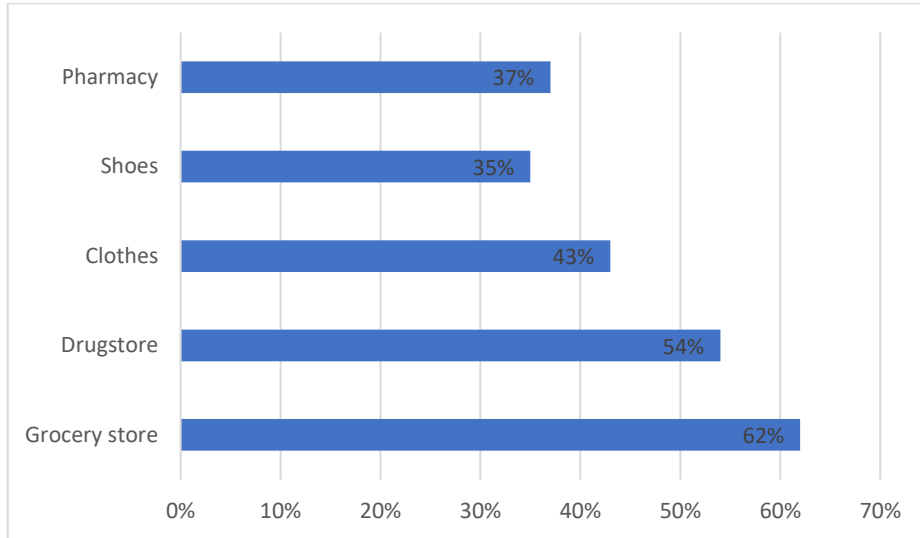
The questionnaire entitled "The future of retail in city centers" contained three sections: retail in city centers, shopping streets or shopping malls, and demographic data.

### 2.3 Retail in city centers



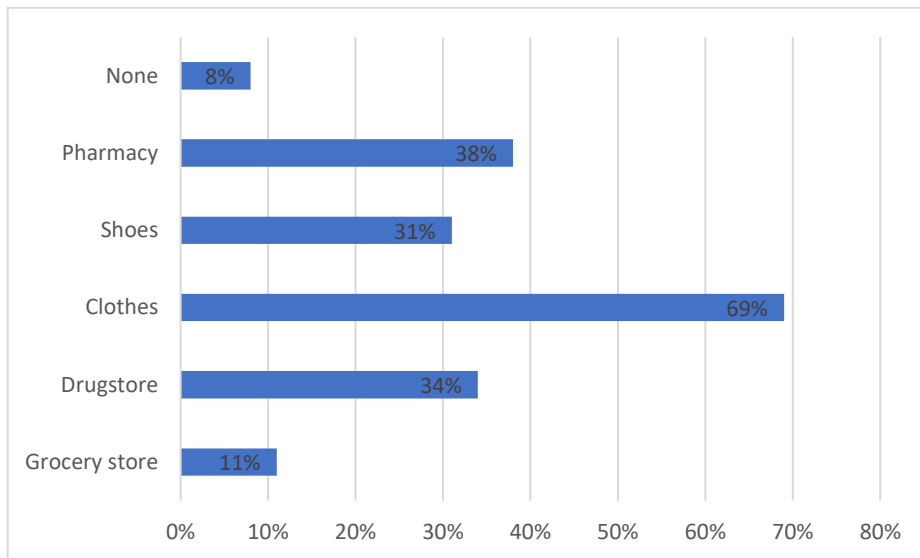
**Graph 1** Do you shop in retail stores directly in city centers? (Source: Own processing)

City centers attract people and thus customers for retail shops. As many as 70% of respondents answered in favor of retail in city centers.



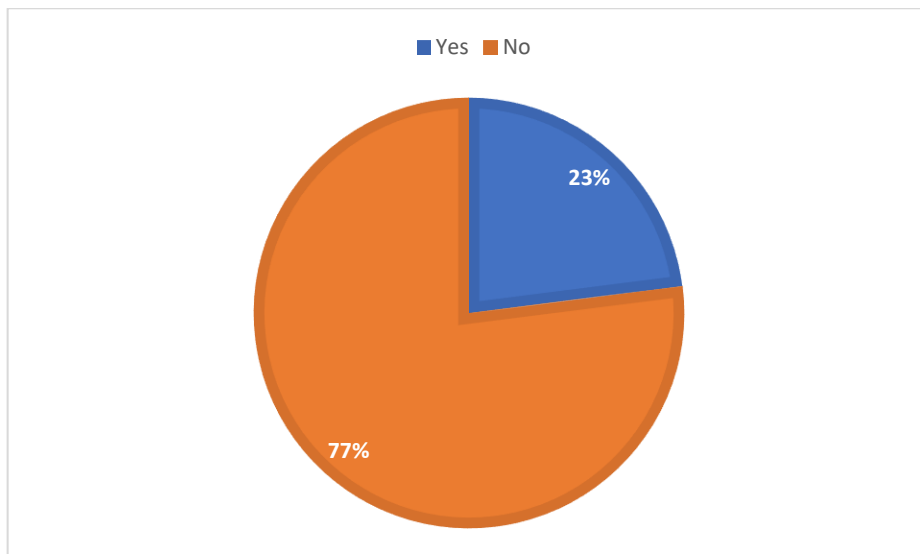
**Graph 2** What kind of retail do you prefer in city centers? (Source: Own processing)

The Graph 2 shows that consumers are most pleased with food retail or supermarket in city centers. It can be stated that food belongs to the essential needs of each of us and therefore it is practical to place them in the centers of cities where a large number of people are constantly moving.



**Graph 3** Which of the offered goods can you imagine shopping only online? (Source: Own processing)

With a significant difference, young people point out what they buy the most online. It's just the clothes compared to the other categories listed. On the contrary, they buy food online least often.



**Graph 4** Can you imagine city centers without any retail? (Source: Own processing)

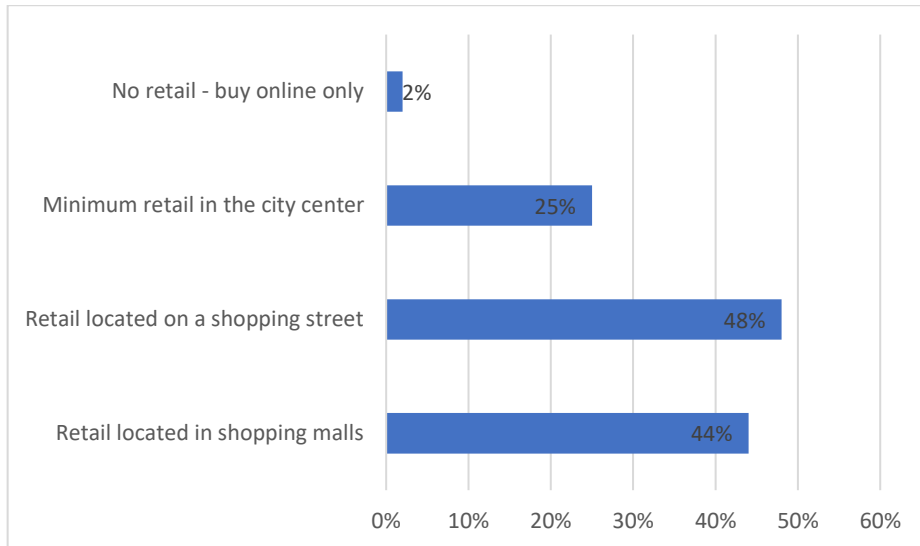
The answer to the above question is clear. Most of the young current generation cannot imagine city centers without retail. Only 23% of them chose the option without shops located in the city centers.

#### 2.4 Shopping malls and shopping streets

**Table 1** Do you prefer shopping malls or shopping streets in city centers? (Source: Own processing)

	Shopping malls	Shopping streets
Yes	55%	65%
No	45%	35%

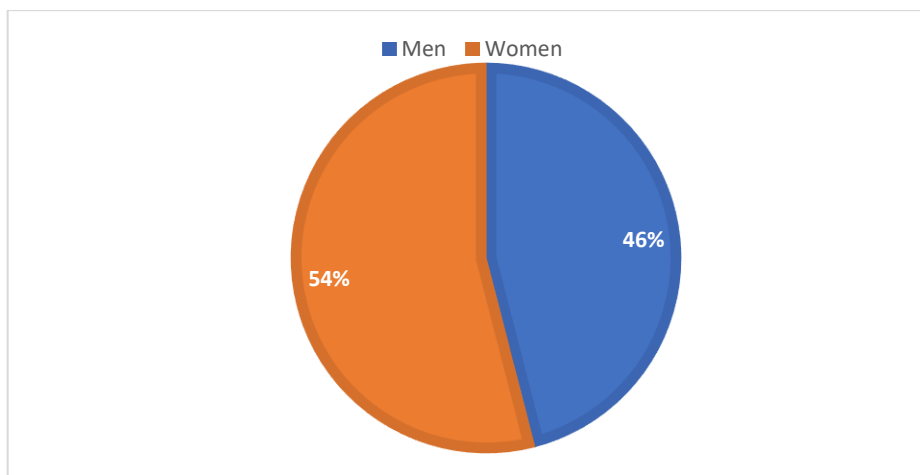
Table 1 shows consumers' view of shopping malls as well as shopping streets. We see that shopping streets in city centers have received 10% more positive reviews.



**Graph 5** The future appearance of city centers (Own processing)

Graph 5 shows us a clear answer. People can't imagine shopping just online and they also prefer retail located in city centers. The minimal difference, only 4%, is between the idea of placing retail in shopping malls or creating shopping streets in city centers. People are more inclined to shopping streets than we can see in the world. Popular shopping streets include Mariahilfer Straße, Oxford Street, Champs-Élysées and others.

## 2.5 Demographic data



**Graph 6** Distribution of respondents according to gender (Source: Own processing)

Demographic data present a sample of 100 respondents. As we can see in Graph 6, the sample consisted of only 8% fewer men than women. The age of the respondents was limited between 18 and 25 years of age, with the largest sample being people aged 25 years.

## 2.6 Summary

Here are the answers to our research questions.

“Q1: What types of retail Z generation prefer in city centers?”

The results show that Generation Z prefers supermarkets in city centers. However, it is also necessary to take into account the error rate due to the method of sample selection. They also consider a drugstore necessary. Both groups belong to the basic necessities of life. Clothes and shoes are a category in themselves, but young people also prefer their presence in city centers. Generation Z considers a pharmacy to be the least necessary retail in city centers.

“Q2: Does the Z generation prefer retail either on the main street or in shopping malls?”

Z generation likes shopping streets more than free-standing shopping malls in city centers. This may be related to comparisons abroad. There are many popular shopping streets in the world's capitals with luxurious and beautifully decorated windows. Although it should be noted that the difference was not very significant, it was only 4%. Also, it is important to note the deviation due to the method of sample selection.

## Conclusion

The aim of the article was behavioral research. It is aimed at generation Z young people and their consumer behavior in the field of retail in the centers of large cities in Slovakia. In particular, it is possible to place retail in shopping malls, on shopping streets or outside city centers. The goal can be considered fulfilled.

Retail is currently undergoing changes. It is linked to the pandemic situation in the world. Most stores were forced to move to the online environment. A generation of young people have been working with the Internet almost since birth. It is thanks to this fact that this part of the population made up the research sample. Even with the current facts, they cannot imagine shopping only online in the future. It is essential to continue to address the issue of urban retailing.

In general, it can be stated that retail in city centers has its place. Just look abroad, the famous shopping streets in the world's capitals are known to each of us. The young generation of people prefer such a location of shops, shopping streets in city centers. It cannot be said that shopping centers are lagging behind. But it is better to build them on the suburb of the city than in the center itself. However, it is also necessary to take into account the error rate due to the method of sample selection.

Based on the above, it follows that the preconditions for future research are clear. Placing retail in city centers has the potential as people cannot imagine shopping online. They also prefer shopping streets full of shops compared to shopping malls.

## **Acknowledgement**

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# Awareness and Perception of Intercultural Competence among Expatriates Living in Slovakia

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**Abstracts.** In an age where connections around the world have become commonplace, intercultural competence is undoubtedly a valuable asset. Every day, both at work and in private life, we encounter people from different countries and cultures who are likely to hold different values and beliefs than we do. It is for this reason that intercultural competence is important - and essential in today's world. The present paper focuses on the perception and awareness of intercultural competence among expatriates living in Slovakia. In the first part of the paper, we discuss the theoretical concepts of intercultural competence. In the practical part, we evaluate the results of a questionnaire that aimed to determine the awareness and perception of CQ among expatriates living in Slovakia. The main findings, among others, show that despite the importance of the topic, expatriates in Slovakia do not consider themselves interculturally competent, as well as that they are not provided with sufficient training in this area on the employer's side. The paper concludes with practical recommendations.

**Keywords:** intercultural competence, expatriates, cross-cultural adjustment

**JEL:** M14, D83, Y80

## 1 Introduction

It is estimated that labour migration will increase with the increase in globalisation, due to the fact that developed countries will experience a shortage of skilled labour in certain age categories of the working population. This will require more migrant labour to fill the gap. With increasing globalisation, the world can expect to see even more migration of workers across international borders, especially from lower-income countries to higher-income countries. The term migration is also associated with many challenges that expatriates face when changing their home country. For expatriates to integrate seamlessly into a new cultural environment, it is important that they possess certain intercultural knowledge and skills that will make it easier for them to operate in a new culture. Slovakia is one of the countries where the

number of foreign residents is relatively high due to the fact that many international companies and corporations outsource their business activities from Slovakia. Significant changes in the management of corporate processes and especially the application of lean management have led to the increasing use of outsourcing in the search for ways to reduce costs. The simple form of delegating non-core activities to an external supplier has become popular also thanks to the fact that it allows companies to prefer their core business, to perform the most important activities more efficiently and to focus on innovative development. According to data from the end of 2021, as many as 53,770 foreign entrepreneurs own business entities in Slovakia.<sup>1</sup> This is also one of the factors which is the reason for the relocation of foreign workforce to Slovakia. According to the statistics of the Central Office of Labour, Social Affairs and Family of the Slovak Republic, as of May 2022, 21,758<sup>2</sup> third-country nationals with an employment permit in the Slovak Republic and 30,696 citizens of EU/EEA countries with an information card are working in Slovakia. According to HRL (Human Rights League), it is estimated that more than 10% of the capital's population is made up of foreigners<sup>3</sup>. As integration into a new culture brings with it certain challenges, the present article will discuss the importance and awareness of intercultural competence among expatriates living in the territory of the Slovak Republic. Based on quantitative methods, in the form of a questionnaire, we will try to find out what the awareness level of this phenomenon among expatriates who have decided to operate in Slovakia is, whether they have sufficient knowledge about intercultural competence, despite the fact that this competence is taken for granted among foreigners. Last but not least, the aim of the paper is to raise awareness of this issue in Slovakia, which would facilitate the integration of foreigners into the Slovak cultural and working environment.

## 2 Theoretical and conceptual background

### Cultural intelligence (CQ) of an expatriate

CQ is a concept that has evolved within a specific research paradigm, namely multiple intelligences (Gardner, 1993). Earley and Ang (2003) introduced the concept of cultural intelligence (CQ). The authors define it as an *individual's ability to function effectively in situations that are characterized by cultural diversity*. Cultural intelligence can also be defined as *a person's ability to understand cultural differences and be able to manage them in different cross-cultural settings* (Ang et al, 2007). Intercultural competence is considered to be a type of mental process that incorporates *what, when, why and how* is related to culture. Cultural intelligence provides a platform for an individual to seek answers to questions related to cultural differences and further enables an individual to think, understand and behave in a cross-cultural environment. Triandis (2006) argues that CQ can be achieved if an individual avoids judgement until

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<sup>1</sup> finreport.sk

<sup>2</sup> upsvr.gov.sk

<sup>3</sup> hrl.sk

they acquired sufficient information. Thus, if a person has high cultural intelligence, they can function effectively not only within any culture but also across cultures (Ng & Earley, 2006).

From a theoretical perspective, CQ has four dimensions: (1) metacognitive; (2) cognitive; (3) motivational and (4) behavioural (Earley & Ang, 2003). Gooden, Creque and Chin-Loy (2017) state that these dimensions can be mutually reinforcing, and in some contexts, a particular combination has a significant impact on overall CQ.

**Metacognitive CQ** refers to the mental processes that individuals use to acquire and understand cultural knowledge, including knowledge and control over individual thought processes regarding culture. It includes strategic planning prior to intercultural interactions, adapting cultural knowledge when interacting with people with different cultural backgrounds, and monitoring the accuracy of cultural knowledge during intercultural encounters.

**Cognitive CQ** refers to expatriates' universal and culturally specific knowledge regarding the practices, norms, and conventions of different cultures. It also reflects their knowledge regarding different social, cultural, legal, and economic systems.

**Motivational CQ** is essential because it reflects expatriates' ability to engage in greater cultural learning (Xu and Chen, 2017). It involves a natural preference for interacting with people from different cultures, confidence in culturally different interactions, and coping with the stress of adjusting to unfamiliar environments. Individuals with high motivational CQ focus attention and energy on intercultural situations based on intrinsic interest and confidence in their intercultural efficacy.

**Behavioural CQ** refers to the ability of expatriates to perform cultural nonverbal and verbal activities when interacting with people with different cultural backgrounds (Lin, Chen, & Song, 2012). It means having a flexible and wide range of behaviours. An individual who has higher behavioural CQ is generally accepted by the associated group, which leads to better interpersonal relationships.

#### Emotional intelligence (EQ) of an expatriate

EQ and emotions are reported to play a key role in the intellectual functioning of expatriates (Salovey and Mayer, 1990). The concept of EQ was first proposed by Salovey and Mayer (1990), who defined it *as the enduring ability to understand, manage, identify, and use emotions, and subsequently use them in cognitive processing*. They divided EQ into three categories: (1) the appraisal and expression of emotions (in self and others); (2) the regulation of emotions (in self and others); and (3) the use of emotions in problem solving (i.e., creative thinking, flexible planning, motivation, and redirecting attention).

Evaluating and expressing emotions helps expatriates recognize the emotional reactions of others and develop a sense of empathy. Emotion regulation helps expatriates recognize their own and others' moods. This ensures estimation, control, and regulation of emotions. Using emotions to solve problems means that individuals with positive emotions can recall information that can help them solve problems creatively.

### Cross-cultural adjustment

Cross-cultural adjustment refers to the level of psychological comfort an expatriate enjoys in the host culture (Salgado & Bastida, 2017; Black & Gregersen, 1991). The literature specifies the following domains of intercultural adjustment (ibid): (1) adjustment to the general environment (level of comfort with general living conditions such as diet, medical facilities, and climate); (2) adjustment to interacting with the host country's citizens; and (3) adjustment to work (job and supervisory responsibilities and performance standards). Black's (1988) model of cross-cultural adjustment has been widely used in various studies.

The first category of cross-cultural adaptation includes factors that affect expatriates' daily lives, such as food, driving, shopping, living conditions, health care, and cost of living. The second category refers to the comfort level of expatriates in interacting and communicating with host nationals in different settings. Finally, the third category of cross-cultural adjustment is defined as the level of adjustment of expatriates with respect to their work and work environment (ibid). Cross-cultural adjustment is a primary and temporal outcome of expatriate assignment that can influence more distant or secondary expatriate adjustment such as job satisfaction, job strain (Hechanova, Beehr, & Christiansen, 2003), performance, and organizational commitment.

## **3 Methodology**

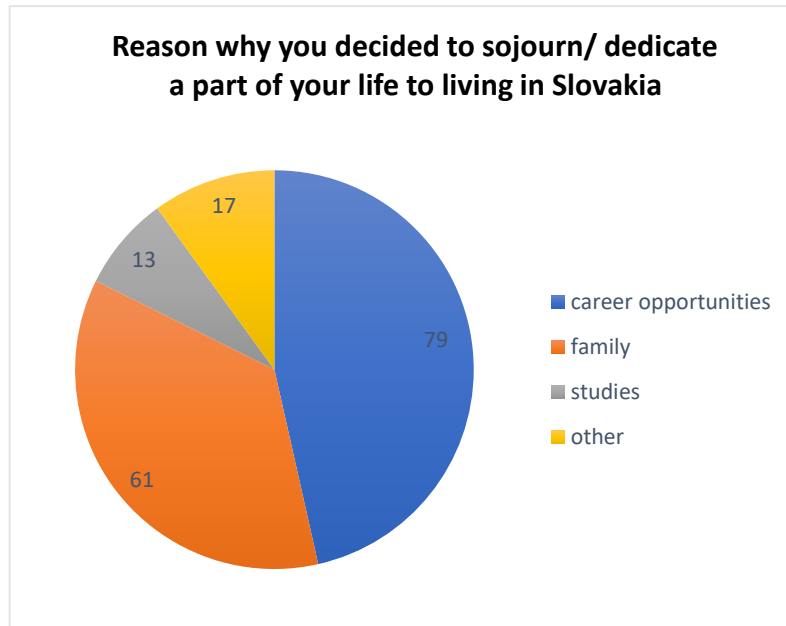
In the present article we focus on the awareness and importance of intercultural competence among expatriates living in the Slovak Republic. In the previous part of the article, we defined the basic theoretical and conceptual basis that serves for a better understanding of the issue under study. Of course, there are several approaches and perspectives on defining the concept, but due to the limited scope of the article and its needs, we have chosen the above theoretical approaches. As for the practical part of the paper, we have chosen a quantitative method in the form of an online questionnaire to investigate it. The aim of the questionnaire is, among other things, to find out whether expatriates working in Slovakia have sufficient knowledge about intercultural competence, despite the fact that this competence is taken for granted among foreigners. Last but not least, the aim of the paper is to raise awareness of this issue in Slovakia, which would facilitate the integration of foreigners into the Slovak cultural and working environment. In total, 170 expatriates participated in the questionnaire, which included open-ended and close-ended questions. After checking the completeness of the submitted data, we did not find any discrepancies and all responses were taken into account when processing and evaluating the results. The survey was conducted during the month of June 2022. Among other things, we tried to find out whether employers provide expatriates with sufficient training in this area and, last but not least, whether expatriates consider Slovakia to be an expatriate-friendly country, what the main pitfalls and obstacles, from the foreigner's perspective, await expatriates after their

arrival in Slovakia. Due to the variety of answers, we took into account those that appeared 10 or more times in the answers. Questions that occurred less than 10 times are not included in the charts, however, can be used to draw conclusions in the last chapter.

## 4 Results and discussion

### Reason why you decided to sojourn/ dedicate a part of your life to living in Slovakia

The first question we asked the expatriates was about the reason why they decided to come to Slovakia. As we can see in the chart below, one of the main reasons why expatriates come to Slovakia and decide to work there is *job opportunities* they have on the Slovak labour market. As mentioned above, Slovakia is one of the countries where the number of expatriates is relatively high due to the fact that many international companies and corporations outsource their activities from Slovakia. It is this option that is attractive for foreigners if their home country does not provide them with sufficient job opportunities or financial remuneration that they can be found in Slovakia. The second most common reason given by expatriates was *family*. In some cases, respondents also mentioned both options, i.e. job opportunities and family. 8% of the respondents (13) mentioned *studying* as the reason for their stay in Slovakia. We assume that in this case, these are Erasmus students who have been in Slovakia for a certain period of time. In this case, only the future will tell if they decide to stay in Slovakia. 17 respondents, representing 10% of the respondents, gave *other* as the reason for their stay in Slovakia. The most frequently given answers in this category were: *internships*, *voluntary activities* (ESC programme: a programme which helps young people from Europe and programme countries to develop their sense of solidarity by participating, either individually or in group, in non-profit, unpaid voluntary activities.). Respondent number 51 even gave "*better quality of life*" as the reason for choosing to live in Slovakia.



**Source: the author based on his findings**

**What do you understand under the term "intercultural intelligence/competence" (CQ)?**

With the second question, we sought to find out whether expatriates working in Slovakia have an awareness of what the term *intercultural competence* means. The question was asked in the following form "What do you understand under the term "intercultural intelligence/competence" (CQ)?", and the respondents could insert their answers. For the purpose of this paper, we decided to select a few of them that we consider relevant and may help us to better understand the issue under study. Cultural intelligence (referred to as CQ) is a relatively new phenomenon that was first defined by Ch. Earley and S. Ang (2003) as "a person's ability to function effectively in situations characterized by cultural diversity".

Respondents provided the following answers:

- how people understand the unwritten social etiquettes;<sup>4</sup>
- skill to function effectively in culturally diverse settings;

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<sup>4</sup> The answers are given in an authentic form, only the grammatical aspect of the answers has been edited if the answer required it for better understanding.

- skills and aptitudes that allow an individual to adapt to cultural environments different to his/her cultural baseline;
- being able to see the other culture, what is different from mine for example, and what is special. Also once knowing it, being able to include these new habits into mine, and being able to navigate with them and around them. For example, during a conversation, once knowing it then one can avoid a misunderstanding;
- intercultural intelligence, is a term that is used for the capability to function effectively in culturally diverse settings and consists of different dimensions (metacognitive, cognitive, motivational and behavioural) which are correlated to effectiveness in global environment (cultural judgement and decision making, cultural adaptation and task performance in culturally diverse settings);
- it's first time I see this term. My first guess is that it means awareness and open-mindedness about culture other than your own. Ability to accept and appreciate cultural differences;
- understanding and adapting to the local culture;
- functioning effectively in diverse cultural situations;
- never heard it before;
- the fact that one has enough experience abroad to make him able to adapt to any new culture he is in, be understanding to the people's traditions and values, and tolerant to their communication which might sound disrespectful to other cultures;
- not much but associating it with terms EQ and IQ, I assume cultural awareness;
- how to be culturally aware around a certain group/culture and the perception.

In general, we can confirm that the majority of respondents answered this question correctly, or if they were not familiar with the term, they were approximately correct in their guesses as to what it might mean. Surprisingly, there were also some answers where the respondents had never heard of the term (some of the answers are listed above). It is this fact that even some expatriates are not aware of the concept that can lead to misunderstandings in international encounters, as this competence involves one's ability to adapt effectively to a new cultural context and to use knowledge of a given cultural environment. One of the components of CQ is the cognitive level of intercultural competence. It is this component that relates to how an individual understands the similarities and differences between cultures.

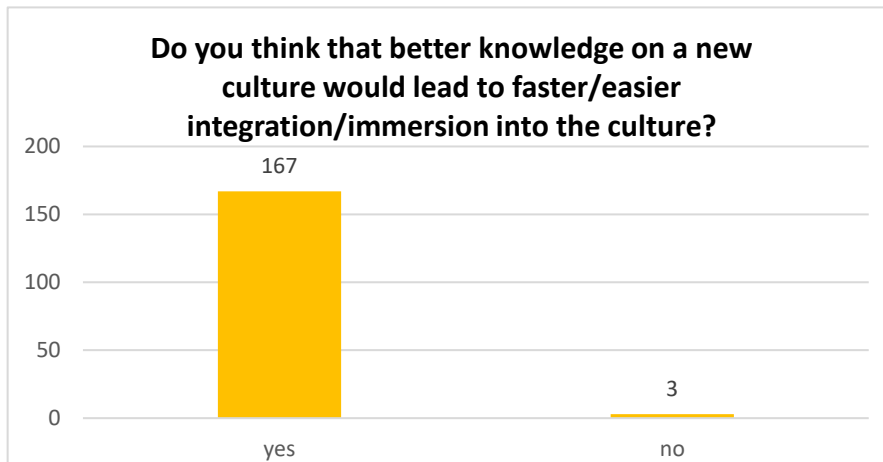
**Have you ever experienced a pleasant/unpleasant situation while staying in Slovakia that was caused by not knowing/ not having sufficient knowledge on the culture/local habits?**

In the next question, we tried to find out if the respondents ever experienced a pleasant/unpleasant situation while staying in Slovakia that was caused by not knowing/ not having sufficient knowledge on the culture/local habits.

It is this question that is related to the model of intercultural competence (cognitive component) that we described above. Regarding the answers of the respondents, we can conclude that most of the respondents did not have unpleasant experiences that were caused by their lack of knowledge about the culture. Some respondents, such as respondent number 78, reported a problem with communication *"Not really but sometimes struggle with communication"*. In some cases (respondent number 23) this situation was facilitated by intercultural training which provided the respondent with the necessary information about Slovak culture *"I had intercultural training before, but sometimes I still had difficulties accepting certain habits. No negative experiences though by not knowing."*

**Do you think that better knowledge on a new culture would lead to faster/easier integration/immersion into the culture?**

Through the following question, our intention was to find out whether respondents consider intercultural competence as an important element that can help expatriates to better integrate into a new culture. As we can see in the chart below, almost 100% of the respondents indicated *yes* as an option, meaning that they consider intercultural competence as an important element in integrating into a new culture. Based on this response, we can confirm that expatriates are aware of the importance of intercultural competence, and its role in integrating into a new culture.



Source: the author based on his findings

**On the scale from 1 to 10, how would you assess your cultural competence? (1 being an expert, 10 being very poor)**



Although the respondents are aware of the importance of intercultural competence, we were interested in how they would rate their level of intercultural competence. The respondents could choose a level on a scale from 1 to 10, where 1 represented the best rating and thus the respondent has excellent knowledge in this area. On the other hand, option 10 meant that the respondent has only basic to poor knowledge of the subject. Surprisingly, as many as 63 respondents thought that their level of intercultural competence was close to the "inadequate" rating. This may be due to the fact that despite being aware of the importance of CQ, the respondents do not possess sufficient knowledge and competencies required in an intercultural setting and thus lack confidence in their own skills. 7 respondents would rate their CQ at level 9, which represents very poor skills. On the other hand, 41 and 18 respondents think that their CQ level is at a high level and hence they are able to function effectively in an intercultural environment. None of the respondents rated their intercultural competence at levels 1 and 10.

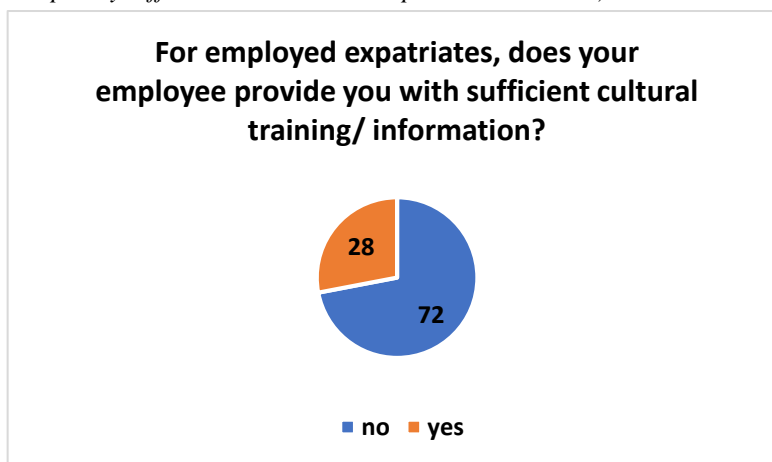


**Source: the author based on his findings**

**For employed expatriates, does your employer provide you with sufficient cultural training/ information?**

The following question was for employed respondents solely. The aim was to find out whether foreigners working in the Slovak Republic are provided with sufficient training in this area. We believe that intercultural training provided also by employers could help expatriates to better integrate into the working environment and cultural milieu. As far as the work environment is concerned, intercultural training could help to improve workplace relations as well as the efficiency of employees. As stated by Matveev (2017), intercultural competence is a critical characteristic in achieving effectiveness abroad, also in successful international management, in completing international projects or studying abroad, as well as in coping with intercultural

encounters in the home environment. Most expatriates feel that their employer does not provide them with sufficient information or cultural training. As respondent number 65 stated *"Not really, there are nice initiatives, but when it comes to realisation they are far away from planned."* When evaluating this question, we have to underline the fact that foreigners did not mention their employer's or company's name. We assume that international corporations, since they employ the most people with different cultural backgrounds, try to provide sufficient information to their employees. However, this assumption has to be proved, maybe in the future research. As an example, we quote the answer by the respondent number 78 *(Yes, I work for an international company, a completely different world when compared to Slovakia.)*

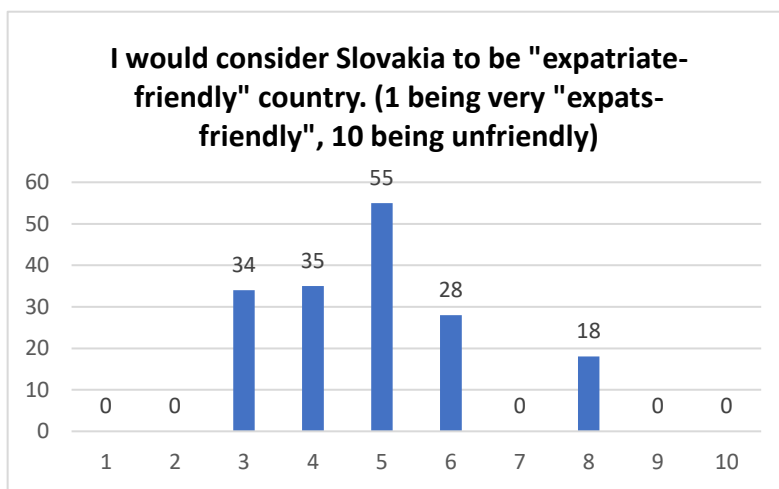


**Source: the author based on his findings**

**I would consider Slovakia to be "expatriate-friendly" country. (1 being very "expats-friendly", 10 being unfriendly)**

In the following question, we tried to find out whether expatriates perceive Slovakia as an expatriate-friendly country. Surprisingly, we found that the majority of respondents consider Slovakia to be a *neutral country* in this respect. From this, we can conclude that this issue is highly topical and therefore it is important to discuss and inform/educate also Slovak citizens about it. We have also encountered similar opinions, which support greater awareness of this issue in Slovakia, from respondents number 34 *(Thanks for the questionnaire, this is important topic here, in Slovakia.)* or respondent number 23 *(Please promote cultural awareness and competence. Also, for Slovaks working with foreigners, needs adaptation from both sides)*. Most respondents also agreed that one of the biggest problems they experience as a foreigner in a new country is *the language barrier*, as an example we quote the answer number 42 *(thank you for this question. As an expat I experienced isolation from cultural life in Slovakia, here is quite a challenge to find proper information about cultural events and institutions without knowing the language. At the same time, a lot of foreigners prefer*

*not to study the language, because it's quite hard and you can always explain basic things in English or German. So I see quite a lot of foreign people in Slovakia who are educated and cultured, who are looking forward to some cultural activities, or who can make a quite good impact on Slovak cultural life, because of their skills in music, arts, fashion, filmmaking, edutainment and so on and so on, but they just don't have an infrastructure or any source of information about how to make themselves useful.) It is the lack of information in the English language as well as the availability of this information that act as factors that make it difficult for foreigners to integrate into our culture.*



**Source: the author based on his findings**

## **5 Conclusion and recommendations for practice**

Cultural intelligence opens up opportunities to interact with different cultures by cultivating a sense of flexibility, tolerance and acceptance of diverse cultural traditions that are stimulating, motivating and ultimately make one a better and more aware global citizen. It is possible to use CQ to leverage differences in the workplace to become a mechanism for change and more meaningful cross-cultural adaptation regardless of host country. In our increasingly interconnected and globalized world, intercultural competence is increasingly important. As we already mentioned in the article, it is essentially the ability to communicate effectively across cultures and to work with people from different cultural backgrounds. There is no doubt that intercultural competence is a valuable asset in this day and age when connections around the world have become commonplace. Every day at work and in our private lives, we come into contact with people from different countries and cultures who are

likely to have different values and beliefs to our own. This is where intercultural competence comes in handy - and in today's world, it is essential.

In essence, intercultural competence can be defined as the ability to develop focused knowledge, skills, and attitudes that lead to observable behaviours and communications that are effective and appropriate in intercultural interactions. Thus, the essential characteristics of intercultural competence are *knowledge*, *skills*, and attitudes. Intercultural competence is particularly important for people who have decided to start their lives in a new country. Therefore, in the present article we discussed the importance and awareness of intercultural competence among expatriates living in Slovakia. Based on quantitative methods, in the form of a questionnaire, we were able to find out that among the main factors why expatriates decide to come to Slovakia are *job opportunities*. HRL came to the same conclusion when in their survey they found that up to 34.7% of foreigners cite employment and 23.5% business as the purpose of their stay in Slovakia<sup>5</sup>. Thus, these two categories can be merged into one group, i.e. *employment and career opportunities*. From the above, we can conclude that the main reasons for which foreigners decide to immigrate to the Slovak Republic are *job opportunities*, followed by *family*. Another of the findings we were able to identify is the fact that despite the relevance of the topic, not all expatriates were aware of the term *intercultural competence*. Based on this finding, we would recommend that more attention be paid to this topic, both on a personal and professional level. We believe that employers should provide employees with sufficient quality training in intercultural competence, communication, etc. for example, in the form of training, workshops, discussions, etc. This issue is addressed in Slovakia by Benčíková D. (see Benčíková 2013, 2015, 2016, 2017). We cannot forget about the teaching of intercultural communication at universities, not only foreigners who come to a new culture, but also permanent residents of Slovakia, should have intercultural competence, which leads to mutual understanding and understanding of the individual actors of social interaction. A surprising finding was that the majority of respondents did not consider their knowledge in the field of intercultural communication to be sufficient. This fact may as well lead, from a practical point of view, to the fact that the process of integration into a new culture is hindered. One of the forms that could help to increase the knowledge and skills of intercultural competence of expatriates in Slovakia would be the aforementioned intercultural trainings and better information about this phenomenon. For this reason, we again call for increased awareness of the issue. Greater attention should be paid to this topic from school days onwards. As far as expatriate workers are concerned, we believe that employers, whether they are international companies or small and medium-sized enterprises, should invest in quality intercultural training. The fact that integration into the Slovak environment is not always easy is also indicated by the last question in which the majority of respondents rated Slovakia as a neutral or more negative country in relation to expatriates.

In conclusion, we would like to state that our research was largely limited by the fact that it was conducted using a web-based survey. It would be appropriate to use other scientific, especially qualitative methods in the form of individual in-depth

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<sup>5</sup> hrl.sk

interviews. However, the nature and content of our research allowed us to use quantitative methods, and to obtain data for future research that we would like to pursue. In the end, we can confirm that our goal has been met, and we hope that the article will be an inspiration for other researchers, as well as for ordinary people dealing with the topic of interculturality.

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# Assessment of Electric Vehicles Lifetime Emissions Methodologies Including Suggestions for their Future Evolution

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## **Abstract.**

To compare the life cycle emissions from EV (electric vehicle) and ICE (internal combustion engine) car is very important task. Results will influence general perception of EV potential buyers as well as policy makers. The methodologies to properly calculate LCA (life cycle assessment) emissions for EV and ICE are subject of development and their applications differ across the studies.

Some of the suggestions for LCA methodologies adjustments as suggested by this article includes novum, other (like battery recycling, battery second life, longer EV life span) occurs already today in different LCA analyses, however there is still rather a big diversity of the ways of their application.

The suggestions have a methodological nature, should open wider debate related to LCA methodologies development and possibly might inspire future research work in their application. By working on this paper, the author finds out that due to the methodological robustness of LCA, country specific inputs (mainly for the energy mix), diversity of LCA applications, lacking worldwide precise standard on LCA methodology, whenever you read any outcomes related to LCA EV or ICE emissions, the reader has to go rather deeply to how the LCA was applied by author/s, in which environment, what sort of datasets were used and only after thorough assessment of the author approach, respective results can be used for further decision making.

**Keywords:** Electric Vehicles, Life Cycle Emissions, LCA Methodology improvements

**JEL classification:** F18, L62, L80

## **1 Objective of the article**

The problematics of environmental impacts evaluation of electric vehicles production and their operation is highly getting momentum as general public often has the possibility to read different, many times contradictory outcomes of several surveys and researches, which are frequently cited in the public medias.

The reason why I have decided to investigate further this problematic is highly pragmatic. If the perception of the future customers to buy electric vehicle is being influenced by information which relates to environmental impact of its purchase and operation, then this information should be based on correct methodology taking into account also updated and trustful inputs.

Policies are being implemented in transport area worldwide to tackle the climate change challenges and policy makers need to have objective assessment tools and methodologies to measure the impact of set targets and action plans.

Objective of this article is to provide the basic overview of respective methodologies, asses them and provide opinion on their future possible evolution. As a side objective of this paper was the identification of possible methodological shortcomings and investigation of their conceptual improvements.

The research approach of this paper is to explore the existing methodologies with regards to researched topic. From methodological perspective, method of analyses and synthesis, including comparison is about to be used. After identification of the respective works, the author will try to derive conceptual outcomes by using methods mentioned above including generalizing his deductions for the particular areas.

## **2 Methodologies to evaluate emissions in e-mobility industry**

The methodologies for assessment of the production of EV, including battery production evolve continuously. Already for decades the professionals and researchers around the globe are defining and finetuning the methodology which should with highest objectivity assess the environmental impacts of EV production and operation.

Some of the research papers and respective methodologies have a focus on life cycle environmental assessment of different types of batteries for EV and Plug in hybrids [1] Within this reference the bottom-up approach of manufacturing process of different types of batteries is the main subject of the research, taking into account the material requirements, processing and energy requirements, transport and infrastructure needs and related emissions for every particular battery component (cathode, electrode, separator, electrolyte, battery management system and other subcomponents) while calculating emissions for production and processing of raw material.



What is the lifecycle approach to emissions? Usually, it covers emissions produced over their “life cycle” of BEV production and usage—from the raw materials to make the car through manufacturing, driving, and disposal or recycling.

Well to Wheel methodology grasps only the fraction of global warming emissions, when compared with life cycle analysis of the production, maintenance, and disposal of the vehicles. It concentrates on two subparts - energy provision and vehicle efficiency.

Energy provisioning part usually in the Well to Wheel methodology for EV considers emissions which result from extraction of raw materials needed to produce the necessary energy, delivery of these raw materials for further processing (e.g. coal) it also includes emissions from burning the fuel in the power plant to generate electricity. Methodology also includes emissions which are associated with transmission and distribution losses.

For comparable gasoline vehicle Well to Wheel methodology covers in energy provisioning part oil extraction emissions, emissions associated with transporting of crude oil to refinery, refining the crude oil to gasoline, delivering the gasoline to gas stations.

For EV and ICE cars vehicle efficiency is considered in determining emissions from combusting the gasoline in the engine, or alternatively consuming the electricity stored in battery to power the electric engine. We should bear in mind that one of the biggest advantages of EV compared to ICE is its higher efficiency, to be followed by possibility to produce the electricity from renewable sources.

The relation between Full life cycle approach and Well to Wheel methodology is described on the picture below.

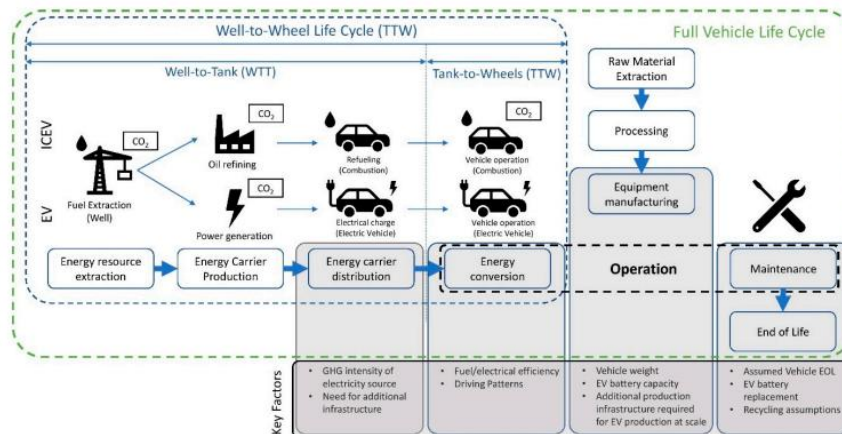
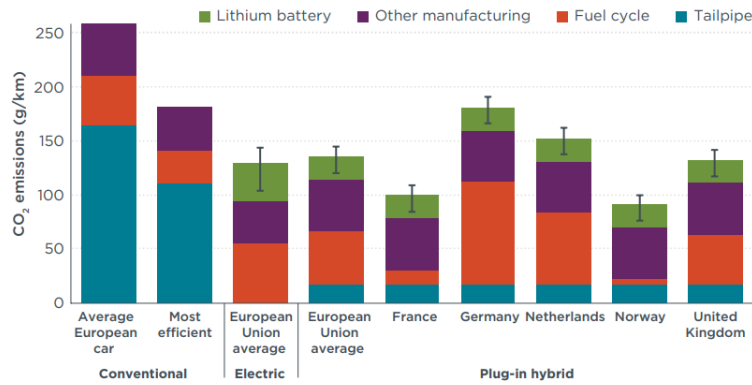


Fig 1. Full life cycle approach and Well to Wheel methodology [2]

For the evaluation of lifecycle emissions, it is important to assess the methodology. There are several studies and research work which compared the recent status of research in this field. The purpose of this article is not to duplicate the comparative process of LCA (life cycle assessment) studies, rather to bring the new insights from methodological point of view.

## 2.1 LCA methodologies survey & comparison

According to ICCT [3] “Overall, electric vehicles typically have much lower life-cycle greenhouse gas emissions than a typical car in Europe, even when assuming relatively high battery manufacturing emissions. An average electric vehicle in Europe produces 50% less life-cycle greenhouse gases over the first 150,000 kilometers of driving, although the relative benefit varies from 28% to 72%, depending on local electricity production.<sup>4</sup> An electric car’s higher manufacturing-phase emissions would be paid back in 2 years of driving with European average grid electricity compared to a typical vehicle. This emissions recovery period is no more than 3 years even in countries with relatively higher-carbon electricity such as in Germany. When comparing to the most efficient internal combustion engine vehicle, a typical electric car in Europe produces 29% less greenhouse gas emissions.”



**Fig. 2 Comparison of EV, Plug-in hybrid and conventional vehicle LCA emissions [3]**

Bellow I will try to point out the few findings which are results from comparing the methodologies and their application, as already identified by the comparative studies.

Excerpt from study bellow shows significant diversity based on used methodology, technology and territory applied for the battery production (just one, still significant element of LCA)

**Table. 3** Comparison of LCA studies, according to ICCT [3]

Authors	Year	Battery production emissions (kg CO <sub>2</sub> e/kWh)	Additional notes	Reference
Messageia	2017	56	Assumes vehicle with 30 kWh battery constructed in the European Union, finding that BEVs will have lower life-cycle emissions than a comparable diesel vehicle when operated in any country in Europe.	Maarten Messageia, Life Cycle Analysis of the Climate Impact of Electric Vehicles, Wije Universiteit Brussel, Transport & Environment, 2016. <a href="https://www.transportenvironment.org/publications/electric-vehicle-life-cycle-analysis-and-raw-material-availability">https://www.transportenvironment.org/publications/electric-vehicle-life-cycle-analysis-and-raw-material-availability</a>
Hao et al	2017	96-127	Uses China grid for battery manufacturing. Finds substantial differences between battery chemistries. Batteries produced in U.S. create 65% less GHGs.	b Han Hao, Zhexuan Mu, Shuhua Jiang, Zongwei Liu, & Fuquan Zhao, GHG Emissions from the Production of Lithium-Ion Batteries for Electric Vehicles in China, Tsinghua University, 2017. <a href="http://www.mdpi.com/2071-1050/9/4/504">http://www.mdpi.com/2071-1050/9/4/504</a>
Romare & Dahlöf	2017	150-200	Reviews literature, concluding manufacturing energy contributes at least 50% of battery life-cycle emissions. Assumes battery manufacturing in Asia.	Mia Romare & Lisbeth Dahlöf, The Life Cycle Energy Consumption and Greenhouse Gas Emissions from Lithium-Ion Batteries, IVL Swedish Environmental Research Institute, 2017.
Wolfram & Wiedmann	2017	106	Models life-cycle emissions of various powertrains in Australia. Manufacturing inventories come primarily from ecoinvent database.	Paul Wolfram & Thomas Wiedmann, "Electrifying Australian transport: Hybrid life cycle analysis of a transition to electric light-duty vehicles and renewable electricity," Applied Energy, 2017, 206, 531-540.
Ambrose & Kendal	2016	194-494	Uses top-down simulation to determine GHG emissions for electric vehicle manufacturing and use. Manufacturing process energy represents 80% of battery emissions. Assumes manufacturing grid representative of East Asia.	Hanjiro Ambrose & Alissa Kendal, "Effects of battery chemistry and performance on the life cycle greenhouse gas intensity of electric mobility," Transportation Research Part D: Transport and Environment, 2016, 47, 182-194. <a href="http://www.sciencedirect.com/science/article/pii/S1361920915500390">http://www.sciencedirect.com/science/article/pii/S1361920915500390</a>
Dunn et al	2016	30-50	Uses bottom-up methodology, with U.S. electricity used for manufacturing.	Jennifer Dunn, Linda Gaines, Jarod Kelly, & Kevin Gallagher, Life Cycle Analysis Summary for Automotive Lithium-Ion Battery Production and Recycling, Argonne National Laboratory, 2016. <a href="http://www.anl.gov/energy-systems/publication/life-cycle-analysis-summary-automotive-lithium-ion-battery-production-and-recycling">http://www.anl.gov/energy-systems/publication/life-cycle-analysis-summary-automotive-lithium-ion-battery-production-and-recycling</a>
Ellingsen, Singh, & Strömman	2016	157	BEVs of all sizes are cleaner over a lifetime than conventional vehicles, although it may require up to 70,000 km to make up the manufacturing "debt".	g Linda Ager-Wick Ellingsen, Bhawna Singh, & Anders Strömman, "The size and range effect: lifecycle greenhouse gas emissions of electric vehicles," Environmental Research Letters, 2016, 11 (5). <a href="http://iopscience.iop.org/article/10.1088/1748-0221/11/05/054001">http://iopscience.iop.org/article/10.1088/1748-0221/11/05/054001</a>
Kim et al	2016	140	Study based on a Ford Focus BEV using real factory data. Total manufacturing of BEV creates 39% more GHGs than a comparable ICE car.	Hyung Chul Kim, Timothy Wallington, Renata Arsenuit, Chulheung Bae, Suckwon Ahn, & Jaeran Lee, "Cradle-to-Gate Emissions from a Commercial Electric Vehicle Li-Ion Battery: A Comparative Analysis," Environmental Science & Technology, 2016, 50 (14), 7715-7722. <a href="http://pubs.acs.org/doi/abs/10.1021/acs.est.6b00830">http://pubs.acs.org/doi/abs/10.1021/acs.est.6b00830</a>
Peters et al	2016	110 (average)	Reveals significant variety in carbon intensities reported across literature based on methodology and chemistry.	Jens Peters, Manuel Baumann, Benedikt Zimmermann, Jessica Braun, & Marcel Weil, "The environmental impact of Li-ion batteries and the role of key parameters – A review," Renewable and Sustainable Energy Reviews, 2017, 67, 491-506. <a href="http://www.sciencedirect.com/science/article/pii/S1364032116304713">http://www.sciencedirect.com/science/article/pii/S1364032116304713</a>
Nealer, Reichmuth, & Anair	2015	73	Finds that BEVs create 50% less GHGs on a per-mile basis than comparable ICEs, and manufacturing (in U.S.) is 8%-12% of lifecycle emissions.	Rachael Nealer, David Reichmuth, & Don Anair, Cleaner Cars from Cradle to Grave, Union of Concerned Scientists, 2015. <a href="http://www.ucsusa.org/clean-vehicles/electric-vehicles/life-ev-emissions#.WVamkNnUTY">http://www.ucsusa.org/clean-vehicles/electric-vehicles/life-ev-emissions#.WVamkNnUTY</a>
Majeau-Bettez, Hawkins, & Strömman	2011	200-250	Uses combined bottom-up and top-down approach. Different battery chemistries can have significantly different effects.	k Guillaume Majeau-Bettez, Troy R. Hawkins, & Anders Hammer Strömman, Life Cycle Environmental Assessment of Lithium-Ion and Nickel Metal Hydride Batteries for Plug-In Hybrid and Battery Electric Vehicles, Norwegian University of Science and Technology (NTNU). <a href="http://pubs.acs.org/doi/abs/10.1021/es102670c">http://pubs.acs.org/doi/abs/10.1021/es102670c</a>

Maintenance is also quite important element where emissions are being produced over vehicle life time, and below table shows, how unclear is the methodology in many LCA emissions studies.

**Table 4** Maintenance within LCA methodology [5]

Approach	Additional Comments	Number of Studies
Not discussed and not included		3
Out of scope—identified as limitation		1
Included with an unclear methodology	a. Maintenance stated as included, but unclear what was included within maintenance (i.e., part replacement, oils, road, etc.)	7
	b. Uncertainty within the maintenance phase further heightened when battery replacement is mentioned as part of the maintenance phase, but not aggregated in results	
Included with clear methodology	c. Clearly defined methodologies, specific parts or processes identified	8
	d. Maintenance of roads included within the maintenance of the vehicle	
	e. Scaling factor of production emissions	

The similar applies also to calculating end of the lifetime vehicle emissions as compared within the same study [6].

**Tab. 5** End of lifetime within LCA methodologies [6]

Approach	Additional Comments	Number of Studies
Not discussed and not included		1
Out of scope—identified as a limitation	Limitations often mention lack of precedence due to mass-market EVs not having reached EOL or citing relative impact being less than 2% of total life-cycle emissions in studies that have included EOL.	3
Included with an unclear methodology	Aggregated EOL emissions into other processes, making the environmental impact associated with EOL unclear. Because EOL often includes recycling materials, uncertainty increases because recycling can lead to positive or negative GHG emissions depending on methodology.	4
Included with clear methodology—positive environmental impact	Positive environmental impact in terms of reducing GHG emissions due to material recycling.	2
Included with clear methodology—negative environmental impact	a. Direct calculations of EOL emissions	9
	b. Partial inclusion of EOL, often only taking energy use within recycling/disposal process into account	
	c. Scaling factor of production emissions due to uncertainty in EOL processing	

### **3 Outcomes and discussion**

There are however several methodological issues, which should be emphasized and which concerns the majority of concerned studies. The purpose of this paper is not to generate a new study focused on calculating emissions for EV production and use, rather to critically assess used methodology and identify possible shortcomings and to provide recommendations from methodological point of view.

#### **3.1 Comparative period/life span of vehicles**

The different studies (including those mentioned in this paper) take certain amount of mileage/km driven when comparing the lifetime emissions of EV's and combustion engine propelled cars. It should be recognized that lifetime of car produced after year 2000 is in general is longer, and there are very many evidences that recent lifespan of car approaches 200,000 miles (320,000 km), [8] Rather dramatical increase of lifespan (compared to previously recognized standard 150 000 miles) is caused by mix of factors like better longevity materials used, better diagnostic technology, supervision and control systems, tighter tolerances, antic- corrosion coating and others.

Moreover, electric vehicles produced recently are expected to have longer lifespan– reaching 300 000 miles or even longer [8] 1 000 000 miles (even though, there are very few evidences in reality nowadays).

We can conclude that usage of the EV is associated with environmental benefits with regards to emissions produced when compared with ICE car which is even more highlighted when we compare these benefits over longer lifespan. 150 000 km lifespan assumption often used in different studies is simply short and detrimental to the EV's.

#### **3.2 Battery second life**

EV have another comparative advantage when compared with ICE propelled cars. The battery, when reaching 70-80 % of their initial capacity, was considered to not be suitable any more for it 's original usage in EV.

We should take into consideration, that driving range and hence battery capacity of EV's is continuously rising, so it is quite probable that lower share (cca. 50%) of original battery capacity will still be suitable for propelling an electric engine/s in EV. Obviously, battery capacity deteriorating curve, charging and usage patterns, battery chemistry and other factors will influence whether original battery in EV will still be suitable for driving purposes, or it potentially will serve for secondary purpose – battery second life.

Increasing battery capacity which we can see over last decade of EV production is happening in high speed, or rather in multiples (EV produced 2012 has a battery capacity of cca. 24kWh, recently in 2022 you can easily find EV models with capacity of battery from 60 kWh -100 kWh).

Bigger battery capacity allows for higher mileage of range, but it also influences lifespan of EV's. (since it provides higher allowance for battery degradation, which will be still sufficient for driving purpose). On the other side, increased battery capacity, taking into account the degradation after primary use (EV purpose) improves the prerequisites for most business cases in the battery second life.

Second life of the battery can result in saving of additional emissions throughout its usage in many applications. One of the most frequent and representative use case for second life of the EV battery is storage of electricity for households or commercial purposes. Storage for electricity allows more extensive integration of renewables, which provides for structural change in electricity generation leading to low carbon economy and thus lower emissions.

It is foreseen that second life battery can last up to or even more than 10 years, utilizing in this period up to 60% [10] of the original battery capacity.

Therefore, from methodological point of view, saved emissions which are a consequence of second life battery usage (e.g. storage of battery) should be incorporated in comparison with ICE alternative.

### **3.3 Recycling of the batteries**

As the battery is very important element, which production from virgin raw material causes significant emissions) one of the ways forwards is recycling of the batteries from EV in order to reduce emissions and increase energy efficiency.

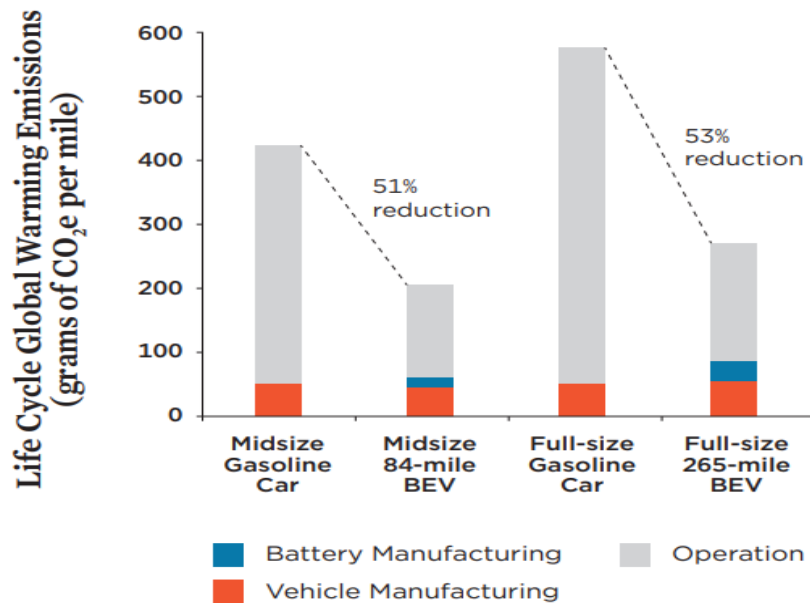


Fig. 5 Battery impact within LCA [7]

Recycling of the EV batteries is still in rather in early stage, as the whole industry is very young and there are very few companies / use cases which on European market which specialize in this field. The recycling processes and legislation are under way and research is continuously ongoing. Recently we recognize two main technological process of pyrometallurgy and hydrometallurgy [7], but obviously due to the lacking batteries which have reached the end of lifespan (and which were built for EV's, later had their second life) calculating the effects of recycling would be rather theoretical exercise.

Recycling is also energy demanding process which generate own emissions but is more efficient compared to obtaining virgin raw materials with respect of mainly cobalt, lithium, nickel and manganese.

Therefore, from methodological point of view, recycling effects should be taken into account when calculating emissions from battery production, as this will be the case for future EV production. Recent status (where very few materials entering battery production lines come from recycled sources) is rather reflecting very early stage of EV battery productions.



### **3.4 Mining equipment, Crude oil pipeline, Refineries, Gas stations network versus Energy generation and charging stations network**

If we have the ambition to cover all emissions which are generated during the production, use and recycling of ICE and EV, we should not underestimate the whole supply chain which serves to deliver electric energy to EV or products from oil to ICE (lubricants, diesel, gasoline).

To cover also these emissions in methodology the ICE car emissions should include lifecycle emissions from mining equipment construction, operation and disposal, lifecycle emissions from crude oil pipeline construction, operation and disposal, also lifecycle emissions from refineries construction, their operation and disposal and last but not least lifecycle emissions covering construction of gas station network, their operation and disposal including supply chain logistics of oil products.

One can argue, that crude oil products are not only used in transport (and thus consumed by ICE vehicles) but we use crude oil products also in the agriculture (e.g. fertilizers) very many industry, chemical and consumer applications (from different polymers products, asphalt, pharmaceuticals to heating substances). In order to reflect other than transport usages, only portion of above-mentioned lifecycle emissions related to transport (¾) should be considered.

On the EV side, parallel approach should be applied (which in fact with regards to energy generation for EV and Battery production and EV usage is the case in majority of methodologies). EV lifecycle emissions should incorporate allocated proportion of Chargers production, their operation (idle time electricity consumption, charging effectivity) and disposal.

Even in the subtitle there is missing electricity transmission and distribution networks, which is happening by purpose. From methodology point of view, only emissions attributable to lifecycle of EV should be taken into account, whereas there needs to be direct causal effect. Transmissions and distribution networks were built long time before recent uptake of e-mobility. They were designed to distribute to final customers electric energy with certain qualitative characteristics, while vast majority of their services/outputs is satisfying other than EV's needs, therefore we can neglect emissions associated with their design, operation and disposal. In case of very prudent approach, allocation of emissions regarding the operation and disposal according to volume of electric energy transmitted and distributed to e-mobility industry compared to total energy might be considered.

### **3.5 Emissions from maintenance services**

It is well recognized fact that service interventions and maintenance in case of EV are less frequent and simpler compared to ICE vehicle. This result from construction and design simplicity of EV (when compared to ICE vehicle). In particular engine problems

and maintenance is much simpler (for EV hardly any), there is no DPF filter or EGR vent in EV, no tail pipe, brakes in EV have much longer lifespan due to regenerative braking, there are no engine oils and related filters to be regularly changed in EV's, EV has no transmission gear which has to be serviced.

Emissions as the result of spare parts production and service centers running should be incorporated in the methodology to assess overall EV lifetime emissions, benefitting from lower need for spare parts (compared to ICE) and less services centers (as a consequence of simpler and less time demanding maintenance needs).

### **3.6 Electricity gets greener/non static approach**

In many methodologies, usually fix assumptions are taken into calculations and modeling of lifetime emissions. This is however simplification, which for longer lifespan of EV is not reflecting reality. Implementation of renewables into energy mix is not a short process, on the other side from perspective of 10 – 20 years there are significant changes on energy generation and distribution market observable. Tendencies to integrate low or zero carbon sources into energy generation sources are evident and rather differs regionally in the pace and structure.

Therefore, methodologies to cover emissions should rather model the evolution of energy mix in given region, taking into account rising proportion of renewable sources of energy over time, when defining lifetime emissions of EV.

## **Conclusions**

Excerpt from studies related to LCA of EV emissions shows significant diversity based on used methodology, technology and territory applied mainly for the battery production.

The purpose of this paper is not to generate a new study focused on calculating emissions for EV production and use, rather to critically assess used methodologies and identify possible shortcomings and provide recommendations from methodological point of view.

We can conclude that usage of the EV is associated with environmental benefits with regards to emissions produced when compared with ICE car, which is even more highlighted when we compare these benefits over longer lifespan. 150 000

km lifespan assumption often used in different studies is simply short and detrimental to the EV's.

From methodological point of view, saved emissions which are a consequence of second life battery usage (e.g. storage of battery) should be incorporated in comparison with ICE alternative. This element is still missing in many studies, that elaborate on this topic.

If we have the ambition to cover all emissions which are generated during the production, use and recycling of ICE and EV, we should not underestimate the whole supply chain which serves to deliver electric energy to EV or products from oil to ICE (lubricants, diesel, gasoline). To cover also these emissions in methodology the ICE car emissions should include lifecycle emissions from mining equipment construction, operation and disposal, lifecycle emissions from crude oil pipeline construction, operation and disposal, also lifecycle emissions from refineries construction, their operation and disposal and last but not least lifecycle emissions covering construction of gas station network, their operation and disposal including supply chain logistics of oil products

In LCA methodologies covering emissions should rather the evolution of energy mix in given region be taken into account thus reflecting rising proportion of renewable sources of energy over time, compared to standardly used fixed assumptions.

Emissions as the result of spare parts production and service centers running should be incorporated in the methodology to assess overall EV lifetime emissions, benefitting from lower need for spare parts (compared to ICE) and less services centers (as a consequence of simpler and less time demanding maintenance needs).

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# The History of Golf in Slovakia

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**Abstract.** Golf has come a long way in the world since the 13th century, but also in Slovakia. The beginnings of golf in Slovakia date back to before the First World War. The blossoming was halted by the Communist regime, which golf considered to be unacceptable. In Slovakia, the expansion of golf began only in the new millennium, with the construction of golf courses and the increase in the number of golfers. Twenty-five years of golf in the heart of Europe suffered from various prejudices. Golf is a snobbish and expensive sport for Slovaks, despite the cost is comparable to skiing. The turning year 2020 affected all parts of our lives with the Covid 19 pandemic. What slowed down our lives, that started the world of golf. The corona closed all sports grounds and closed people at home in Slovakia. Since golf is safe even in the event of pandemics, the courses were limited only for a few weeks and then they filled up with golfers to the last spots. Not only the pandemic, but also the 2020 Olympic Games helped in the development of golf in Slovakia. For the first time in history, Rory Sabbatini the Slovak golfer started with a double cross on his chest. Thanks to him, many prejudices against this sport have changed.

**Keywords:** history of golf, golf, Europe golf

**JEL classification:** L83, Z21, Z32

## 1 Introduction

At the beginning of the golf era, sheep shepherds were in the 13th century. In the 19th century [21] time at work was reduced by a game in which stones were rubbed into rabbit holes with sticks. At first, golf was banned by monarchs who did not want ordinary people to neglect their duties. In the end, golf won them, too. Since the 18th century, we can say that golf has taken on the current contours since the first golf club [10] was officially established. A lot has changed in golf since then [5], but its main idea has never changed, namely fair play, without distinction, for everyone [12]. In Slovakia, golf appeared before the First World War under the Tatras later in the spa town of Piestany.

The aim of the scientific contribution is to bring the development of golf closer in the Slovak Republic. The subject of the solution is the history of this sport on the territory of the Central European country. An analysis of the status quo has become the starting point. To achieve the goal, we have analyzed the development of this sports sector since 2003, since when we have had accurate statistics. Using a regression model, we have identified an aspect of several golf courses per number of golfers playing. The data for this study were collected based on statistics of the Slovak Golf Association. We realized the research in the regions of Slovakia (N=8), in which we watched the composition of golfers. Based on the correlation analysis, we investigated the impact of the construction of golf courses on the increase in the number of golfers and the impact of the COVID 19 pandemic on the played rounds. The analysis of individual parts of golf history in Slovakia will help as a base of my dissertation work which deals with development in golf. Because without past it is not possible to do the analysis of future, this analysis is initial for my work.

## **2 Golf in Slovakia**

Slovakia is a small country and so we cannot expect golf to be as popular as in the USA, for example, where players count in millions [13]. In Slovakia, according to the annual report of the Slovak Golf Association, we registered only 8837 golfers before the pandemic year 2020. It is woefully few, even in comparison with the Czech Republic with more than 52,000 golfers. Motivating Slovaks to play golf is a huge challenge [9].

### **2.1 Start before the First World War**

In Slovakia, golf began to develop before the First World War in the High Tatras, Tatranska Lomnica. In 1906 [18], the first golf match was played in Hungary, which was attended by the top of the then golf. The first golf tournament took place on the racetrack, and after three years later, in 1909, the first golf course was built in Hungary. In 1914, Winters built a golf course in Piestany.

The First World War paralyzed the successful expansion of the spa and thus also influenced the development of golf in Piestany. It successfully began to develop again only after the end of the war and after the necessary reconstruction of the golf course. In 1932, the Golf Association of the Czechoslovak Republic was founded, which was also a founding member of EGA (European Golf Association). Both pitches continued their activities during the interwar period. However, with the advent of communism, they disappeared, thanks to the designation of golf as bourgeois entertainment [4]. This sport has become ideologically inappropriate and unwelcome [11].

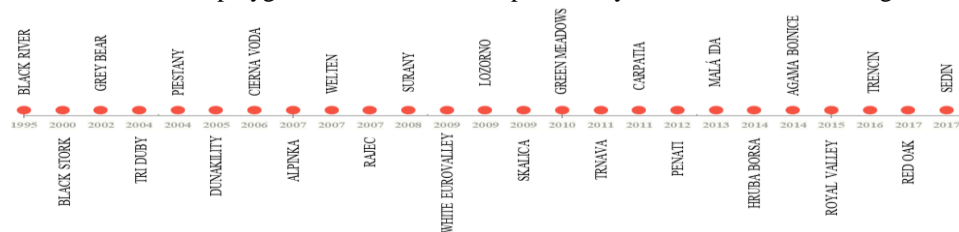
Lady Luisa Abrahams was a woman [6] who took care of the boom in golf in Czechoslovakia. She was born in 1910 in Prague in a medical family. She has been involved in sport since childhood, started tennis and won a championship junior title. She started playing golf in Austria. After the initial failures, Arthur Lees, at that time a highly sought-after and busy guest coach in Marianske Lazne, took her over. The first real successes came in 1934, winning the Junior Competition and then a much more valuable 2nd place in the GCP Championship on blows, called the Ring Hoffer Cup.

Her next fate was influenced by political and war events, but she survived the war in England, saving her from a terrible war crime. The Abrahams couple also made friends with the Queen Elizabeth II husband, Prince Philip [7]. When The Sunningdale Men's Golf Club also opened the women's section, Ms. Luisa became its first member. In 1968, the couple went to Mariánske Lázně and brought to Czech golfers a lot of older but still very good golf clubs and balls, after which there was an incredible hunger for it at the time. She helped with her contacts to regain the lost status of Czechoslovak golf and opened the door to world and international golf institutions. Thanks to her, golf was remained and played throughout the all period as the only country in the Eastern Bloc. She died at the age of 95 and an annual tournament for the best golfers is played in honor of her [19].'

Golf was rediscovered only in 1974 by the creation of a golf club in the sporting union of Elan Bratislava. Elan in the 1980s and 1990s of last century organized the unofficial Championship of Pairs in Golf in the Czechoslovak Republic. Founding member of the club Ing. Miroslav Kaliciak and subsequently Ing. Juraj Lupsin since 1983 became members of the Presidium of the Czechoslovak Golf Association. In 1991, the Slovak Golf Union with 178 golfers was established in Stupava on the founding meeting. The first president became Ing. Juraj Lupsin, who acted in this office for 10 years. After devision of Czechoslovakia in 1993, the Czech Republic automatically became the successor to Czechoslovakia in EGA (European Golf Association) and WAGC (World amateur golf council), but Slovakia did not meet the conditions to be a proper member in these structures, as we lacked the existence of a golf course on our territory, unlike in the Czech Republic where there were 8 playgrounds. The implementation of the 9-hole pitch in Bernolakovo in 1995 was accepted SGA as a member at the EGA annual meeting in Milan and in 1997, St Andrews in Scotland, also included in the world golf association WAGC.

## 2.2 Modern development

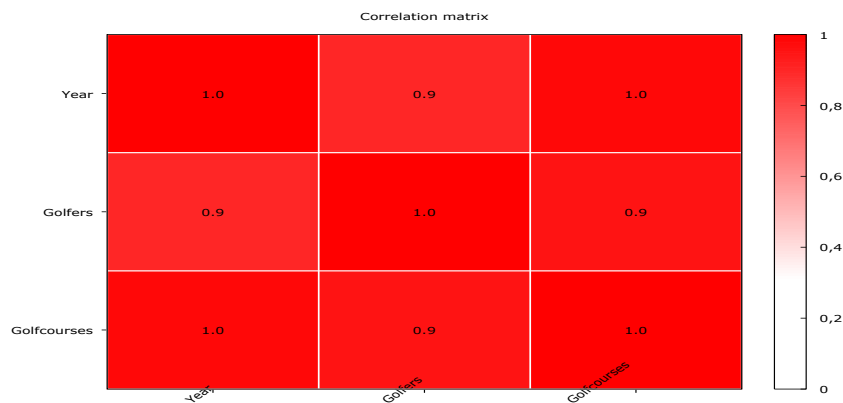
After the realization of the course in Bernolakovo in 1995, the construction of golf courses stopped. With a new millennium came to Slovakia also the restoration of the playground under the High Tatras, the construction of the Black Stork playground in Velka Lomnica in 2000. Gradually, in the span of two years, playgrounds in central Slovakia in Tale and Sliac were added. The rebirth of the first golf club in Hungary in Piestany occurred only in 2004. A year later, Slovak players opened a golf club in a beautiful castle park in Dunakility, Hungary. The first playground in the far east, namely in Kosice, was created only in 2007 and so far, it has only 9 holes of playground. The second Kosice playground, Mala Ida was opened only in 2013. In the Zilina region,



golf started to be played in 2007 in Rajec and in Záhorie only in 2009. The only PGA pitch in Slovakia with two 18-hole pitches opened its doors in 2012 in Sajdikove Humence. The latest additions in 2017 were added in Nitra's Red Oak and Sedin. Together 25 golf courses have grown, including one 36 holes, three 27-hole courses, eight 18-hole courses and 14 nine-hole courses.

**Fig. 1.** Timeline in the build-up of golf courses in Slovakia in modern history

Just as the background of golf courses in Slovakia has grown, the membership base of this sport has grown. As we can see, there is a great dependence between the construction of golf courses and the recruitment of new golfers [1].

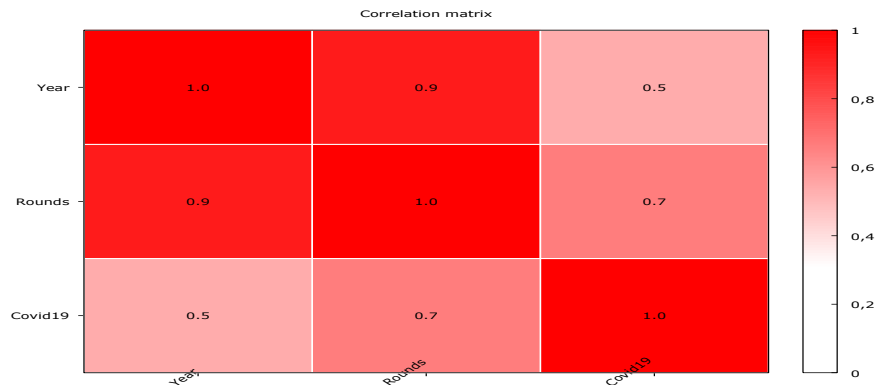


**Fig. 2.** Correlation matrix of dependence between the construction of golf courses and the number of players

### 2.3 The turning year 2020

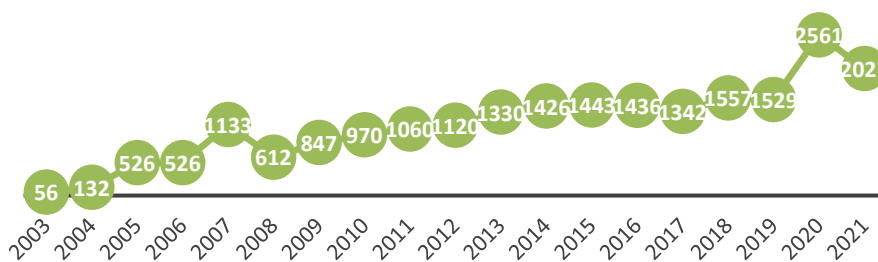
2020 was a turning point in all spheres of life. The Covid 19 pandemic entered our lives, which hit us not only in spring, but also in autumn. People had limited movement and spent time at home. We can see an increase in the number of rounds depending on the corona pandemic, as indicated by the correlation matrix.





**Fig. 3.** Correlation matrix of the dependence of the rounds played on the impact of time and the Covid 19 pandemic

Golf was one of the few sports activities that could be carried out even during the pandemic period. Fortunately, the golf courses were only closed for a few weeks and then fully filled up as we see Fig. 4, where the travel ban was fully reflected. Golfers are known for travelling [2] abroad. Air connections were cancelled, people stayed in Slovakia and golf courses were filled up to the last place. Year-on-year, the number of rounds has increased by a maximum of 20% since 2009. Before this year, the number of rounds played was largely influenced by the construction of golf courses. In 2007, three golf courses were opened, which caused a year-on-year increase of 115%. Such a significant year-on-year increase was no longer taking place in Slovakia, but the travel bans during the pandemic caused a year-on-year increase of 68%.



**Fig. 4.** Development of the number of rounds of golf, during the years 2003-2021

The 2020 Olympic Games in Tokyo, where Slovak golfer Rory Sabbatini stood up for the first time and became the oldest Slovak Olympian medalist, as a breakthrough in Slovakia. Rory is a native South African and left his native Durban to study in the U.S. with a golf scholarship [15]. He did very well in college golf, later after successfully qualifying on the PGA TOUR [16], where he has won six times. He was not very successful on the PGA Circuit since 2011. The change came in 2018, where he once again climbed into the top of 100 best players in the world [3]. In this successful

year he acquired Slovak citizenship as his wife is Slovak. Before the start of the Olympic Games, he stood the grin by the whole nation when he wanted to compete under five circles with a sport that had absolutely no tradition in Slovakia. However, he gained beautiful silver medal with hard work, which shook our entire country. An absolute outsider became a hero [20]. Suddenly, golf appeared in all the media. It was no longer a snobbish walk, but in the eyes of the Slovaks, golf was finally considered as sport. Rory has participated in various media appearances, supporting charity events. He became an ambassador for the Olympic Hope Tournament, where the future stars of the golf world compete. Thanks to Rory, golf became popular in Slovakia and people began to see it as an Olympic sport and not a sport for the rich.

### 3 Golf statistics

We can only see the exact golf statistics since 2003, when a single golf server was introduced, which brought together golf in Czechoslovakia. We therefore report the following statistics only from this year. Golf in Slovakia has developed slowly. In 2003, the total number of golfers was 419 of them 312 men and 107 women. This number doubled after 12 years of operating Slovak golf, but it was not a big increase from the original 178 golfers. A big increase of more than 400% occurred in 2004 for 1770 golfers. This was also caused by the construction of 2 playgrounds. With this addition, 5 golf courses were active in Slovakia. Since then, golf has developed year-on-year. The slight decrease occurred in 2015, when the economic crisis was [8]. As you can see on Fig. 5 women make up 25-30% of the total number of golfers. The aims not only of the world but also of Slovak golf associations are mainly the development of women's golf. Women are the creators of the leisure program and therefore it is important to get them for this sport.

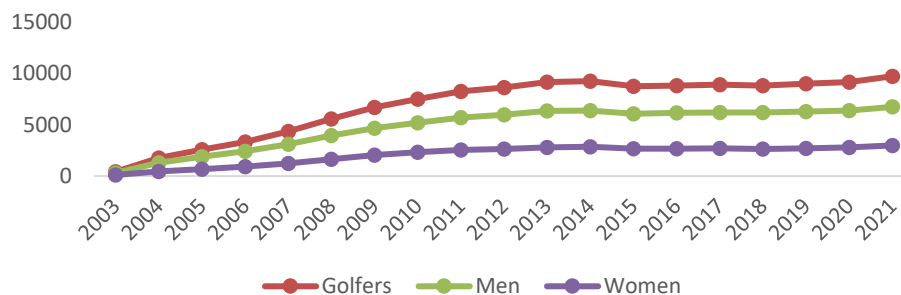
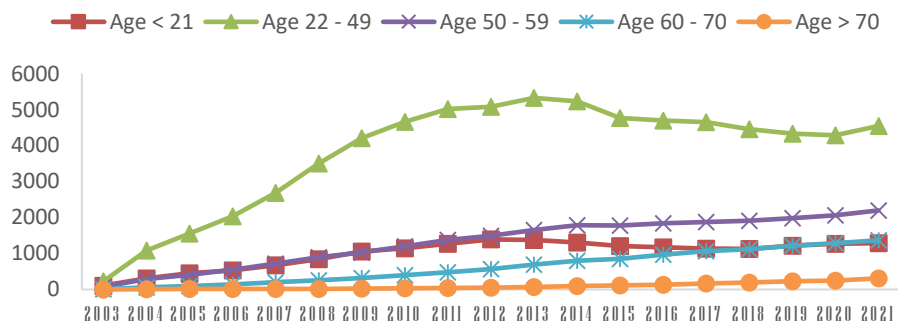


Fig. 5. Development of the number of golfers in Slovakia during the years 2003-2021

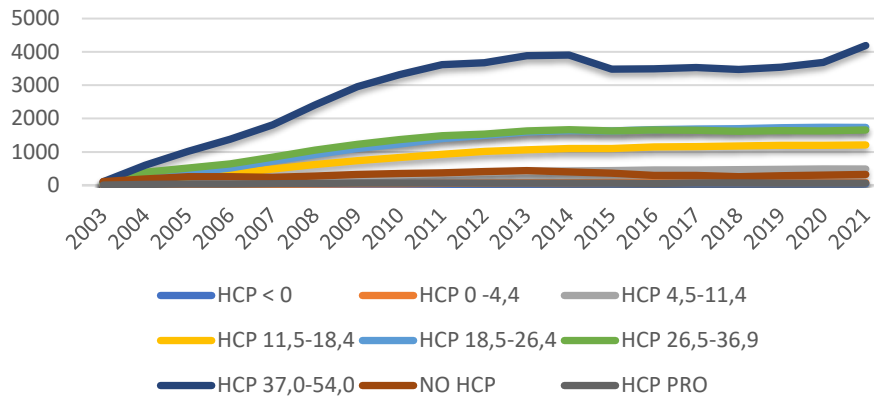
Demographic structure of golfers in Slovakia Fig. 6 represents a clear predominance of players in the 22-29 age structure. This is mainly because in Slovakia men in managerial positions [14] play at this productive age. On the early days of the millennium, the players took their children with them, so the under-21 category was significant in the early days. The breakthrough came in 2010, where they were overtaken by category 50-59 [17] It is logical, as people who started golf at productive

age got older and they reached a higher age group and for the same reason another 10 years later they have already overtaken this category even the age category 60-70. In this category we already find people who have been playing golf for over 20 years. We can see that the youngest category was not only overtaken by the last category of those oldest golfers over 70 years. For young people, golf is not attractive. In recent years, other sports sectors have also registered a reduction in children's interest. Golf is a sport that can be played until old age, and this is also the case in Slovakia.



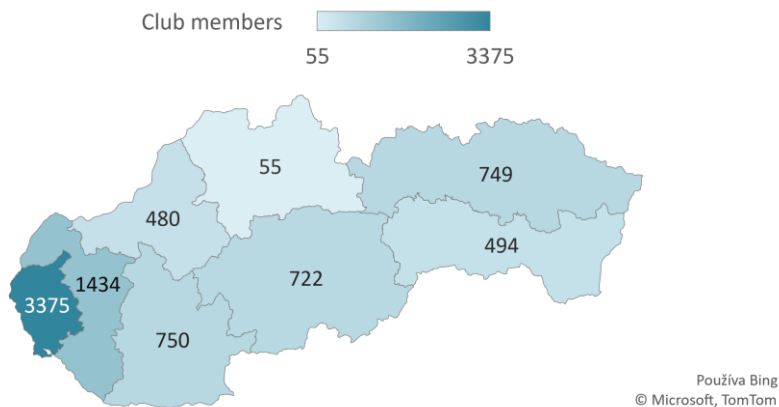
**Fig. 6.** Demographic development of golfers in Slovakia during the years 2003-2021

In Slovakia, golfers with a handicap higher than 37 are very prevalent, it means, they are absolute beginners. In the world, this category does not exist, because passing a green card is more time-consuming often in months, so golfers already have higher quality and get the handicap 36. A card in Slovakia, which is something like a driving license to play golf, lasts a weekend and therefore golfers have only a basic command of beginnings. A lot of people get a green card, but within a year, they're going to end up with this sport. Therefore, these statistics are mainly influenced by the first decisive year. In the middle positions there are golfers who play golf only a few times a month. Below are golfers who have made a green card but have not registered in any golf club. They mostly do not continue to play golf. We see the smallest number of golfers in the category of people who spend their time on the golf pitch at least 3 times a week. They are golfers with handicaps under 11.4.



**Fig. 7.** Development of golfers in Slovakia in terms of handicap during the years 2003-2021

Up to 31/3/2022, the Slovak Golf Association lists 8059 club golfers Fig. 8. They are golfers with paid membership fees in individual clubs for 2022. As can be seen, this number is lower than the number of total golfers in Slovakia up to date 31/12/2021, which was made up of 9714 golfers. Nearly 1,700 golfers have no golf club membership and play golf sporadically. The highest concentration of golfers 3375 is in the Bratislava region, where there are also the highest numbers of golf courses in total seven. The second significant region is Trnava with 1434 club members and six golf courses. There are also regions of Nitra, Banska Bystrica and Presov where we find proportionally the same number of game holes on golf courses. There are up to 500 members in Kosice and Trencin, who play on two nine-hole pitches. The worst part is the region of Žilina.



**Fig. 8.** Number of club golfers in the regions as at 31.3.2022

That we see on the map is also a regression model of the impact of the number of golfers on the construction of golf courses and training grounds in Table 1.

**Table 1.** Regression analysis of the impact of the number of golfers on the construction of golf courses

	<i>Coefficient</i>	<i>Std. Error</i>	<i>t-ratio</i>	<i>p-value</i>
const	-0,3793	1,4793	-0,2564	0,8007
Golfers	0,0025	0,0002	12,4602	<0,0001 ***
Mean dependent var	16,6316	S.D. dependent var		7,6682
Sum squared resid	104,5064	S.E. of regression		2,4794
R-squared	0,9013	Adjusted R-squared		0,8955
F(1, 17)	155,1728	P-value		5,67e-10
Durbin-Watson	0,2226			

$$\hat{y}_i = -0,3793 + 0,0025x_i \quad (1)$$

Supposing there would be 100 club members in a particular region of Slovakia probably it would not be enough to build a golf course. Making a prognosis: If we got 550 club players, the estimated total increase of golf courses would be on the level 1.

The regression coefficient is statistically significant - the number of golfers affects the number of golf courses in Slovakia. The regression model with independent variable number of golfers can explain 90.13% of the variability in the construction of golf courses. However, we see that the Durbin-Watson value is low and so there is a risk of spurious regression. Our problem is endogeneity. We cannot clearly distinguish the direction of causality. That is, whether the construction of a golf course will bring in new golfers, or whether new golfers will be able to exert pressure for the construction of another new course. We will continue to research the impact of these aspects.

## 4 Conclusion

The aim of this work was an analysis of historical milestones in golf development in Slovakia. Increasing golfer's membership was chosen as a subject matter of the analysis. On the basis of research of golf history on the territory of The Slovak Republic we found out that the highest aspect that influences on the development of this sports branch was the time. The construction of golf courses in individual regions had significant influence on increasing number of golfers. We found out that the biggest part on golf courses especially in western Slovakia makes 70 % of men at productive age. These men play golf only for leisure what is visible at the high golf handicap. As the pandemic Covid 19 theme is still actual we proved by our research that Corona had considerable influence on the rise in golf and especially in the number of played rounds which were increased thanks to closing borders and another sports grounds.

## Acknowledgement

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# The Importance of Stabilizing the Syrian Pound Exchange Rate for Achieving Economic Stability

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**Abstract:** The aim of this article is to measure the impact of the fluctuations in the real exchange rate of the Syrian pound on the key macroeconomic indicators of the Syrian economy during the period 1961-2020 to analyze the role of the real exchange rate in achieving economic stability. Since 2011, the Syrian economy suffered from a devastating war that effected all economic and social aspects of business activities leading to high fluctuations and instability of the macroeconomic ecosystem. During the first 40 years of study, the political stability in Syria has not been translated into economic stability on at the macroeconomic level. Moreover, during the last 11 years, the political instability has worsened the economic situation. To achieve the objective of this study, we applied autoregressive model and simple regression model on a various macroeconomic variables including the real exchange rate. The results show that the real exchange rate has a significant positive impact on the balance of payment, inflation, GDP gap, and negative impact on Real GDP, unemployment rate, monetary supply (M2).

**Key words:** real exchange rate, economic stability, Syrian Economy, macroeconomic fluctuations.

**JEL classification:** C22, E00, F3



## 1. Introduction

The exchange rate shows the number of units of a particular currency that must be paid to obtain one unit of another currency [3]. Thus, it can be said that the exchange rate of a currency is the price of one currency in terms of another currency, which is made based on the swap [1].

There are two methods of currency pricing, namely direct pricing, and indirect pricing. As for direct pricing, it is the number of units of foreign currency that must be paid to obtain one unit of the national currency [7]. As for indirect pricing, it is the number of units of the national currency that must be paid to obtain one unit of foreign currency, and most countries use this method of pricing, including Syria [2].

“Economic stability characterizes the economy without excessive fluctuations in the aggregate measures. An economy with constant output growth and stable inflation would be considered economically stable. An economy with frequent large recessions, a pronounced business cycle, very high or variable inflation, or frequent financial crises would be considered economically unstable” [16].

Real macroeconomic output can be decomposed into a trend and a cyclical part, where the variance of the cyclical series derived from the filtering technique (e.g., the band-pass filter, or the most used Hedrick–Prescott filter) serves as the primary measure of departure from economic stability [13].

Stability of the exchange rate is one of the most important reasons for economic stability and economic growth, as the exchange rate is one of the most important variables of the macroeconomic environment. It is also known that the Syrian Arab Republic has been suffering from instability in the exchange rate of the Syrian pound for more than 10 years. The Real value of the Syrian pound has collapsed, the hyperinflation rates can only be described as fictional, and the standard of living of the Syrian citizen has greatly decreased, and it can be said that 80% of the Syrian population lives below the poverty line. Therefore, an extremely interesting question is knowing the reasons for the instability of the Syrian economy and the consequences of instability in the long term. The goal of the paper is to study this question and find effective and realistic ways that are commensurate with the nature of the Syrian economy to work on addressing the instability in the Syrian economy.

## 2. Literature review

The exchange control system, and the end of the floating exchange system, the important role that the exchange rate plays in influencing economic variables. This, in turn, places the monetary authorities in front of the responsibility of choosing the best exchange system, which makes the exchange rate of their currency an important role in serving the economic objectives of the state [4].

A simple method of decomposition involves regressing real output on the variable

“time”, or on a polynomial in the time variable, and labeling the predicted levels of output as the trend and the residuals as the cyclical portion. Another approach is to model real output as difference stationary with drift, with the drift component being the trend [5] Macroeconomic instability can be brought on by the lack of financial stability, as exemplified by the Great Recession which was brought on by the financial crisis of 2007–2008 [6].

Economic instability can have several negative effects on the overall welfare of people and nations by creating an environment in which economic assets lose value and investment is hindered or stopped [9]. This can lead to unemployment, economic recession, or in extreme cases, a societal collapse [13]

When a stabilization policy is implemented, it generally involves the use of either monetary policy or fiscal policy. Either of these may be advocated by Keynesian economists. However, they are generally opposed by monetarists and real business cycle theorists [15]. Monetarists believe that well-intentioned countercyclical monetary policy will generally be counterproductive, adding to the existing variability of real output, and real business cycle theorists believe that such policies are misguided because they do not address the underlying causes of fluctuations, which they believe lie on the supply side of the economy [8][13].

Economic stability in Syria can be expressed through the stability of economic stability indicators, and for the Syrian economy, they are the value of the national currency, the real GDP, the real GDP per capita, the rate of inflation, unemployment, the volume of exports and imports, and the money supply [14][12]. In this study, I will focus on some macroeconomic variables according to the relative importance of each. I will study the effect of the Syrian pound exchange rate on some of the most important macroeconomic variables due to the sensitivity of the Syrian pound’s exchange rate to the rest of the variables [16].

There is a positive relationship between the exchange rate and economic stability, especially when the exchange rate is cheaper but stable, which helps stimulate the process of economic development [10]. The exchange rate policy plays a major role as a tool to enhance economic stability and growth. However, the theoretical development and empirical evidence of the exchange rate influencing economic growth is not unambiguously decisive [11].

Previous studies concluded that the local currency exchange rate has an important role in the process of stability and economic growth, as studies have found a positive relationship between the stability of the exchange rate and economic stability, especially when the local currency is priced below its value, which helps stimulate economic growth as exports are stimulated. And increase production, which leads to real growth in the economy.

### **3. Methodology**

The study used econometric models to study the simple relationship between the study variables using the STATA program for the statistical analysis of the real exchange rate of

the Syrian pound as independent variable, and as dependent each of the following: the real GDP, the balance of payments, inflation, unemployment, the GDP gap, and the money supply, each separately. And the researcher notes that due to the lack of some data, such as foreign direct investment and cash reserves at the Central Bank, the researcher will rely on studying the simple relationship between the variables. It should be noted, however, that the results of the study are to be slightly biased due to the unavailability of data for some variables. However, the researcher believes that the results of the study are useful to the Syrian Arab Republic, considering that the research is the only one in terms of the study period from 1961 to 2020. The importance of this research lies in studying the effect of the exchange rate on economic stability in Syria.

So, the research question is “Does the stability of the real Syrian pound exchange rate have a positive effect on the macro-economic indicators in Syria?” “The data of the study were taken on an annual basis for the period from 1960-2020, from official websites of “Federal reserve economic data, World Bank, International Monetary Fund. The lack of data was supplemented by the Central Bureau of Statistics and some local sources in Syria”. The Data values will be converted into US dollars by dividing the data numbers in local currency by the real exchange rate of the Syrian pound against the dollar each year separately for data from local sources.

### 3.1. Estimation Models

#### 3.1.1. Real exchange rate with its previous value function model 1:

According to economic theory, an inverse relationship is expected between the change in the exchange rate and its previous value.

$$diff \log(Real_{EXRt}) = \alpha_0 + \beta_1 * diff \log(Real_{EXRt}) + \mu_i \quad (1)$$

#### 3.1.2. Real GDP function model 2:

According to economic theory, an inverse relationship is expected between the change in the exchange rate and the gross domestic product. The rise in the exchange rate leads to a decrease in exports on the one hand, and an increase in imports on the other hand, and vice versa. It also affects the movement of capital to and from the country.

$$diff (GDP) = \alpha_0 + \beta_1 * diff \log(Real_{EXRt}) + \mu_i \quad (2)$$

#### 3.1.3. Balance of Payments function model 3:

According to economic theory, there is an inverse relationship between determining the exchange rate of the Syrian pound and Syrian BOP.

$$diff (BOP) = \alpha_0 + \beta_1 * diff \log(Real_{EXRt}) + \mu_i \quad (3)$$

#### 3.1.4. Inflation function model 4:

According to economic theory, there is an inverse relationship between the change in the exchange rate of the Syrian pound and the rate of inflation. The rise in the exchange rate of the Syrian pound will lead to a decrease in inflation rates.

$$diff(INF_t) = \alpha_0 + \beta_1 * diff \log (Real_{EXR_t}) + \mu_i \quad (4)$$

### 3.1.5. Unemployment function model 5:

According to economic theory, there is a positive relationship between the exchange rate of the pound against the dollar and unemployment rates. The rise in the exchange rate results in an increase in unemployment rates.

$$diff(UNEMP_t) = \alpha_0 + \beta_1 * diff \log (Real_{EXR_t}) + \mu_i \quad (5)$$

### 3.1.6. Money Supply model 6:

There is an inverse relationship between the money supply and the exchange rate, where the model studies the relationship between the exchange rate and the money supply, as the researcher used the logarithm of both variables as it expresses the independent variable at the exchange rate.

$$diff \log (M2_t) = \alpha_0 + \beta_1 * diff \log (Real_{EXR_t}) + \mu_i \quad (6)$$

### 3.1.7. Economic Stability Index Model “REAL GDP GAP” 7:

This model studies the relationship between the exchange rate and the economic stability index, and where the researcher used the logarithm of the exchange rate as an independent variable, the economic stability index as a dependent variable and the researcher did not take the logarithm due to the presence of negative values in the real GDP gap.

$$diff (ESIM_t) = \alpha_0 + \beta_1 * diff \log (Real_{EXR_t}) + \mu_i \quad (7)$$

**Where:**

- $diff \log (real\_EXR_t)$ : first differences of the logarithmic of exchange rate of Syrian pound
- $\log(GDP, BOP, Unemployment\ rate, Inflation, GDP\ gap)$  : logarithmic of each variable.
- $diff \log (M2)$ : first differences of the logarithmic of money supply.
- $U_i$ : a random stochastic term that satisfies the usual assumptions

### Building an indicator of economic stability in Syria:

The economic stability index by relying on the GDP gap, as follows:

$$C + S + T = GDP = C + I + G + (X - M) \quad (8)$$

$$S + T = I + G + (X - M) \quad (9)$$

$$S - I = (T - G) + (X - M) \quad (10)$$

Putting the relative weight of expenditures and revenues, the final equation for the indicator becomes as follows:

$$(S - I) = w1(T - G) + w2(X - M) \quad (11)$$

w1: Relative weight of the expenditures w2: Relative weight of the revenue. From the last equation, it becomes clear that the closer the GDP gap is to zero, the more there is an indication of the stability of the economy”.

The relative weight of expenditures and revenues was calculated as follows:

$$w1/w2 = 62/ 61 \quad (12)$$

σ1: Expenditure standard deviation

σ2: Revenue standard deviation

$$w1 + w2 = 1 \quad (13)$$

From equations 1 and 2 we find:  $w1/1 - w1 = 62/ 61 \quad (14)$

Thus, the final equation of the REAL\_GDP gap becomes:

$$(S - I) = 0.809956(T - G) + 0.190044(X - M) \quad (14)$$

The results will show the causes of the Syrian economic stability in certain periods of time and its instability in other periods, then I will present solutions to find out the most important reasons for the stability of the Syrian economy and provide appropriate solutions to address the economic instability in the last period of the study.

## 4. Results

### 4.1. Evolution of the variable's indexes:

The study shows that the exchange rate of the Syrian pound against the US dollar is constantly increasing according to the indirect pricing system that the value of the Syrian pound against the US dollar is depreciate continuously. Syria lost more than 85% of the real GDP during the 10 years of the war. The last ten years witnessed a decrease in

unemployment rates due to the mass emigration of workers, the balance of payments, its trend is volatile, due to economic instability, inflation rates, it is constantly increasing, meaning that its trend is always upward due to the deficit financing policy adopted by the government. The same thing applies to the supply. The monetary trend is upwards for the same reasons, the GDP gap tends to go down during the first 35 years, then it takes an upward trend, the reason is the expansion policy of the government. Acknowledgment of inflation rates.

#### 4.2. Autocorrelation and correlograms analysis

The results show that there is an autocorrelation in all variables, which means that the series are not stationary due to the trends observed in data.

AC shows that the correlation between the current value and its value one year ago for example real GDP by USD and its value one year ago is 0.9357. AC can be used to define the q in MA(q) only in stationary series.

PAC shows that the correlation between the current value and its value one year ago for example real GDP by USD and its value one year ago is 0.9594 without the effect of the two previous lags. PAC can be used to define the p in AR(p) only in stationary series.

Box-Pierce' Q statistic tests the null hypothesis that all correlations up to lag k are equal to 0. This series of all variables show a significant autocorrelation as shown in the Prob>Q value which at any k are less than 0.05, therefore rejecting the null that all lags are not correlated so there is autocorrelation in series.

#### 4.3. Testing the series stationarity by Dickey-Fuller Unit roots test

The results of Dickey-Fuller Unit roots test presented in table 1 show that the series of the exchange rate of the Syrian pound stationer at the second difference with a confidence degree of 98%. The GDP series is stationer at the first difference with a confidence degree of 95%, the unemployment rate, inflation, log(M2), GDP gap series are stationers at the first difference with a confidence degree of 98%. So, study shows that the used variables are stationery but at different levels.

**Table 1. Augmented Dickey-Fuller test**

Variables	Level I (0)	1 <sup>st</sup> diff I (1)	2 <sup>nd</sup> diff I (2)
Log (Real exchange rate)	1	0.06*	0.000***
Balance of payment	0.04*	0.000***	-
Real GDP	0.7	0.012**	-
Inflation rate	0.95	0.0009***	-
Unemployment rate	0.35	0.000***	-
Log (Monetary supply)	0.96	0.000***	-
GDP gap	0.22	0.000***	-

Source: Own calculations, based on the STATA output.

#### 4.4. Analyze the relationship between Real exchange rate and MACRO variables

According to the models there is a positive relation between the exchange rate and BOP, inflation, and GDP gap but there is a negative relationship with Real GDP, M2 and Unemployment rate.

According to the R-squared the exchange rate of the Syrian pound has the strongest effect on GDP gap then GDP, inflation, unemployment, BOP finally, the m2 where we note that the model does not explain anything.

According to the p-value/ Prof F models 1,2,4,5 are statistically significant at the 99%, model 3 statistically significant at the 95% confidence level, model 7 statistically significant at the 90% confidence level but model 6 isn't statistically significant.

According to the Durbin Watson (DW) statistic there is a positive autocorrelation between the exchange rate and GDP, inflation, unemployment rate, M2.

For the serial correlation of the residuals of the models, no serial correlation was founded.

**Table 2: Models Output**

diff log EXRt	Coeff	Const	R <sup>2</sup>	Adj-R <sup>2</sup>	P-Value	T-Ratio	DW	Prop F
Model (1) Lag.EXRt	0.0008***	0.051*	0.30	0.29	0.000***	4.99	1.47	0.000***
Model (2) d.GDP	-5.4e+10***	6.15e+09**	0.48	0.47	0.000***	-7.35	1.78	0.000***
Model (3) d.BOP	9.84e+09**	-1.09e+09	0.09	0.08	0.016***	2.48	2.18	0.016**
Model (4) d.Inflation	73.37***	-4.57	0.43	0.42	0.000***	6.76	1.61	0.000***
Model (5) d.Unemployment rate	-4.24***	0.69**	0.25	0.24	0.000***	-4.44	2	0.000***
Model (6) d.Log(M2)	-0.085	0.121***	0.014	0.001	0.36	-0.91	1.19	0.366
Model (7) GDP GAP	0.086*	-0.016	0.053	0.03	0.076*	1.8	2.7	0.076*

Source: Own calculations, based on the STATA output.

## 5. Conclusion

There is positive relation between the exchange rate and GDP gab, BOP, and inflation but there is a negative relationship the real GDP, M2, Unemployment rate, Money supply and GDP Gap. And there is a relation but exchange rate and its previous value so we can expect future exchange rate value by its previous value, and we can expect future value of macroeconomics variables by changes in exchange rate, so study shows that exchange rate has effect on economics stability.

The structure of exports witnessed a remarkable change during the beginning of the twenty-first century, as the share of oil exports decreased at the expense of an increase in private sector exports due to Investment Law No.10.

There is relationship between the real exchange rate and BOP, due to political factors, political incompatibility, the state, and economic restrictions, as exports were restricted during the past ten years to some commodities that have no relative weight in the structure of exports.

The real exchange rate has a pivotal role in the Syrian economy. Therefore, decision-makers must focus on reducing the fluctuation of the Syrian pound's exchange rate to ensure economic stability in Syria. But the degree of flexibility of the effect of the exchange rate on the study variables varies as inflation is affected to the greatest extent, followed by unemployment, then the money exhibition, then both the real GDP, exports and imports, and the real GDP gap. The exchange rate represents the link between local and international prices through the channels of goods and services, the labor market, and the financial assets market.

The central bank, as the authority empowered to issue money, must stop printing money that is not in correlation with the creation of GDP in the economy and matched by a real demand for goods and services, "deficit financing."

The government must go to more economic openness by supporting foreign direct investment, which in turn will increase the supply of foreign currencies in the local market and increase the demand for the national currency, which will adjust the sanitary exchange rate, meaning that the exchange market will balance at a minimum point, "the rise in the real value of the national currency".

The government must activate the tax exemption system that prevailed before 2011, where although the tax exemption will increase the money supply in the short term, this encourages local investors to open new investment fields, i.e., in the long term, increase exports and thus the market will correct itself in the long term.

Adjusting the official exchange rate of the Syrian pound to match the real price. Although this will destabilize the exchange rate in the short term, this will give investors' confidence in the long term. "When the price stabilizes due to the state's pricing of the pound in line with reality, this will lead to investor confidence." Individuals in the state and therefore prefer to deal with the state rather than the black market.

The government should stop adopting the policy of "a job for every university graduate", as this will encourage graduates to seek job opportunities in the private sector "real work", meaning that the salary will meet a visit in the real economy "goods and services" and thus the market will balance at a point Higher on the supply and demand curve, and this will also reduce the rate of underemployment, which is much higher than the stated rates. This also helps to reduce the fake money supply, "deficit financing".



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# Position and Comparative Advantages of Sectors and Countries in Global Value Chains<sup>1</sup>

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**Abstract.** This paper contributes to the empirical evidence on the position of each industry in the world production chains in 2014. Using the World Input-Output database we have documented the longest output supply and value-added demand production chain for the sector of manufacturing and services and the shortest production chains for the construction sector and sector of public services. Based on the structural interpretation proposed by Fally (2012) we identify industries, with the most/least possible negative impact on output if a negative shock to productivity due to the upcoming fossil-fuel crisis in Europe would occur in the industry of gas and coke and refined petroleum products manufacturing. We also documented new revealed comparative advantages for each industry, and we find highly prevalent industries with comparative advantages, especially in the manufacturing and service sectors. We find, that countries with higher revealed comparative advantages tend to vertically specialize more than those without them. The same observation does not hold for most of the sectors.

**Keywords:** Input-Output Analysis, Fragmentation of Production, Supply and Demand Chain Length

**JEL classification:** F13, F14, O24

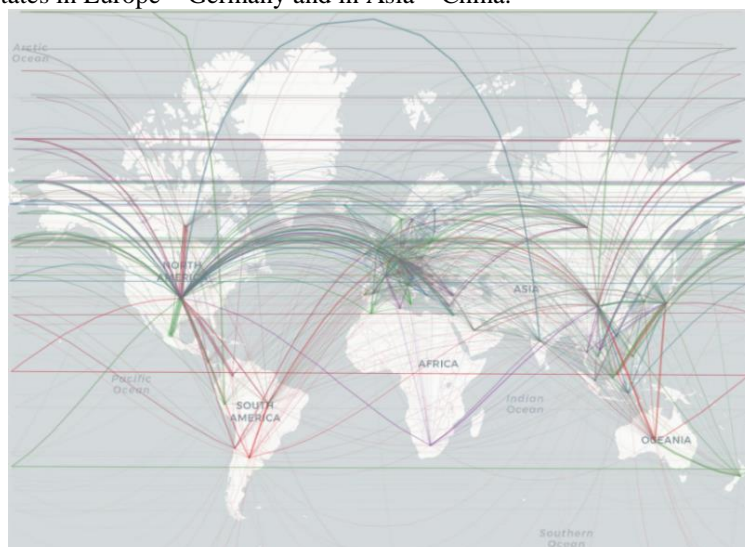
## 1 Introduction

The technological and institutional change in the world economy has fueled significant globalization and fragmentation of production processes across countries. The typical” ‘Made in’ labels in manufactured goods have become archaic symbols of an old era (Antràs & De Gortari, 2020), where Portuguese wine was traded for English cloth.

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Figure 1 presents the complexity of world trade by plotting all significant trade links in countries' value-added that is embodied in partner's exports (induced by partner's final foreign demand). With insights provided in Li et al. (2019) we could identify the economies that serve as the important buyer (hubs) of domestic value added in highly dense production structures and their respective hub economies in North America – the United States in Europe – Germany and in Asia – China.<sup>2</sup>



*Fig. 1 – Trade in Domestic Value Added embodied in Foreign Final Demand as a Share of Receiving Country's Exports. Author's illustration based on the TiVA indicators database in 2011.*

The sole display of trade links gives us an incomplete picture of the position of countries and their industries in the production process. Are European value chain more fragmented and thus distant from final demand or primary inputs? What are the lengths of supply and demand of sectoral production chains? Do industries with accrued comparative advantages vertically specialise more than industries with their absence? Are central hubs economies comparatively more advantageous in international trade? This paper is devoted to providing empirical pieces of evidence to answer this set of questions and associate them with some policy implications. This draw research is closely tied to core work in this field, which constructed and mapped the position of individual sectors (Antràs et al., 2012; Fally, 2012; Johnson & Noguera, 2012; Miller & Temurshoev, 2017) and reproduce the previous analysis with the emphasis on the relationship between the position of countries in supply and demand production chains and their involvement in international production sharing activities that are subsequently linked to their vertical specialisation in trade. Our work also connects an augmented traditional Balassa's revealed comparative advantage index based on the precise decomposition developed by (Koopman et al., 2014; Wang et al., 2017) to the

<sup>2</sup> Interactive map with bilateral labels can be found in online appendix:  
<[https://rpubs.com/TomasOles/dva\\_foreigndemand\\_share\\_of\\_partner](https://rpubs.com/TomasOles/dva_foreigndemand_share_of_partner)>

relative positions of industries/countries in production-sharing activities and their relative downstreamness and upstreamness positions in production chains. The remainder of the paper is structured as follows. In Section 2 we discuss the calculation of the main indicators used in this study. Section 3 presents the empirical result and discusses the most important finding on the position and length of sectors' and countries' production chains. Section 4 concludes.

## 2 Methodology

The position of sectors and countries in the value chain process, as well as vertical specialisation and revealed comparative advantage could be calculated using the harmonized input-output tables. In our paper, we are solely using the World Input-Output Tables (henceforth WIOT) rel. 2016, for the last available year 2014 was constructed by Dietzenbacher et al., (2013) and Timmer et al., (2015). The WIOT links national supply-use tables with bilateral trade data in goods and services to produce a global I-O table to represent the world economy. The database covers 27 European countries and 16 other major world economies and comprises 56 industries, corresponding to a broad the International Standard Industrial Classification Revision 4 (ISIC Rev. 4). The core of the WIOT table is a square matrix  $\mathbf{Z}$  collecting trade in intermediate goods and services produced industries classified as sectors  $s$  ( $s = 1, \dots, S$ ), subdivided in individual industries  $i$  ( $i = 1, \dots, N$ ) located in country  $c$  ( $c = 1, \dots, C$ ). Typical element  $z_{i,j}$  denotes a dollar value of intermediate goods and services produced by industry  $i$ . and purchased in industry  $j$ . WIOT contains the vector of gross production  $\mathbf{x}$ , with the typical element  $x_i$  which stands for gross production of industry  $i$ . The gross production of an industry is either purchased as an intermediate input by other sectors, or it travels to the final demand represented by matrix  $\mathbf{F}$  where typical element  $f_{i,k}$  denotes the final demand for goods or services of industry  $i$ . by the final demand sector  $k$  (households, government, investors). The on-diagonal elements of the block  $\mathbf{Z}$  matrix represents the domestic production process, while off-diagonal blocks represent trade in intermediate production among countries. The same can be said about the block  $\mathbf{F}$  matrix concerning trade in final products. Thus, in our case, we can obtain 2464 value chains with the direct and indirect links in the whole production line.

### 2.1 Industries' Upstreamness and Downstreamness Measures

The position of a country/sector in the value chain can be calculated by applying the decomposition of production stages pioneered by Fally (2012), later extended by (Antràs et al., 2012). We can assess the position of a country's or sector's production process from the two perspectives. Firstly, we can find how many additional plots a product from a sector  $s$ . on average must travel to reach the final demand. Conversely, we can count an average number of stages that sequentially must have entered the product/industry production of the  $s$ -th sector. The preceding indicator measures the sector's *upstreamness*. If all the production is directly sent to the final demand (households, government, or investors henceforth *HGIs*). A sector has the upstreamness measure equal to one. The ascending indicator measures the sectors' *downstreamness*.

On condition that all primary inputs (capital and labor from households) enter the production of sector  $s$ . directly in one step, the downstreamness measure corresponds to the one.

Miller and Temurshoev (2017) using well-known relations in the I-O model derived the same measurement as Antràs et al., (2012) and Fally (2012) the for upstream and downstream position of sector/country in the value chain, and in our paper, we are using their computational strategy. Nevertheless, we are relying on theory based Fally's (2012) structural interpretation of obtained terms. We start by writing the output-side accounting identity:

$$\mathbf{x} = \mathbf{L}\mathbf{f} \quad (1)$$

where  $\mathbf{L} = \mathbf{I} + \mathbf{A} + \mathbf{A}^2 + \dots = (\mathbf{I} - \mathbf{A})^{-1}$  is the Leontief-inverse matrix (Leontief, 1936) and  $\mathbf{f}$  is aggregated vector across final demand sectors  $k$ . Further, let  $\mathbf{B}$  denote the allocation matrix with typical entry  $b_{j,i}$  that stands for the share of industry  $j$ 's output that is used in industry  $i$ 's production. And denote vector  $\mathbf{v}$  as the industries' vector of primary inputs (value added) coefficients. Then the input-side accounting identity is in form of:

$$\mathbf{x}' = \mathbf{v}'\mathbf{G} \quad (2)$$

where  $\mathbf{G} = \mathbf{I} + \mathbf{B} + \mathbf{B}^2 + \dots = (\mathbf{I} - \mathbf{B})^{-1}$  is Ghosh-inverse matrix and prime stands for transposition.

Using the definition of  $\mathbf{A} = \mathbf{Z}\hat{\mathbf{x}}^{-1}$  and  $\mathbf{B} = \hat{\mathbf{x}}^{-1}\mathbf{Z}$  the link between the Leontief's and Ghosh's matrices is:

$$\hat{\mathbf{x}}^{-1}\mathbf{L}\hat{\mathbf{x}} = \hat{\mathbf{x}}^{-1}(\mathbf{I} - \mathbf{Z}\hat{\mathbf{x}}^{-1})^{-1}\hat{\mathbf{x}} = [\hat{\mathbf{x}}^{-1}(\mathbf{I} - \mathbf{Z}\hat{\mathbf{x}}^{-1})\hat{\mathbf{x}}]^{-1} = (\mathbf{I} - \hat{\mathbf{x}}^{-1}\mathbf{Z})^{-1} = \mathbf{G} \quad (3)$$

With equation (1) and (3) we can obtain upstreamness as (Miller & Temurshoev, 2017):

$$\mathbf{U} = \hat{\mathbf{x}}^{-1}(\mathbf{I} + 2\mathbf{A} + 3\mathbf{A}^2 + \dots)\mathbf{f} = \hat{\mathbf{x}}^{-1}\mathbf{L}\mathbf{f} = \hat{\mathbf{x}}^{-1}\mathbf{L}\mathbf{f}\hat{\mathbf{x}}\mathbf{t} = \mathbf{G}\mathbf{t} \quad (4)$$

the  $\mathbf{t}$  stands for unit summation vector and  $\mathbf{U}$  is the column vector of average industries' upstream position. Better understanding of upstreamness can be seen in an recursive representation of  $\mathbf{U}$ :

$$\mathbf{U} = \mathbf{t} + \mathbf{B}\mathbf{U} \quad (5)$$

That illustrates the fact that industries that are important input suppliers to customer industries that have higher upstreamness are themselves far away from final consumption (Branger et al., 2019). The upstreamness measure are exactly industries' total forward linkages in terms of gross output (Miller & Blair, 2009b; Miller & Temurshoev, 2017), which is highlighted in recursive representation in equation (5).

Similarly using identities (2) and (3) the downstreamness of the sector is column sums of Leontief's matrix (Miller & Temurshoev, 2017):

$$\mathbf{D}' = \mathbf{v}'(\mathbf{I} + 2\mathbf{B} + 3\mathbf{A}\mathbf{B}^2 + \dots)\hat{\mathbf{x}}^{-1} = \mathbf{v}'\mathbf{G}\mathbf{G}\hat{\mathbf{x}}^{-1} = \mathbf{t}'\hat{\mathbf{x}}\mathbf{G}\hat{\mathbf{x}}^{-1} = \mathbf{t}'\mathbf{L} \quad (6)$$

We also can rewrite downstreamness in a recursive representation:

$$\mathbf{D}' = \mathbf{t}' + \mathbf{D}'\mathbf{A}$$

Which analogously captures the fact that industries that purchase large shares of their inputs from supplier industries that have a high downstreamness are themselves far away from primary inputs (Branger et al., 2019). The downstreamness measure are exactly industries' total backward linkages in terms of gross output (Miller & Blair, 2009b; Miller & Temurshoev, 2017).

## 2.2 Industries' Vertical Specialization

To capture how each industry is involved in international production sharing activities we rely on the measure of *import content of exports* proposed by Hummels et al. (2001). We start with the further disaggregation of the  $\mathbf{A}$  matrix into domestic (on-diagonal) part  $\mathbf{A}_d$  and imported (off-diagonal)  $\mathbf{A}_m$  to country  $c$ . We can find total direct and indirect import requirements by finding the import inverse matrix:

$$\mathbf{R} = \mathbf{A}_m(\mathbf{I} - \mathbf{A}_d)^{-1} \quad (7)$$

the sum of each column of  $\mathbf{R}$  gives us the import requirement ratio for the corresponding sector/industry, influenced by both domestic and foreign demand. The induced amount of imports to change in total demand  $\mathbf{f}$  can be easily obtained:

$$\mathbf{M} = \mathbf{R}\mathbf{f} \quad (8)$$

we can easily find the import content of export by disaggregating the final demand into domestic demand  $\mathbf{f}_d$  and third's country demand  $\mathbf{f}_t$ , which are in fact country's exports. The last step is to obtain the import content of exports in form:

$$\mathbf{vs} = \frac{\mathbf{1}'\mathbf{R}\mathbf{f}_t}{\mathbf{1}'\mathbf{f}_t} \quad (9)$$

where vector  $\mathbf{vs}$  contains the sum of import content of export for each industry and country or in other words sector's *vertical specialisation* in global value chain activities in gross terms (Hummels et al., 2001). To acquire a relative comparability across countries we construct the relative vertical specialisation measure as the share of import content of export on the value added for each industry.

## 2.3 Industries' New Revealed Comparative Advantages

Traditional Balassa's revealed comparative advantage (RCA) index is based on the relative export performance of an industry -  $i$ . We are saying that if the share of a country-sector's gross export in the country's total gross exports divided by the sector's gross exports from all countries as a share of world total gross exports is relatively higher (above one), a country must have a comparative advantage in the production of goods and services of that specific sector. The concept of Balassa's RCA index, however, ignores two facts: that the sector's value added could be exported via the country's exports to other sectors and should be then included in the sector of its origin. And secondly, it ignores the fact that the country's gross exports partly include foreign value added embodied in the domestic sector's export. The decomposition pioneered by Koopman et al. (2014) and further developed by Wang et al. (2017) enables us to calculate the sector's *new revealed comparative advantage* index, defined as a share of a country-sector's forward linkage based measure of domestic value-added (henceforth DVA) in exports in the country's total domestic value added in exports divided by that sector's total forward-linkage based DVA in exports as a share of global value added in exports, in the form:

$$NRCA_i^c = \left( \frac{DVA_{Fi}^c}{\sum_i^N DVA_{Fi}^c} \right) / \left( \frac{\sum_{k=1}^c DVA_{Fi}^k}{\sum_{k=1}^c \sum_i^N DVA_{Fi}^c} \right) \quad (10)$$

The domestic value added embodied in total export and a lot of other calculations and decomposition in this paper was technically obtained thanks to R-package '*decompr*' written by Quast & Kummritz, (2015).

### 3 Results

In this section, we discuss structural patterns among industries and countries, which can be derived from the above-defined measures. We firstly plot the relative up-downstream position of each industry and add a linear smoothing curve to assess the different relationships among various industries' positions in the value chain that are aggregated to 7 typical WIOT sectors (Figure 2). What is immediately apparent is the strong positive relationship between downstreamness and upstreamness in each industry, which could be misleading because their partial labels indicate the opposite. The upstreamness ( $U$ ) and downstreamness ( $D$ ) measures, however, capture two different chains. While  $U$  quantifies the upstream position of the industry along the global output supply chain;  $D$  characterizes the relative position in the global input demand chain. Both indicators are calculated relative to the respective demand (supply) of the final (original) demand (supply) sectors of goods (primary factors). We thus observe the fact that industries that sell a large portion of gross output directly to final demand, also directly absorb a large share of value-added from their owners (households, government, investors (HGIs)). The closer the sectors are to the origin [1, 1] the weaker their intermediate input or output supply or demand links are (which implies closely interrelatedness with forward and backward industrial linkages). It moves us to the second compelling observation on the length of supply or demand chains of various sectors. The lengths of these chains vary from the shortest in the sector of *Public services* to the *Manufacturing* or sector of *Services*, which appear to be immensely fragmented and highly engaged in the trade of intermediate products.

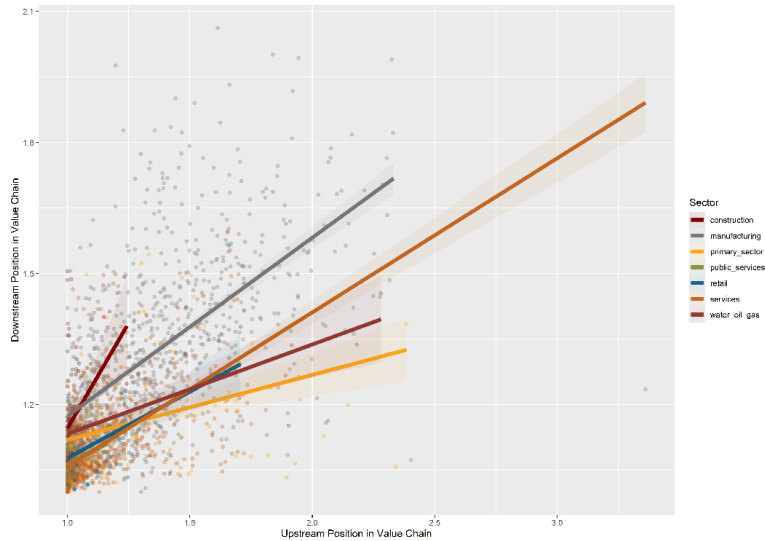


Fig. 2 Relative downstreamness and upstreamness of sectoral clustered industries in 2014. Author's calculations based on the WIOT database.

Identified length of supply and demand chains are in line with the traditional finding of I-O literature that uses the hypothetical extraction method (chapter 12 in (Miller & Blair, 2009a)), and we do observe the lower overall intensity of both upstream and downstream activities in *Primary sector*, *Oil, Gas and Water sector*, *Construction sector* and surprisingly *Retail sector*, while the high intensity of *Manufacturing* and *Services*. As one may notice in the above Figure, we see observe different steepness of each sector's average curve. All sectors (except the *Construction*), have their aggregate sector's curves slopes lower than 1, which means that on average they are positioned closer to the supplier of primary inputs than to the buyers of their gross outputs. The supply chains are then much longer from the perspective of households than the respective demand chains of their primary inputs. It indirectly implies that the sectors with the very low steepness of sectoral curves are much more prone to outsourcing of inputs (even our measures cannot differentiate between the domestic outsourcing and foreign outsourcing enriching discussion in Antràs & Chor (2018)), and it is reasonable to assume that much of these inputs are outsourced from foreign markets if the sector is labor-intensive and oppositely if the sector is R&D oriented (Tomiura, (2009) demonstrates the firm-level empirical evidence).



We explore a relationship between the position in demand and supply chain fragmentation (defines as their average length) by plotting in Figure 3 the position of each industry and their respective vertical specialisation defined in Equation (9). To capture possible non-linearities in the relationship, we add the sector-specific polynomial smoothing curve.

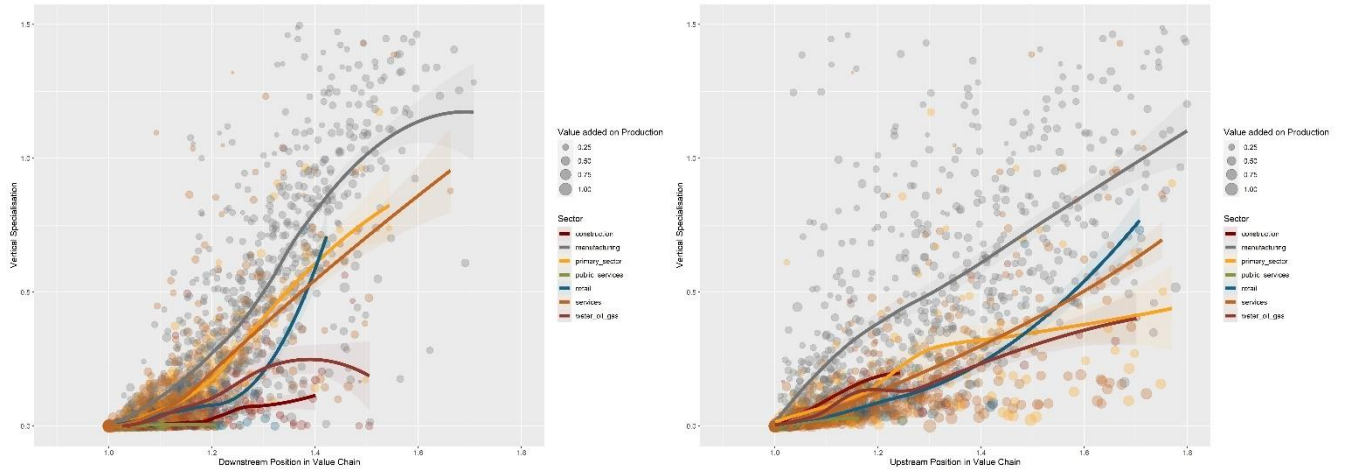


Fig. 3 Relative downstreamness (left panel) and upstreamness (right panel) of countries' industries to their vertical specialisation in 2014. The polynomial smoothing curve and the size of the bubbles are weighted by the sector's value added on production. Author's calculations based on the WIOT database.

As apparent in Figure 3, the longest and most fragmented production chain across the borders is in the *Manufacturing sector*. On average we can observe that in all sectors a positive tendency of the industry's average distance relative to final demand or source of primary inputs tends to be positively related to the import content of the industry on value-added. While from both perspectives we observe diminishing returns of vertical specialisation in play, with an exemption of the *Retail sector*. As was foreseeable by the character of the production of the retail sector, our result only underlines the fact that if the retail sector is more distant from the final demand or source of primary inputs, the volume the intermediate production that must come from imports increases in a higher proportion to distance. Unsurprisingly, the *Construction* and *Public services* sectors report a low vertical specialisation combined with previously discussed small average distances from the HGIs. The findings here suggest a well-established fact of a very high downstream position to a value-added source (and thus low backward industrial linkages) of the *Oil, Gas, and Water sector* and a fairly low upstream position (high forward industrial linkages) in the production chain to a final demand, which lies in a fact that the primary energy products are one of the most important intermediate products entering to the production in the world economy.

According to the structural interpretation of different magnitudes for upstreamness and downstreamness of different sectors (in detail discussed in (Fally, 2012)), we can make a couple of conclusions from obtained measures. Firstly, higher values of

downstreamness measure, imply higher transportation costs within the input demand-supply chain that are accumulating across the further value-added must travel along the production chain. In a Cobb-Douglas production and preference economy, the output multipliers to positive productivity shock (or error shock with opposite sign) is positively dependent on the higher the measure of downstreamness of an industry is. In a Leontief production and preference economy, a positive productivity shock has a higher effect on output the further the industry lies from the final demand. The price effects of the productivity shocks in a specific industry tend to negatively depend on the size of a measure of downstreamness of a specific industry (Fally, 2012). Regarding the possible implications of highly probable negative productive shocks, to especially exposed industry in Europe D35 - *Electricity, gas, steam and air conditioning supply* the very low measure of upstreamness are in Cyprus, Austria, Spain, Italy, Greece, Portugal on the other side of the spectrum stand Belgium, Slovenia, Denmark, Hungary, and Estonia. Instead, if we assume a Leontief type of production function and preferences, a relatively higher negative impact could be assumed if the negative productivity shock would occur in the especially second group of countries. On the other hand, with the assumption of the Cobb-Douglas economy, for a sector C19 - *Manufacture of coke and refined petroleum products* the highest negative output multipliers, if a negative productivity shock would occur (e.g. in an expected scale of -30% to refinery Slovnaft a.s. in Slovakia), we could (*ceteris paribus*) assume the most severe output impacts along the production chains from Malta, Belgium, Austria, Bulgaria, Slovakia, and Germany.

To better understand the fragmentation of the production chain and the above-discussed position of industries in the world economy, we rather loosely indicated some bi-directional causal relationship between the position of industries along the value chain to the vertical specialisation of industries. It could be interesting to see, whether industries with previously accrued relative comparative advantages, that we can precisely measure on the level of every industry, tend to be also more deeply involved in the production sharing activities. Thus, in the following exercise, in Figure 4 we show the accrued relative comparative advantages ( $RCA > 1$ ) of 2464 industries, and we have found that almost 40% of industries have some level of revealed comparative advantage. For the *Manufacturing sector*, the level of cross-border production sharing activities tends to trend (on average) higher than in the sector of *Services*, while others with a lower limit of *Public services* sector tend to be on average less vertically specialised.

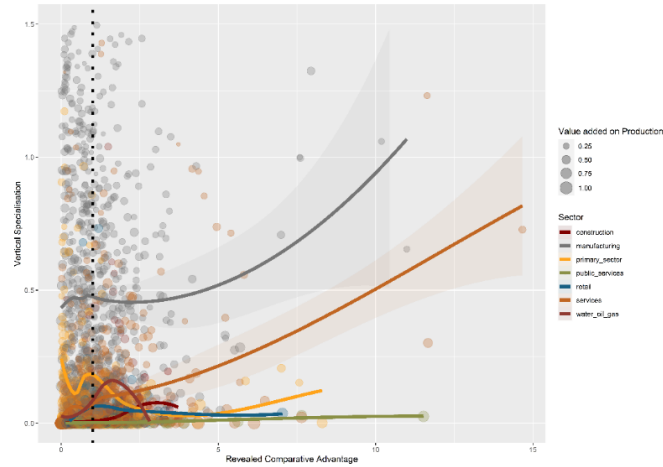


Fig. 4 New revealed comparative advantages of countries' industries to their vertical specialisation in 2014. The polynomial smoothing curve and the size of the bubbles are weighted by the sector's value added on production. Author's calculations based on the WIOT database.

It must be stated that even we do observe not an impaired tendency of industries that have a comparative advantage in the production to be more interconnected to trade in global value chains. However, the preceding observation strongly holds for the industries with the highest comparative advantages in manufacturing and services.

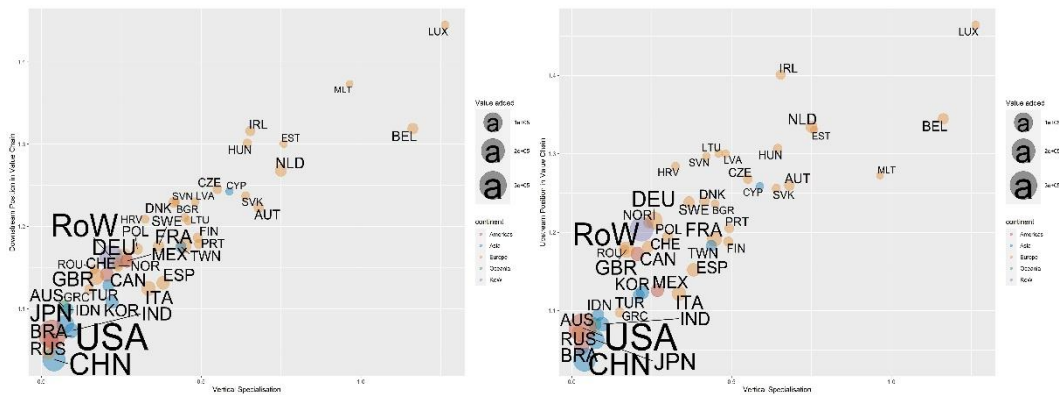


Fig. 5 Relative downstreamness (left panel) and upstreamness (right panel) of countries to their vertical specialisation in 2014. The size of the bubbles is weighted by the countries' total value-added. Author's calculations based on the WIOT database.

To uncover the countries' aggregate participation in production sharing activities and their averaged position in the supply and demand chain, we show the relative size of vertical specialisation of countries concerning their aggregated down, up- streamness along with all sectors. What is apparent at the first sight is the high degree of vertical specialisation (small countries naturally tend to trade more) and the longest supply and demand chain of countries that belong to the European cluster of value chains (top right quadrant of Figure 5). A quite surprising fact is the low position of China, one would

expect a much higher upstream position in the value chain, but in our analysis, it turns out that China's industries tend to be centered much directly around the final demand with an exemption of *air and water transport and manufacturing of computer, electronics optical product, electrical equipment, fabricated metal product except the production of machinery and legal and accounting services* has an average distance from final demand higher than 1.1, and only the industries that produce *computer, electronics optical product, basic metals or coke and refined petroleum product* tend to be rather distant from the source of primary inputs. Even a strong imperative presented in (Antràs, 2020) tells us that the individual firms and plants (nor industries or countries) decide to outsource or offshore their activities to multiple stages of production, it may be interesting to map the position and intensity of international fragmentation of individual countries in production chains because ultimately policymakers in countries set policies to adjust market equilibrium. The position of the country in the production chain relative to the degree of international sharing activities creates the policy framework with imperatives of higher efficiency of industrial (positively productivity augmenting) policies in countries positioned in the top-right quadrant of Figure 5. Based on a well-elaborated treatment of exogenous shock transmission in the value chain network in Boehm et al. (2019) on the 2011 Tōkuhu earthquake example, we can expect an enormous effect, especially to hubs economies (Figure 1 – Germany, the United States, and China) proportional to their relative position to country's difference in *y-axis* distance from hub where the shock occurs.

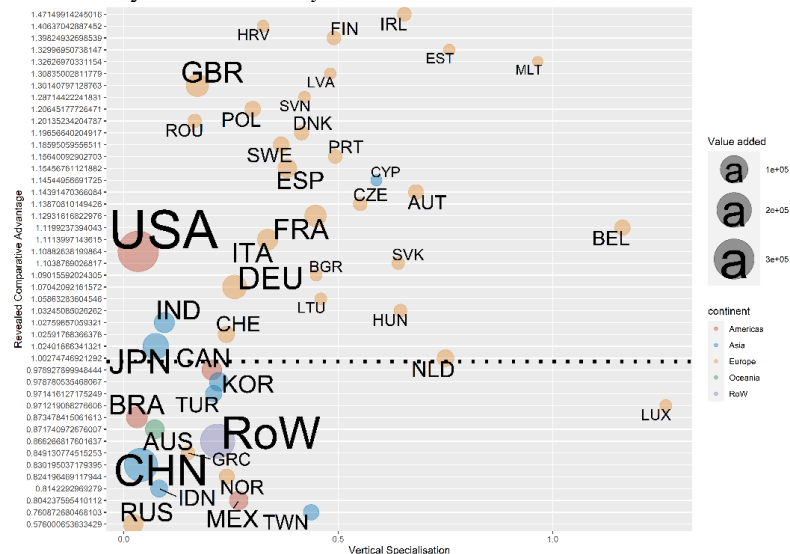


Fig. 6 Countries' new revealed comparative advantages to their vertical specialisation in 2014. The size of the bubbles is weighted by the country's total value added. Author's calculations are based on the WIOT database.

In the upper panel (Figure 6) we graph country's new accrued comparative advantage relative to the vertical specialisation in trade. On average, we observe many of the European countries to be located above the horizontal dashed line that indicates

the comparative advantage of the country in the production. The countries' position ranging from the lowest comparative advantages in Russia to the highest in Ireland. What is interesting to observe is the position of GVC hubs economies, while the United States indicates to have the highest comparative advantage followed by Germany. China's comparative advantage, if we have removed traditional biases of RCA index tends to no longer have an aggregate comparative advantage in trade.

## 4 Conclusions

In this paper we analyzed the position of industries/countries from the households, government or investors in the twofold role industry are to these NGIs. We have found that the position of all sectors is quite diverse. While the sector of Public services, Construction and retail tend to be positioned very close to the final demand as well as the source of primary inputs, a many industries within the sector of Manufacturing and Services are positioned quite distant from households, government and investors (NGIs) in their two-fold role. We have pointed out that labor-intensive industries that are mostly distant from final demand and primary inputs are prone to outsourcing of inputs and offshoring of outputs. To this respect, we interlinked the position of each industry to production-sharing sharing activities across the border (measured by import content of exports on value added) and found out that especially in the Manufacturing and Service sectors tend to have embodied a larger part of import content in their export. Unsurprisingly, the Construction and Public services sectors report a low vertical specialisation combined with previously discussed small average distances from the HGIs. The findings here suggest a well-established fact of a very high downstream position to a value-added source (and thus low backward industrial linkages) of the Oil, Gas, and Water sector and a fairly low upstream position (high forward industrial linkages) in the production chain to a final demand, which lies in a fact that the primary energy products are one of the most important intermediate products entering to the production in the world economy. With the exact supply and demand position of each industry in hands, we assumed that the possible negative productivity shock to whole sector of Manufacturing coke and refined petroleum products, could result in the highest negative output multipliers in Malta, Belgium, Austria, Bulgaria, Slovakia, and Germany. We also documented new revealed comparative advantages for each industry, and we found their highly prevalent presence in Manufacturing and Service sector. We have established a fact that countries with higher revealed comparative advantages tend to vertically specialize more than those without them, and the China as a whole, even serving as the GVC hub economy do not exhibit a new revealed comparative advantages on an aggregate level.

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# Household Financial Decision-Making Models: Which to Choose for Experimental Investigation

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**Abstract.** The paper offers a comparison of household financial decision-making models considering a household as one of the initial economic units, understanding the decision-making process and utility function perception of which is influential for the conception of the integrate economic development of a society. Paper provides a brief description of the most applicable within-household decision-making models, namely unitary, bargaining, and collective ones, denoting the pros and cons of their employment for experimental investigation by stating the appropriateness conditions, which are as follows: the ability to include more than two members considering their own preferences, various possible scope of modelled decisions, and framework allowing for empirical research. Regarding previous research, the collective model with Pareto weights appears to be the one, which justifies the conditions set.

**Keywords:** Household, Financial Decision-Making Models, Utility Function

**JEL classification:** *D10, D70, G50*

## 1 Introduction

A household is an initial economic unit at the microeconomic level, which makes its financial decisions under constraints and in turn influence other economic units both on the microeconomic and macroeconomic levels. The utility of the household, which in theory has to be maximized by its rational members, has been and still is the one of the issues of a great interest for the researchers (Becker, 1991; Neuwirth, Haider, 2004; Bertocchi et al., 2014; Chiappori et al., 2015; Saelens, 2019, and others). As decision-making process within households is in the sphere of concern for policy makers on the government level (Le Cacheux, 2005; Himmelweit et al., 2013) and practically all products and services suppliers, modelling of that process is helpful and virtually inevitable for understanding the preferences and sharing of resources in potentially conflicting within-household relations.

Initially the majority of the economists starting with Becker (1991, originally published in 1981) rested on the assumption that financial decision making within households in traditional microeconomics analysis is based on *unitary* utility function<sup>1</sup> meaning that members have unitary preferences. However, not all of the researchers agreed with the previous assumption and the *non-cooperative* approach appeared, according to which the individual preferences are different and each of the household members maximizes his/her own utility function. As non-cooperative procedures typically lead to inefficient outcomes, a *cooperative* approach was introduced with a restriction of the Pareto efficient household decision making. Such an approach with Pareto efficient household decisions (when no other feasible choice is likely to be preferred by all household members) is also referred to as *collective* one (Browning et al., 2011). However, as it is visible from the divergence of the models' classifications in different sources given below, there is still no agreed structure proposed in the literature<sup>2</sup>.

The *aim* of the research is to extract the decision-making model of the household suitable for applying in experimental investigation of financial decision making<sup>3</sup> based on the previous research studies (Becker, 1991; Neuwirth, Haider, 2004; Bertocchi et al., 2014; Browning et al., 2011; Chiappori et al., 2015). Experimental investigations are made using experimental methods in order to testify theoretical predictions by gathering empirical evidence in laboratories (Friedman, Sunder, 1994; Nikiforakis, 2010).

For the purpose of our research we make a *hypothesis* that collective models are the more suitable for applying in experimental investigation of financial decision making in sense of their framework, scope of the decisions that can be modelled, and empirical research application. Thus, the *research question* is whether the collective model is the most suitable financial decision-making model for experimental verifying the theoretical predictions about the financial decision making within households.

The paper proceeds as follows: section 2 contains literature review on the household decision-making models including unitary, bargaining and collective ones; section 3 describes the methodology adopted to make a choice of the proper model for experimental investigation of the financial decision making within households; section 4 presents the main results; section 5 suggests discussion; section 6 concludes.

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<sup>1</sup> In the context of the research, we assume that decision making within household has its model, and the utility function represents not the model itself, but the preferences of the members within the decision-making model. The paper is focused on the model selection remaining the utility function derivation as the purpose for further research.

<sup>2</sup> Le Cacheux pointed out, that 'A large number of empirical studies has emphasized the limits of the usual model. However, the new models are scattered and no theoretical framework has clearly taken over'; and by usual model Le Cacheux meant a model, when households are treated '... as if they were individuals' (Le Cacheux, 2005, p. 1).

<sup>3</sup> We apply financial decision making of the household as made by the individual members grouped together according to the behaviour of other members. The sphere of such decisions may include, for example, income spending on goods consumed privately or household public goods, as well as the time to contribute to that income or time spent in domestic production (Himmelweit et al., 2013).



## 2 Literature Review on Household Decision-Making Models

In the literature concerning decision process on resources allocation within households the majority of authors starts with describing the models of the household decision making with their advantages and disadvantages in general and particularly regarding the issues of further research (Woolley, 1990; Becker, 1991; Mattila-Wiro, 1999; Browning et al., 2011; Bertocchi et al., 2014; Chiappori, Mazzocco, 2017; Saelens, 2019).

According to the existing literature, there is no common agreed structure of the models constructed during the last decades. In earlier literature authors, for example, divided the models of decision making at within-household level into cooperative, non-cooperative, institutional, and transaction cost approaches<sup>4</sup> (Woolley, 1990). Chiappori et al. (1993) divided models into unitary and collective, in their turn collective were split in two other broad types as cooperation and non-cooperation<sup>5</sup> ones. Le Cacheux (2005) described unitary or ‘usual’ model in the traditional approach of household decision making, but do not include it into the typology of the within-household decision models, consisting from two main categories, namely cooperative and non-cooperative bargaining models, and in its turn cooperative ones consist of Nash-equilibrium bargaining rule and predetermined sharing rule. Mattila-Wiro (1999) divided the models into unitary and collective as well, and after split collective into cooperative, bargaining and non-cooperative. Also, the author made a comparison of the different models including important characteristics, as the number of members and utility functions, etc. (Table 1).

**Table 1.** A comparison of the main features of the various economic models.

	Consumer theory	Becker’s model	Efficient cooperative models	Bargaining models	Non-cooperative models
Number of members	One individual (one consumer) with own egoistic preferences	Two individuals with own preferences, one individual has altruistic preferences	Two individuals with own preferences	Two individuals with own preferences	Two individuals with own preferences

<sup>4</sup> In turn, the cooperative models were divided to marriage market model, Nash-bargaining model and Pareto optimal agreement model. Institutional approach was suggested for modelling intra-household income allocation determined by the shares of market and household production within household. Transaction cost approach was focused on organizing production within the household and the nature of the marriage contract.

<sup>5</sup> In the scheme of the household models authors showed that cooperation models include Pareto optimal modes, which in turn include Nash bargaining models, which finally include unitary model (Chiappori et al., 1993, p. 10).

Number of utility functions	One utility function	One utility function	Two utility functions	Two utility functions	Two utility functions
Utility	Utility depends on the consumption of market goods	Utility is derived from the consumption of basic commodities	Utility depends on the members' own consumption	Utility depends on the individual consumption plus the consumption of household public goods	Utility depends on the individual consumption plus the consumption of household public goods
Intra-household behaviour	No conflicts, individual maximizes own utility function	Member's own preferences cause conflicts which are resolved through the altruistic behaviour of one household member	There is no assumption about intra-household behaviour, decisions made are Pareto efficient, the sharing rule divides the resources between household members	Bargaining process through cooperative game, solution depends on the bargaining power of each participant, the result is Pareto efficient	Household has separate gender-specific economies, there is income transfers between wife and husband, bargaining is described by non-cooperative game, not all equilibria are Pareto optimal
Threat point				Outside option, divorce	Non-cooperative equilibrium within marriage from which bargaining proceeds, equilibrium is based on traditional gender roles and specialization to contain tasks

Source: Mattila-Wiro (1999)

In the recent research on economics of the family Browning et al. (2011) distinguished such models as unitary, non-cooperative, cooperative with the collective approach (concluding bargaining models), and collective models. Himmelweit et al. (2013) divided the models in three broad categories, namely unitary models, bargaining (including cooperative and non-cooperative), and collective (as a generalization of cooperative models). The similar division of the static household decision models had

Chiappori and Mazzocco (2017) distinguishing between unitary, Nash-bargaining and collective models.

To the purpose of our paper, we follow the common classification of models suggested in the recent literature (Himmelweit et al., 2013; Chiappori, Mazzocco, 2017) consisting from the three main groups given below<sup>6</sup>. We briefly outline them as to make the main ideas and differences clear.

## 2.1 Unitary Models

The unitary model was the pioneering one created for economic modelling of collective decisions using the tools of rational choice theory initially intended for the analysis of decision making at an individual level (Backer, 1991, originally published in 1981). According to such a model, households make decision on income spending by maximizing a single members' *utility function* subject to the single common budget constraint (representing the common income of all the household members) under the notion of income pooling. The notion means that there is no difference, who contributes what amount into the budget as this does not influence on how the budget is spent.

Arguable assumption of the model is the identical preferences for all members, which is in a conflict with methodological individualism. Another problematic assumption relates to the household head making potentially altruistic decisions for the household members. There is no rational grounds for the statement, that actually the household head is the person, who is both altruistic and having enough authority as to convince the others in making the best decisions in their interests. In addition, income-pooling assumption creates evidence from the empirical front saying, that reallocation of the income (in the form of non-labour income) from one member to another does not influence on the household expenditure composition. However, empirical studies show that there is a difference in who brings income for how it is spent (Himmelweit et al., 2013).

## 2.2 Bargaining Models

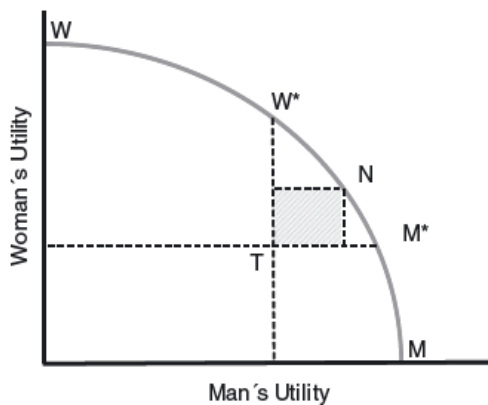
Bargaining models do not have the limitations, which are typical for the unitary models as their assumptions correspond better to sociological insights about intra-household power (Himmelweit et al., 2013). These models are based on game theory to show the bargaining by members of the household whose preferences differ (Lundberg, Pollak, 1993; Manser, Brown, 1980; McElroy, Horney, 1981; Pollak, 2005). The bargaining models featured in the two versions. First version is a *cooperative model*, where each of the family members has own utility function and negotiate with other members to achieve Pareto efficient outcome. This Pareto efficient outcome is defined as a situation in which one member cannot achieve greater utility without reducing the utility of

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<sup>6</sup> We tend to dividing the models into two broad categories, namely unitary and collective, and then classifying the collective models according to the main characteristics (similar to Chiappori et al. 1993; Mattila-Wiro, 1999). Such a categorisation, thus, is not the aim of the paper given, and remains as one of the directions for further research.

another member, when the resources remain constant. To reach efficient cooperative outcome as a key assumption, long-term relationship between household members is used to reduce short-term gains from game (Donni, Ponthieux, 2011).

Situation of the bargaining cooperative model is shown in the Fig. 1, which represents Pareto-efficient allocations of a couple. Those allocations should be viewed as the frontier of the set of all combinations of utility achievable by household members under a given budget constraint. On vertical axis we can find utility of woman, and on horizontal one the utility of man. The area beneath the frontier and to the left of it contains the possible variants of utility levels for the partners of all eventual outcomes, while the frontier from W to M shows the Pareto-efficient outcomes that could be reached by bargaining. There are many such outcomes, which differ in favouring one or another member of the household. As we can see, combinations near W-point are more favourable for the woman and those near M-point are more auspicious for the men. As each household member has a relative bargaining power, the final bargaining outcome depends on such power.



**Fig. 1.** A household's utility in a *bargaining* model (see Himmelweit et al., 2013).

The point of intersection T in the Fig. 1 represents the *threat point*<sup>7</sup>, which expresses the utility gained by each individual in case of the cooperation collapse. The woman will not agree to outcomes below M\* as this outcome will make her worse than threat point. On the opposite side, the man will not be satisfied with the combinations, located on the left from W\*. Then between W\* and M\* lies Pareto-efficient bargaining outcome. The outcome at the point N, which lies on the frontier that maximizes the product of the two partners' gains in the utility terms over the threat point, is called Nash bargaining solution (Apps, Rees, 2007). How good will be the outcome at N, depends on the bargaining power of each member according to the threat point T. The equilibrium shifts along the frontier due to decline in the bargaining power of one member and increasing power of the other one (Donni, Ponthieux, 2011).

<sup>7</sup> Also known as disagreement point or breakdown position.

In bargaining model shown, two different types of the threat point are in place. First one is divorce, which represents the household dissolution. The second one is the situation, when the household members stay together without cooperation, which refers to the non-cooperative game theory (Himmelweit et al., 2013).

### 2.3 Collective Models

This type of models was developed in order to tackle with the shortcomings of the unitary and bargaining models, and assume the Pareto efficient outcome of the decision making within households. Collective models are the most general from the models of household decision making, considering Pareto efficiency as the only assumption made concerning the minimum expression of the desire of living in a couple, which Chiappori called a *collective rationality* (Chiappori, 1988). According to Browning et al. (2011), collective models also have to rely on the assumption of existence of the *decision process* in the household; also, collective models include cooperative bargaining models and unitary models as special cases. Those models account for individuals *caring behaviour* and may include *more than two decision makers*. They may include *financial decision making* on household production, taxes and spending on private and public household goods as well as the labour time and participation on the labour market (Himmelweit et al., 2013).

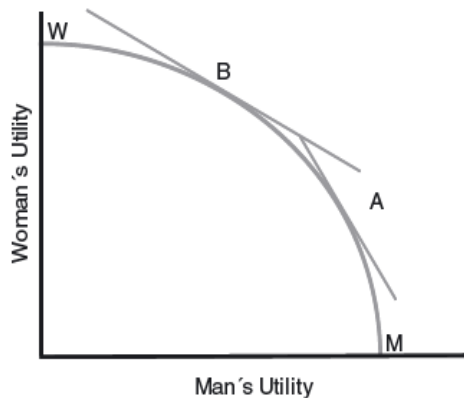
The existence of collective-rationality theoretical assumption of the models allows for representing of any outcome of a household decision making as the result of maximizing a function, which is a *weighted sum of the household members' utility functions* subject to the total budget constraint. Those Pareto weights combine individual utility functions and represent the respective power of each household member over the outcome of the decision-making process. Fig. 2 presents the same couple's household utility possibility frontier, as in the example of bargaining model depicted in Fig. 1. Point A, as the point of tangency of the Pareto weights line, is relatively higher for man, which gives the better outcome for man, than B; and in turn, outcome B is better for the woman, than A.

One of the useful features of collective models is that they can allow for any factor not influencing individual preferences of the household members affecting the outcome of the model by changing the Pareto weights. Those may be factors, which enter the household budget constraint, switching the range of probable outcomes, such as wage rates, goods prices, as well as individual or household non-labour income. At the same time, the factors of influence on the Pareto weights may be *distributional*<sup>8</sup> ones, which do not influence preferences of household or the variables having impact on the household budget constrain. When they change, the frontier on the Fig. 2 remain unchanged, but there will be a shift in the relative power of the household members, influencing the relative weight of the members' individual utility function in the form of the tangents slope in Fig. 2. This will result in the change of the Pareto-efficient

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<sup>8</sup> McElroy and Horney (1981) refer to those factors as 'extra-household environmental parameters'.

outcome of the household decision making<sup>9</sup> (Himmelweit et al., 2013). Such distributional factors may include some individual characteristics of the members of the household as their age and human capital<sup>10</sup>. Also, they may include some legal and welfare rules (e.g., laws pertaining to marriage, divorce, abortion, right to be protected from domestic violence, property rights, etc.) as well as sociological or cultural characteristics including partners' social background or gender role attitudes, and even national customs (Browning et al., 2011; Donni, Ponthieux, 2011).



**Fig. 2.** A household's utility in a *collective* model (see Himmelweit et al., 2013).

Except of Pareto weights there is another concept for measuring decision-making powers within households, which rely on using the *sharing rule*<sup>11</sup> reflecting the power of each partner, that may depend on the variables describing household environment. In case of sharing rule implementation, the decision-making process can be decomposed into two phases: (1) the income is shared between the two household members according to the sharing rule; (2) each member maximizes his/her utility under the budget constraint determined in the phase (1) by the sharing<sup>12</sup> (Donni,

<sup>9</sup> Donni and Ponthieux (2011) explain that '... if two distribution factors affect the demand for any good in identical ways, we can then conclude that their impact on the equilibrium on the efficiency frontier must be the same. In addition, any other demand for goods must be affected in the same way by the two distribution factors in question'. The aforementioned explanation of the theoretical model properties allows for the conclusion of the model testability on empirical data.

<sup>10</sup> However, Donni and Ponthieux (2011) classify age along with education and sex as *preference factors*, i.e. the variables, which tend to alter individual preferences in case of an individual or household with several members.

<sup>11</sup> The conditions for applying the sharing rule are egoistic preferences and no public goods involved, so that economic interactions within the family are minimal and members live side by side, but consume independently (Browning et al., 2011, p. 167).

<sup>12</sup> Although Donni and Ponthieux (2011) pointed out that '... the sharing rule concept has become so popular that some see it as a cornerstone of research on collective models', there is no common

Ponthieux, 2011). Browning et al. (2011) emphasize that in the aforementioned context the efficiency relates solely to the phase (2), because the allocation will be efficient provided the utility maximization by the household member, whatever the sharing rule of the collective part of the process (1), entailing bargaining, formal rules or others, is.

### **3 Methodology**

As the research gives theoretical grounds for further investigation, we use the general research methods such as comparison, analysis and synthesis, induction and deduction for investigating the main features of different approaches to decision-making models and utility functions of the households. We analyse the models used nowadays as theoretical basis for decision making at the household level, compare their characteristics with required for the purpose of experimental investigation of the financial decision making within households and select an appropriate model<sup>13</sup>.

For the purpose of our research we review the literature as to analyse the existing models of financial decision making within households that meet certain conditions. The first condition is that model may include more than two members of the household as we suppose that modern households usually consists of more than two members having their own preferences. With the first condition implementation we support the statement of methodological individualism, which was a motivation for Chiappori's research saying that "Modelling a group (even if reduced to two participants) as if it were a single individual, hence, should be seen as a mere holistic deviation" (Chiappori, 1989, p. 3). Thus, we suppose that within the household the preferences of each member matters. The second condition regards the scope of the decisions which can be modelled (i.e. consumption, spending, income, or time allocation), as there is a lack of evidence and data concerning within-household decision making and it is vital to have a choice in selection of data for the model. The third condition is that the model has a framework allowing for empirical research.

According to the aim of the paper, the question of choosing the appropriate household financial decision-making model with utility functions of the household members leads us to the brief analysis of the main models' shortcomings. Then we make a choice and ground it on the basis of literature review and the conditions stated.

### **4 Results**

We briefly outline the shortcomings of the models in the same order as they are described in the literature review.

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approach to its determination and 'the terminology is not completely tied down' (Browning et al., 2011, p. 128).

<sup>13</sup> Similar methodological approach to household decision models, although without choosing one for further research, is presented in Mattila-Wiro (1999), Le Cacheux (2005), Himmelweit et al. (2013).

The unitary model based on the unitary utility function of the household and decisions are supposed to be made by the household as a unit, which is seen to be far from reality, and separate interests and preferences of the household members are to be considering. The assumption of constant preferences is also quite arguable, as individual members' preferences cannot assume to be constant (Grossbard-Shechtman, 1999). Within unitary model, the household remains a 'black box', as the intra-household choices are independent of which member receives resources or consumes goods (Le Cacheux, 2005). Therefore, the framework does not address such issues as the allocation of resources within the household and obviously does not allow taking the effects of distributional factors (e.g. social or fiscal policy implementation) into account.

Bargaining models mostly rely on the framework of two household members with their specific utility functions, and the models require a specific setting: a threat point for each member has to be defined describing the utility level, which he/she may reach in the case of disagreement. If the threat point is outside the Pareto set, there will be no agreement between the household members since at least one of them would lose (Browning et al., 2011).

Collective models' framework mostly consists of two utility functions with application of Pareto weights or sharing rule conditions. One of the collective models' shortcomings relates to the caring preferences meaning household members' concern for each other. Thus, collective models with caring preferences are seen as potentially invalidating a sharing rule interpretation in case of caring not about the level of utility, but the way of how it is achieved. Another point in critics is that in collective models the efficient outcomes are only achievable on cooperative basis, which lack may be seen as a reason of many inefficient empirical outcomes in developed and developing countries. Gender norms, e.g. in division of unpaid labour or domestic violence, are often reported as causes of the lack in such a cooperation. Another criticism is from the empirical front saying that sharing rule is difficult to estimate (Himmelweit et al., 2013).

Despite aforementioned disadvantages of the collective models, Donni and Ponthieux (2011) argue that recently appeared collective approach plays a prominent role in household economics. Unlike bargaining models, collective ones do not require *a priori* specified threat points as to test the influence of distributional factors, which can be directly determined from the outcomes of household decision making (Himmelweit et al., 2013).

According to Browning et al. (2011, p. 127), for the collective model, which depends on the Pareto weights, the household utility function can be defined as:

$$u^h(Q, q, \mu(P, p, x, z)) = \max_{q^a, q^b} \{ \mu(P, p, x, z) u^a(Q, q^a, q^b) + u^b(Q, q^a, q^b) \}$$

subject to  $q^a + q^b = q$  (1)

where  $u^h$  stands for household utility; Q – public goods; q – private goods; P – market prices for public goods; p – market prices for private goods; x – household total expenditures; z – distribution factors;  $\mu(P, p, x, z)$  – Pareto weight.



Browning et al. pointed out that implementation of the household utility function of the collective model, which depends on the Pareto weights, ‘... makes analysis using a collective model almost as easy as using a unitary model which is an important consideration when considering non-unitary alternatives’ (Browning et al., 2011, p. 128).

Based on the analysis of the earlier and recent literature concerning the within-household decision making, we assume that collective model, which depends on the Pareto weights<sup>14</sup>, has the most appropriate framework for the purpose of experimental investigation of financial decision making within the household. The characteristics, that fit our requirements, are as follows: the collective model may include more than two decision makers, covers the large scope of the household decisions including spending, income or time allocation, etc., and do not require a particular bargaining framework to be specified, thus being more open to empirical application. In spite of the fact that at the present stage of the research it is not quite clear, which factors will be included to the model, we assume applying collective model with Pareto weights and several utility functions: one for each household member.

## 5 Discussion

The topic of the paper is quite actual nowadays as both public and private sector decision makers on the higher and lower levels are interested in the household decision-making process. The models we describe are used now for policy implementation testing at the governmental level, as well as for testing of supply and demand matching for the business. The expectations from the model application then consist of reflecting the behaviour of the households in the way appropriate for making accurate predictions. Although all three main types of the decision-making models on the household level are implemented nowadays (Himmelweit et al., 2013), there is expanding opinion of the specialists that ‘... multi-person households cannot be accurately characterised by the aggregation assumptions that are inherent in the unitary model. A direct comparison of the unitary and collective model firmly establishes the collective model as the go-to approach to analyse observed behaviour of multi-person households’ (Saelens, 2019). Also, in recent studies authors mention that new generation of models open a new direction for further research considering the dynamic nature of decision-making processes within households (Donni, Ponthieux, 2011).

The investigation of the literature on the household decision making showed that in spite of the bulk of the research on the topic, there is still much room for both theoretical and empirical improvements and developments. The aforementioned inconsistency of the theory needs to be tackled. The other main development direction is related to the data availability. We agree with Himmelweit et al. (2013) pointing out that given the importance the policymakers and other interests place on economic and quantitative evidence of decision making within households, it is incumbent on those who have

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<sup>14</sup> This kind of collective model in contradiction to the model with sharing rule allows avoiding aforementioned shortcomings of the latter one.

influence on data collection to understand and overcome the data limitations for making more extensive use of those models feasible in the nearest future. Donni and Ponthieux (2011) emphasized, that ‘Over the past dozen years, the empirical studies performed on the basis of these improvements have made significant contributions, yet remain hindered by the complexity of models and the availability of relevant data’. Understanding the circumstances, under which the financial decisions are made within the household, and over which resources, is crucial for implementing the policies affecting the intra-households resource allocation and finally to opening the ‘black box’ of the intra-household financial relations.

## 6 Conclusion

We analyse the more frequently used theoretical models for household decision making along with their advantages and disadvantages as to choose one appropriate for experimental investigation of the financial decision making within household. We set three main conditions for the model, which are as follows: model may include more than two decision makers; allow for a wide scope of the decisions that can be modelled; allow for empirical implementation. On the basis of the literature review and the conditions set, the collective model with Pareto weights appears to be the more appropriate for the purpose of further research.

As the extension of the paper it is planned to select appropriate database<sup>15</sup> for empirical implementation of the chosen model in two steps. Firstly, we plan to determine the scope of the decisions, which will be modelled according to the data available. Secondly, we will create a model and check it according to the data. Thus, we plan to check the theoretical modes described in the paper with real data. Then we will design an experiment as to verify whether the theory coincide with the data obtained in a laboratory.

Although we have already extracted the model for the research, we may still re-estimate its appropriateness according to the scope of the decisions available for modelling, and the time horizon of the research. As we extract theoretical model for testing it on experimental data, we concentrate our attention on static models according to Mazzocco (2007) and Chiappori, Mazzocco (2017), as it is appropriate approach for the purpose of our ongoing research. In future we plan to extend the scope of the research as to include household intertemporal behaviour peculiarities, and consequently to apply some of the dynamic models, which allow for including time and generation changes (Chiappori, Mazzocco, 2017). Although the dynamic models are not in the list of the most applicable ones in the literature on the topic nowadays, we assume that the future belongs actually to those more complicated and thus more precise models.

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<sup>15</sup> Now we are considering and exploring the data from the Household Financial and Consumption Survey as to verify the possibility of modelling the financial decision making within households in Slovakia. Information on the Survey is available at the webpage of the National Bank of Slovakia in the part of Household Finance and Consumption Network [14].

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# Impact of Active Labor Market Measures on the Return of Disadvantaged Applicants to the Labor Market

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**Abstract.** Disadvantaged jobseekers make up a significant proportion of all jobseekers in Slovakia, mainly the long term unemployed, so it is interesting to examine whether the provided employment services contribute to raising their standard of living and make it easier to find employment in the labor market, which is not always welcoming disadvantaged groups. However, at a time when a high number of jobseekers are disadvantaged, it is important to look at the needs of these groups and try to motivate them through active labor market policies, while finding a way to bring them back to the labor market effectively and in the long term by finding suitable employment, which would help to improve their living situation. These groups usually meet with insufficient support from the state and the institutions in their efforts to solve their difficult life situation, because the institutions often provide only the necessary services for the groups. Therefore, the question arises as to whether it would not be necessary to focus on improving employment services for the given groups, as an increasing percentage of the population is among the disadvantaged.

**Keywords:** disadvantaged jobseekers, employment services, active labor market policy

**JEL classification:** *J480, J680, M210*

## 1 Overview of literature

One of the main instruments of the European Union (EU) is the European Social Fund (ESF) with an annual budget of approximately EUR 10 billion, and its function is to improve the efficiency of labor market measures for their inhabitants. This amount, which represents 10% of the EU budget, is usually supplemented by approximately half the national contribution. As the budget is aimed at improving the position of individuals in the labor market, it makes sense to examine the effectiveness of the funds spent and to verify their importance. Therefore, it is important to ask the question "What labor market policy will be effective in order to increase the number and quality of

jobs?". This question is investigated by several authors, we will focus on the study of Brother, C.-Lombardi, S. et al. of 2014 in which the authors evaluate the effectiveness of individual labor market policy measures and the evaluation of their effectiveness using the Counterfactual Impact Evaluation (CIE) method.

In this method, they try to assess the direct impact of labor market policies on their beneficiaries. This method compares the situation of the beneficiary with the situation if he did not receive assistance through the intervention at all. Thus, the given method compares the result of the labor market policy of those who benefited from the given benefits (treatment group) with those inhabitants who were not affected by the given measure, meaning the control group. In this method, the authors draw information on the impact of labor market policy from scientific studies from various databases such as SCOPUS, IDEAS, SSRN. The second source is a summary of interventions funded by the ESF and is reported in the ESF-EEN (European Social Fund Expert Evaluation Network database). This database is managed by the EU's Directorate-General for Employment, Social Affairs and Inclusion, which collects data provided by Member States on the impact of the ESF in each EU country.

The research unit in the given report are the findings and not the number of research papers. Research papers often describe several interventions by the state, not just one. The work has three orientations: the first focuses on the list of countries, target groups and interventions that have not been examined by the CIE method. In the second, if any interventions are examined, it compares whether all the research papers came to the same conclusion. The result of the analysis is usually the probability of finding a job for the target group of given intervention. Some papers also examine results other than the likelihood of finding or staying in a permanent job. Third, the report focuses on differences in outcomes by comparing the costs of policies and the number of beneficiaries.

This report focuses on the active labor market policy measures, dividing each measure into one of the following categories:

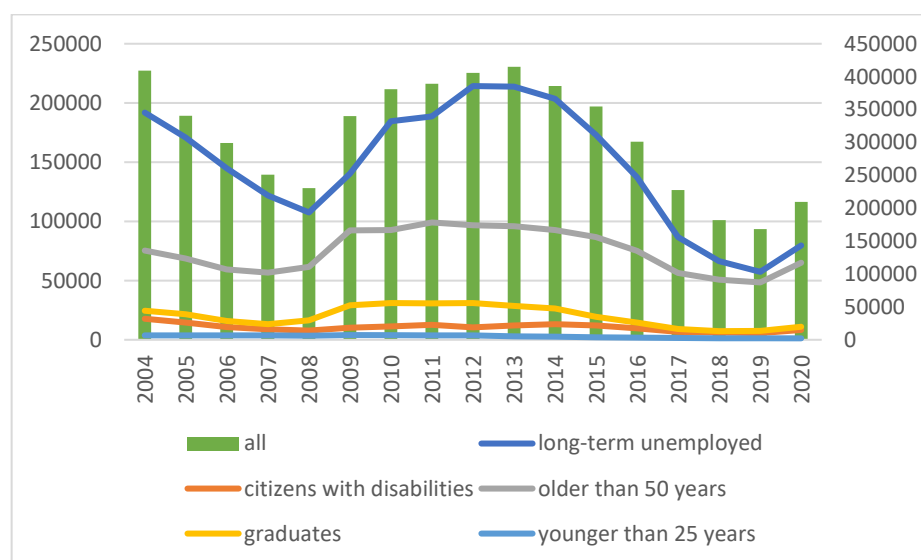
1. Education and training for the labor market
2. Contributions provided by the private and public sector
3. Active labor market measures

### **1.1 A look at the development of unemployment and active labor market policy in Slovakia**

According to a study by Domonkos, S. (2016), the main problem is the effectiveness of the labor market policy in Slovakia, the low share of active labor market policy expenditure in total GDP (around 1%) and also the low financing of public services in general. In the last decade, the social security system in Slovakia has undergone a significant change, but even today it still has significant features of the post-socialist country. Such as the low level of benefits, the high interconnection of contributions and received benefits, the wide coverage of different social situations and the broad public support for solidarity.

In order to examine the effects of a particular labor market policy or reform, it is first necessary to analyze the labor market situation. Like in other post-socialist countries, unemployment in Slovakia was virtually non-existent before 1989. The state regime provided employment and therefore the institutions that would deal with the phenomenon of unemployment as it is known for market economies were underdeveloped. The highest unemployment rate was so far in 2001, when it reached the level of 19.2%. We also present a graph showing the development of unemployment in Slovakia since 2004, together with the development of unemployment of disadvantaged job seekers.

As it can be seen in Figure 1, long-term unemployment is very high. For example, in 2013, 2/3 of all unemployed people were the long-term unemployed. If we also compare the number of long-term unemployed with the EU average, Slovakia had the third highest share of long-term unemployed in the EU in 2020 (31.6%), after Greece (47.6%) and Italy (32.9%).



**Figure 1** Development of unemployment in Slovakia together with disadvantaged job seekers (2004-2020)

Within the structure of jobseekers, disadvantaged groups require special care, while the most numerous group are long-term unemployed, which are citizen in the register for at least 12 months. This development is due to the fact that the DN group is largely made up of the low-skilled unemployed, often with little experience. Therefore this group is the most difficult to return to the labor market.<sup>1</sup>

The second most numerous group of disadvantaged jobseekers, despite rich work experience, are citizens older than 50 years. The third most numerous group are

<sup>1</sup> Projekt zvyšovanie nezamestnanosti a zamestnatelnosti znevýhodnených uchádzačov o zamestnanie (2010). [www.upsvr.gov.sk](http://www.upsvr.gov.sk)

graduates, ie citizens under the age of 25 who have completed continuous vocational training less than two years ago and have not obtained regular paid employment. The cause of high unemployment among school graduates is mainly the lack of experience. A special group of disadvantaged applicants are people with disabilities, this is a group difficult to employ as employers are not willing to employ them due to the fear of frequent absence for work, lower qualifications or work performance.

The problem with the disadvantaged unemployed is the insufficient interest of state institutions in solving their situation, which can be proved by the fact that often the only support they receive is a benefit in material need, which is the subsistence level for one adult and which often fails to cover basic needs and not to help the unemployed return to the labor market. Active labor market policy focuses much more mainly on the short-term unemployed and their return to the labor market.

Active labor market policy (ALMP) has been used since the beginning of Slovakia's transformation in the 1990s. Already the first Labor Code, which was created after 1989, contained several measures to increase employment and job creation. At that time, the community service works used today are also introduced to support the integration of the unemployed into the working population. Approximately 80% of ALMP spending went to community service in the 1990s.

Programs such as graduate practice were much less used at the time. Despite the significant changes that the Slovak labor market underwent in the years 1990-2000, the distinctive features remained almost unchanged. The most preferred method of support through job creation is that overall, expenditure on ALMP in Slovakia does not reach the EU average in more developed countries. While in Western countries, expenditure on ALMP is about 0.4% of GDP in our country, it is only half 0.2%.

### **1.1 Overview of active labor market policy measures**

The individual active labor market measures can be divided according to their focus on measures and contributions that increase the employability of job seekers, increase employment by supporting the creation of new jobs and measures and contributions that support the maintenance of existing jobs.

ALMP oriented on the supply side of the labor market, that is to develop the potential of the workforce and increase its employability and job mobility, are:

- providing reimbursement of parts of jobseeker travel expenses related to an interview or selection procedure with the employer (Section 32 (12) (d) of the Act),
- information and advisory services (Section 42 of the Act),
- professional consulting services (Section 43 of the Act),
- education and training for the labor market of jobseeker and disadvantaged jobseeker (§ 46 of the Act),
- contribution for the performance of graduate internship (Section 51 of the Act),
- a contribution to the activity in the form of small municipal services for the municipality or in the form of smaller services for the self-governing region (§ 52 of the Act),
- contribution to activation activities in the form of voluntary service (Section 52a of the Act).



ALMP focused on stimulating the demand for labor, especially in the form of providing contributions to employers and jobseeker for the creation of new jobs are:

- employment mediation (Section 32 of the Act, except Section 32 (12) (d) of the Act),
- allowance for self-employment (Section 49 of the Act),
- contribution for the employment of a disadvantaged jobseeker (Section 50 of the Act),
- contribution to support the development of local and regional employment (Section 50j of the Act),
- allowance to support job creation in the first regularly paid employment (Section 51a of the Act),
- allowance for the creation of a new job (Section 53d of the Act),
- allowance for the establishment of a sheltered workshop and a sheltered workplace (Section 56 of the Act),
- contribution to a citizen with a disability for the operation or performance of self-employed activity (Section 57 of the Act).

The ALMPs aimed at supporting the retention of employees, the retention of existing jobs and the prevention of the abolition of jobs or collective redundancies are:

- education and training for the employee's labor market (Section 47 of the Act),
- contribution to support the maintenance of jobs (Section 50k of the Act),
- allowance for attendance at work (Section 53 of the Act),
- allowance to support mobility for work (Section 53a of the Act),
- allowance for transport to employment (Section 53b of the Act),
- relocation allowance (Section 53c of the Act),
- contribution to the integration company (§ 53f of the Act),
- compensatory allowances to the integration company (Section 53g of the Act),
- allowance for keeping a citizen with disabilities in employment (Section 56a of the Act),
- allowance for the activity of a work assistant (Section 59 of the Act),
- a contribution to the running costs of a sheltered workshop or sheltered workplace and to cover the costs of transport of employees (§ 60 of the Act)

## **2 Hypothesis**

Individual active labor market policy measures should cover a number of situations in which the unemployed person may find himself in need of support, either in the form of a contribution or through various training courses or counseling services. Specifically, in this paper we focus on evaluating the effectiveness of ALMP on the most difficult employable group of the disadvantaged, which includes the long-term unemployed, young unemployed, the disabled and those over 50 years of age. We would therefore like to find out whether the given measures also contribute to the improvement of the quality of life of the given group of jobseeker.

According to the mentioned CIE method, we will evaluate the effectiveness of ALMP and verify the hypothesis whether they have a positive effect on reducing unemployment in Slovakia and thus on improving the overall quality of life of the disadvantaged on the labor market. The paper targets a group of disadvantaged

jobseekers and seeks to identify the impact of active labor market measures for participants in various measures and to assess their contribution to their quality of life. We will focus on verifying the hypothesis indirectly through other scientific studies that address the issue of ALMP evaluation.

### 3 Data and methodology

We will analyze ALMP measures for the disadvantaged and their impact on employment or unemployment of disadvantaged groups. We will compare the effectiveness of individual measures and evaluate their contribution to the employment of the main group of unemployed. We categorize scientific studies according to which group of unemployed people it specifically focuses on, what statistical method the authors used in it, and what conclusion they came to, whether the given measure had a positive or negative final effect. Thus, for each measure for which we will have scientific studies, we will evaluate whether the study evaluates the measure as a positive or negative benefit and accordingly we will assign +/- points to the measure and finally evaluate which one has the most points and is de facto the most effective. With this step, we can summarize and overall evaluate most ALMPs for which we find their evaluation in scientific studies.

The vast majority of scientific studies were drawn from the pages of analytical departments - the Institute of Social Policy and the Institute of Financial Policy.

### 4 Direction and conclusions

Employment support in Slovakia has long struggled with several problems. One of them is the higher concentration of active labor market policy measures for the short-term unemployed than for the long-term unemployed. Overall, a higher percentage of expenditures goes to them (up to 60%), while the long-term unemployed are left with less than 40% of ALMP expenditures. If we look at the development of total expenditure on the unemployed through the ALMP, we can observe an increase compared to 2011 from EUR 162 million to EUR 216 million in 2020, as can be seen in Table 1.

**Table 1** Development of ALMP expenditure vs.GDP (2011-2020)

YEAR	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Average registered unemployment rate in % (from available jobseekers)	13,2	13,59	14,11	12,79	11,5	9,48	7,06	5,42	5,00	6,78
ALMP expenditure (actual)	162	142	127	129	135	171	165	184	185	216

<b>drawdown in mil €)</b>										
<b>GDP at current prices (EUR millions)</b>	70	72	73	75	78	80	83	84	93 865	91 104
<b>Share of ALMP expenditure in GDP</b>	420	420	835	560	686	958	913,30	020	,20	,80
<b>Number of job seekers (in thousands)</b>	0,23	0,196	0,172	0,171	0,172	0,212	0,197	0,219	0,198	0,238
<b>Share of expenses per job seeker (in EUR)</b>	%	%	%	%	%	%	%	%	%	%
	373	386	394	366	323	274	229	184	161	186
	435,16	367,79	323,16	353,24	418,06	626,36	721,26	1000,64	1151,88	1163,58

Source: ALMP 2020 evaluation

When we look at the development of expenditures, which are aimed at solving the problems of the unemployed, it increased compared to 2011 from EUR 162 million to EUR 216 million in 2020, as it can be seen in Table 1. The number of jobseeker decreased from 373 thousand in 2011 to 186 thousand in 2020, which means that the share of expenditure per person increased from 435,16 EUR to 1163,58 EUR in 2020. However, it is questionable whether this increase in the share of expenditure was reflected as a benefit or positively on services that are provided to the unemployed.

If we look at the direction of spending on ALMP, we find that the focus is on supporting employment through various contributions and not through education and training, as is common in other EU countries, and as recommended by the EU. On the other hand, in Slovakia there is also a visible decrease in the interest of the unemployed in participating in one of the ALMP measures. According to Štefánik, M (2018), it is possible to observe a declining trend of jobseekers for the period from 2007 to 2017 from 10% to 5%. Which can correlate with the fact that the ALMP is more focused on contribution than upskilling.

In the next part scientific works are presented that deal with the evaluation of the success of individual ALMP measures. An overview of the studies and the measures they deal with is shown in Table 2.

**Table 2** List of scientific studies dealing with the impact of ALMP

Target group	Autors	Intervetions
Unemployed	Štefánik, M. (2018) Van Ours and Lubyová (1999) Hidas (2016)	Public benefit work, Retraining, Graduate practice, Commuting / relocation allowance

	Štefánik, Karasová, Studená (2016,2018) (OECD, 2005; Lehmann & Kluge, 2008; OECD, 2015)	Educational and training programs
Disadvantaged	Van Ours and Lubyová (1999) Petráš, J. (2019)	Sheltered workplaces, Temporary work project
Long-term unemployed	Štefánik, M. (2018)	Activity in the form of small community service for local government
Young unemployed	Štefánik, M. (2018), Hidas (2016), Štefánik, Karasová, Studená (2016,2018)	Graduate practice, Support for employment in the private sector
Low qualified	Hidas (2016)	Activity in the form of small community service for local government
Unemployed over 50 years	Štefánik, M. (2018)	Temporary work project

We have presented only some of the number of scientific studies that deal with the topic of evaluating the effectiveness of ALMP. We have selected studies that address the evaluation of as many measures as possible. The authors of the given studies evaluated the effectiveness of the measures according to the probability of finding the job of the applicant who participated in the given measure and the candidate who did not complete the given measure. We divided the studies according to categories such as evaluation method (PSM, Regression, DID, RDD...), the periods they evaluated, the effectiveness of the measure and the type of participant in the measure (unemployed, handicapped, young unemployed, low-skilled, over 50). The results of the analysis are summarized below in Table 3.

**Table 3** Evaluation of the success of individual ALMP measures according to published studies

Type	Evaluation of impact						
	Public benefit work	Sheltered work	Retraining courses	Graduate practice	Attendance allowance	Temporary work project	All
Regression						1	1
PSM	1,1	1	1,1	1,1	1	1	9
DID							
RDD				1	1		2
IV							
till 2000	1	1	1				3
till 2005			1				1
till 2010			1				
till 2020	1	1	1	1	1	1	6

Shortterm	1		1		1								3
Midterm													
Longterm							1		1				2
Unemployed	+	-		-	+		+		+		+		+
Young							+						+
unemployed													+
Long					+						+		+
unemployed					+						+		+
Unemployed													
after 50 year													
Disabled				-									-
unemployed													

Source: own processing

It is clear from Table 3 that several graduate internships (Hidas, Štefánik, Karasová) see the measure as positive, which even has a long-term effect, according to the authors. However, paradoxically, this measure has a negative effect on the amount of income in the future, ie when the applicant finds a job after completing the graduate internship. A positive effect on probability of finding and remaining at work was assessed in commuting allowance and relocation allowance (Štefánik, Karasová).

From the submitted studies, we came to the conclusion that out of the six ALMP measures examined, 5 had a positive impact on the employment of the unemployed and thus also contributed to the improvement of the lives of the given groups. The only measure that was evaluated as negative from the studies were the so-called sheltered workshops, which are primarily intended for the employment of people with disabilities. A study by Luby and Van Ours (1999) found that the measure had a negative impact on the continued employment of a disadvantaged jobseeker, ie without the assistance of the ALMP.

The ALMP graduate internship measure, which even had a long-term positive effect on the employment of mainly young job seekers, was evaluated positively by several authors. Retraining courses were also evaluated positively, especially for applicants over the age of 50 and the long-term unemployed, for whom this measure has become key for returning to the labor market. However, the measure is still not a preferred measure in Slovakia and this could be crucial for reducing long-term unemployment, which is a characteristic feature of the Slovak labor market.

## 5 Conclusion

As mentioned in the previous section, ALMPs can have different net effects on employment, income and the overall quality of life of the unemployed. Scientific works that focus on the impact of the ALMP on the employment of the long-term unemployed several of them agree with the fact that the long-term unemployed have only a small participation in ALMP projects, resp. nor are they included in the measures. Few of the research studies examined the impact of ALMP on the severely disabled, as in most

cases they are expected to receive a disability pension or work in a social enterprise or sheltered workshop and not to take an active part in other active labor market policy measures, therefore they are not primarily intended for the disabled.

One of the possible solutions for the overall improvement of employment services can be their technological improvement. Deploying an IT infrastructure for employment services can reduce operating costs and free up human resources for personalized counseling and professional services. From the presented measures, we could conclude that out of 6 measures 5 had a positive effect on increasing employment and one measure had a negative effect on employment. At present, it is possible to observe a trend of declining interest of the unemployed in participating in the ALMP. Regarding the costs of EU funds for the programming years from 2014 to 2020, which reached 10 billion EUR and the state budget expenditures of the Slovak Republic of approximately 150 million EUR according to the analysis of a sample of studies dealing with the impact of ALMP on employment, we can assess that most have positive impact. In the future, given the declining number of jobseekers, ALMP services are expected to focus more on the individualized needs of jobseekers than on entire groups.

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# Low Risk Anomaly and Coskewness: Evidence from Europe

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**Abstract.** Empirical findings that less risky stocks consistently outperform the riskier ones have motivated a great number of studies on the low risk anomaly. This paper aims to explain it away by controlling for coskewness of stock returns with the market return on the European stock market represented by constituents of the S&P 350 Index. Stocks are double sorted on coskewness and beta volatility into 2x5 quintile portfolios, and their excess returns are subsequently regressed on the Fama-French three and five factor models separately for both coskewness categories. In the low coskewness category, a persistent, highly significant low risk anomaly is identified. As the coskewness increases, the low risk anomaly dramatically decreases and loses statistical significance. As a result, in the high coskewness category, less risky portfolios no longer consistently outperform the riskier ones. Results demonstrate that accounting for coskewness in the model remarkably decreases the profitability of low risk and betting-against-beta strategies in European data.

**Keywords:** low risk anomaly, coskewness, portfolio

**JEL classification:** *G11, G12*

## 1 Introduction

High risk, high return, that is how the equity market is supposed to operate according to the risk- return tradeoff principle. As specified by the traditional Capital Asset Pricing Model (CAPM) created by Sharpe (1964), investors should be rewarded for facing risk by earning a higher expected return. However, it is well known by now that the CAPM is not considered the reliable model it has been deemed for decades. Number of studies suggest that return and risk within equity markets show no correlation, or if they do, they are negatively correlated. Rosenberg, Reid, and Lanstein (1985) and Bhandari (1988) reveal that CAPM betas only have little or no informative power for the cross- section of average returns, when implemented alone. Furthermore, Jensen,

Black, and Scholes (1972), Fama and MacBeth (1973) show that the relationship between average return and market beta is flat, or even negative in some cases.

This astonishing contradiction appears to be true, persistent and not varying largely with differences in markets and methodological choices. More recently, an extensive body of academic research has highlighted that the negative risk- return relationship is observable within asset classes (for example equity class) if not across them. This phenomenon called low risk anomaly. According to Joshipura and Jushipura (2015), the principal hypothesis is that a portfolio comprised of low risk stocks outperforms its high volatility equivalent over a period of full market cycle.

Ever since the honored article of Ang et al. (2006) confirmed a negative relation between the level of volatility and the cross- section of U.S. stock market returns, the existence of the low risk anomaly has been profoundly discussed, and many reasons justifying its existence have been analyzed. Even though it is troublesome to explain its presence and persistence using traditional finance theory and models, there are some reasonable explanations, which provide meaningful clarifications on the profitability of low risk investment strategies. So far there are two sets of explanations. The first one aims to offer evidence of low risk anomaly utilizing behavioral reasoning, while the collection of economic justifications attempts to explain it away.

On the account of behavioral explanations, the majority of them reached a conclusion that investors underestimate low risk stocks. Blitz and Vliet (2007) provide a mental accounting interpretation. Although investors can make rational risk- averse decisions for asset allocation choices, with regard to security selection within the asset class, they exhibit risk- seeking tendencies, and show strong preference for high volatility investments. Barber and Odean (2008) also demonstrate that investors exhibit preference for volatile, attention- grabbing stocks. Another explanation lies in overconfidence. Falkenstein (2009) discloses that a lot of people are convinced that they are capable of picking stocks successfully. In turn, investors may be biased toward higher risk. Overweighting risky stocks with aim of generating return premia indeed negates the effect via their collective action, giving rise to the low risk anomaly.

The stream of economic reasoning proposes several clarifications on the low risk anomaly as well. Baker, Bradley, and Wurgler (2011) attribute its presence to the reality of institutional investors usually striving to surpass a chosen benchmark. Since pursuing riskier stocks is a simpler way of doing so, investments in low risk stocks are discouraged. Contrarily, Hong and Sraer (2012) show that returns to trading low risk anomalies lie in high risk stocks being more prone to speculative overpricing. Short selling constraints prevent arbitrageurs from correcting the overblown prices of high beta stocks promptly, which then gives rise to their underperformance. Ultimately, Schneider, Wagner, and Zechner (2020) express that low risk anomalies can be justified by the equity returns skewness, which is repeatedly neglected by standard measures of risk. Their U.S. specific findings demonstrate that anomalous empirical patterns do not constitute asset pricing puzzles if coskewness of equity returns with the market is considered. This incites an immediate follow-up question: Does coskewness reduce the low risk anomaly in other equity markets too?

With the aim of evaluating the impact of equity returns' coskewness on the magnitude of the low risk anomaly outside the U.S., the attention of this study is shifted



to European markets represented by the constituents of S&P Europe 350 Index. In order to compare the existence and the magnitude of the low risk anomaly across different coskewness levels, double sorted 2x5 stock portfolios are assembled. At first, each stock is assigned to either high or low coskewness category based on its coskewness with market return. Subsequently, stocks in both categories are split into equally weighted quintile portfolios depending on their beta volatility estimated in the CAPM. The difference portfolio<sup>1</sup> specified as the difference of the lowest and the highest quintile portfolio is created too. Finally, the low risk anomaly is tested for each portfolio in each coskewness category separately using Fama-French three factor (FF-3) and Fama-French five factor (FF-5) model.

Results demonstrate that accounting for coskewness in the model remarkably decreases the profitability of low risk and betting-against-beta strategies in European data. As the coskewness becomes substantially less negative, the excess returns in such strategies decline, which confirms results of Schneider, Wagner and Zechner (2020). Results obtained for the low coskewness category confirm the existence of the low risk anomaly in the cross section of European stocks. The long-short portfolio is found to yield a positive average monthly return, and its alpha is discovered to be highly statistically significant for both models. In the high coskewness category, all estimated alphas are lower than in the previous category. None of the excess returns for the Q1-Q5 portfolio have been proved statistically different from zero, implying that the less risky portfolios no longer outperform the riskier ones. These results confirm the shrinkage, or even disappearance of the low risk anomaly in high coskewness category.

The structure of the remainder of this paper is as follows. The second section is focused on the presentation of data used in the empirical analysis and the description of methodology. Next section interprets the obtained results on the comparison of presence and magnitude of the low risk anomaly for all quintile portfolios across both coskewness categories. The final section summarizes the main findings and offers conclusion.

## 2 Data and methodology

The empirical analysis is conducted on the monthly stock prices of the constituents of S&P Europe 350 Index retrieved from the Thomson Reuters Eikon terminal. S&P Europe 350 is a leading equity index comprised of 350 blue-chip companies and is one of seven headline indices<sup>2</sup> that are included in the S&P Global 1200. With intention of measuring the market performance of large capitalization companies trading on the 16

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<sup>1</sup> Throughout the whole of this paper the terms Q1-Q5, difference portfolio, and long-short portfolio are used interchangeably.

<sup>2</sup> The remaining 6 indices are S&P 500, S&P Asia 50, S&P/ASX 50 Index, S&P/TOPIX 150, S&P Latin America 40 and S&P/TSX 60.

major developed European markets<sup>3</sup>, it is float-adjusted and market capitalization weighted, while including both common and preferred shares. The obtained sample ranges from January 2010 to February 2020 in order for results not to be biased by the financial crisis of 2007-2009 and the later Covid-19 crisis. Apart from the stock price data, the monthly Fama- French three and five factor European time series are fetched for the same period from the Kenneth French Data Library.

So as to prepare the data for the subsequent analysis, the application of extensive filtering methods is administered. All companies with missing data in the researched period are excluded from the study, which leads to the notable reduction of the sample size to 267 companies.

For the purpose of analyzing, contrasting and comparing the presence and the extent of the low risk anomaly across different coskewness and riskiness levels, double sorted 2x5 stock portfolios are constructed. In the first place, every stock is assigned to either high or low coskewness category based on the coskewness of its return with market return. As a next step, stocks in both categories are split into equally weighted quintile portfolios based on their beta volatility determined by the CAPM, which is a measure chosen to assess the riskiness of individual stocks. The difference portfolio Q1-Q5 is constructed as well. Ultimately, the existence and magnitude of the low risk anomaly is tested for each portfolio in each coskewness category separately using FF-3 and FF-5 model. The low risk anomaly is defined as an identified positive difference in estimated excess returns of the least and most risky portfolio.

Methodology regarding coskewness estimation, beta volatility and Fama-French modes is addressed in this section.

## 2.1 Coskewness

In the field of statistics, coskewness serves to measure to what extent two random variables change together. If applied in finance it can be utilized to assess security and portfolio risk. Investors favor positive coskewness, as it suggests a higher likelihood that two assets in the same portfolio are going to yield extreme positive returns in excess of market returns simultaneously. In case return distributions of the two chosen assets feature negative coskewness, it implies that both assets have a higher probability of underperforming the market synchronously.

Stocks' coskewness with market return is determined by the first moment or the population mean ( $\mu_m$ ), market return ( $R_m$ ) and historical stock returns ( $R_i$ ). It is calculated using standard moment estimators as follows:

$$Coskew_{i,m} = \frac{COV(R_i, (R_m - \mu_m)^2)}{E[(R_m - \mu_m)]^3} \quad (1)$$

As a second step, the median coskewness is calculated and stocks are divided into two groups: high coskewness with market return, and low coskewness with market return.

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<sup>3</sup> The constituents of S&P 350 Index must be domiciled in Italy, Sweden, Denmark, Finland, Belgium, the Netherlands, Spain, Ireland, Austria, Greece, United Kingdom, Portugal, Norway, or Luxembourg.

Subsequently, each coskewness group is split into equally weighted quintile portfolios according to the beta volatility of stock returns.

## 2.2 Beta volatility

The ongoing discussion about the relation between beta and realized return in the academia validates the usability of beta as a measure of the volatility of a security or portfolio in comparison to the market. In this paper, beta for the time series of each stock is estimated from regressions of stock returns on market excess returns (MKT) using the CAPM defined as:

$$E(R_i) - R_f = \alpha + \beta_i^{TS} MKT \quad (2)$$

The estimated beta for the time series of a stock  $i$  ( $\beta_i^{TS}$ ) is given by:

$$\beta_i^{TS} = \rho \frac{\delta_i}{\delta_m} \quad (3)$$

Where  $\delta_i$  and  $\delta_m$  are estimated standard deviations for the stock  $i$  and the market with their correlation being represented by  $\rho$ .

In the interest of reducing the influence of outliers, the methodology of Vasicek (1973) is followed, shrinking the time series estimate of  $\beta_i^{TS}$  towards the cross-sectional mean  $\beta^{XS}$  using the shrinkage factor  $\omega_i$ :

$$\beta_i = \omega_i \beta_i^{TS} + (1 - \omega_i) \beta^{XS} \quad (4)$$

In favor of simplicity, rather than employing time varying shrinkage factors as in the model of Vasicek (1973), the approach of Frazzini and Pedersen (2014) is pursued, setting  $\omega_i = 0.6$  and  $\beta^{XS} = 1$  for all periods and across all stocks. The selection of the shrinkage factor does not influence the manner in which individual securities are assigned into portfolios, since the common shrinkage does not alter the ranks of the security betas. Based on the estimated and shrunk betas, stocks are divided into equally weighted quintile portfolios, and employed in FF-3 and FF-5 models.

## 2.3 Fama-French models

Fama-French asset pricing models were proposed to clarify many inconsistencies in the CAPM. Banz (1981) discovers a size effect by observing that average returns of small are too big relative to their beta estimates, and vice versa for larger stocks. Furthermore, Basu (1983) shows that earnings- to -price ratio has explanatory power on the cross-section of average returns. Next discrepancy is the positive relationship between stocks' average returns and firm's book- to- market ratio, which is reported by Rosenberg, Reid, and Lanstein (1985). Finally, Bhandari (1988) documents that leverage facilitates the explanation of the cross- section of average stock returns, when tested alongside size and market beta.

Fama and French (1992) assert that all existing inconsistencies are only different variations of stock prices scaling. As a result, they commence the evaluation of the combined roles of market beta, size, and book- to- market equity, earnings- to- price and leverage in the cross- section of stock returns. Their conclusions fail to present support of the CAPM as no positive relationship of average stock returns and market betas is found.

Building on their 1992 findings, Fama and French (1993) introduce the FF-3 model for stock returns given by the following equation:

$$E(R_i) - R_f = \alpha + \beta_1MKT + \beta_2SMB + \beta_3HML \quad (5)$$

Where  $\beta_{123}$  denote factor coefficients with the three factors being: the market portfolio (MKT), the size (SMB) and the book- to- market- equity factor (HML). SMB stands for the difference in average returns between small and big stock portfolios, while HML symbolizes the difference between the average returns of high book- to market and low book- to- market firms' portfolios.

Including two additional factors called operating profitability (RMW) and investment (CMA), a five-factor model is published in Fama and French (2015, defined as:

$$E(R_i) - R_f = \alpha + \beta_1MKT + \beta_2SMB + \beta_3HML + \beta_4RMW + \beta_5CMA \quad (6)$$

Which is shown to describe the cross- section of returns even more accurately than the FF-3. To put in another way, by controlling for additional factors, the abnormal returns of the model are diminished, as low volatility stocks are affiliated with firms characterized with comparably strong operating profitability and a conservative investment approach. The FF-5 model, nevertheless, does not succeed in completely capturing average returns, as the low risk anomaly is still recognized.

### 3 Results and discussion

For stocks in both coskewness categories, the same methodology is applied for sample period from January, 2010 to February, 2020. Equally weighted quintile portfolios are formed by sorting stocks based on their beta volatility determined by the CAPM. The portfolio with the highest (lowest) beta volatility is denoted Q5 (Q1) and buying Q1 and selling Q5 yields the long-short portfolio<sup>4</sup> denoted Q1-Q5. Excess return denoted alpha is estimated for each portfolio when accounting for the systematic risk given by FF-5 or FF-3.

#### 3.1 Low coskewness

The low coskewness category is characterized by significantly negative coskewness with market return. The midpoint of a frequency distribution of observed values, i.e., median is -0.58, meaning that the market and low coskewness portfolios are likely to underperform at the same time.

The summary of results is reported in Table 1. For the vast majority of quintile portfolios, a clear pattern of mean return decreasing, and standard deviation increasing is apparent, when moving towards riskier portfolios. The pattern is also confirmed in the long-short portfolio, which generates a positive average return of 0.16% per month. Such outperformance of less risky portfolios provides a first indication of the existence of the low risk anomaly.

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<sup>4</sup> Also called betting-against-beta, or betting-against-volatility in Frazzini and Pedersen (2014) and Schneider, Wagner and Zechner (2020).

Another piece of evidence in favor of its presence is obtained when controlling for systematic risk factors in FF-3 and FF-5 models. Alphas generated by both models are identified to be noticeably higher in less volatile portfolios. As a matter of fact, only two least risky long portfolios demonstrate statistically significant alphas at 1% level. Since estimated alphas for riskier portfolios are not statistically significant, the actual outperformance of less risky portfolios may be even higher.

**Table 1.** Portfolios formed of low coskewness stocks. Robust t-statistics is presented in square brackets. The symbol “\*” implies significance at 1% level.

Portfolio	Mean return	St. deviation	FF-5 Alpha	FF-3 Alpha
Q1	0.3185	1.3058	0.3199 * [2.492]	0.2956 * [2.423]
Q2	0.3110	1.3271	0.3049 * [-2.332]	0.2739 * [2.204]
Q3	0.2173	1.2575	0.2015 [1.644]	0.1859 [1.591]
Q4	0.1019	1.4954	0.0825 [0.578]	0.0544 [0.397]
Q5	0.1585	1.7660	0.1265 [0.757]	0.1003 [0.630]
Q1-Q5	0.1600	1.0241	0.1913 * [2.158]	0.1932 * [2.296]

Focusing on the difference portfolio, the Q1-Q5 portfolio yields a statistically significant positive alpha for both models, which further validates the presence of the low risk anomaly in low coskewness stocks. Results also demonstrate the decrease of excess returns for the long-short portfolios when controlling for two additional risk factors in FF-5 model compared to the FF-3 model. This confirms the findings of Fama and French (2015), who illustrate that the inclusion of supplementary factors leads to the reduction of the low risk anomaly.

### 3.2 High coskewness

The median coskewness of stocks in the high coskewness category is -0.20, which is a 65% increase compared to the previous category. Main results are presented in Table 2. Overall, in the high coskewness category, mean portfolio returns are lower than in portfolios exhibiting low coskewness with market return. There is no observable trend, as mean returns are alternately increasing and decreasing, as well as standard deviations. The decrease in mean portfolio returns is notable in the Q1-Q5 portfolio too, where the positive average return falls to 0.4% per month.

Controlling for systematic risk factors in FF-5 and FF-3 model, all long portfolios demonstrate statistically significant excess returns on at least 5% level. Their closer inspection suggests a substantial decrease in the magnitude of the low risk anomaly. Not only are all alphas lower than in the low coskewness category, but also the pattern

of an outperformance of less risky portfolio is diminished, with exception of the least and most risky portfolio.

**Table 2.** Portfolios formed of high coskewness stocks. Robust t-statistics is presented in square brackets. The symbol “\*” implies significance at 1% level and “.” indicates significance at 5% level.

Portfolio	Mean return	St. deviation	FF-5 Alpha	FF-3 Alpha
Q1	0.2294	0.9536	0.2209 * [2.350]	0.2066 * [2.316]
Q2	0.2597	1.0375	0.2493 * [2.442]	0.2333 * [2.411]
Q3	0.1794	0.9332	0.1826 * [2.002]	0.1617 . [1.811]
Q4	0.2374	0.9882	0.2272 * [2.379]	0.2059 * [2.256]
Q5	0.1914	0.9177	0.1750. [1.962]	0.1656 . [1.939]
Q1-Q5	0.0380	0.4013	0.0438 [1.105]	0.0388 [1.016]

The difference portfolio also demonstrates the shrinkage of the low risk anomaly. Although positive, alphas generated by both Fama- French models are considerably lower than for stocks exhibiting low coskewness with market return. Neither of the two alphas for the Q1-Q5 portfolio has been found statistically different from zero, meaning that the least risky portfolio no longer outperforms the riskiest one. These finding further supports the decline, or even vanishing of the low risk anomaly in high coskewness category.

The aforementioned findings in are in accordance with the research of Schneider, Wagner, and Zechner (2020). Controlling for coskewness in the model eliminates the benefit of betting-against-beta strategies. After the coskewness is considered, such strategies do not render statistically significant excess returns and low risk anomalies disappear.

## 4 Conclusion

The low risk anomaly has sparked a lot of interest in the recent years due to its puzzling nature conflicting the traditional finance theory. Schneider, Wagner and Zechner (2020) demonstrate on the wide range of U.S. data that it can be fully eliminated, when controlling for stock’s downside risk represented by coskewness.

The present paper aims to investigate the role of coskewness in the low risk anomaly of the European stocks, which are constituents of S&P 350 Index. With that objective in mind, double sorted 2x5 stock portfolios are assembled. At first, stocks are assigned to either high or low coskewness category. Afterwards, both categories are divided into equally weighted quintile portfolios conditional on their beta volatility estimated by the

CAPM, and the difference portfolio. Finally, the low risk anomaly is assessed for each portfolio in each coskewness category using FF-3 and FF-5 model.

Results obtained for the low coskewness category confirm the existence of the low risk anomaly in the cross section of European stocks. Alphas estimated by both FF-3 and FF-5 models is only significant in two least risky portfolios, and much higher in less volatile portfolios, compared to riskier portfolios. The long- short portfolio yields a positive average monthly return. On the top of that, its alpha is found to be highly statistically significant for both models, which further validates the presence of the low risk anomaly in low coskewness stocks.

In the high coskewness category, the median coskewness of stock return with market return is 65% lower than in the previous category. Although all long portfolios demonstrate statistically significant excess returns in FF-3 and FF-5 models, their analysis signals a sizeable decrease in the low risk anomaly. All estimated alphas are lower than in the low coskewness category. The difference portfolio also demonstrates the reduction in the size of the low risk anomaly. Although positive, alphas generated by both Fama- French models are substantially lower. In addition, neither of the excess returns for the Q1-Q5 portfolio has been proved statistically different from zero, implying that the less risky portfolios no longer outperform the riskier ones. These results further validate the shrinkage, or even disappearance of the low risk anomaly as the stocks' coskewness with the market increases.

Altogether, findings are in line with existing research and provide their further extensions. Results demonstrate that accounting for coskewness in the model remarkably decreases the profitability of low risk and betting-against-beta strategies in European data. As the coskewness becomes substantially less negative, the excess returns in such strategies decline.

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# Determination of Environmental Justice Using the Environmental Quality Index (EQI)

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## Abstract.

The environment is one of the factors that affect the health and quality of life of the population. The environmental characteristics here represent health impacts and are relatively well measurable or detectable. The aim of this paper is to analyse the environmental quality index in agglomerations and zones by measurement, SHMU operates the National Air Quality Monitoring Network as the authorized organization for the Air Act. SHMU uses stations that monitor basic pollutants, such as PM10, PM2.5, NO2 and O3. The article showed that above-average values are concentrated in the largest cities, less often also average values of environmental quality. On the contrary, smaller cities are assessed as areas with below-average environmental quality. These parts can be identified as areas with an increased environmental burden and the risk of environmental injustice, and this is how it is necessary to approach the planning of further development. Especially because these are areas that provide economic benefits for the whole city, such as good transport accessibility, services, business activities or jobs, but externalities fall significantly on the population of this area.

**Keywords:** Environmental Quality Index, Environmental Justice, Regions of Slovakia, European Air Quality Index

**JEL classification:** P28, Q56, R58

## 1 Introduction

The environment is one of the factors that affect the health and quality of life of the population. Coan and Holman (2008) argue that the main role here is played by the biophysical quality of the environment. The environmental characteristics here represent health impacts and are relatively well measurable or detectable, which can be e.g., values of individual pollutants in the air or noise level. According to many studies by Balestra et al. (2012) show that people increasingly perceive the issue of environmental degradation and depletion of natural resources. The aesthetic value of

the environment, which is much more difficult to define, even though it has unquestionably positive effects on the mental health and quality of life of the population, is also gaining more and more attention. People are aware of the benefits of cultural and regulatory ecosystem services, especially appreciating clean air, access to forests or other green spaces, which offer them the satisfaction of basic leisure needs, relaxation, and meeting others (Balestra et al., 2012).

With the ever-increasing proportion of people living in urban areas, there is a growing need to address these needs within urban areas. In a densely populated urban environment, social and economic benefits are concentrated, which are based on the concentration of shops and services, job opportunities, infrastructure, etc. On the other hand, the externalities of human activities also accumulate in the urban environment, which manifest themselves as negative effects on the quality of life and health of the population living in cities. As is the case on a global scale, externalities do not affect all residents equally in the inner urban space. Access to ecosystem services within an inhomogeneous urban environment is also uneven. By Fann et al. (2011) pointed out that this leads to the creation of sub-urban zones with different levels of environmental quality and that it is essential for local authorities to reflect this fact to guarantee the sustainable development of the whole area. To do this, it is necessary to eliminate inequalities not only at the generally accepted level of social, economic, but also environmental. Since market mechanisms cannot well reflect local conditions and the state of the environment in the intra-urban area, several interventions by authorities to ensure environmental justice are applied.

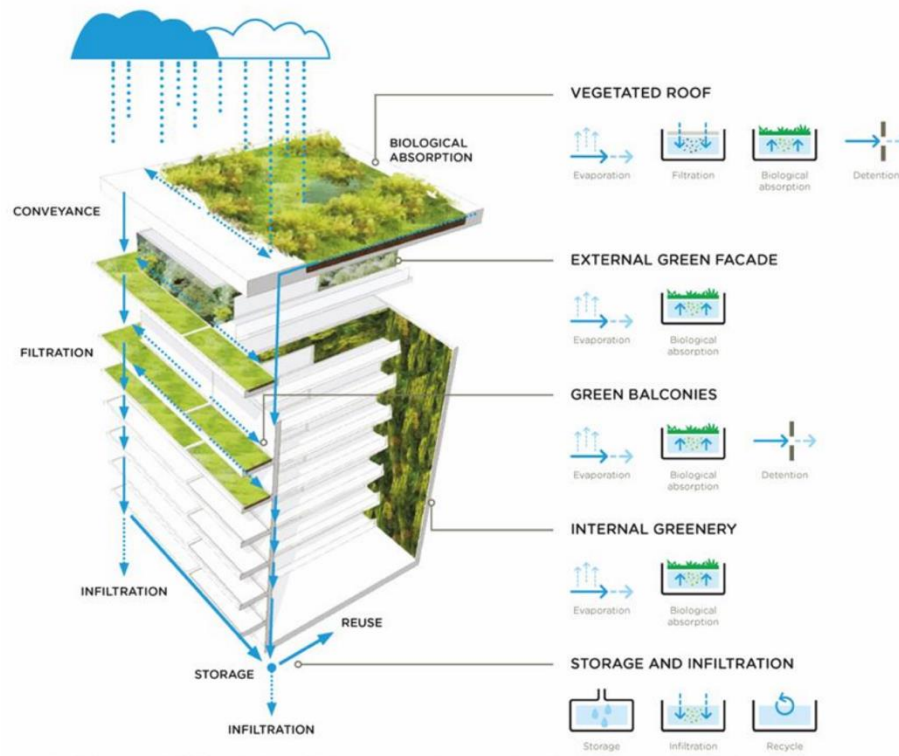
Environmental justice, as defined by the U.S. Environmental Protection Agency (EPA, 1998), "guarantees all people, regardless of race, national origin, or income, to be treated fairly and involved in the development, implementation, enforcement of environmental laws, regulations, and policies." The literature (Middleton et al., 2015; Svarstad and Benjaminsen, 2020) distinguishes three basic approaches to environmental justice:

- a) an approach that addresses the implementation of environmental interventions according to who receives or loses environmental benefits or, conversely, who is affected by the environmental burden, so - called *distributive justice*;
- b) an approach where we identify who is involved in decision-making processes and who has an influence on them, the so-called *procedural justice*;
- c) an approach where we describe to whom the interests, values and point of view are respected and considered and, conversely, neglected, the so-called *fairness of recognition*.

## **2 Factors Affecting Environmental Quality**

There are several factors that reflect the nature of the environment and can be divided into two main groups. The first group represents environmental benefits that can improve the quality of the surrounding environment and have a positive impact on the quality of life and health of local people. The second group represents the

environmental burden, which in turn reduces the quality of the surrounding environment, which results in negative impacts on the quality of life and health of local people.



**Fig. 1.** Building-scale BGI solutions<sup>1</sup>

In the first place from the group of factors of environmental benefits, the factor reflecting the green infrastructure must be mentioned. Greenery includes not only city parks, but also gardens, alleys, green belts, green roofs, riverbanks and more. It has a positive effect on human health, both physical and mental, because it influences stress reduction, relaxation, and overall well-being (Laforteza et al., 2009; Streimikiene, 2015). In this context, we are talking about the cultural ecosystem services that greenery provides. In addition, greenery provides ecosystem services in a regulatory manner, where it significantly affects the microclimate, the shares of the water regime as well as the shares for air purification, dust capture and noise reduction. Several studies by Maas et al. (2006) and Lakes et al. (2014) explain that one of the main factors that affect the health of the population in urban areas is greenery. A wide range of data is used to identify green infrastructure, and data from remote sensing of the Earth are increasingly

<sup>1</sup> Source: Mehraj U. Din Dar et al. 2021. *RETRACTED: Blue Green infrastructure as a tool for sustainable urban development*. Journal of Cleaner Production 318(3):128474 Available at: <https://doi.org/10.1016/j.jclepro.2021.128474>

being used. The advantage of this approach is that, unlike most map materials and inventory documents, it can also consider small areas of greenery, grass strips or free-standing trees, regardless of the ownership structure.

Another indicator that demonstrates the environmental benefits is the blue infrastructure, represented mainly by natural water features. Amaral and others (2021) in the studies point to the fact that green and blue infrastructure are combined into one indicator of blue-green infrastructure, because ecosystem water services are largely identical to green, for example in terms of microclimate regulation or increasing aesthetic values of the environment. Of the indicators that represent the environmental burden, indicators of pollution are often used, most often air, sometimes also water pollution. The negative effects of pollutants on human health have long been studied and described. Concentrations of PM10 and PM2.5 dust particles, nitrogen oxides or ground-level ozone are investigated within the negative monitored environmental characteristics (Streimikiene, 2015). Finally, noise, which is associated with negative health effects such as insomnia, hearing loss, depression, anxiety, and concentration disorders, are among the factors that worsen the quality of the environment (Dizdaroglu, 2015).

### **3 Methods and Methodology**

Composite indicator methods were used to compile the index. This was preceded by the processing of several data layers of the area of interest in the environment of SHMU (*Slovak hydrometeorological institute*) stations, which was also used in the visualization of the results. The methodology of compiling the index is described in more detail later in this chapter.

#### **3.1 Air Quality Index - Monitoring Area of Interest**

The area of interest to which the methodology has been applied is the territory of the Slovak Republic, where SHMU uses stations that monitor basic pollutants, such as PM10, PM2.5, NO<sub>2</sub> and O<sub>3</sub>. To air quality assessment, the territory of the Slovak Republic was divided into agglomerations and zones. For sulphur dioxide, nitrogen dioxide, nitrogen oxides, particulate matter PM10 and PM2.5 fractions, carbon monoxide, polycyclic aromatic hydrocarbons, and benzene there are 2 agglomerations and 8 zones, for lead, arsenic, cadmium, nickel, mercury, and ozone it is 1 agglomeration and 1 zone. Within agglomeration 1, the territory of the capital of the Slovak Republic, Bratislava, is monitored, and agglomeration 2 covers the territory of the city of Košice and the municipalities of Bočiar, Haniska, Sokoľany and Veľká Ida. 8 zones represent the territory of 8 regions: Bratislavský, Trnavský, Nitriansky, Trenčiansky, Banskobystrický, Žilinský, Košický and Prešovský.

To provide the basis for the assessment of air quality in agglomerations and zones by measurement, SHMU operates the National Air Quality Monitoring Network (NMSKO) as the authorized organization for the Air Act. In 2020, 40 monitoring stations were included in the network with a different measurement program, which depends on the type and location of the MS. The number of MS considers the

requirements of Decree no. 244/2016 Coll. on air quality as amended by Decree no. 296/2017 Coll. to determine the minimum number of sampling points for the continuous measurement of concentrations of individual pollutants in ambient air. In 2020, out of the total number of 40 NMSKO monitoring stations, 4 stations (Chopok, Topoľníky, Stará Lesná and Starina) were in the European EMEP network and the Chopok station was in the global GAW (*Global Atmosphere Watch*) WMO network.



Fig. 2. NMSKO network of monitoring stations in 2020<sup>2</sup>

Individual agglomerations and zones are very diverse both in terms of area and population. They are similarly heterogeneous in terms of the nature of the landscape and its use and functional arrangement. There are parts with a clear urban character, high density of buildings and industrial areas, as well as parts with a rather rural character with arable land to areas with a relatively high proportion of forests.

### 3.2 Environmental Quality Index Indicators

The index was compiled using eight sub-indicators, four belong to the group of environmental benefits and the other four then represent the environmental burden. The structure of the environmental quality index is shown in Fig. 3. Data sources and data sets obtained from NMSKO monitoring stations were searched for these indicators. These were very diverse data, and it was necessary to process them to capture the evaluated properties of the areas of interest, i.e., the monitored zones and agglomerations. On the environmental benefits side, groups of factors were used to compile the index, considering both green and blue infrastructure.

<sup>2</sup> Source: Slovak hydrometeorological institute (SHMU). Ministry of Environment of the Slovak Republic. Monitoring network. Available: <https://www.shmu.sk/sk/?page=224>

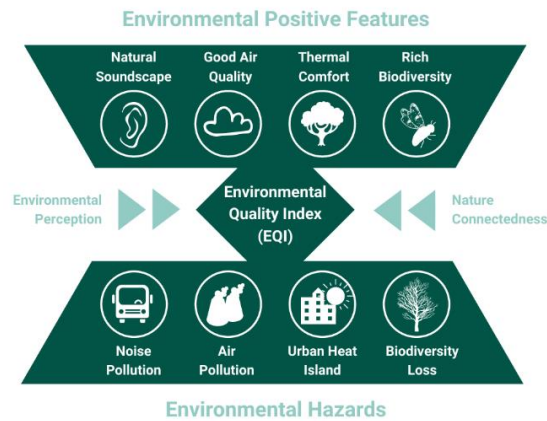


Fig. 3. Approach and Environmental Quality Indicator Theoretical Framework<sup>3</sup>

### 3.3 European Air Quality Index

Air quality assessment is based on measuring the concentrations of several pollutants in the air. Air quality is often expressed by an index. The air quality index converts pollutant concentrations expressed in  $\mu\text{g} / \text{m}^3$  into a multi - level word scale (e.g., air quality - good, satisfactory, acceptable, bad, and very bad) or into a numerical scale (e.g., 1-10 or 0-500, etc.).

As there is currently no uniform calculation methodology, there are several air quality indices (AQI), for example:

- **European Air Quality Index** (The European Environment Agency, EEA)
- Daily Air Quality Index (UK - Committee on Medical Effects of Air Pollutants, COMEAP)
- Real-time air quality index (global air pollution according to The United States Environmental Protection Agency, EPA)
- Air Quality Health Index (Canada)
- Air Pollution Index (Malaysia)
- Pollutant Standards Index (Singapore)

#### European Air Quality Index

It is based on measurements of the concentrations of five basic pollutants at a given station in individual European countries (a total of more than 2,000 stations). These concentrations are then converted to an air quality index according to the Tab. 1:

<sup>3</sup> Source: Using the right environmental indicators: Tracking progress, raising awareness, and supporting analysis. UNSTATS Publication. Available: <http://dx.doi.org/10.6027/TN2012-535>

**Table 1.** European Air Quality Index<sup>4</sup>

Pollutant	Index level (based on pollutant concentrations in µg/m <sup>3</sup> )				
	Good	Fair	Moderate	Poor	Very poor
Particles less than 2.5 µm (PM <sub>2.5</sub> )	0-10	10-20	20-25	25-50	50-800
Particles less than 10 µm (PM <sub>10</sub> )	0-20	20-35	35-50	50-100	100-1200
Nitrogen dioxide (NO <sub>2</sub> )	0-40	40-100	100-200	200-400	400-1000
Ozone (O <sub>3</sub> )	0-80	80-120	120-180	180-240	240-600
Sulphur dioxide (SO <sub>2</sub> )	0-100	100-200	200-350	350-500	500-1250

The index level (*European AQI*) expresses a 5-scale scale (air quality - good, satisfactory, acceptable, bad, very bad) and corresponds to the worst value (level) of all measured pollutants at a given station, where:

- Transport stations - monitor fewer pollutants, only those that measure NO<sub>2</sub> and PM (PM<sub>2.5</sub> or PM<sub>10</sub>) at the same time are taken from them.
- Other stations - the calculation of the index includes those that simultaneously measure at least three pollutants NO<sub>2</sub>, O<sub>3</sub> and PM.
- Index for PM<sub>10</sub> and PM<sub>2.5</sub> is calculated from concentrations based on 24-hour moving averages (this is the average of consecutive 24-hour values).
- Current index captures the situation six hours ago; The site also provides the ability to view its values seven to 48 hours ago.
- *European AQI* was launched in November 2017.

## 4 Research Results

Based on the above methodology, an environmental quality index was calculated for each agglomeration and zone. With its help it is possible to compare individual zones with each other and it is also possible to visualize in the form of map output. This makes it possible to identify wider links and relationships throughout the city and to identify potential problem areas that may increase the potential for inequality. The values of the indices of individual parts are summarized in Tab. 2.

<sup>4</sup> Source: European Environment Agency. *Air Quality Index*. GIS Map Application. Published 18 Nov 2021. Available: <https://www.eea.europa.eu/themes/air/air-quality-index>

**Table 2.** Values of the Air Quality Index on 29.06.2022, 15:00<sup>5</sup>

Stanica	IKO	PM <sub>10</sub>	PM <sub>2,5</sub>	NO <sub>2</sub>	O <sub>3</sub>	SO <sub>2</sub>									
Banská Bystrica, Zelená								30	23	30	2				
Bratislava, Kamenné nám.	17	17	1					47	23	34	11	47			
Bratislava, Trnavské Mýto	25	16	24	25				22	21	22					
Bratislava, Jeséniova	54	19	20	5	54	1		50	16	28	2	50			
Bratislava, Mamateyova	52	20	23	4	52	4		46	27	36	11	46			
Bratislava, Púchovská	17	15	17	13		4		49	24	39	2	49	2		
Rovinka, mobilná AMS	22	22		3		5		44	33	44	14				
Pezinok, Obrancov mieru	52	17	18	4	52			42	33	42	10	42	14		
Senec, Boldocká	52	16	27	9	52			48			2	48			
Nitra, Janikovce	51	15	14	2	51			41	24	41	4		4		
Nitra, Štúrova	23	22	23			2		58					58		
Komárno, Vnútrotná okružná	15	14	15	6				35	23	35					
Piášťovce	51	26	35	2	51			37	28	37	15			8	
Topoľníky, Aszód, EMEP	50	14		2	50	1		48	15		3	48			
Senica, Hviezdoslavova	32	25	32			5		30	16	30					
Trnava, Kollárova	32	23	27	32				28	19	28					
Sereď, Vinárska	18	13	18	3				48	22	35	7	48			
Trenčín, Hasičská	33	29	26	33		4		35	26	35	17			1	
Púchov, 1. mája	32	25	32			10		35	23	35	7				
Bystričany, Rozvodňa SSE	24	21	24			18		45	19	23	2	45			
Handlová, Moroviánska cesta	28	21	28			6		46	21		3	46			
Prievidza, Malonecpalská	47	25	38	17	47	10		41	28	41	38				
Žarnovica, Dolná	29	20	29	10				47	28	41	5	47			
Žiar nad Hronom, Jilemnického	35	29	35					41			2	41			
Zvolen, J. Alexyho	29	20	29					30	22	30					
Banská Bystrica, Štefánikovo nábřežie	38	36	38	34				31	24	31				3	
								46	33	40	6	46			

**Note:** Good air quality - green colour ("Enjoy your usual outdoor activities")

Deteriorated air quality - orange colour ("Old and sick people, pregnant women and young children: Consider limiting strenuous outdoor activities, especially if you experience health symptoms." and "Entire population: In case of symptoms such as eye irritation or cough, consider limiting strenuous outdoor activities.")

Poor air quality - red colour ("Old and sick people, pregnant women and young children: Avoid strenuous outdoor activities." and "Entire population: Limit strenuous outdoor activities.")

Due to the effective assessment of air quality, the territory of Slovakia is divided into zones and agglomerations. In individual zones, the concentrations of pollutants are not the same in all parts of the zone. Usually there are areas with significant sources of emissions and deteriorating air quality, but also relatively clean areas without sources. After a gradual analysis of all monitored regions, we could evaluate the situation.

#### 4.1 Evaluation of Air Quality in the Monitored Slovak Regions

The AQI in the **Bratislava** region reaches **53**, which can be assessed as **poor**.

**Table 3.** Air quality in the zone: Bratislava region, 29.06.2022, 18:00<sup>6</sup>

Area:	The population:	Population density:	Sensitive groups:
1 685,40 km <sup>2</sup>	236 076 persons	140,07 persons / km <sup>2</sup>	Age: 0-14:19,68 % 65+: 14,81 %

<sup>5</sup> Source: Slovak hydrometeorological institute (SHMU). Ministry of Environment of the Slovak Republic. SHMU Station. Available: [https://www.shmu.sk/sk/?page=1&id=oko\\_iko](https://www.shmu.sk/sk/?page=1&id=oko_iko)



The AQI in the **Trnava** region reaches **31**, which can be assessed as **good**.

**Table 4.** Air quality in the zone: Trnava region, 29.06.2022, 18:00<sup>6</sup>

Area:	The population:	Population density:	Sensitive groups:
4 146,30 km <sup>2</sup>	565 324 persons	136,34 persons / km <sup>2</sup>	Age: 0-14:14,68 % 65+: 17,75 %

The AQI in the **Trenčín** region reaches **33**, which can be assessed as **good**.

**Table 5.** Air quality in the zone: Trenčín region, 29.06.2022, 18:00<sup>6</sup>

Area:	The population:	Population density:	Sensitive groups:
4 501,81 km <sup>2</sup>	582 567 persons	129,41 persons / km <sup>2</sup>	Age: 0-14:14,02 % 65+: 18,88 %

The AQI in the **Nitra** region reaches **50**, which can be assessed as **poor**.

**Table 6.** Air quality in the zone: Nitra region, 29.06.2022, 18:00<sup>6</sup>

Area:	The population:	Population density:	Sensitive groups:
6 343,73 km <sup>2</sup>	671 508 persons	105,85 persons / km <sup>2</sup>	Age: 0-14:13,83 % 65+: 18,75 %

The AQI in the **Žilina** region reaches **45**, which can be assessed as **moderate**.

**Table 7.** Air quality in the zone: Žilina region, 29.06.2022, 18:00<sup>6</sup>

Area:	The population:	Population density:	Sensitive groups:
6 808,53 km <sup>2</sup>	691 136 persons	101,51 persons / km <sup>2</sup>	Age: 0-14: 15,87 % 65+: 16,26 %

The AQI in the **Banská Bystrica** region is **40**, which can be assessed as **moderate**.

**Table 8.** Air quality in the zone: Banská Bystrica region, 29.06.2022, 18:00<sup>6</sup>

Area:	The population:	Population density:	Sensitive groups:
9 453,99 km <sup>2</sup>	643 102 persons	68,02 persons / km <sup>2</sup>	Age: 0-14:14,69 % 65+: 18,03 %

The AQI in the **Prešov** region is **41**, which can be assessed as **moderate**.

**Table 9.** Air quality in the zone: Prešov region, 29.06.2022, 18:00<sup>6</sup>

Area:	The population:	Population density:	Sensitive groups:
8 972,76 km <sup>2</sup>	827 028 persons	92,17 persons / km <sup>2</sup>	Age: 0-14:18,02 % 65+: 14,81 %

The AQI in the **Košice** region is **35**, which can be assessed as **moderate**.

**Table 10.** Air quality in the zone: Košice region, 29.06.2022, 18:00<sup>6</sup>

Area:	The population:	Population density:	Sensitive groups:
6 457,94 km <sup>2</sup>	556 832 persons	86,22 persons / km <sup>2</sup>	Age: 0-14:18,23 % 65+: 14,71 %

Based on the environmental quality index set in the monitored regions of Slovakia, we can observe that above-average values are concentrated in the largest cities, less often also average values of environmental quality. On the contrary, smaller cities are

assessed as areas with below-average environmental quality. These parts can be identified as areas with an increased environmental burden and the risk of environmental injustice, and this is how it is necessary to approach the planning of further development. Especially because these are areas that provide economic benefits for the whole city, such as good transport accessibility, services, business activities or jobs, but externalities fall significantly on the population of this area.

When planning targeted interventions by the responsible authorities, it is also necessary to monitor in such risky areas the share of the population group that is more susceptible to environmental aspects, especially low-population groups, people with lower education and the long-term unemployed. The prioritization of measures should be measured to show the synergy of the negative impacts of the environmental burden together with the economic and social burden (Fann et al., 2011).

## **5 Conclusion**

The air quality index is primarily a tool for communicating air quality information to the public. At the same time, it also makes it possible to comprehensively assess air pollution with several pollutants. In both cases, the key factor is the choice of pollutants to be included in the index calculation. In Slovakia, current information on air pollution at individual measuring stations is published in real time and information on long-term trends in air quality in the annual assessment reports of the SHMU. We also have data on air quality throughout Slovakia in the form of a web map service.

Based on values of average annual concentrations NO<sub>2</sub>, SO<sub>2</sub> and PM<sub>10</sub>, the average annual air quality index was calculated according to the methodology of Kotlík (1997). The map expression of the air quality index shows the improvement of air quality after 2006 practically in the whole territory of Slovakia. The most endangered localities with polluted air, endangering sensitive persons, include the area of Horná Nitra, the surroundings of the U. S. Steel Košice plant and the capital of the Slovak Republic, Bratislava. The disadvantage of the selected index is the highlighting the impact of SO<sub>2</sub> and the neglect of annual exceedances daily PM<sub>10</sub> limit values in some areas, so another task will be to obtain the necessary input data and to calculate the European YACAQI index, which better reflects the real state of air pollution.

Long-term air quality indices can be used primarily as a source of information to support decision-making processes in politics and public administration. From this point of view, it would be beneficial to link the values of the air quality index with demographic data.

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# Key Performance Indicators in the Context of Sustainable Business Development

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**Abstract.** KPI stands for key performance indicator. The name suggests, a corporate KPI is nothing more than an indicator that measures the performance of a particular business activity or area. There can be instantly find out from car's speedometer and other indicators on the dashboard. Well-chosen KPI combination will allow to run business effectively, not only provide information on how business is doing, but will be able to identify emerging issues in time, take corrective action and see at least a little bit into the future. With KPI, there can be tracked not only a company's financial results, but also performance in all other important areas, such as sales, marketing, manufacturing, customers, suppliers or employees. KPIs also differ depending on the different sectors and the nature of the activity (production / trade / services / logistics ...). Performance indicators can take various forms: absolute number (eg sales achieved in €), relative data (% sales growth), ratio (number of pieces produced per day), ranking or rating (customer satisfaction). From a global perspective, it is the goal of all initiatives addressing the issue sustainable development to correctly define the essence of sustainability, to formulate principles and measures to improve and maintain economic, social conditions from an environmental point of view, to set acceptable targets, to contribute with active interventions to fulfill them, but also to choose the right indicators, indices or other permanent measures sustainability

**Keywords:** KPI, Sustainable development, Goal

**JEL classification:** M12, M14, Q56

## 1. Introduction

The global digital world as of today includes smart sustainable development, value creation and wealth are among the most important goals of society. Industry performance includes inclusion the objectives of smart sustainable development, in particular social and territorial cohesion, economic efficiency, innovation, digital and environmental performance into the company's operating procedures. Companies that

compete globally, must commit to the overall intelligent implementation of operational initiatives and deliver reports on them. The current framework of indicators available to measure the overall sustainability of business, do not effectively address all aspects of sustainability at the operational level.

The meaning of "sustainable development" should be kept simple: sustainability is a state that can prevail in the long run, in fact forever. Sustainable development is a process that brings sustainability closer (someone considers sustainability and sustainable development to be the same). Sustainability usually refers to a system that involves not only society and people, but also nature or the environment. The system can be a city or a country, but today it is the most common world with everything that concerns it, including nature, people and our society. It is often mentioned that sustainable development has three dimensions: environmental, economic and social. These three parts of the system can be divided into smaller parts. The environment consists of life forms, atmosphere, soil, etc., while the social dimension can be divided into human well-being and society with all its institutions. Thus, it is clear that this huge system has many components.

## **2. Methodology**

The issue of indicators of sustainable development, whether at the micro or macro level, is relevant not only from a practical point of view, but also from a theoretical point of view. The aim of the contribution was to provide a theoretical overview of approaches to measuring sustainability at the macro and micro level, i.e. at the global level of countries and within the business environment.

In the article, by collecting and studying valuable information from domestic and foreign literature, articles and internet sources is a basic prerequisite for gathering important facts about the issue being addressed. The acquired knowledge on the topic in question is the fundamental basis for processing the paper, which is dedicated to and describes the issue of Key performance indicators in the context of sustainable business development, its importance, inclusion within the complete controlling system.

Foreign and domestic publications, whether articles, books, or internet resources, which discuss the issue in question, are mainly used to prepare the contribution. The observations and knowledge of individual authors and the expression of their opinion within the given thematic area are captured here. Here were taken into account the positions of the authors of the published works and formed our own opinion on the topic under investigation.

## **3. Key Performance indicators**

According to Wagner (2009), a company's performance can be characterized as its ability to enhance the resources invested by its activities, produce profit, increase the company's value and at the same time it is the ability to secure future development. Lesáková (2007), on the other hand, understands the company's performance - the company's ability to achieve the desired effects or outputs, if possible, in measurable

units. For this reason, it is necessary to know the individual KPIs of the company and to be able to measure them.

Key Performance Indicators (KPIs) are important navigational tools that managers use to understand whether their business is on a successful path or whether it is deviating from a prosperous path. The right set of indicators identifies performance and highlights areas that require attention. "What is measured is done" and "if you can't measure it, you can't control it" are just two popular proverbs used to emphasize the critical importance of metrics. Without the right KPIs, managers swim blindly. (Marr, 2012)

Performance measurement is a fundamental principle for managing an organization. Measuring performance is important because it identifies current gaps between actual performance and the required plan and provides an indication of progress toward closing the gaps. A carefully selected performance indicator can accurately identify where steps need to be taken to improve performance. The challenge for today's companies is how to align performance measures with business strategy, corporate culture, the balance between merit and cost of implementing measures, and ways to implement these measures (Weber, 2005).

KPIs are indicators that measure a company's performance in a given process, strategy or specific action. Continuous evaluation of KPIs is key for the company to achieve the desired results, as well as to understand where it is and how to improve. (Syndle, 2021). ISO 9004: 2009 defines KPIs as factors that are managed by an organization and that are critical to its sustainable success. They should therefore be subject to performance measurement and should be identified.

KPIs can be assigned to a process, service, organizational unit, resp. the whole organization and in the latter case show how effectively the company achieves key strategic, respectively, business goals. KPIs express the required performance, which can be quality, efficiency or economy. They are used by both individuals and organizations at all levels of management. KPIs at the TOP level mainly focus on the overall performance of the company, while at the middle and lower levels they are focused on processes within departments.

KPIs should be quantifiable and should enable the organization to set measurable targets, identify, monitor and anticipate trends and, where necessary, provide corrective, preventive and improvement measures (Namešanská - Pačaiová, 2012). KPIs should be progressively developed as performance indicators for relevant functions and levels of the organization to support the achievement of top-level objectives. At the same time, top management should choose KPIs as the basis for strategic and tactical decisions (feedback). According to Nenadál (2005), KPIs should correspond to the nature and size of the organization and its products, processes and activities. It is the task of top management to create, implement and properly set up the structure of KPIs in the organization. They need to be consistent with the organization's goals, which should further be consistent with its strategy and policy. Specific information related to risks and opportunities should be taken into account when selecting KPIs. When selecting KPIs, the organization should ensure that they provide information that is measurable, accurate and reliable and useful in implementing corrective action when performance is not in line with objectives. In addition, they

should provide information that can be used to improve the operation and efficiency of processes.

Parmenter (2014) states that only a small number of companies evaluate KPIs correctly. One of the reasons for incorrect evaluation may be the very nature of the indicators, which managers and other responsible persons in the company do not know. To properly understand what KPIs are, the author lists their 7 basic features:

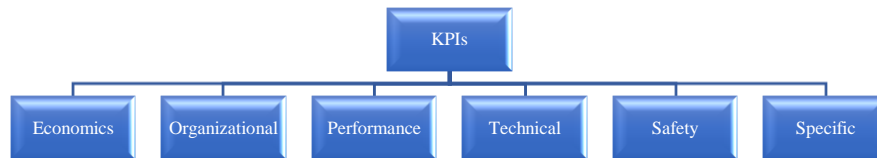
- a. non-financial indicators (not expressed in dollars, yen, euros, crowns, etc.),
- b. repeatedly measured (eg daily or 24/7),
- c. they are dealt with by the CEO and top management,
- d. understanding of indicators and remedial measures by all employees,
- e. responsibility is linked to the individual or team (it does not follow the result influenced by several activities, managed by several managers, this is dealt with by other indicators),
- f. significant impact (eg affects most major critical success factors and more than one Balanced Scorecard perspective),
- g. positive impact (eg positively affects all other performance indicators).

The choice of KPIs is conditioned by the area of operation of the company. However, a general structure and a minimum list of indicators for each area have not yet been defined. From our point of view, we would add the perspective of corporate social responsibility to the basic KPIs that the company reports. Examples include the carbon footprint tracking indicator, the water footprint, energy consumption, supply chain miles, waste reduction rates, waste recycling rates and more.

The authors Namešanská - Pačaiová (2012) divide KPIs into 6 basic groups (see picture no. 4):

- a. Economic: indicators that take into account the economic effect / consequence include, for example, unit production costs, total personnel costs, warehouse value, total maintenance costs, organizational profit.
- b. Organizational: indicators based on activity management include e.g. average training costs per employee, employee productivity, number of complaints.
- c. Performance / customer: indicators that point to the processes / activities themselves. KPIs in the field of quality, customer-oriented and continuous improvement are also included here, specifically e.g. customer satisfaction,% of failures, total productivity, net production time,% of plan fulfillment.
- d. Technical: so-called Reliable KPIs, such as KPIs in maintenance and the like, include downtime, MTTR, OEE,% corrective interventions.
- e. Safety / environmental: indicators that take into account the health and safety effect are also included here. Specifically, it is e.g. o Injury index, electricity consumption, water consumption, etc. (
- f. Specific: indicators that are specific to a given company and that the company in question decides to include in its structure.

Picture 1: Division of KPIs into areas of management in the company



Source: Namešanská - Pačaiová, 2012, own processing

We are in favor of the above breakdown of individual KPIs, but we would pull the marketing and sales perspective into a separate category. We would propose to modify the Technical Indicators group as new, namely Operational Processes and Supply Chain. Within this category, we will be able to further discuss the issue with the relevant indicators

#### **4. Quantification of possibilities of sustainable development of companies**

At the microeconomic level, the sustainable growth of companies is often measured in quantitative terms using data from accounting - financial statements or the ability of companies to accumulate resources (Babalola 2013). Financial performance measured by profit and profitability levels is clearly related to sustainable growth (Demirgunes, Ucler 2015). Companies that rely on their own financial resources are growing slower because it is more difficult for them to invest. The use of indebtedness and the increase in additional financing costs lead to sustainable growth of companies. On the other hand, the introduction of an adequate value added control system leads to a more efficient use of resources, to an increase in investment capacity, and thus to a better situation for companies with sustainable growth (Abraham, Harris, Auerbach 2017). Despite the complexity arising from the many interpretations of sustainability issues and the multifaceted nature of sustainability, a corporate sustainability assessment should be carried out to ensure environmental efficiency, fair trade practices and environmental justice (Marshall, Toffel 2005).

The economic outlook is often expressed through costs (Metta, Badurdeen 2013), revenues (Choudhary et al. 2015), profit sharing (Chaabane et al. 2012) or economic value (Pimentel, Gonzalez, Barbosa 2016). Such an approach, however, does not take into account the concept of sustainability in the true sense of the word. Sustainable business performance is a multidimensional concept based on the idea of sustainable development, which replaces the traditional understanding of company performance



only as a capital appreciation for the owners (shareholders). Nevertheless, according to Kocman et al. (2011), indicators of a company's economic performance continue to be a major concern for owners and investors. However, together with information on environmental and social factors, they provide a comprehensive picture of the state of corporate sustainability. Businesses should therefore seek to achieve long-term benefits by implementing sustainability activities at the very core of corporate strategy (Chabowski, Mena, Gonzalez-Padron 2011). In this regard, it is essential that they set measurable and relevant sustainable development goals and select appropriate metrics to measure them (Dočekalová 2012).

Valid analysis and assessment of the company's sustainability are based on an adequate and reliable information spectrum, while emphasis should also be placed on the selection criteria for the assessment of sustainability. In this context, it must be decided whether the assessment of sustainability should be based solely on financial reporting data that reflects its financial situation or whether other parameters should be used. For this reason, the need for an integrated reporting model for evaluation has been emphasized in recent years. 7 (2), pp. 12-25 20 <http://www.mladaveda.sk> sustainability. Such an approach means taking into account not only financial criteria, but also criteria that reflect both the internal and external environment (Bogićević, Domanović, Krstić 2016). In addition, according to Fraser, Ormiston (2013), some of the key information needed to evaluate the company's performance in the financial statements is not available, some are difficult to find and many cannot be measured, and in recent years attention has been focused on the need to use non-financial criteria for evaluating the company's performance.

As stated by Kocmanová, Dočekalová (2011), sustainability is a strategy of the process of sustainable development. It is important for companies to know what indicators can be used to measure results in individual areas. The economic side of sustainability certainly plays an important role in this system. The basic desire of investors and business owners is to increase economic performance and determine whether the company is able to increase its value, and thus provide them with a reasonable return on investment. For this reason, the company's basic goal is to maximize market value in the long run. Currently, the literature offers a number of methods for measuring this value. In recent years, the Economic Value Added Indicator (EVA) has been increasingly used. As stated by the authors Kisel'áková, Šoltés (2016), indicators such as profit, turnover, added value, costs, etc. are very often applied to measure corporate sustainability. Due to the wide range of sustainability measurement tools, however, not all of them can be applied and it is important for companies to select only key indicators that can demonstrate progress towards sustainability.

In 2018, the international company ING Wholesale Banking interviewed 210 financial managers in large and medium-sized companies based in the USA regarding the importance of sustainability for business strategies. They found that more than 80% of companies incorporate sustainable thinking into their business growth plans, and nearly half of managers said that sustainability concerns influenced their growth strategies. Firms with the strongest sustainability strategy usually perform better in terms of revenue, loans and credits. Almost all the companies contacted confirmed that their financial results play an important role in the process of building sustainability

initiatives. In addition, its report (Sustainability and Finance Study 2018) sets out the factors that lead companies to take sustainability measures:

- a. sales growth (39%),
- b. cost reduction / savings and efficiency (35%),
- c. brand reputation (30%),
- d. keep up with the competition (29%),
- e. regulatory requirements (23%),
- f. cheaper financing (16%),
- g. tax benefits (16%),
- h. attracting new employees (13%).

As part of the analysis, ING Wholesale Banking also focused on the financial side of companies in order to find out what goals the companies have set for the next 2 years in the field of sustainable financial development (Sustainability and Finance Study 2018):

- a. improve the ability to model future revenues from sustainability initiatives (60%),
- b. develop appropriate metrics for measuring sustainable activities (49%),
- c. gain knowledge of environmental financing instruments (47%),
- d. adjust traditional asset valuation approaches (41%).

## **5. Current challenges, barriers and possible solutions in the field of sustainable business development**

According to Schaltegger, Lüdeke-Freund, Hansen (2012), despite the many different business models of sustainability, they all have a common goal - to create value by integrating economic, environmental and social aspects, and not just to prioritize profit. However, the integration of these aspects is difficult because they may conflict with management objectives, as focusing on profitability objectives often overlaps with the pursuit of sustainability in business (Van Bommel 2018).

According to the University of Cambridge Institute for Sustainable Leadership (2018), the most important challenges for sustainable business include:

- a. ensuring a link between shareholder value and sustainable business,
- b. harmonizing the concepts of business growth and sustainability,
- c. transforming business models in the context of sustainability,
- d. bridging the gap between objectives and action on a practical level,
- e. implementation of goals at all levels in the company,
- f. maintaining the sustainability momentum.

According to the Sustainability and Finance Study report (2018), the main barriers that eliminate companies' investments in sustainability initiatives include:

- a. identification of business opportunities in the field of sustainability (52%),
- b. prediction of corporate performance (50%),

- c. problems in measuring performance and quantifying benefits (50%),
- d. government regulations (40%),
- e. access to finance (30%),
- f. insufficient commitment to sustainability from the board of directors (29%),
- g. lack of expertise (24%),
- h. Incomplete company-wide sustainability framework (19%).

In this regard, the University of Cambridge Institute for Sustainable Leadership (2018) also defines the most promising solutions in the field of business sustainability:

- a. Resolve the false dichotomy between profit and business intent (companies that are successful and profitable in the long run generate benefits for society and stakeholders).
- b. Be honest and authentic (you need to understand the meaning and values of the business and actively fight for sustainability issues).
- c. Create space for meaningful discussions at the level of the board of directors and management (basic changes in the strategy cannot be implemented overnight) and this requires raising awareness of solutions on this topic).
- d. Innovate and identify new forms of value creation (it is essential to support innovation and create business processes and processes that align sustainability with business performance).
- e. Report the impact of the sustainability concept, not only on financial performance (develop meaningful impact indicators).

The Sustainability and Finance Study (2018) states that several steps need to be taken by companies on the path to sustainability:

- a. Companies must strive to increase sustainability by complying with stricter laws and regulations.
- b. Businesses need to realize that sustainability actions can improve business performance, which results in increased efficiency and lower costs.
- c. Businesses need to become more interested in their customers and suppliers and see how they can help them meet their sustainability goals.
- d. Businesses must adopt the concept of sustainability as the basic framework in the strategy that meets the needs of sustainable growth.

## **6. Conclusion**

In connection with efforts to meaningfully apply the concept of sustainability in everyday practice, great efforts are made to design and implement various indicators to monitor, measure and subsequently assess whether the development of the selected entity (enterprise, industry, region, state, etc.) in accordance with the principles and criteria of sustainable development or not.

The issue of sustainable development indicators, whether at the micro or macro level, is relevant not only from a practical point of view, but also from a theoretical

point of view. The aim of the paper was to provide a theoretical overview of approaches to measuring sustainability at the macro and micro levels, ie at the global level of countries and within the business environment. Based on a search of professional literature and scientific studies, we have come to the conclusion that there is currently no uniform measure, index or approach quantifying the level of sustainable development. However, the opinions of experts are not so different, however, we must point out the significant ambiguity of the analyzed approaches. In the following articles, the research direction will focus on the practical application of the processed theoretical starting points in order to evaluate the degree of sustainable development of Slovakia and EU countries within the selected global indicators reflecting the basic pillars of sustainability.

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# Production and Price Development of Agricultural Commodities: Wheat, Corn and Sunflower Seeds in 2022

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**Abstract.** Agricultural commodities prices skyrocketed during the first quarter of 2022, mainly driven by the escalation of the situation between the Russian Federation and Ukraine, but also by extreme climate conditions in certain geographies and protectionist measures introduced by governments to protect domestic supplies.

Within this paper the authors would like to provide an overview of the biggest producers and exporters of the selected agricultural commodities, being wheat, corn, and sunflower seeds and oil, and their price development in 2022. For all of them, the two conflicting countries, the Russian Federation and Ukraine, play an important role in world production and export.

The production and export volumes should be analyzed along with the price developments in the first months of 2022. As the products are traded on the commodity market the comparison is based on the traded prices.

**Keywords:** Agriculture, Export, Wheat

**JEL classification:** *F10, Q17, E31*

## **1 INTRODUCTION**

Inflationary pressures on agricultural commodities started already in 2021, driven by the strong demand as a result of global economic recovery after the COVID-19 pandemic and reduced harvests due to the extreme climate conditions and lack of labor force. This pressure is certainly not limited to agricultural commodities but is visible in various goods and services. Nonetheless, the impact on the prices of agricultural products is immense.

In addition to the recovery after the pandemic, in February 2022 the escalation of the conflict between the Russian Federation and Ukraine created true havoc on commodity markets. Quite unexpectedly, the conditions in the commodity market changed.

Even though the Russian Federation, as well as Ukraine, are both not large in output terms, they are among the largest producers and exporters of some of the essential food products, energy, and minerals. Ukraine is, for example, one of the world's largest exporters of wheat and maize and the world's largest exporter of sunflower oil. The ongoing conflict between Russia and Ukraine disrupted the production and the export of these commodities, bringing their prices to all-time high levels, but also a risk of a strong undersupply in some countries, including Africa.

At the current moment, the conflicting parties have not found a viable solution for exporting harvested proceeds located in Ukraine, including its occupied territory, from the last harvesting period while it is expected that the production in the current period will decline. As a result, the prices of agricultural commodities are still expected to rise or remain at their high levels.

## **2 DATA & METHODOLOGY**

The aim of this article is to provide an overview of the largest producers and exporters of selected agricultural commodities, being wheat, corn, and sunflower seeds (oil,) and their price development in 2022, before and during the conflict between the Russian Federation and Ukraine. In order to achieve this aim, the data used in this article is obtained from various sources. Reports and statistics retrieved from different organizations and international agencies (such as [www.usda.gov](http://www.usda.gov), [www.fao.org](http://www.fao.org), etc.) were sources of data concerning the biggest producers and exporters of selected agricultural commodities. Countries included in our research are Brazil, China, EU, Russia, Ukraine, and the USA as they are the most important players in the production and export of these commodities. The data on price development was gathered from Bloomberg terminal and statistical data from World Bank ([www.worldbank.org](http://www.worldbank.org)), OECD ([www.oecd.org](http://www.oecd.org)), The Global Economy (<https://www.theglobaleconomy.com>), etc.

The period in which price development of selected agricultural commodities was analyzed includes the start of the Russian invasion of Ukraine on 24 February 2022 which triggered faster inflation of these commodities. Online text analysis was also used to keep pace with the newest information regarding the ongoing war situation between Russia and Ukraine and its impact on the global economy.

### 3 THE GLOBAL PRODUCTION OF WHEAT, CORN and SUNFLOWER SEEDS

Wheat, corn, and sunflower seeds are among the key crops cultivated around the world. It can be noted that for all three types of agricultural products both production and exports are largely predominated by a few major players [9]. The top two players generally hold a considerable share of the world's production and exports. For instance, in the 2021/2022 marketing year the European Union and China accounted each for approximately 18% of wheat production. (see Table 1 Wheat Production, metric tons mn).

TABLE 1 – WHEAT PRODUCTION, METRIC TONS MN

Country	2020/2021	2021/2022 Preliminary	2022/2023 Projected
EU	126.69	138.42	136.50
China	134.25	136.95	135.00
India	107.86	109.59	108.50
Russia	85.35	75.16	80.00
USA	49.75	44.79	47.05
Others	271.82	274.38	267.78

Source: USDA

Considering the overall volume of production Ukraine with 25.42 million tons in 2020/2021 is not one of the largest producers. The volume is rather similar to Pakistan (25.25 million tons), and less than Australia or Canada [19].

In terms of the world's corn production, the USA is the definite leader in producing almost one-third of the global corn. It is followed by China, with 22% of the world's corn production. (see Table 2 Corn Production, metric tons mn). The corn production of Ukraine, being 30.30 million tons in 2020/2021 is expected to decrease by more than fifty percent to 19.5 million tons in 2022/2023 [19].



TABLE 2 – CORN PRODUCTION, METRIC TONS MN

Country	2020/2021	2021/2022 Preliminary	2022/2023 Projected
USA	358.45	383.94	367.30
China	260.67	272.55	271.00
Brazil	87	116.00	126.00
EU	67.14	70.50	68.25
Argentina	52	53.00	55.00
Others	303.74	319.63	293.17

Source: USDA

As for sunflower seed production, Ukraine has been the world leader until 2022 with 30% of the world's total production. However, the recent local conflict disrupted the country's agricultural production, and its sunflower seed output is expected to experience a decline of 37% in 2022/2023.

The country is expected then to account for approximately 22% of the global production of sunflower seeds. In 2021/2022 number two sunflower seed producer was Russia with 27% of the world's sunflower seed production. It is expected to become the leader of the sector in 2022/2023, as Ukraine's production is likely to experience a considerable decline. European Union is also a major sunflower seed producer, in 2021/2022 it accounted for 18% of the global output. (see Table 3 Sunflower seed, metric tons, mn) [19].

TABLE 3 – SUNFLOWER SEED, METRIC TONS MN

Country	2020/2021	2021/2022 Preliminary	2022/2023 Projected
Ukraine	14.10	17.50	11.00
Russia	13.27	15.57	14.50
EU	8.92	10.43	10.50
Argentina	3.43	3.35	4.20
China	2.57	2.90	2.80
Others	6.96	7.63	7.72

Source: USDA

#### 4 THE LARGEST EXPORTING COUNTRIES OF WHEAT, CORN, AND SUNFLOWER SEEDS

For the three agricultural products in the analysis, it is important not only to consider the annual production but also the export volumes. Not focusing on the local consumption in the country of production the following overview highlights some of the largest producing countries.

#### **4.1 China**

China is among the world's leaders in the production of several agricultural products. It holds a strong agricultural sector, which is, however, mainly aimed at satisfying the country's internal needs. Consequently, being the world's number two producer of wheat and corn, and number five producer of sunflower seed, (see Figure 3 Sunflower and Seed exports, 2020) the country does not show considerable export volumes.

This is mainly due to limited land resources: the country's arable land per capita is 0.073 hm<sup>2</sup>, which accounts for less than one fourth of the world per capita arable land [5].

Food security is one of the priority issues for the country, considering its large population and limited arable land available. Several governmental policies are thus aimed at stimulating the country's agricultural production in order to be able to feed the country's population. According to USDA forecast, wheat production in China is expected to go through a slight decrease in 2022/2023 (approx. 1%). However, the average dynamic over the last five years is positive (1% increase). Production of corn in China is also forecasted to go down, however, by less than 1%. China's sunflower seed production is expected to decrease 3.4% [19].

#### **4.2 Russia**

Russia is one of the largest agricultural producers in the world, with 10% of global arable land on its territory [14]. It is the world's number four wheat producer, number two sunflower seed producer, number one wheat exporter and number two exporter of sunflower seed. (see Table 1 Wheat Production, metric tons mn; Table 3 Sunflower seed, metric tons mn; Figure 1 Wheat exports, 2020; Figure 3 Sunflower and seeds exports, 2020).

One of the main characteristics of agricultural production in Russia is its high level of concentration in certain regions. It is mainly concentrated in the Central, North Caucasus and Volga Federal districts. Grains are mainly produced in Krasnodar, Rostov, Tatarstan, Voronezh, Bashkortostan, and Volgograd regions [14]. Russia's agricultural output in general has experienced a steady growth during the recent years. It receives a considerable support from the government in the framework of the country's import substitution policy aiming at increasing the level of Russia's self-sufficiency, incl. in agricultural products. According to the USDA forecast, Russia is expected to produce 80 metric tons mn of wheat in 2022/2023 marketing year. This would mean a 6% increase compared to the previous year, and an average growth of approx. 2% over the last five years [19]. Production of sunflower seed is expected to experience a slight decrease. However, the country is still forecasted to become the leader in terms of the volume of produced sunflower seed.

### 4.3 European Union

Agriculture of the European Union is managed under the CAP (Common Agricultural Policy) established back in 1962 in order to support the development of agricultural production in the countries of the EU. The EU agricultural sector is highly subsidized. Gathering agricultural production of 27 countries, it is one of the strongest agricultural sectors in the world. The EU became indeed the world's leader in production of wheat in 2021/2022 and is expected to keep this position in 2022/2023, in spite of potential yield decrease due to climate conditions. It is the world's fourth producer of corn, and number three producer of sunflower seed. Several EU countries are also major exporters of agricultural products. For instance, France is the world's fourth wheat exporter, accounting for 10% of the global wheat exports. Romania is number five in terms of corn exports (3% of global volume), and is the world's leader in sunflower seed exports, holding 21% of the total export volume of sunflower seed.

According to the USDA, the production of wheat in the EU is expected to decrease by 1.9 million tons in 2022/2023. However, the average dynamic over the last five years is a 3% increase. EU's corn production is also forecasted to decrease slightly (3%), while its sunflower seed production will remain stable [8].

### 4.4 USA

Agricultural production is a major sector for the USA. The country is also a massive exporter of agricultural products. It is number one producer of corn worldwide, as well as number five wheat producer.

Corn is the most cultivated crop in the USA. It accounts for 95% of feed crops grown in the country. The core corn cultivation region of the country is Heartland region (incl. Illinois, Iowa, Indiana, eastern portions of South Dakota and Nebraska, western Kentucky and Ohio, and the northern two-thirds of Missouri). Iowa and Illinois are the top producers of corn, which account for approx. one-third of the country's corn production volume [7]. Corn planted land has been growing over the recent years. Corn production has thus also experienced an increase, due both to larger planted land areas, technological development, and improvement of production practices. Wheat is number three most cultivated field crop in the country. Wheat production, a traditionally strong segment of agriculture in the country, has been slowly declining since 1980s, both in terms of planted land and production volumes. This trend is mainly due to the growing competition coming from Russia and European Union, whose wheat exports are on the rise, as well as to the profitability for the farmers of selling wheat inside the country has been going down as well. However, the demand for wheat, which has been rising lately, might push the farmers to keep or develop their wheat production capacities [6].

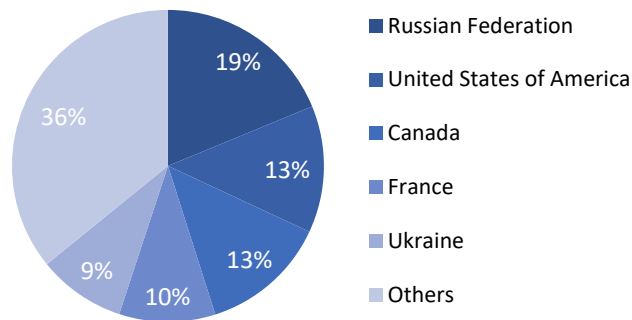
In terms of exports, the USA is number two in wheat exports, with a 13% of total volume, and the leader in corn exports, accounting for 27% of global corn exports. As for the dynamic of the agricultural production of grains in the country, production of

wheat in the USA is forecasted to go up (according to USDA) 5% in 2022/2023, while corn production is expected to experience a 4% decrease.

#### 4.5 Brazil

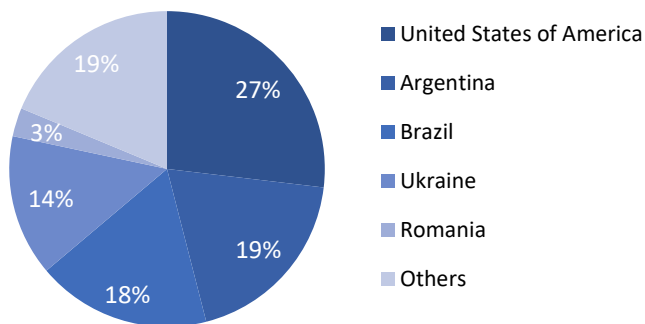
Agricultural sector plays a rather important role in Brazil's economy. The core crop is corn, of which the country is the third largest producer, and the third largest exporter in the world, accounting for 18% of the global corn exports. According to USDA, in 2022/2023 Brazil's corn production is expected to go up 8.6%. The country's wheat production and exports have also recently been on the rise due to the favorable climate conditions as well as rising demand. Traditionally being one of the world's biggest wheat importers, Brazil imports approximately 50% of its wheat consumption volume. A considerable increase in production of wheat could allow the country to reduce its dependence on imports and increase its self-sufficiency [17].

FIGURE 1. WHEAT EXPORTS, 2020



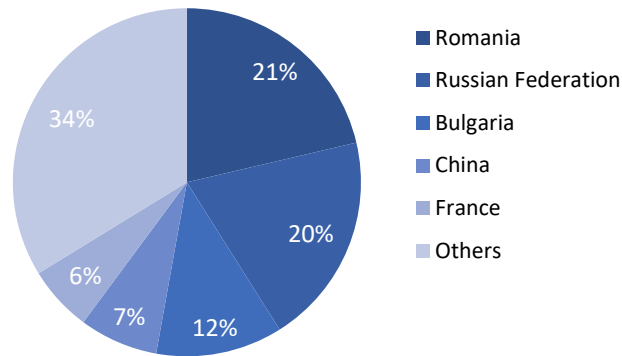
Source: FAOSTAT [11]

FIGURE 2. CORN EXPORTS, 2020



Source: FAOSTAT [11]

FIGURE 3. SUNFLOWER SEED EXPORTS, 2020



Source: FAOSTAT [11]

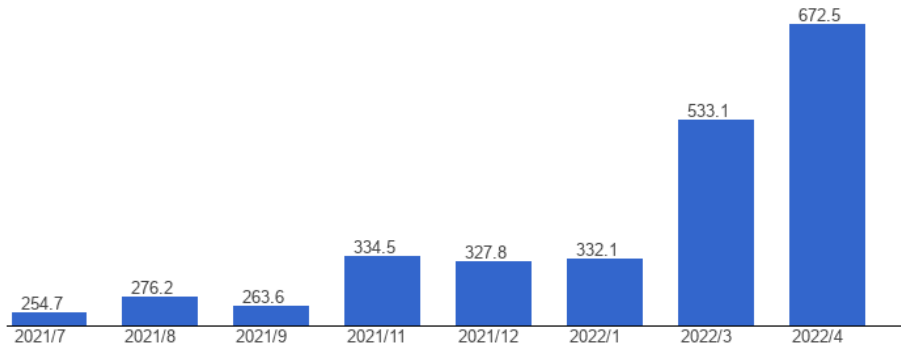
## 5 WHEAT, CORN AND SUNFLOWER OIL PRICE DEVELOPMENT IN 2022

Inflationary pressures on agricultural commodities started already in 2021, driven by the strong demand as a result of global economic recovery after the COVID-19 pandemic and reduced harvests due to the extreme climate conditions and lack of labor force. Then in February 2022 the conflict between the Russian Federation and Ukraine has started and created a true havoc on commodity markets.

### 5.1 WHEAT

Wheat prices in 2022 skyrocketed (see Figure 4 Wheat price development) due to the ongoing conflict between Russia and Ukraine, negative climate conditions, supply disruptions and imposed export bans (e.g. India). As to estimates that agricultural production in Ukraine will decrease from up to 50% and consequently keep wheat prices at historically high levels in the mid-term. The fear of famine and social unrest in poorer countries is likely to increase because many vulnerable countries, like Lebanon or Nicaragua, greatly rely on the Ukrainian wheat.

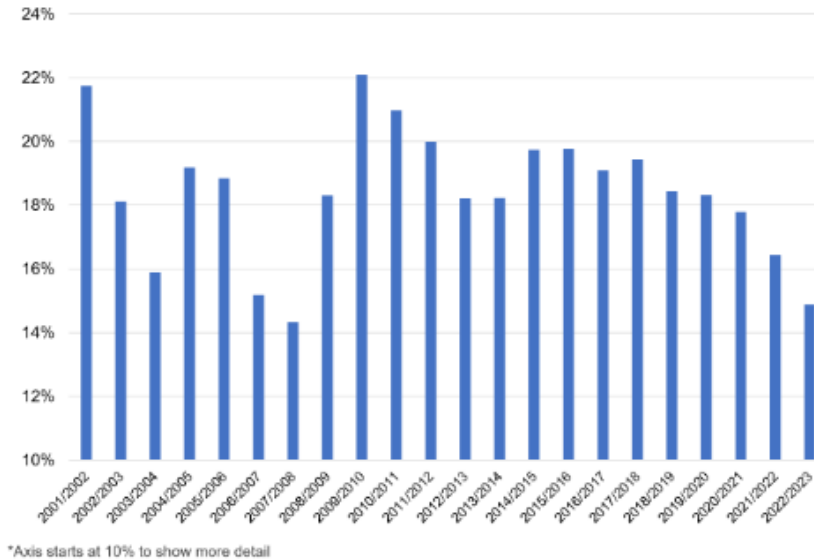
FIGURE 4 WHEAT PRICE DEVELOPMENT, USD PER METRIC TONS



Source: [https://www.theglobaleconomy.com/World/wheat\\_price/](https://www.theglobaleconomy.com/World/wheat_price/)

On the one side we are seeing wheat prices at historic all-time-high levels and on the other side world wheat stocks at one of the lowest levels in the recent history. The record low of 14.3% is from 2007/2008 and for 2022/23 we are seeing wheat stocks at 14.9% comparing with the average of 19%.

FIGURE 5. WORLD WHEAT STOCKS-TO-USE (EXCL. CHINA)



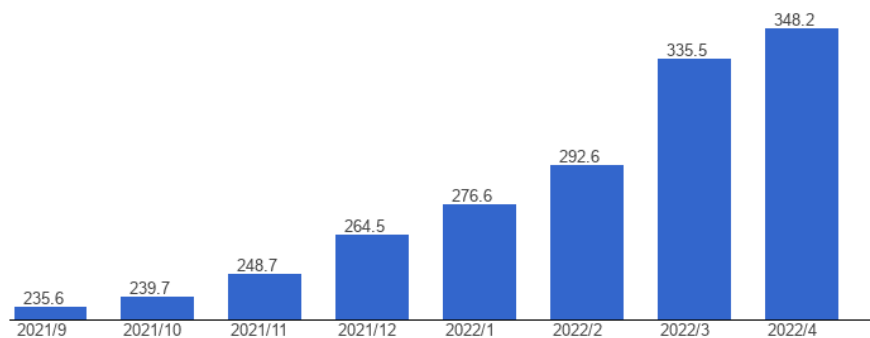
Source: <https://www.reuters.com/markets/commodities/>

The outlook for wheat remains bullish due to the high levels of uncertainty coming from the ongoing war, worsening climate conditions, supply disruptions and lack of work force in many countries.

## 5.2 CORN

During April 2022 corn price reached record high levels as a result of a strong demand on the one side and the situation in Ukraine, the dryness in parts of Europe and Americas and protectionist measures being taken by governments to protect domestic supplies on the other side. The outlook for corn remains bullish due to the aforementioned factors (war, climate conditions, etc.) that cannot be changed in a short term and a high level of uncertainty.

FIGURE 6. CORN PRICE DEVELOPMENT, USD PER METRIC TONS



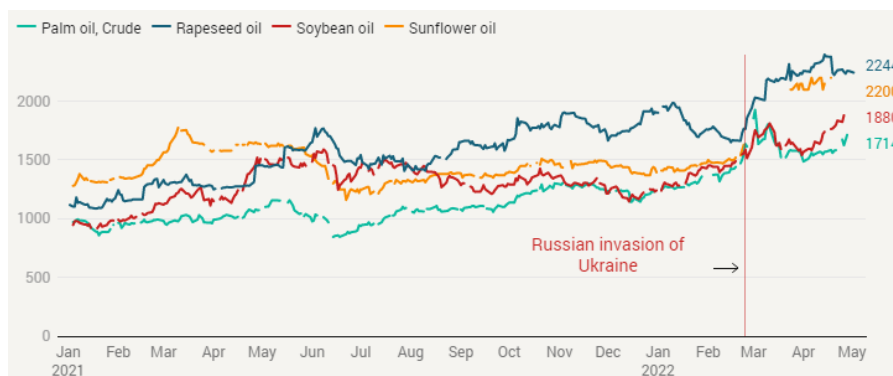
Source: [https://www.theglobaleconomy.com/world/maize\\_prices/](https://www.theglobaleconomy.com/world/maize_prices/)

## 5.3 SUNFLOWER OIL

In 2021, Ukraine was the world's largest exporter of the sunflower oil and together with Russia it accounted for almost 75 percent of total sunflower seed oil production. Even before the escalation in Russia-Ukraine conflict, global vegetable oil supply was under pressure because of unfavorable weather conditions in countries that have an important role in vegetable oil production (e.g. drought in South America and Canada, Typhoon Rai in Malaysia).

The start of the war in February 2022 disrupted harvests and export from Ukraine but also put in danger agricultural production in 2022, especially for commodities that are planted in spring, e.g. sunflower seed. Another pressure on the price and supply of vegetable oils is the growth of biodiesel capacity driven largely by regulations. As a consequence, we are seeing sunflower oil, but also other vegetable oils at their historic high levels (see Figure 7 Daily vegetable oil prices, current USD). The outlook for sunflower oil remains bullish based on the prior mentioned factors that are not likely to diminish in the short term.

FIGURE 7 DAILY VEGETABLE OIL PRICES; CURRENT USD



Source: [www.ifpri.org](http://www.ifpri.org)

## 6 CONCLUSION

Wheat, corn and sunflower seeds are among the key crops cultivated around the world and their importance in human nutrition is tremendous. The USA, China, and the EU are the biggest producers of wheat and corn, while the production of sunflower seeds is strongly concentrated in Ukraine and Russia.

To understand better the current situation in the agricultural commodities market it is important to emphasize that some of the key producers of corn and wheat, like China, do not show considerable export volumes (mainly due to limited land resources and satisfying the country's internal needs) and consequently do not participate in the global supply of these commodities. On the contrary, Russia and Ukraine, which are not among the biggest producers, have a very important role in the export of corn and wheat, especially sunflower seeds where they hold together almost 75% of the production.

Food prices were under pressure already in 2021 due to the disrupted supply chains, strong demand triggered by the COVID-19 pandemic recovery, extreme climate conditions, and a lack of labor force. After the escalation of the conflict between Ukraine and Russia in February 2022, agricultural commodities prices skyrocketed, especially those where Russia and Ukraine are large exporters, e.g. wheat, corn, and sunflower oil. In Ukraine, a country known as the “breadbasket of Europe”, the war raised concerns over whether crops will be harvested and if and how will they be exported globally since a lot of inland transport infrastructure and seaports in Ukraine were destroyed. Also, planting for the season 2022/23 is at huge risk because Ukraine is facing war conditions, a lack of labor force (a lot of farmers are fighting in the war, and a certain number of them fled or died), and restricted access to fertilizers. Russian export and production of agricultural products are fully operational (international



sanctions exclude food and fertilizers), but imposed economic sanctions on Russia could hinder the import of agricultural inputs such as pesticides and seeds, which could result in less planting and lower yields, meaning less production in the end. As Russia is one of the key players in the global energy market, the imposed sanctions on Russian oil and gas export sent energy prices to historic highs and triggered further increase in food prices. Agriculture was extremely hit by inflated energy prices as it is highly-energy intensive industry, especially in developed countries. Higher overall input prices increased the production cost, and in the end, resulted in higher food prices. Countries like Egypt, Argentina, India, Indonesia, Serbia, and Hungary already imposed a certain level of control over the export of essential commodities in order to stabilize the prices and domestic supply. This kind of policy made the already bad situation even worse, pushing food prices only higher. Despite disruptions in the export market, no food shortages are expected in the terms of global supply as the gap caused primarily by the extreme reduction of production and export of agricultural products in Ukraine will be filled by increased export from countries like Argentina, Brazil, and the USA. Poor and developing countries like Nicaragua or Tunisia are most vulnerable because they are highly dependent on imports from these conflicted countries. The prices of analyzed agricultural commodities are expected to stay at elevated levels and therefore governments are facing an immense challenge to protect the most vulnerable groups from these price shocks.

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# The Impact of COVID-19 on Revenues and Expenditures of Main Regional Cities in Slovakia

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**Abstract:** At the beginning of March 2020, Slovakia found itself in a situation unparalleled in its modern history. The COVID-19 pandemic has brought a wave of uncertainty into regular live of people. This uncertainty has affected every aspect of life and every economic subject. The central governments of the countries were forced to take unpopular measures to close their economies or socio-cultural life. The consequences of COVID-19 had to bear local governments. The aim of this work is to assess the extent to which COVID-19 has affected the financing of regional cities in Slovakia. Focuses on expenditure and revenues over period 2011 – 2021. The results suggest that pandemic negatively affected finances of all sampled cities. More affected were capital expenditures, which rate declined and personal income tax during pandemic year 2020. Shortfall in revenues was replaced in increase of property tax income and grants and transfers from central government.

**Keywords:** Local government, COVID-19, Slovakia

**JEL classification:** H12, H27, H72

## 1 Introduction

Since 1993, when the Slovak Republic has been established country has faced many challenges. Major transformation processes occurred in 1998, culminating in its accession to the European Union in 2004 and subsequent adoption of Euro as its currency on 1 January 2009. Another major challenge was the economic crisis and the debt crisis in the euro area. However, the COVID-19 pandemic brought with it an extraordinary situation that was almost unimaginable in the 21st century. The first patients with the new virus began to appear in early March 2020. It was clear to the incumbent Slovak government that the virus could only come from abroad and was one of the first countries in the EU to take anti-pandemic measures to reduce the spread of the disease and reduce mobility. The government has taken measures such as closing

all schools and shops except food, drugstores and pharmacies, but also establishments, bars, hotels, fitness centers, sports clubs and services. The measures taken have had a significant impact on the owners of these businesses and their employees. As a result of these measures, smaller companies and employers have been forced to lay off employees (Svabová, Metzker, Pisula, 2020).

The pandemic also affected local authorities, which had to cope with certain tasks, whether it was testing for the virus in their citizens, protecting the elderly or vaccinating.

The article focuses on the period 2011 - 2021 and provide an analysis of the pandemic impact on local governments budgeting. Main focus is on expenditure (current and capital), as well as revenues (tax income, non-tax income, grants). The results are summarized in last chapter.

## **2 Literature review**

The academic community began to address the impact of COVID-19 almost immediately after the outbreak of the global crisis. The first articles began to appear, of course, in the field of epidemiology, medicine, vaccine research.

The finances gradually examined the impacts on macroeconomic indicators, countries' indebtedness, and health expenditure. In 2020, a survey by the Organization for Economic Co-operation and Development (OECD) and the European Committee of the Regions (CoR) was conducted to assess the impact of the global COVID-19 pandemic and the socio-economic crisis on regional and local authorities. In an online survey conducted from June 2020 to July 2020 across the European Union (24 countries out of 27 EU countries), they received 300 responses from representatives of local and regional authorities or various territorial intermediaries. This survey showed that up to 63% of respondents expected a significant or very significant negative impact on lower public administrations, 26% of respondents expected a medium impact and 10% expected a low impact. There were also differences in the size of municipalities, with large cities with more than 250,000 inhabitants, where almost 80% of respondents expected a negative impact, compared to municipalities with less than 10,000 inhabitants, where just under 50% of municipalities expected a negative impact. In the area of finance, about half of local governments expected a negative short-term and medium-term impact. The impact was expected to reduce revenues and increase expenditures. On the expenditure side, upward pressure was expected on social services or social security spending, unemployment benefits and small and medium-sized enterprises affected by the closed economy. Almost 55% expected a very negative impact on tax collection, a slight impact 28%, the remaining respondents could not answer or did not expect a change or expected an increase (approximately 3% of respondents). (OECD - CoR, 2020)

In the area of impacts on local government finances and budgets, Nemeč and Špaček (2020) conducted quantitative research in the period after the coronavirus pandemic broke out before 30 June 2020. The authors sought to determine the preliminary impacts of COVID on local government revenues and expenditures in Slovakia and the Czech

Republic. They focused on whether there were fiscal imbalances compared to the central level and answered the question of the adequacy of resources in relation to the state of emergency.

As this was research at a relatively early stage of the pandemic, the contribution used mainly secondary sources and publicly available government sources, international statistics, and published articles. The key results of the research were that the central governments of the surveyed countries did not provide an adequate response to the situation, especially in terms of resources and their adequacy to the tasks they had to perform by law.

Čajková, Šindleryová, Garaj (2021) in a recent study follow only the Slovak Republic, where they focused only on Slovak cities. The analysis examined 141 Slovak cities and looked at budget shortcomings caused by the COVID-19 pandemic. The authors present the findings of the Ministry of Finance of the Slovak Republic, which in 2020 reported on the negative impact of the coronavirus pandemic on the collection of personal income taxes across the country. The Ministry of Finance responded with financial assistance on October 23, 2020, and for the second time, local governments received assistance on December 7, 2020. The paper also presented a methodology based on which the ministry covered 100% of personal income tax shortfalls through either the Non-Repayable Financial Contribution (NFC) or the Reserve Fund (RF). Data from larger cities are interesting. The cities of Banská Bystrica (1,874,305 EUR), Bratislava (9,308,872 EUR), Košice (5,345,256 EUR), Nitra (1,834,157 EUR), Prešov (2,246,523 EUR), Trenčín (1,280,520 EUR), Trnava (1,462,429 EUR), Žilina (2,047,137 EUR), also applied for financial support.

Other studies focus on negative fiscal impact of the pandemic to employment reductions at state and local governments (Green, D., Loualiche E., 2021) or financial resilience of local governments in England (Ahrens, T., Laurence, F., 2020).

### 3 Data and Methodology

This chapter contains a specification of the relevant data collection process and a sample description. As is clear from the previous chapter, the main research question will be to assess the impact of the COVID-19 pandemic on the revenues and expenditures of the largest cities in Slovakia.

As can be seen in Table 1, we chose regional cities where higher territorial units are located, of which there are eight in Slovakia. In Table 1, these cities are also shown with a code according to the NUTS 3 classification.

**Table 1.** List of cities included in this analysis (NUTS3)

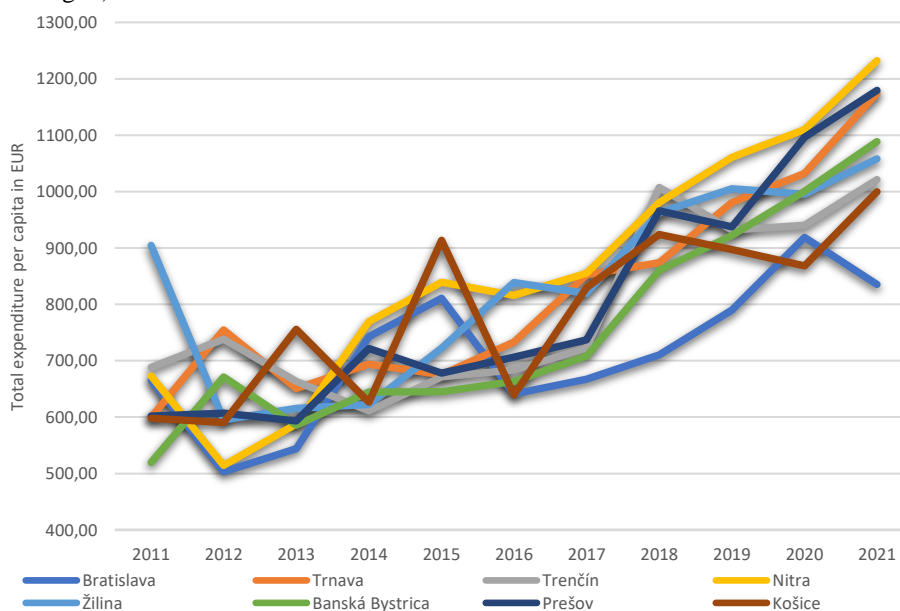
SK010 Mesto Bratislava	SK031 City of Žilina
SK021 City of Trnava	SK032 City of Banská Bystrica
SK022 City of Trenčín	SK041 City of Prešov
SK023 City of Nitra	SK042 City of Košice

In the analysis, we compiled our own database of individual main indicators during the period 2011 - 2021. We focused on the overall sources of funding for cities and the use of these resources. We then tracked sources of funding or total income in accordance with their largest items, which are personal income tax, real estate tax. We also followed a comparison of tax revenues, non-tax revenues as well as grants and transfers from a higher government level. We divided expenditures into current expenditures and capital expenditures.

## 4 Results

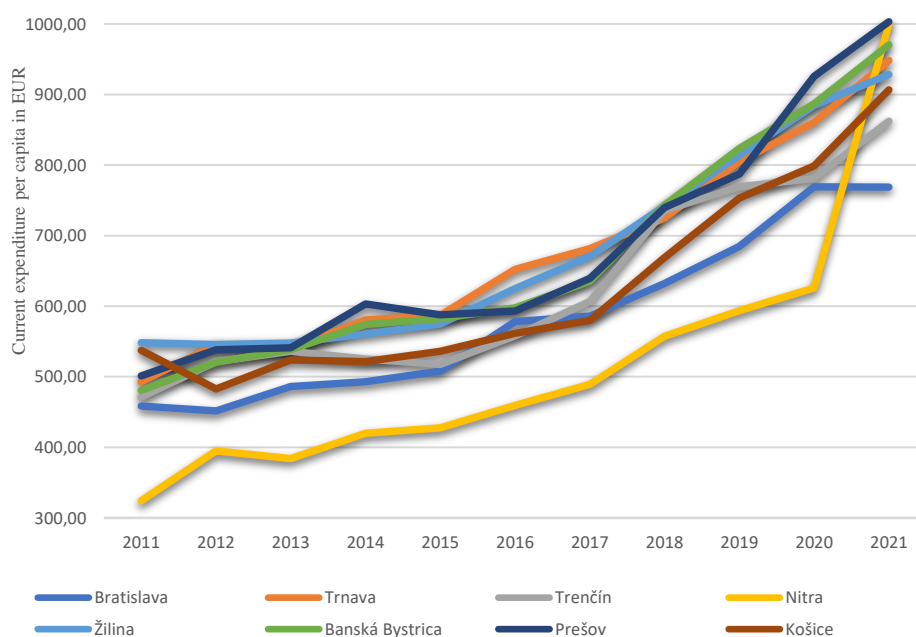
This chapter contains a specification of the relevant data collection process and a sample description. As is clear from the previous chapter, the main research question will be to assess the impact of the COVID-19 pandemic on the revenues and expenditures of the largest cities in Slovakia.

Figure 1 shows the development of total expenditure per capita over the last ten years. Prior to the start of the pandemic, per capita spending grew at an average rate of 5% per year. In 2020, during the first wave of the COVID-19 pandemic, there was an increase in total expenditure in Bratislava (17.19%), Prešov (16.22%), Banská Bystrica (7.99%), Trnava (4.83%), Trenčín (0.94%), Nitra (3.96%). The city of Žilina decreased its expenditure by 1.35% and Košice by 3.45%. In the following year 2021, the pandemic manifested itself fully and total expenditures increased on average by another 6.95%. The largest increase was in Nitra (13.32%), Trnava (11.01%) and Košice (9.99%). The decline was only in Bratislava, in absolute numbers as well as per capita. (see Fig. 1)



**Fig. 1.** Total expenditure per capita during the period 2011 – 2021 **Source:** own calculation

When looking at the current expenditure of cities, it is possible to observe an average increase in expenditure during the years 2011 - 2019 at the level of 5.95% per year (see Fig. 2). Year-on-year growth in current expenditure in 2020 averaged 7.96% per year. Current expenditures grew in all cities. The largest increase was in Prešov (16.78%), Bratislava (7.78%), Žilina (8.23%). The following year 2021, the increase was on average 13.97%, with the biggest distortion being made by Nitra (62.95%). Without the city of Nitra, the increase was only 6.97%. Moreover, interesting results are observable in capital expenditures (see Fig. 3).

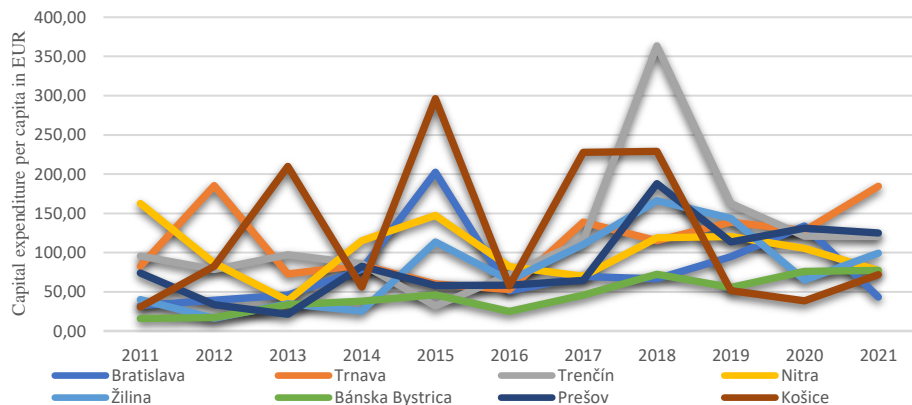


**Fig. 2.** Current expenditure per capita during the period 2011 - 2021 **Source:** own calculation

Capital expenditures form a specific area in the research of expenditures. Many municipalities have sought to cover the increase in current expenditure by reducing investment. The decrease in 2020 occurred in 5 out of 8 cities, on average by about 25%. Namely, capital expenditures decreased in Žilina (-54.97%), Trenčín (-25.62%), Košice (-24.97%), Nitra (-13.10%) Trnava (-8.23%). Of the mentioned local governments, the decline continued in 2021 by another 25.21% in Nitra, but also in Trenčín (-2.05%). In Košice, there was a return to the original figures in 2020, where capital expenditure per capita increased from 38.62 EUR to 71.79 EUR. In the city of Trnava, there was a year-on-year increase of 40.83% in 2021 from 127.97 EUR per capita to 184.55 EUR per capita.

The remaining three cities, which recorded an increase in expenditures in 2020, Bratislava (42.35%), Banská Bystrica (35.90%), Prešov (14.72%) reduced their expenditures a year later. The largest decrease was in Bratislava (-65.30%), Prešov (-9.16%), Banská Bystrica (-1.24%).

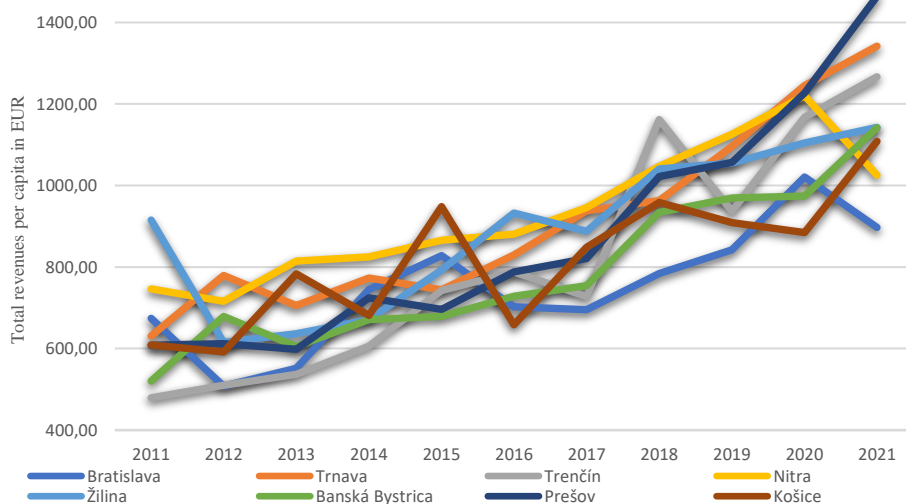




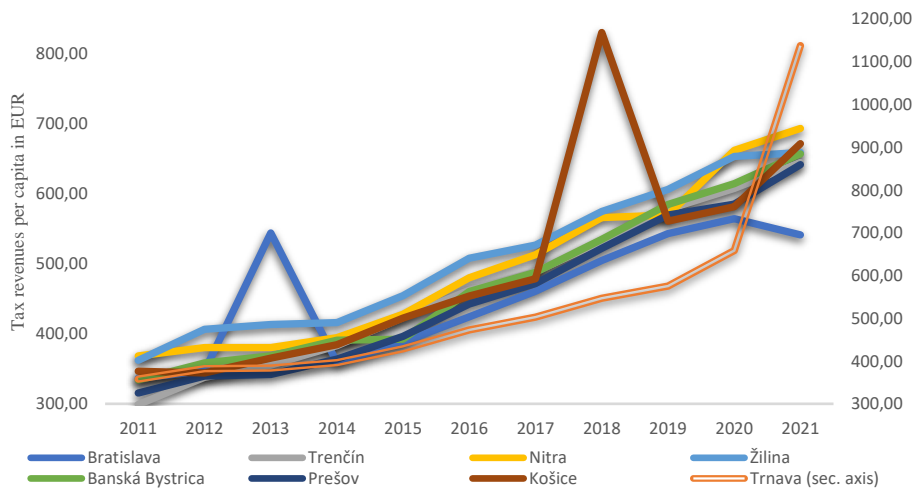
**Fig. 3.** Capital expenditure per capita during the period 2011 - 2021 **Source:** own calculation

Following chart (see Fig. 4) focuses on total income development in sample cities. Total revenues grew at a rate of 6.79% per year between the period 2011 - 2019. In 2020, an increase was observed almost in all cities. The income of cities in Trenčín (24.72%), Bratislava (22.09%), Prešov (15.36%), Trnava (7.70%), Žilina (4.30%) grew. Revenues stagnated in Banská Bystrica (0.00%), only Košice recorded a decrease by 2.83%. Income per capita ranged from EUR 884.67 in Košice to 1,244.74 EUR in Trnava.

In 2021, revenues continued to increase in Košice (19.68%), Prešov (13.88%), Banská Bystrica (13.62%), Trenčín (6.62%), Žilina (5.43%), Trnava (5.24%). The decrease occurred in Bratislava, when total revenues decreased by 5.25% and total per capita incomes to EUR 1,020.92 to EUR 896.84. Nitra's total per capita income decreased from EUR 1,220.28 to EUR 1024.98 with an overall decrease of 14.26%.

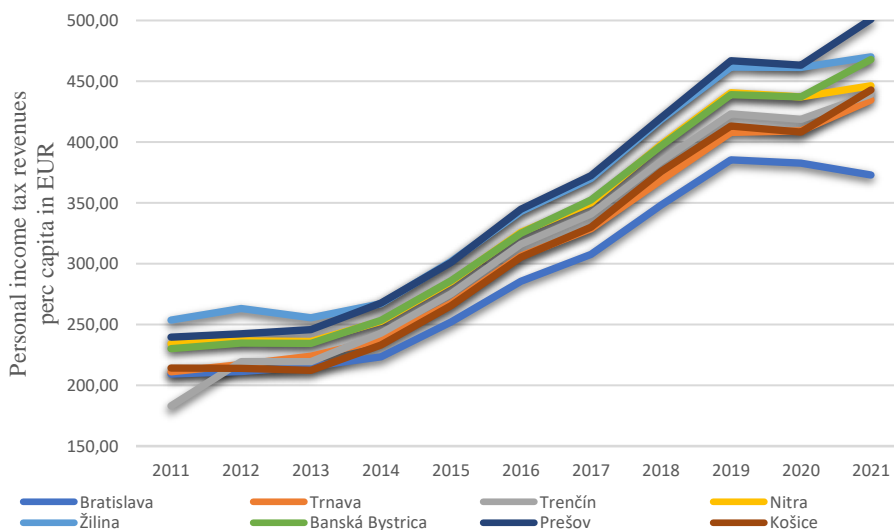


**Fig. 4.** Total income per capita during the period 2011 - 2021 **Source:** own calculation



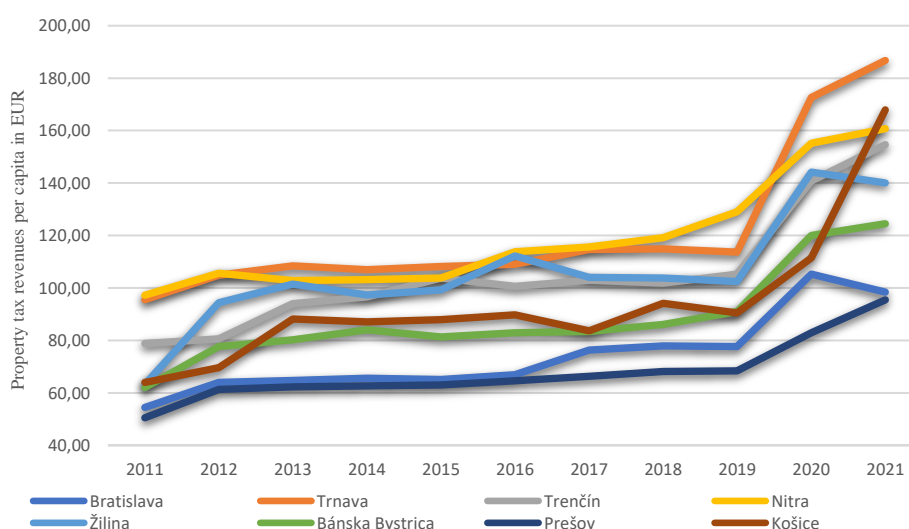
**Fig. 5.** Revenues from taxes per capita during the period 2011 - 2021 **Source:** own calculation

Tax revenues (see Fig.5) have been growing regularly since 2011, at an average annual rate of 7.40%. Over the last ten years, tax revenues per capita increased from an average of EUR 339.97 in 2011 to EUR 573.47 in 2019. The overall increase in tax revenues increased by 7.11% year-on-year in 2020 and by approximately 13%. The largest increase was in Trnava by 68.57%, the growth was recorded in all cities. In terms of per capita income, total income decreased in Bratislava alone from 564.48 EUR to 541.28 EUR.



**Fig. 6.** Revenues from personal income tax per capita during the period 2011 - 2021 **Source:** own calculation

In terms of total revenue, personal income tax is the largest component in local government budgeting. From 2011 to 2019, they grew at a regular average annual rate of 8.45% (see Fig. 6). In 2020, there was stagnation and economic recession, which was caused by the COVID-19 pandemic. The average decline in personal income tax revenues averaged -0.84%. In terms of individual cities, the decrease was as follows: Prešov (-1.44%), Nitra (-1.42%), Košice (-1.39%), Trenčín (-1.00%), Banská Bystrica (-0, 92%), Žilina (-0.43%), Trnava (-0.13%), Bratislava (0.00%). The per capita personal income tax averaged 427.25 EUR. In 2021, revenues started to grow again, by 3.81% on average.

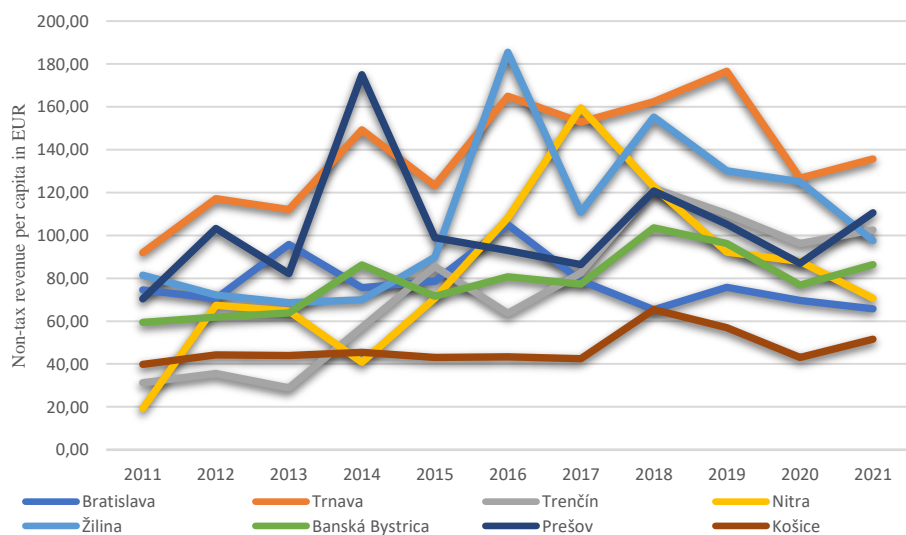


**Fig. 7.** Revenues from property tax per capita during the period 2011 - 2021  
**Source:** own calculation

The second most profitable tax is the real estate tax, which accounts for about 20% of all municipal revenues. The following chart (see Fig. 7) shows the development of the last 10 years, and we can see that this is a relatively stable source of revenue for local governments, which grew by an average of 4.33% between 2011 - 2019. In connection with COVID-19 we can see an increase in income tax revenues per capita from EUR 97.24 to EUR 129. In each of the mentioned places, the increase in revenues was above 20%, while on average the growth rate was 31.97%. The largest increase was in Trnava (51.18%), Bratislava (36.64%) and Trenčín (33.76%). The lowest growth was in Nitra (19.43%), Prešov (20.38%) and Košice (22.99%).

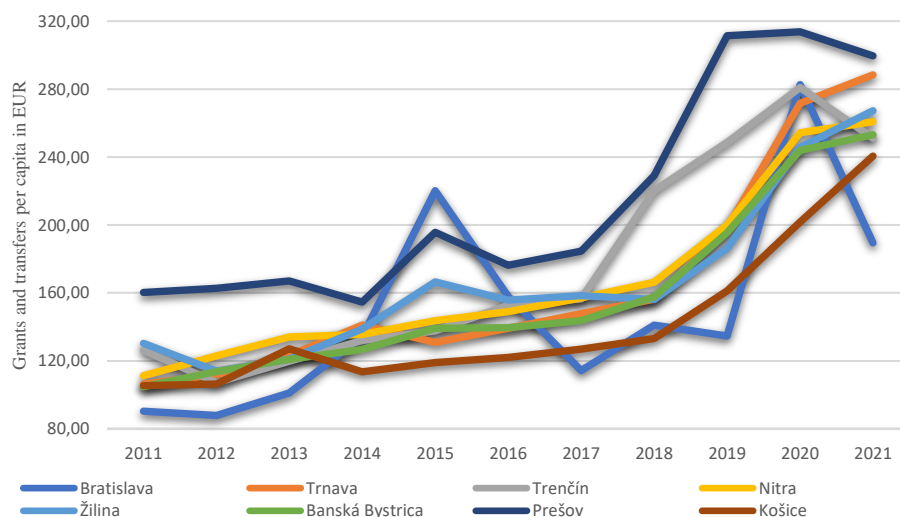
In the following year 2021, growth continued average by 9.18%. The largest increase was in Košice and reached 43.80%. Compared to 2019, when revenues were EUR 90.50 per capita, in 2021 these revenues amounted to EUR 167.89. In Prešov, there was an increase between 2019 and 2021 from EUR 68.39 per capita to EUR 95.44. The city of Bratislava (0.77%), Banská Bystrica (0.56%) increased property taxes only

minimally. In Žilina, taxes fell by 0.98% and per capita (EUR 140.05) were at one of the lowest levels.



**Fig. 8.** Non-tax revenues per capita during the period 2011 - 2021 **Source:** own calculation

The following chart (see Fig. 8) shows the development of non-tax revenues of local governments in the period 2011 - 2021. Non-tax revenues account for approximately 10% of total municipal revenues. Based on data, non-tax revenues decreased by an average of 15.11% during the pandemic. The largest decrease was measured in Trnava by 28.57%, non-tax per capita income decreased from 176.58 EUR to 126.72 EUR. The mentioned decrease in 2020 was observable in all monitored cities. In the following year 2021, non-tax revenues increased slightly.



**Fig. 9.** Revenues from grants and transfers per capita during the period 2011 - 2021  
**Source:** own calculation

Grants and transfers from the central level account for about 20% of total municipal revenues. In the period 2011-2013, grants per capita ranged from € 105 per capita to € 135 per capita. The capital Bratislava received a lower subsidy in this period at an average of 93 EUR per capita. The city of Prešov received the highest subsidy from the state budget, averaging EUR 163.32, which accounted for approximately 27% of total revenues. Until 2017, per capita grants increased at the same rate. The change occurred in 2018 and 2019, when there is an observable increase in the cities of Prešov and Trenčín. For example, in 2019 in Prešov, these grants accounted for up to a third of budgeted revenues.

## 5 Conclusion

The COVID-19 pandemic has brought about an unprecedented situation in the history of modern Slovakia. Almost every aspect of life and the economic entity was affected. The local governments were no exception, as they had to take on a number of tasks in dealing with the pandemic situation and, in addition, had to deal with funding problems.

The results of the analysis of this article confirm the negative impact of the COVID-19 pandemic on the financing of the largest Slovak cities, which are expected in Nemeč and Špaček (2020). In this study, we focus more on the revenue and expenditure impacts. Within expenditures, total expenditures increased in Bratislava (17.19%), Prešov (16.22%), Banská Bystrica (7.99%), Trnava (4.83%), Trenčín (0.94%), Nitra (3.96%).

There was a decrease only in Žilina (1.35%) and Košice by 3.45%. In 2021, spending increased by an average of 6.95%. Current expenditures increased by approximately 8% in 2020. The pandemic negatively affected investments represented by capital

expenditures in most cities in 2020 by an average of 25%. Cities with an increase in capital expenditures Bratislava, Prešov and Banská Bystrica in the following years 2021 decreased.

From the revenue side, there was a decline in personal income tax revenues. This loss was compensated through grants and transfers from the state budget, which was presented in the paper Čajková, Šindleryová, Garaj (2021) and compensated by an increase in real estate tax revenues, which is a relatively more stable income.

The situation of the pandemic has opened up many questions of the stability of local government financing and the reassessment of the adjustment of the tax mix in the Slovak Republic. In terms of size, the impact was not as dramatic as initially expected. In further research, it would be appropriate to focus on the effects of the pandemic on smaller municipalities and compare them regionally.

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# Application of BSC to Management of Production Processes in the Analyzed Company

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**Abstract.** Financial analysis provides information for achieving quality results in assessing the efficiency of businesses. Business performance is analyzed from a few perspectives. When analyzing the retrospective view (ex-post), financial ratios such as ROA, ROE, liquidity ratios (stage I, II and III) are used... Ex-ante produces a prediction of the future performance of the business. In terms of the availability of information sources, we divide performance evaluation approaches into traditional and modern. The interconnection of the given approaches brings about an increase in the efficiency of business management. The aim of this paper is to show the practical implementation of the modern BSC method in the management of the enterprise.

**Keywords:** BSC, business performance, business management

**JEL classification:** B41, G2, M2

## 1 Literary researcher

Performance measurement is currently symptomatic. Measurement itself brings the possibility of finding a way to solve the problems of the enterprise. During the COVID-19 pandemic that has prevailed in the world, it is necessary to collect as much information as possible about the problem areas in the enterprise. The crisis has affected all departments, so the question of solving the problem of profitability is to guarantee sales in the future. The solution to guaranteeing economic profit is to pinpoint the optimal management decision. In a time of crisis in the world, it is necessary for managers to focus on collecting up-to-date data about the enterprise. Coping with crisis decision-making guarantees not only profit but also the preservation of employees' jobs.

In practice, this means that by looking for bottlenecks and how to solve them, the crisis manager can keep the business running. Accounting has up-to-date data on costs incurred, from which business management can deduce problems.

The financial analysis provides a summary overview of all business activities. In terms of time interval, it tracks the movement of costs incurred and income received. The flow of finance is analyzed from a retrospective (ex-post) and a prospective (ex-ante) perspective. The ex-post, a look into the past of the financing of the enterprise, defines the indicators that have acted positively or negatively on the enterprise. The nature of the factors is also assessed in terms of time, i.e., the duration of their impact. Certain principles must be observed in any analysis, and this is also true for ex ante and ex post financial analysis. Krařtová (2002) talk about the principles of efficiency, objectivity, comprehensiveness, applicability, correctness, and others. The common goal of all the principles is the realization of quality analysis. When the principles are followed, the analyst will exclude all unfavorable attributes of the analysis and can evaluate a realistic view of the financial side of the enterprise. Ex-post analysis is characterized using economic indicators of profitability, liquidity, indebtedness of the enterprise... Ex-ante analysis is referred to as a prediction of future development. By using economic indicators and methods it is possible to anticipate opportunities, threats that may arise in the future. [6] Bhavana (2021) confirms this and adds to it the idea that the future event of ex ante prediction is the returns that the enterprise can achieve. Ex ante uses data from financial statements (balance sheet, income statement, notes) that talk about the financial condition of the firm over the period under review. [1] Lesáková et al. (2007) supplement the standard methods, i.e., scoring methods, mathematical-statistical methods, evaluation of financial analysis prediction with multicriteria evaluation methods and neural network method. In his study, he presents a division of mathematical-statistical methods based on the number of indicators used into univariate and multivariate discriminant analysis. From the above findings, we conclude that the financial situation of a company and its prediction for the future depends on the key attribute of ex ante analysis, i.e., verbal and evidence-based results in the current period under study. The future depends on a well-conducted financial analysis of the enterprise. [7]

In the crisis of the outbreak of Covid-19, which was first reported in the world in March 2019, businesses cannot rely with certainty on ex post analyses. Table 1 summarizes approaches to assessing a company's financial analysis in terms of the availability of information sources.

**Table 1:** Methods of measuring business performance

<b>Traditional</b>	<b>Modern</b>
Liquidity ratios	BSC
Labor productivity indicators	EMA
Profit indicators (EAT, EBT, EBIT)	EVA
Profitability indicators (ROA, ROE, ROS)	MVA
Debt ratios	CFROI
Activity indicators	CAPM
	CROGA

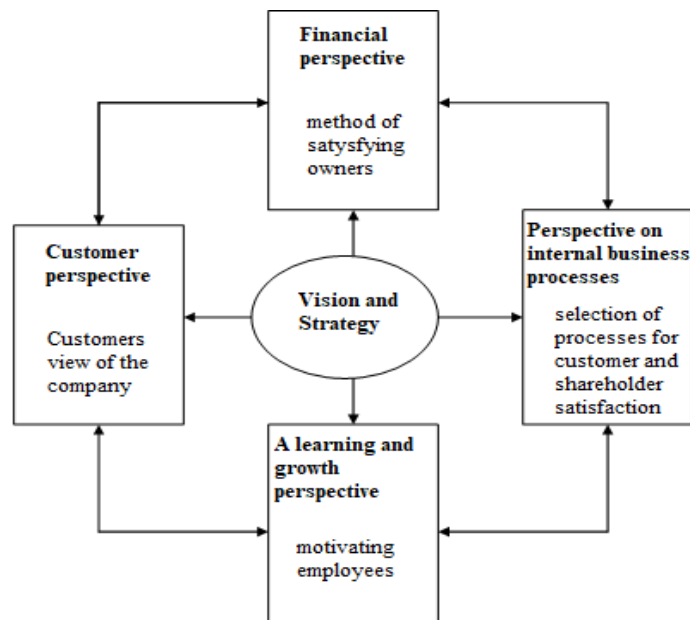
Source: own processing according to Zalai et al. (2016) [12], Vřrostová (2014) [11]



The basic idea of traditional approaches is to focus on increasing the efficiency, the cost-effectiveness of enterprises. Modern methods bring a new perspective to the solution of the issue of minimizing or optimizing the performance of the enterprise. These are methods that can be approached from a few perspectives, e.g., technical, and technological equipment of the enterprise, personnel, ecological, social, or material aspects of the production process of the enterprise.

### 1.1 Balanced Scorecard (BSC)

The BSC method is a balanced scorecard system of evaluating the performance of a company based on the company's strategy. Durkáčová - Kalafusová (2012, p. 7) define BSC as: "a strategic and managerial system of evaluation and management of an enterprise, creating a link between strategies and operational activities, with an emphasis on performance measurability." [2] Németh (2017) refers to it as one of the most well-known conceptual frameworks for measuring business performance. [10] The method was developed and popularized by Kaplan and Norton in 1992. They consider the main purpose as striking a balance between financial and non-financial indicators in measuring business performance. The contribution of the BSC method is the extension of the financial indicators to other perspectives of the company's activities, namely the customer perspective, the internal business process perspective, the learning, and growth perspective as well as their interconnection, which are shown in Figure 1.



**Figure 1:** Evolution of the profitability of the undertaking concerned

Source: own processing according to Hudymačová -Hila (2011) [4]

Striking a balance requires that each perspective is given equal attention, only then can a balanced system of business performance indicators emerge. The balance between the indicators is also expressed by the direction of the arrows on the above Figure 1.

Table 2 groups together the most used indicators that are monitored when assessing the performance of an enterprise according to each perspective.

**Table 2:** Perspective indicators of the BSC method

<b>Perspective BSC</b>	<b>Indicators</b>
Financial perspective	value of revenues, cost of eating, profit growth, amount of inventories, time to achieve profitability, financing...
Perspective of internal business processes	machine failure rate, scrappiness, volume of deliveries, cycle time, quality of suppliers...
Prospects for learning and growth	employee qualifications, staff training, education efficiency, efficiency of job interviews, accident rate, stability of employees, staff turnover
Customer perspective	customer loyalty, acquiring a new customer, customer loyalty...

*Source: own processing by Mišún et al. (2018) [9], Forman (2012) [3]*

The qualitative BSC method takes an integrated approach. The method can be suitably combined with other qualitative and quantitative methods. The right combination, linking financial and non-financial indicators, contributes to the successful measurement and evaluation of business performance. Statistical methods, correlation, regression is used in practice to express this dependence of indicators (Jurkovič - Sosedová, 2011). [5]

The practical implementation of the BSC methodology in a company requires the creation of a preparatory team that has information about the company's production strategy. The team is familiar with the customer requirements and other key parties involved in the process. It is aware of the methodologies used in the management of the business to achieve quality and performance. The enterprise team further applies benchmarking to compare itself with competitors. Knows the structure, documentation and management system built. Finally, he/she knows the goals set by the business, whether directed towards the end customer or the business itself. The objectives of the enterprise must meet the SMART condition, i.e., the set objectives must be specified (S), measurable (M), achievable (A), realistic (R) and time-bound within a realistic view (T). Mihalčová - Faltus (2005) complements the basic structure of the BSC concept with the following four operations - formulation of strategic objectives with their specification, causal linking of objectives, determination of measurement tools and setting of target values, development of action plans. [8]

## 2 Results

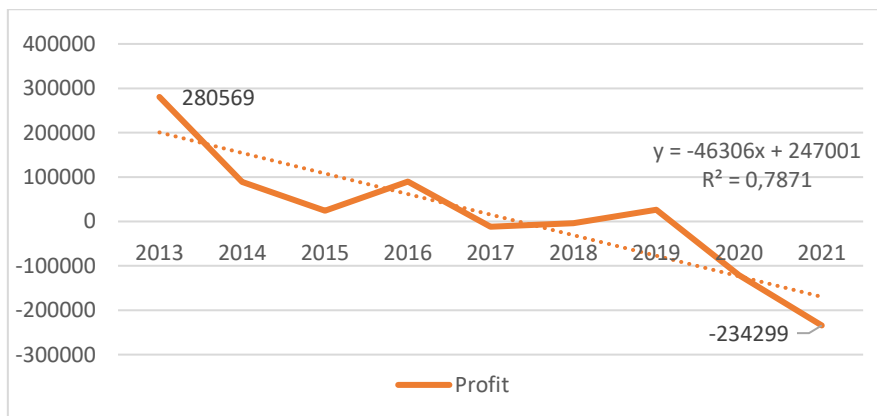
The paper focuses on analyzing a manufacturing company involved in the production of modular systems. For this enterprise we have created a practical demonstration of the application of the BSC method, which highlights the essential elements and relationships that exist between the different perspectives. The main objective is to ensure that the mission of the enterprise is fulfilled with effective use of the strengths and opportunities, with an emphasis on minimizing the threats and weaknesses of the enterprise. We consider the vision to be to build a significantly improved market position in the production of module systems and to make efficient use of the technological capabilities of the enterprise.

### 2.1 Customer perspective

The company operates in Slovakia and abroad, namely in the countries of Germany, Belgium, the Netherlands, France, and the Czech Republic. The group of customers represents a wide range of. These are families interested in the production of modular systems for the construction of house buildings. Customers also include investors, entrepreneurs who perceive the modular system as a lower cost option for building their business branches. The company sees improving awareness (goodwill), business value and increasing customer satisfaction as its vision for the future from a customer perspective.

### 2.2 Financial perspective

The business maintains its profitability trend at a good level. Profits cover costs in full, except for small deviations. The profitability trend for the period 2010 to 2020 is shown in Figure 1.



**Figure 1:** Evolution of the profitability of the undertaking concerned

Source: own processing.

For the period 2013 to 2021, 2013 was the best year for the company in terms of profitability. In that year, it made a profit of € 280 569. The evolution of profitability also shows the most significant decline in profitability, which is recorded during the pandemic period. Since the outbreak of COVID-19, the company has had a negative economic result. The situation has been addressed by using its reserves and contributions from the State to keep the company in the construction industry. The year 2021 is marked by the highest negative profitability, with a loss of € -234 299. This is the most significant decline in the company's history. The enterprise used financing of the type of short-term liabilities, namely short-term trade payables and short-term bank loans. The total indebtedness in 2021 reached 114.6 %. To maintain its position in the competitive market, the enterprise under review must look for solutions to improve its bottlenecks. Otherwise, it faces extinction.

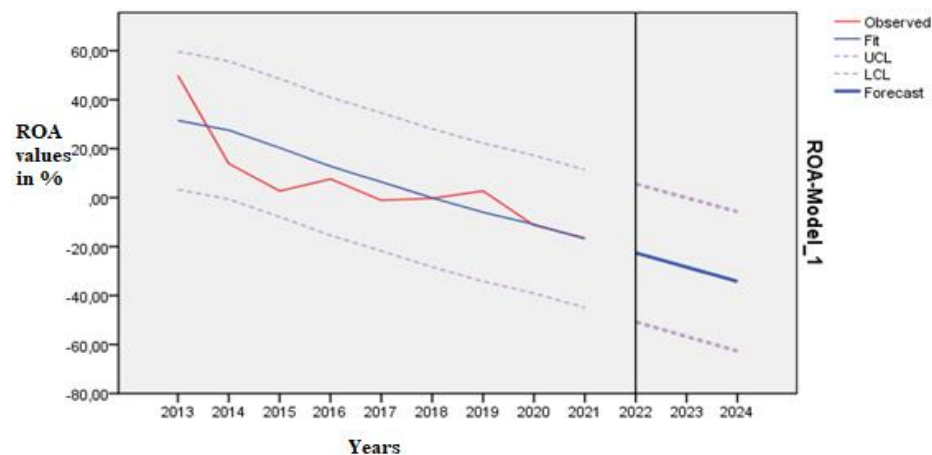
Due to the critical situation of the company and its position on the market, we have used the prediction of the development of the return on assets ratio soon. For the analysis we have based on the calculated ROA values for the period of 2013-2021. The values of the prediction of the ROA indicator with UCL (Upper Control Limit) and LCL (Lower Control Limit) for the next period of 3 years are grouped in Table 3.

**Table 3:** ROA prediction values for the following period 2022-2024

Model		2022	2023	2024
ROA-Model_1	Forecast	-22,58	-28,39	-34,21
	UCL	5,61	-,07	-5,75
	LCL	-50,76	-56,71	-62,67

Source: own processing.

The prediction of ROA values is visually processed in Figure 2.

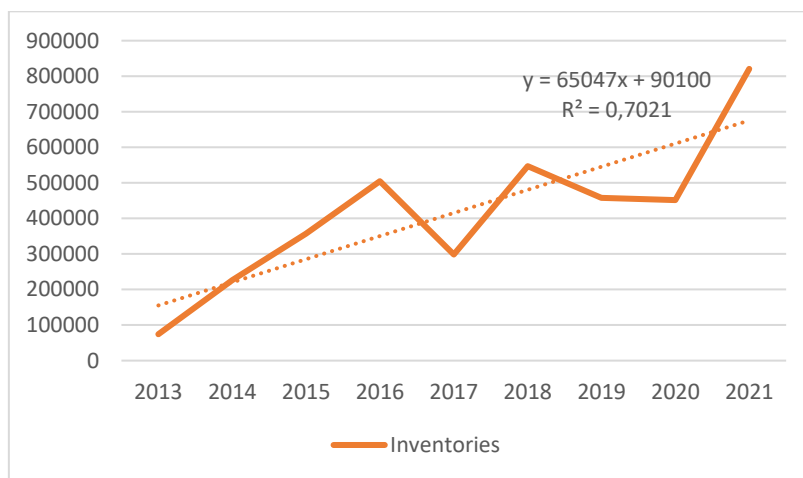


**Figure 2:** Forecast ROA in %

Source: own processing.

The reliability of the prediction of the development of ROA as a function of time is 65.8%, i.e., with a probability of almost 70% we can expect an inertial downward trend in the development of ROA for the next period from 2022 to 2024.

The downward trend in return on assets confirms our observation that the company does not have effective and efficient management. Consequently, we analyzed the inventories from which the company currently operates. The evolution of inventories over the period under review is visually processed in Figure 3.



**Figure 3:** Inventory development

Source: own processing.

The value of the company's inventories in the period 2013 - 2021 has an increasing trend. The year 2017 brought a decrease compared to the previous year 2016. Since 2017, the stock has been rising again. It was only a short-term decline. In times of crisis, the company draws down its inventories, there is a risk that the inventories will not be sufficient in the future.

However, business management must recognize that drawing down inventories is not a sufficient solution to a crisis.

### 2.3 A learning and growth perspective

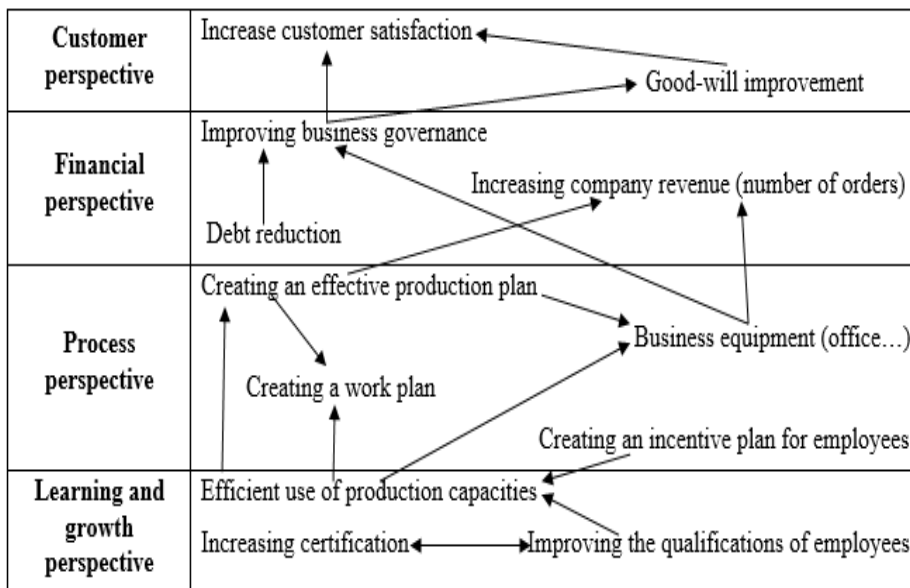
From a growth perspective, the company strives to regularly obtain quality certificates or certificates of authorization to operate. The most recent certificate acquired in 2019 is the certificate of conformity of products with the declared characteristics assessed according to the relevant ISO standards. It regularly trains its employees as the production process is innovated in terms of technological equipment. In addition to the employees involved in production, the company also provides training to the administrative and marketing departments. The growth in the skills of the workers will ultimately be reflected in the growth in the value of the enterprise.

## 2.4 Perspective on internal business processes

The perspectives of internal business processes can include the equipment of individual workshops, offices, the creation of an effective production plan and an incentive plan for employee evaluation. The technological aspect influences the overall production process of the module system, i.e., the overall lifetime value of the product. e.g., the equipment of the paint shop influences on the one hand the spraying of the individual module structures and on the other hand the health of the employees as well. The knowledge of the shortcomings guides the company to increase its attention to production control and to the development of a motivation plan for the employees.

## 2.5 Strategic Map

Having identified the essential elements of the individual perspectives, we can proceed to the actual creation of the strategic map. Figure 4 shows the strategic map we have created.



**Figure 4:** BSC model

Source: own processing.

The created BSC methodology strategic plan is the initial model that the enterprise can practically implement. Based on the correct creation of the BSC strategic map, the enterprise can better explain the causal relationships of the bottlenecks and at the same time improve its management.

In the crisis in which the enterprise finds itself, it is necessary for it to focus its attention on reducing its indebtedness and increasing the number of contracts that will guarantee it a profit.

### 3 Conclusion

Performance measurement is effective if we know the existing relationships between processes in the enterprise. Financial analysis is one of the methods that point out bottlenecks. Traditional methodologies are an effective tool for determining the origin of cost items. By supplementing traditional methods with modern ones, an enterprise gets a picture of the bottleneck location and can clarify its cause. Consistency between traditional and modern analyses is an opportunity for an enterprise to maintain its position in the construction market, gaining a competitive advantage. In this paper, we have pointed out the incorporation of modern BSC method into enterprise management. The proposed strategy map explains the connections between the elements of each perspective of the analyzed enterprise. We recommend the enterprise to pay more attention to the interconnectedness of traditional and modern methods of cost analysis in times of crisis. Overview and definition of the causes of problems helps to prevent the growth of expenses in the enterprise. Based on visualization of essential elements in the perspectives and their analysis, the manager identifies significant problem areas that need to be improved to increase the performance of the enterprise.

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# Landfilling as a Significant Environmental Burden in Slovakia

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**Abstract.** In order to improve the state of the environment, it is essential, that the issue of landfilling, as a significant environmental burden, becomes a priority, as well as activities leading to the removal of existing landfills and the prevention of new ones. The presented paper deals with landfilling as a significant environmental burden in Slovakia, in which we analyze the amount of waste produced in Slovakia, the forms of its management with a closer focus on the rate of landfilling of municipal waste for the period 2005 to 2020. The paper uses descriptive statistics as research methods, specifically frequencies, percentages, minimum and maximum values, dispersion and averages. In the results, the paper states, that the amount of generated waste (without municipal waste) in Slovakia increased by approximately 14,5 % during the period 2005 – 2019. By analyzing the rate of landfilling, it was found, that it has been one of the dominant ways of dealing with municipal waste in Slovakia for several years, despite the fact, that its rate decreased by almost 30 % from 2005 to 2020. It is necessary, that the issue of landfilling becomes a priority in the future, and it is also necessary to develop activities leading to the removal of existing landfills and the prevention of the creation of new ones. In the coming years, Slovakia must proceed with significant structural changes in waste management. One of the possible solutions is to withdraw from the prevailing landfilling and transform to other forms of disposal of waste.

**Keywords:** environmental burden, landfill, environment, waste, Slovakia

**JEL classification:** *F18, F64, O13.*

## 1 Introduction

We live in a society, in which our desire for comfort leads us to increase consumption. We take our day-to-day responsibilities for granted and often do not even realize their impact on the environment. The already mentioned growth of population consumption subsequently causes the growth of waste, which we consider to be a significant

environmental burden, if they are not recovered in an efficient way. Environmental burdens are a much-discussed topic, due to possible impacts on animal health, human health, biodiversity and other impacts on the country. Due to the wide range of possible negative impacts, it is necessary to deal with this topic and find solutions to eliminate and remove it in the future, so as not to overburden the environment beyond its tolerable level. At present, both the European Union and the Slovak Republic are aware of the risk and significant impact of environmental burdens and therefore approach to legislative, methodological and economic procedures, the implementation of which improves the state of the environment.

Waste management is and will be one of the important topics in Slovakia, due to the environmental sustainability, economic growth and consumption. Slovakia is currently one of the countries in the European Union with the lowest recycling rate and the highest landfill rate [4]. New requirements for the transformation of the economy from linear to circulating and the related new environmental requirements lead to Slovakia having to embark on significant structural reforms in waste management in the coming years. As a result, Slovakia will have to withdraw from the predominant landfilling and switch to other forms of waste recovery and disposal. Changes, including the approach of all stakeholders, will be necessary in view of the environmental objectives to which the Slovak Republic has committed itself, to avoid permanent damage to the environment.

The increasing amount of waste produced in landfills is a current topic, that requires considerable attention. The presented paper deals with landfilling as a significant environmental burden in Slovakia, in which we analyze the amount of waste produced in Slovakia, the forms of its management with a closer focus on the rate of landfilling of municipal waste for the period 2005 to 2020.

## 2 Landfilling as an environmental burden

At present, the issue of environmental burdens (hereinafter also EB) in Slovakia is affected by Act no. 569/2007 Coll. on geological works (Geological Act) [1] as amended. According to the Act no. 569/2007 Coll. on geological works, **environmental burden** is the pollution of an area caused by human activities, that poses a serious risk to human health or the rock environment, groundwater and soil, with the exception of environmental damage. The definition therefore says, that the environmental burden is the pollution of a territory caused by human activity, with the exception of environmental damage. The simplest definition characterize environmental burdens as a wide range of areas contaminated by military, mining, industrial, agricultural and transport activities, but also by inappropriate waste management, which was contaminated in the past, but whose effects persist to this day [6].

**Landfilling** can be considered the oldest, simplest and currently most widespread method of waste disposal. Landfills are the last link in the waste disposal chain. From a terminological point of view, they define the term landfill, resp. landfilling both

domestic and foreign authors, but also legislative standards. The legislation on landfilling in Slovakia itself is based on the revised directives adopted by the European Commission, so that Europe can gradually move from a linear economic model to a circular economy.

An important legislation of the landfilling at European Union level is Directive 1999/31/EC on the landfill of waste [5], which aims to ensure a gradual reduction of landfilling, in particular for waste, that is suitable for recycling or other waste recovery [3]. Directive 1999/31/EC on the landfilling [5] defines a landfill as a place for depositing waste on or in the soil, including internal places on waste disposal (i. e. landfills where the waste producer disposes of his own waste directly at the place of production) and permanent places (i. e. more than one year), that are used for temporary storage.

The landfill of waste is in accordance with the Act of the National Council of the Slovak Republic no. 79/2015 Coll. on waste [2] defined as a place with a waste disposal facility, where waste is permanently deposited on or in the ground. An internal landfill is also considered to be a landfill, where the waste producer disposes of his waste at the place of production, as well as a place, that has lasted, i. e. more than one year, used for the temporary storage of waste.

Landfill can be understood as waste disposal in a specially designated area, which in modern locations consists of a pre-built "cell" lined with an impermeable layer (artificial or natural) and with controls to minimize emissions [12]. The term landfill is used to describe a unit activity for the final disposal of municipal solid waste on land, that is designed and built to minimize environmental impact [15]. According to the OECD [11], a landfill refers to the final disposal of waste on or underground, in a controlled or uncontrolled manner, according to various hygiene, environmental and other safety requirements. According to the United States Environmental Protection Agency [16], landfills are a tool used to dispose of various types of waste in any industrialized society.

As already mentioned, the biggest problem of Slovak waste management is the disproportionately high rate of municipal waste landfilling. In Slovakia, an average of 446 kg of waste per person was produced in 2020. Of this amount, almost 44 % of waste was recycled and the share of municipal waste landfills was at the level of 48 % in 2020, while this share decreased by about 3 % year-on-year [8]. In an international comparison, Slovakia is in the unflattering top ten EU countries within landfilling [10].

Landfilling predominates, because it is the cheapest and least technologically demanding way of disposing of waste. However, there are many risks associated with landfilling. Every landfill has the potential to become an environmental burden. The operation of landfills burdens the environment with traffic, noise, odors, as well as environmental pollution by air raids. Fires are also a common problem in landfills, and even closed landfills pose environmental hazards in the future.

Following the above facts and the trend about high landfilling and low recycling rates in Slovakia, the European institutions agreed in 2019 on legislation, that would ban EU states landfilling recyclable waste from 2030. From 2035, the total landfilling of municipal waste can be a member state of EU to reach only 10 percent. According agreement between the European institutions, at least 55 percent waste from households

and small businesses should be recycled by 2025. By 2030, the share of recycled municipal waste should reach 60 percent and by 2035 at least 65 percent [8].

### **3 Methodology**

Most of the data found in this article comes from publicly available sources, i. e. from the Statistical Office of the Slovak Republic. The data are measured in thousands of tonnes of waste produced, at constant prices and in percentages. The paper uses as research methods mainly descriptive statistics, especially frequencies, percentages, minimum and maximum values, spread and averages. In terms of time, the paper works with data within several years. The most common way of displaying is the annual results for the period 2015 to 2020. For a better historical comparison, we also use older data from 2005 and 2010. The last known period is 2020, eventually year 2019, because data from 2021 are not yet publicly available and are published usually in the months of July to August of the following year. From a territorial point of view, the paper monitors the data in question for only one territorial category, namely Slovakia.

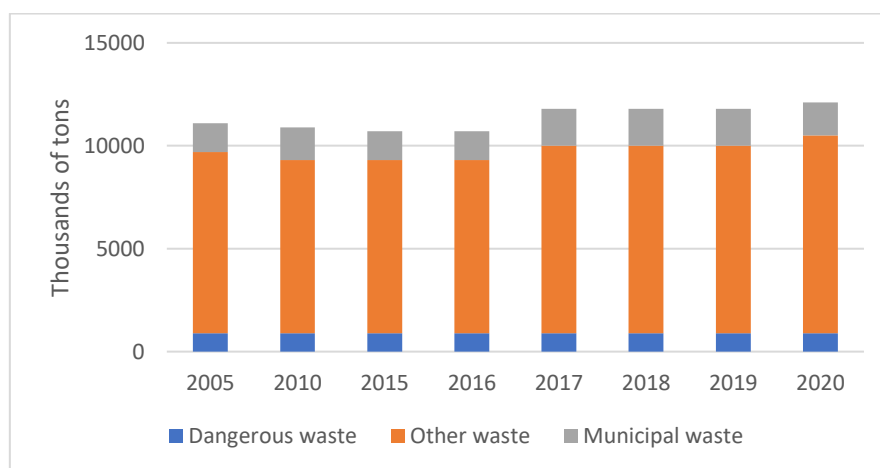
Given the importance of the issue, the main goal of the presented paper is landfilling as a significant environmental burden in Slovakia, in which we also analyze the amount of waste produced in Slovakia, the forms of its management with a closer focus on the rate of landfilling of municipal waste for the period 2005 to 2020. This main objective of the paper is divided into 2 sub-objectives. The first partial objective of the paper is to point out the overall development of waste production in general, for the period from 2005 to 2020 in Slovakia. Also within this partial objective, we compare the amount of waste produced with gross domestic product on the basis of recalculations in the form of an index. We follow the context in the period from 2005 to 2009. Following the first sub-objective, the second sub-objective is to examine the management of municipal waste generated in Slovakia in the period from 2011 to 2020. The second sub-objective in this context examines in particular the so-called landfilling trend in Slovakia during the years 2005 to 2020. As a result of the above main and sub-objectives is the research proposal of this paper to point out the importance of waste management issues in connection with increasing waste generation and inappropriate waste management in the form of landfilling. In order to meet the main and partial objectives of the presented paper, it was necessary in the first step to summarize data on the total production of waste in Slovakia. In the next step, we recalculated the data on the amount of waste produced in the form of an index and compared it with the gross domestic product expressed in constant prices. This was followed by a summary of data in connection with forms of waste management in Slovakia, and subsequently we focused only on the rate of municipal waste landfilling in Slovakia.

### **4 Current state of landfilling and waste management in Slovakia**

Minimizing the negative effects resulting from the generation and management of waste on the environment and human health should be the main goal of waste management policy not only in Slovakia, but everywhere in the world. Waste

management policy itself should also focus on the use of natural resources, as many of them are currently limited, and apply a hierarchy of waste management, that is in line with the idea - „polluter pays”. The main priority of waste management should be, in particular, the prevention of waste, its subsequent re-use, recycling and, finally, its energy recovery, of course, where appropriate and possible from an environmental, technical and economic point of view. Disposal of waste should be a last resort [10]. As a result of the above facts, in this part of the presented paper we will focus on the extent to which the Slovak Republic adheres to the above-mentioned waste hierarchy. We will point out the development of waste management in Slovakia, i. e. we will focus on the generation of waste in general, on the methods of its management, with the main focus on landfilling.

Based on the data of the Register of Environmental Burdens, we record a total of 1,793 environmental burdens in Slovakia as of April 30, 2022. Of this total, already confirmed environmental burdens represent 18 % (326 burdens) and the burdens, that we consider probable environmental burdens account for 49 % (876 burdens). Burdens, resp. location, that are or have already been reclaimed in some way reach a 33 % share (818 burdens). If we analyze the confirmed EB in terms of activities, that cause them, it can be stated, that the landfilling has the largest share in their creation, respectively created landfills for municipal and industrial waste. In numerical terms, landfills constitute the largest item with almost 25 % of all activities causing confirmed EB. Landfills represent 6 % of potential and already reclaimed EB. As a result of this fact, it is clear, that landfilling and created landfills in Slovakia represent significant environmental burdens, which need to be given considerable attention, but especially to eliminate their occurrence in the future and for those, that already exist to look for ways to eliminate them.



**Fig. 1** Development of waste generation in Slovakia in the years 2005 to 2020.

*Source: own processing, Statistical Office of SR.*

In general, the waste produced is divided into three basic categories, i. e. municipal waste, hazardous waste and other waste. Based on fig. 1, we can state, that in the long

run, there has been a steady development in the overall generation of all types of waste since 2005. On the other side, if we look at waste from a medium-term perspective (since 2015), there has been an increase in total waste generation in Slovakia, which can be assessed as a negative. We recorded another negative in the last year-on-year change in the amount of all types of waste produced, as the increase in total waste generation is characterized. From fig. 1 we can also state, that the amount of generated waste (excluding municipal waste) for the period 2005 - 2019 increased by approximately 14,5 %. A year-on-year comparison of 2019 and 2020 showed an increase of 6,9 %. From 2005 to 2019, the amount of generated hazardous waste decreased by a significant 32,2 %. The largest producer of waste according to the classification of activities SK NACE was industrial production (especially other waste) in the whole time series, in 2020 with a share of the total amount of generated waste without municipal waste approximately 28 %. Behind the industrial production, follows transport and storage, with a share of more than ten percent.

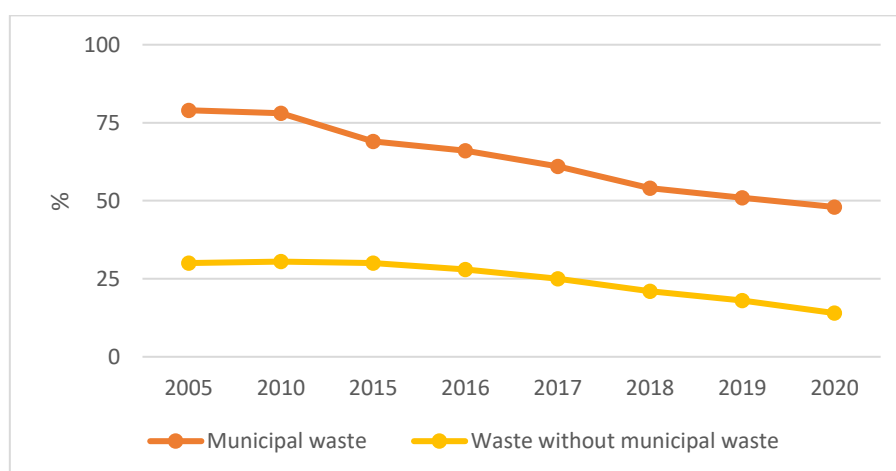
Closely related to the level of economic activity of the country is the indicator of waste generation, which is also an indicator of the raw material consumption model. More waste tends to be produced by those countries, that are richer and less by waste to poorer ones. We often find, that developed countries reduce the total amount of waste produced as a sign of changes in the consumption of raw materials and increase the rate of recycling and reuse.



**Fig. 2** Development of the amount of waste produced and GDP in Slovakia  
*Source: own processing, Statistical Office of SR.*

In order to evaluate the development of waste generation, a comparison of waste production and economic development using the indicator of gross domestic product (hereinafter also GDP) is often used. In this regard, we consider it desirable, if the trend of GDP growth is faster, than the growth of waste generation. In the case of the Slovak Republic, we can state, that the trend of GDP growth is faster, than the growth of waste generation based on fig. 2, which can be considered positive.

As already mentioned, the dominant way of disposing of municipal waste in Slovakia has been landfilling for several years. In the long run, i. e. although the amount of waste deposited in landfills has decreased since 2005, but the high share of landfills still persists. However, the fact, that landfilling of waste without municipal waste, as well as municipal waste themselves, has decreased slightly since 2015. Specifically, if we see on rate of landfilling without municipal waste, it had a declining character in the period 2005 – 2020, while in percentage terms it decreased by more than 20 percentage points (fig. 3). Compared to 2019, a year-on-year decrease from 16,6 % to 10,8 % was recorded in landfilling without municipal waste in 2020, which can be assessed as positive. The rate of landfilling of municipal waste only had a positive declining character in the observed period since 2005. While in 2005 more than 78 % of municipal waste was landfilled, in 2020 it was only 48,4 %.

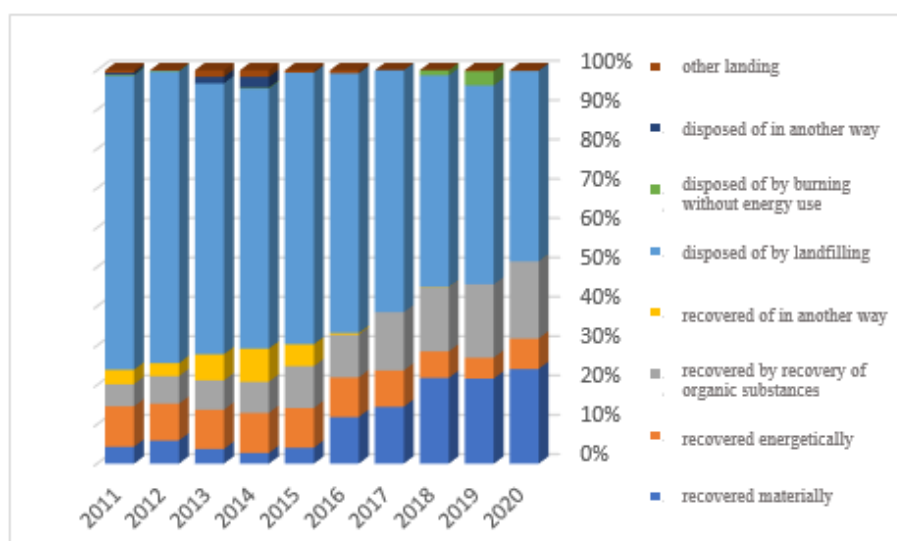


**Fig. 3** Development of landfilling in Slovakia from 2005 to 2020  
*Source: own processing, Statistical Office of SR.*

Although landfilling of municipal waste fell by almost 30 % between 2005 and 2020, the rate of decline is still insufficient and slow. This fact indicates the problem for Slovakia with meeting the goal set in the Environmental Strategy 2030, i. e. reduce the landfill rate of municipal waste to less than 25 % by 2035. Based on this fact and available data, the Slovak Republic must significantly intensify its efforts to reduce this indicator.

At present, 109 landfills are legally operated in Slovakia in a total of 101 areas and with a total amount of municipal waste of 1,2 million tonnes per year [4]. Most landfills are in the category for non-hazardous waste, which also includes landfills for municipal waste. Compared to 2013, the total number of landfills decreased by 15 landfills. From a territorial point of view, most landfills are located in the Banská Bystrica, Košice and Prešov regions, with landfills predominating for non-hazardous waste. On the contrary, the least landfills are located in the Bratislava region [9].

As we have already mentioned, the share of municipal waste landfills in total waste management was 48 % in 2020, which represented a year-on-year decrease of 3 %, but in an international comparison in the field of municipal waste landfills we are in the unflattering top ten EU countries. Countries such as Malta, Bulgaria and Cyprus have the highest landfill rates. On the contrary, the Netherlands, Belgium and Slovenia have the least landfill for municipal waste. However, the latest up-to-date data on landfill rates are only available in Eurostat [7] for year 2018.



**Fig. 4** Total municipal waste management in the Slovak Republic in the period 2011 to 2020  
*Source: own processing, Statistical Office of SR.*

The fact, that in Slovakia municipal waste is mostly disposed in the form of landfills is also confirmed by fig. 4, which shows the overall management of municipal waste in Slovakia from 2011 to 2020. As we can see in fig. 4, since 2011 the disposal of municipal waste in the form of landfill has prevailed in Slovakia, although over time this trend is declining. The fact, that the rate of material recovery of municipal waste has been increasing in Slovakia since 2015 can be assessed positively. The same trend was observed by the recovery of waste by recovering organic substances. The energy recovery of municipal waste recorded relatively fluctuating values during the monitored period. Over time, the rate of this type of waste recovery has been slowly increasing, but in 2018 and 2019 it decreased. Waste disposal, whether without energy recovery or otherwise, was negligible in Slovakia. Despite the fact, that the recovery of municipal waste, whether material or energy has increased in the last five years, this situation is still considered insufficient and it is necessary to constantly intensify these forms of waste management in Slovakia, especially at the expense of landfilling.



## 5 Conclusion

The main goal of the presented paper is landfilling as a significant environmental burden in Slovakia, in which we also analyze the amount of waste produced in Slovakia, the forms of its management with a closer focus on the rate of landfilling of municipal waste for the period 2005 to 2020. Based on the analysis, it can be concluded, that the amount of generated waste (without municipal waste) in Slovakia increased by approximately 14,5 % in the period 2005 – 2019. By analyzing the rate of landfilling, it was found, that it has been one of the dominant ways of dealing with municipal waste in Slovakia for several years, despite the fact, that its rate has dropped by almost 30 % from 2005 to 2020. The share of municipal waste landfilling in total waste management was 48 % in 2020, which represented a year-on-year decrease of 3 %, but in an international comparison, we are in the unflattering top ten EU countries in terms of municipal waste landfilling. The fact, that since 2015 the rate of material recovery of municipal waste has been increasing in Slovakia can be positively assessed. The same trend was observed in the recovery of waste by recovery of organic substances.

In order to improve the state of the environment, it is essential, that the issue of landfilling, as a significant environmental burden, becomes a priority, as well as activities leading to the removal of existing landfills and the prevention of new ones. As already mentioned, in the coming years Slovakia must undergo significant structural changes, respectively to waste management reforms. In particular, it will have to move away from the predominant landfilling and transform into other forms of waste management and disposal.

In recent years, the circular economy has become increasingly important, respectively circular economy, which emphasizes the efficient use of waste. Waste perceived as a raw material or a renewable energy source is currently considered a treasure, that hides valuables in the form of materials, energy or other reusable raw materials. This means, that most of the waste produced so far can be reused as a raw material. The application of material and energy recovery of waste absolutely minimizes the generation of waste, and thus landfills, which ultimately results in the production of electricity or heat, but also the return of materials back to industry in the form of secondary raw materials. At the same time, primary raw material and energy resources are being saved. It is the above facts represent the so-called medicine of landfilling, which is one of the dominant methods of waste management in Slovakia.

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# The Impact of the Covid-19 Pandemic on the Rate of Adaptation of the Industry 4.0 Concept in SMEs

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**Abstract.** The current trend of digitization processes is referred to as Industry 4.0 - the onset of the fourth industrial revolution was a logical outcome of our progress in science and technology. If businesses want to be successful in today's market, they must respond to the digitalization trend. The pandemic revealed the need for digitization and the implementation of Industry 4.0 concepts in the business sector, where it was not necessary before. The aim of this paper is to describe the attitude of small and medium-sized enterprises to the very implementation of Industry 4.0 elements and the latest impact of the Covid-19 pandemic on the speed of adaptation of small and medium-sized enterprises in Slovakia to Industry 4.0. The survey among companies was carried out using an electronic questionnaire. Only small and medium-sized enterprises from Slovakia will join the survey in the period from November 2021 to February 2022. The questionnaire was sent to 512 enterprises. The return rate of the questionnaire was 42.38%, which corresponds to 217 companies. The aim was to analyze the impact of the Covid-10 pandemic on the speed of adaptation to Industry 4.0 in small and medium-sized enterprises. Based on the conducted research and results, we can claim that companies have started the process of implementing Industry 4.0.

**Keywords:** Industry 4.0, Covid-19, SMEs

**JEL classification:** M20, M21

## 1 Introduction

Industry 4.0 reflects the current trend of digitalization of processes in enterprises. The creation of the concept of the fourth industrial revolution was the logical culmination of our progress in science and technology, global competition and the demands of customers that come with it. To achieve long-term success in today's climate, businesses must deliver products of the desired quality, at a price acceptable to their clients, while still pursuing the primary business goal of making a profit. The concept

of Industry 4.0 affects the entire process of enterprise transformation and brings changes that affect the organizational structure of the enterprise, the qualification structure of employees and changes in the way business processes are conducted. Industry 4.0 also includes changes in the external socioeconomic environment, creation of new business sectors, increased intensity of use of the IT sector and changes in the education system. The implementation of Industry 4.0 elements does not only concern multinational, capital-strong organizations, but also small and medium-sized enterprises, which are an integral part of the national industry. In order to maintain their competitiveness, it is essential that they respond to the latest changes in the economic environment. [6] The need for the implementation of Industry 4.0 in small and medium-sized enterprises was highlighted by the Covid-19 pandemic, which revealed the need for digitization even in business sectors that did not need it before. As part of the survey, the questions asked by the company enabled us to find out their attitude towards the implementation of the Industry 4.0 concept and its change due to the Covid-19 pandemic. The main objective of the survey was evaluated based on the question: What impact did the pandemic have on your company's view of the implementation of Industry 4.0 elements? The survey was conducted between November 2021 and February 2022 in order to capture the attitude of businesses at the height of the ongoing pandemic. Due to the shorter duration of the survey, the return of the questionnaire from the enterprises was at the level of 42.38%, which corresponds to 217 enterprises, of which 211 enterprises constituted a usable survey sample. The obtained results will be presented in the following parts of the paper.

## **2 Theoretical background**

Industrial branches of the economy are effected by and subject to constant advancement, which is affected by the level of advancements in science and technology. From a historical point of view, we can highlight the key eras and points of advancements in manufacture. In academic literature, we notice the term industrial revolution. The first industrial revolution started at the end of the 18th century in England and signified the switch from manual manufacture to machine manufacture. The first industrial revolution started a massive wave of industrialization and speeded up the urbanization process. These two concurrent processes radically affected the social categorization of the society, and its way of life. [2]

The second industrial revolution is linked to the turn of the 19th and 20th century and the first use of electricity, advancements in the chemical industry, as well as the car industry. This part of our evolution, in academic literature, is often labeled as Fordism. This label is derived from Henry Ford's car manufacture, started in the year 1913. Apart from the inclusion of conveyor belts in a manufacture, the second industrial revolution is connected to a number of different revolutionary discoveries and inventions: the first flight of a plane, the rise of railway traffic, electrification of cities, inclusion of water systems, and the growth of telecommunications.

The third industrial revolution is often connected to the changes happening during the 70s, in the 20th century. This era is connected to automation of manufacture and its control by computers, and the inclusion of IT systems and electrical systems into

manufacture. The third industrial revolution also brought about the growth of the internet, computers, and mobile phones. For this reason, it is often labeled by the name 'digital revolution. [7]

The third industrial revolution is characterized by a number of phenomena:

- de-industrialization, which systematically lowers the investments into the industry, and the growth of banking, finance, insurance, sciences and tech, telecommunications, and advertisement,
- reindustrialization, in terms of structural changes in the industry,
- the increase of the purpose of IKT, innovation, science and technology, the growth of technological advancements leads to the shortening of the life cycle of the products, which speeds up the implementation of innovations,
- globalization of socio-economic bonds,
- changes in economic thinking, behavior, and motivation,
- organizational and institutional changes are connected with the increase of importance of small and medium enterprises. [8]

The concept of the fourth industrial revolution was firstly specified in 2011 in Germany, in the Hannover Messe market. E. Hofmann and M. Rusch define the fourth industrial revolution as being included in the advancements, growth, sale, and manufacture of autonomous manufacture systems based on knowledge and sensors. This era brings about a number of expected opportunities for enterprises:

- highly flexible mass manufacture,
- optimization of value chains,
- creation of brand-new services,
- real-time coordination,
- lowered costs. [4]

The fourth industrial revolution is based on the use of new technologies in the transformation process of enterprises. The authors of the Industry 4.0 (Hermann, Pentek, Otto) include these as the key elements of the concept:

- cyber-physical system, which integrates computing and physical processes, which means that computers and networks control and monitor physical processes,
- the Internet of things, which is the initiation of Industry 4.0. It is a system, in which objects can be controlled remotely and between each other, due to microchips, sensors, and software,
- the internet of services, which includes systems based in the online space, and the use of cloud storage. Its biggest upside is its connectivity, thanks to which you only really need an internet search engine to use it. This makes the storage of data on personal hard disks obsolete,
- intelligent factories include the previous three elements of Industry 4.0, and are based on the idea of decentralized manufacturing systems. In intelligent factories based on the Industry 4.0 concept, we see the term digital logistics – logistics which integrate the manufacture, storage, and transport systems of the business. [3]

This paper is aimed at small and medium enterprises in the Slovak Republic. According to the advice of the European commission no. 2003/361/ES from 6.5.2003, about the definition of micro, small, and medium enterprises, this size category includes

enterprises that have up to 250 employees, in addition to a financial criterium – an annual turnover of 50 mil. € or less, or the entire annual balance sheet budget of 43 mil. € or less. If a small or a medium enterprise fails to adhere to one of these financial criteria, it still remains a small or a medium enterprise. The changes to the enterprise happen after breaking the financial criteria for two consecutive financial intervals. [1]

### **3 Methodology**

The aim of this paper is to examine the effect of the Covid-19 pandemic on the speed of adaptation of small and medium enterprises to Industry 4.0 To complete the given task, the following research questions have been formulated:

RQ1: What is the current state of the implementation of Industry 4.0 in your business?

RQ2: What are the reasons for the implementation of Industry 4.0 in your business?

RQ3: What are the reasons for the lack of interest in the implementation of Industry 4.0 in your business?

RQ4: What impact did the pandemic have on your business' view on implementing Industry 4.0 elements?

The questions and possible answers were explained in the questionnaire.

The necessary information was obtained using an electronic questionnaire, which was sent to the chosen respondents (small and medium enterprises in Slovakia) in the time from November 2021 to February 2022. The questionnaire was sent to 512 companies, which filled the requirements of the selection process. The return rate of the questionnaire was 42,38%, which reflects to 217 companies. 6 questionnaires were unusable due to incomplete information. The final information was collected from a sample of 211 small and medium enterprises.

Data from individual questions were analyzed by statistical methods. Correlations in individual responses were sought using statistical methods. Pearson correlation was used to evaluate the data, statistical tests were performed at  $\alpha = 0.10$ .

### **4 Results**

The next section of this paper will closely examine the results. It will analyse the gained information, which will lead towards answering the main question of the paper – the effect of the Covid-19 pandemic on the speed of Industry 4.0 adaptation of small and medium enterprises in Slovakia.

From the point of view of the enterprises size, small enterprises (10-49 employees) had the biggest representation. They made up nearly 46% of the sample. Micro-enterprises (less than 10 employees) made up 37% of the sample, and medium enterprises (50-249 employees) made up nearly 17% of the sample.

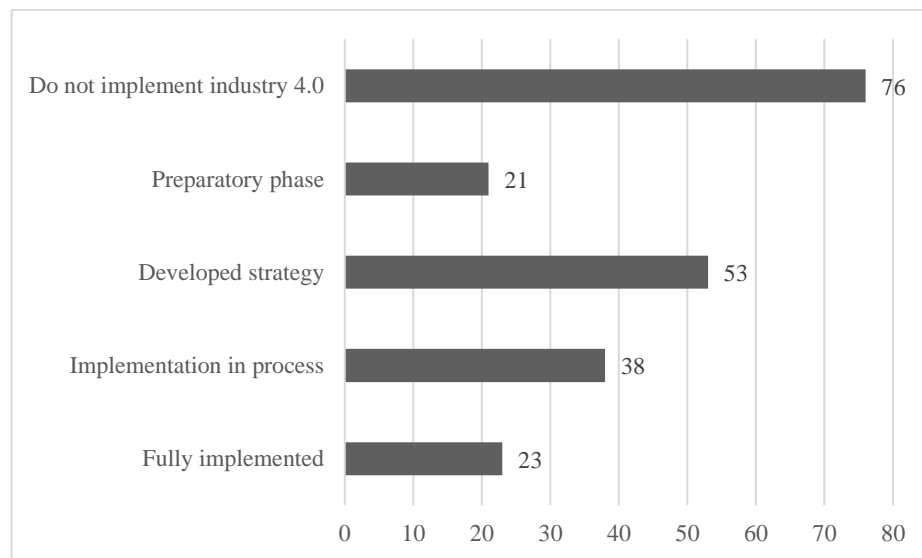
The biggest part of the sample was made up from small and medium enterprises in the branch of small sales, they made up nearly 46% of the sample (98 enterprises).

Enterprises in the wholesale branch represented the second largest part of the sample, 25% (53 companies) to be specific. Other branches had smaller representations – 22 advertisement companies, 18 food companies, 10 financial and 10 transport and logistics companies.

Despite them being enterprises from different industrial branches, they were all affected (directly or indirectly) by the current crisis caused by the Covid-19 pandemic. Therefore, the next subchapter will analyse how the pandemic affected these enterprises approach to digitalization and adaptation to Industry 4.0

#### 4.1 State of implementation of Industry 4.0 elements in SMEs

To allow for the analysis of how the pandemic affected the speed of Industry 4.0 adaptations for small and medium enterprises in Slovakia, it was necessary to find out the state of the adaptation in the chosen enterprises. The goal of the question (RQ1: What is the current state of the implementation of Industry 4.0 in your business?) was to find out, whether the enterprises already include adaptations to Industry 4.0 in their actions, or whether they plan to in the future. The next graph shows the information about the current state of Industry 4.0 implementation for small and medium enterprises.



**Fig. 1.** Current state of implementation of Industry 4.0 elements.

Source: author's research

Out of the 211 companies, only 38 (18%) currently practice the implementation of Industry 4.0 elements. 23 companies (11%) had a fully implemented strategy comprised of Industry 4.0 elements. These were companies in wholesale (13), small sales (8), and logistics and transport (2). 53 companies (25%) have a fully designed strategy to implement Industry 4.0, but have not yet implemented it. 21 companies (10%) stated that they are currently in a preparation phase to implement Industry 4.0. The amount of enterprises with no interest in implementing Industry 4.0 so far was an unpleasant surprise – 36%, or 76 out of 211 companies.

In evaluating the current state of Industry 4.0 implementation for small and medium enterprises, a correlation was identified between the size of the enterprise and the level of implementation of the Industry 4.0 elements. The smaller the number of employees, the less important the implementation of Industry 4.0 elements. The correlation coefficient was  $r = 0.728$  ( $p\text{-value} = .029$ ).

To better understand the stance of small and medium enterprises towards the implementation of Industry 4.0, the questionnaire included a section which asked to enterprises the reasons for implementing (or not implementing) elements of Industry 4.0.

Out of the 135 companies which actively implement, or plan to implement Industry 4.0, 70 (52%) stated that the main reason was keeping up with the competition. This is a logical response from small and medium enterprises, as they often have to compete with large, multinational competitors. It is exactly these corporations, that include technological advancements in their enterprises first. Therefore, small and medium enterprises need to react swiftly, to keep their ability to compete in the market. However, not all small and medium enterprises only want to follow stronger competitors – some want to bring their own technological advancements. Out of the chosen companies, 38 (28%) stated that the main reason for implementing Industry 4.0 was to gain a competitive upper hand. The other 27 (20%) stated that their motivation was to improve their service for their clients. This reason also reflects the effort of small and medium enterprises to keep their ability to compete.

It was surprising to find out that out of the 211 companies, 76 have no yet shown interest in implementing the concepts of Industry 4.0 into their processes.

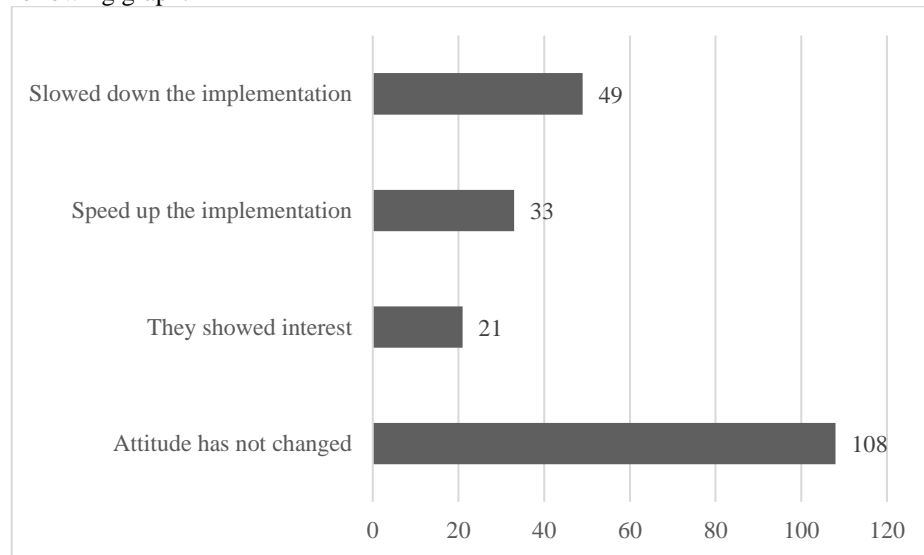
As with the companies that actively do implement Industry 4.0, we also wanted to know the reasons why the other companies have not shown any interest in doing this.

The most common reason for the lack of interest, as stated by 41 companies, was that they do not see the point of it. This may be caused by the fact that not all businessmen and managers have enough information about their options in implementing Industry 4.0 in their businesses. Small and medium enterprises are also put off implementing Industry 4.0 due to the high investment difficulty (26). We can find a positive in the fact that 9 companies have shown interest in examining their options of implementing Industry 4.0 in the future.

The main aim was to analyse the effect of the Covid-10 pandemic on the speed of adaptation to Industry 4.0 in small and medium enterprises. After examining the current state of the implementation of Industry 4.0, it was necessary to find out in which way has the pandemic affected small and medium enterprises relationship with the concept



of Industry 4.0. The answers of the companies to this question are shown in the following graph.



**Fig. 2.** The impact of the Covid-19 pandemic on attitudes towards the implementation of Industry 4.0 elements.

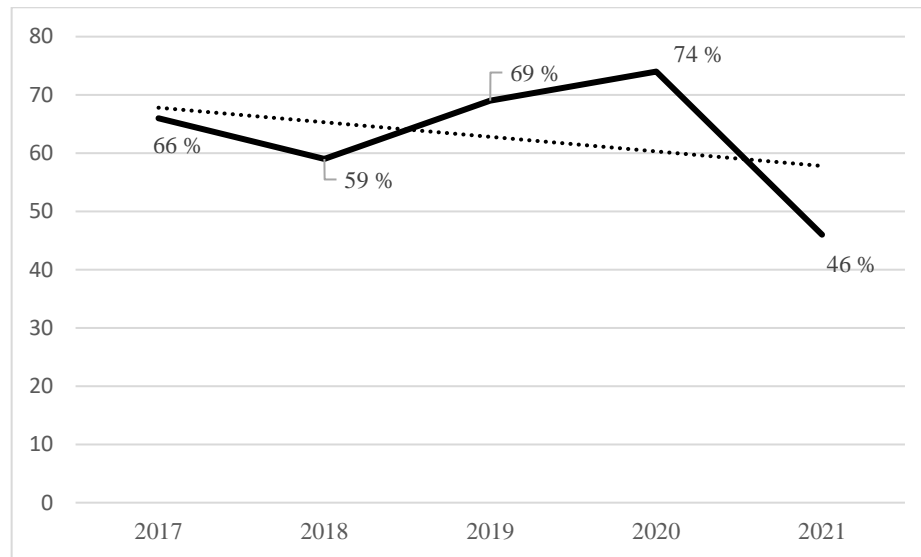
Source: author's research

108 companies have not changed their stance on Industry 4.0 as a result of the pandemic. The rest of the companies have been affected by the pandemic enough to change their opinion on the implementation of Industry 4.0 standards. 33 companies have sped up the process of implementing Industry 4.0. This is an understandable step, as the pandemic and its related heightened security measures increased the need for digitalization in branches, where it was not necessary before. This is also reflected in the change of opinion of 21 companies, who have only shown interest in Industry 4.0 because of the Covid-19 pandemic. Unfortunately, we need to mention that some companies (49) and their view on Industry 4.0 have been negatively affected by Covid-19. These companies have stated that the pandemic has slowed down the implementation of Industry 4.0 standards into their enterprises.

## 5 Conclusions

The aim of this paper was to show the effect of the Covid-19 pandemic on the speed of implementation of Industry 4.0 standards in small and medium enterprises. To fulfill this goal, it was necessary to gather information on the current state of the Industry 4.0 implementation in small and medium enterprises, and how was their stance on digitalization affected by the pandemic. The results from the research done have been presented in the previous part of this paper.

Annually, since 2017, the initiative of the ambassadors of Industry4UM creates a questionnaire for enterprises, in which it finds out the current state of digitalization in enterprises in the Slovak Republic. Last year, this questionnaire revealed the negative trend of perceiving the importance of Industry 4.0 implementation from the view of the enterprises. [5]



**Fig. 3.** The importance of implementing Industry 4.0 for the future of the company - the opinion of companies.

Source: author's processing according to Industry4UM

In the first year, two thirds of enterprises considered the implementation of Industry 4.0 standards important for their future. In the next few years, the view remained relatively unchanged, with two thirds considering Industry 4.0 important for their future. Most companies changed their stance on the importance of implementing Industry 4.0 in the year 2021 – only 46% considered Industry 4.0 important for their future. In the research done for this paper, 36% of companies asked showed no interest in the implementation of Industry 4.0 standards. We can state that companies have two main reasons for not being interested in Industry 4.0 and its implementation – they do not see the point of Industry 4.0 for their business, or they feel threatened by the investment difficulty of Industry 4.0.

The topic of adaptation of the Industry 4.0 concept in small and medium enterprises is a very current theme, which is determined by a myriad factors. Some of the most important factors include the stance of small and medium enterprises themselves, on the implementation of the Industry 4.0 concept, and also their placement in the national industry, which is tightly connected with the institutional support of small and medium enterprises, under the terms and conditions of the Slovak Republic.

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# How the Generosity of Pandemic Aid Has Affected Poverty and Unemployment

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**Abstract.** In the article we deal with the degree of pandemic assistance, resp. its level in terms of the impact on basic economic and social indicators of unemployment and poverty. We will discuss its legislative anchoring and solutions offered by the Slovak government in cooperation with European partners. We analyze in detail its practical application in the conditions of the Slovak Republic with the perspective of incorporating these tools “*kurzarbeit*” as stabilizers for future cases. We will propose development scenarios that describe the situation in the case of none, respectively insufficient aid, in relation to job trends and structures in the context of newly created labor market conditions. We will focus on the possible effects of unemployment and the rate of increase in poverty caused by the pandemic. We will evaluate pandemic aid from the government on the indicators we monitor, unemployment and poverty. We will evaluate possible changes and their impact on the social area and potential problems to which society will be forced to respond.

**Keywords:** labor market, unemployment, pandemic assistance, poverty

**JEL classification** J21, J64, I32

## 1 Introduction

Employment is a key issue in finding an answer to how an individual or family can meet their needs. It is the most desirable form of how to be useful for society and at the same time build your independence and thus your social status. If employment is endangered, it negatively affects the psychological side of the personality and at the same time it also changes consumer habits. Ultimately, this adversely affects society, the economy and social ties. The measures taken affected individual sectors of the economy and thus directly the companies and their employees. Redundancies began to be considered as a subsequent form of rescuing companies when entrepreneurs could not carry out their business. The advantage was given to companies that were able to

implement their business through info-communication technologies. Employees stayed at home for the so-called "Home office" and all activities were carried out via the Internet in electronic form. In the structure of the Slovak economy, this is 29% of jobs (Wood & company) [10], which can be implemented in this form. Analysts from the Ministry of Finance looked at these options in more detail and created an output that analyzes the sectors affected by the pandemic in more detail and to what extent. Politicians have responded to this trend, but in order to avoid unnecessary failures, the European Union has begun to take over as a coordinating body. According to Article 9 itself in Title II of the Treaty on the Functioning of the European Union [11] it should take into account the objective of a high level of employment when defining and implementing its policies. Taking into account the risks and impact in each Member State, this represented major economic losses when companies had to reduce or close down. Impact on workers' working time, in the form of shortening or stopping indefinitely, the EU has been forced to find tools or a mechanism to meet its employment targets. A solution called SURE (Support to mitigate Unemployment Risks in an Emergency) [5], to support the governments of the individual Member States in order to maintain employment. The instrument was activated on 22 September 2020 and Member States can receive money from it through very advantageous loans and thus finance national employment support programs, including the so-called short work. The aim is for employees to receive financial compensation for hours they do not work, because the current situation has forced their employer to shorten or suspend their working hours. € 100 billion [12] is available for all 27 countries. 631 million euros were allocated for Slovakia. SURE is a temporary tool to deal with the acute consequences of a global pandemic.[6] The European Commission is now also working on a new proposal for a European unemployment insurance system. Closely related to this is the risk of poverty, which is still present in Europe and its reduction is only slightly improving.

### **1.1 Unemployment and poverty**

In the EU, about 1/5 of the population [13] is at risk of poverty especially in some post-communist and southern countries. The Slovak Republic has better parameters than the EU average, but this is related to low incomes and relatively low differences in income inequality. We define poverty as a measure of the population with incomes lower than 60% of the median of the national equivalent disposable income in a given country [14]. The higher the average wage, the relatively good real wages may not exceed the poverty line. Therefore, poverty is also defined by additional parameters such as the level of material deprivation, and this speaks of the possibility of obtaining at least three of the nine monitored criteria. In the Slovak Republic, according to the data of the Statistical Office of the Slovak Republic, the situation is as follows.

Table 1: Material deficiencies that most people in the Slovak Republic face

Description	In % population	Number of persons (thousands)
They cannot afford 1 week of vacation away from home	34,8%	1 874
They cannot face unexpected financial expenses (373€)	26,1%	1 408
They can't afford a meat meal every other day	11,8%	634
They can't afford a car	7,7%	415
They have arrears (loans, mortgage, rent, energy)	6,7%	360
They cannot afford adequate warmth at home	5,7%	309
They can't afford a washing machine	0,4%	19
They can't afford a color TV	0,1%	7
They can't afford a phone / mobile	0,1%	6

Source: EU SILC 2020

As the data show, the highest proportion of items are directly dependent on income, the inability to spend 1 week away from home, or the inability to make savings on unexpected expenses reflect low income and at the same time that all funds raised are immediately consumed. This is 1/3 of the population, which does not offer a good picture of social policy in the Slovak Republic and at the same time raises the question of the adequacy of income or, conversely, the ability of individuals or families to manage funds. Unfortunately, this is not possible in the situation of the last months, when the pandemic mainly affected the economy, which was reflected in the growth rate, respectively. decline in GDP as follows. From the first quarter of 2020, we recorded a decline of 5.1%, followed by a deepening decline of -1.1% in the second quarter. It was necessary to respond to this situation with state aid to the sectors concerned. The subsequent short but significant recovery in the third quarter of + 11.6% [14] was a great hope, the shock was only temporary and short-term, and the subsequent waves returned to the situation of negative growth, which needed to be addressed. During 2021, the situation in the economy stabilized in terms of macroeconomic indicators but still did not reach the pre-pandemic level. Our goal will be to analyze how the system of assistance by the Slovak government has mitigated the macroeconomic unemployment rate and we will look at how it affected the numbers of people who fell or could fall into poverty.

## 1.2 Systemic measures taken in the Slovak Republic to alleviate unemployment and poverty

The government tried to solve the situation systematically, mainly through the Ministry of Labor and Social Affairs. The Minister of Labor was active in this direction, declaring the measures taken on the sidelines. „*This year, despite the pandemic, only 4,300 jobs were reported in collective redundancies where people were to lose their jobs.*“ We managed to avert two-thirds of this, which means that only 1,535 people were actually laid off, thanks to the functioning measures in place.“ [7] The seriousness of the situation is also illustrated by the statement of the press and communication

department of the Ministry of Labor and Social Affairs on the situation in the field of tourism, which is very affected by the pandemic., *Tourism in Slovakia accounts for about three percent of gross domestic product and employs about 100,000 Slovaks. "Every million euros we spend on domestic tourism will create or maintain 52 jobs."*

[8] Regarding human resources as capital to be protected, the European Commission recalls that the coronavirus crisis is a major challenge for the European economy and the lives of its citizens. During this health crisis, it is essential that we protect not only the critical sectors of our economy, but also our assets, technologies and infrastructure. [17] An important parameter in resource planning and subsequent assistance is the structure of jobs in terms of the possibility of performing telework.[2]

This mainly affected sectors where there is direct contact with customers. These sectors needed to be supported so that they would not disappear and their employees would not be exposed to a sudden income shock and thus be protected from the threat of poverty. At the end of March 2020, the Government of the Slovak Republic approved measures aimed at mitigating the economic impacts of the COVID-19 pandemic. First, new types of sickness benefits in the form of pandemic sickness and nursing allowances were approved. Subsequently, the government also introduced direct aid measures to maintain jobs within the so-called "First aid" for employees, entrepreneurs and the self-employed. In parallel with these measures, it made it possible to defer or waive social security contributions for some employers. Financial support through the "First Aid" measures was disbursed until the end of February 2022. The first aid system is processed by individual measures 1-4, and is on the page of the Ministry of Labor, for us it was a basic precondition in the first phase.

Following taking into account the current situation and the impact on the economy, the government increased its contributions through additional programs as follows. In February 2021, the so-called First aid + and in July 2021 First aid ++. It was basically an increase in financial assistance in individual programs. To give you an idea, it was an increase of 30% of the previous contribution and then another 20% for first aid ++. A summary of these follow-up measures is given in Table 2.

Table 2: Characteristics of measures taken

Measures	First aid	First aid +	First aid ++
Measures (1 and 3)	80% brutto salary	80% total cost of labor	100% total cost of labor
Measures (2)	180€ - 540€	270€ - 810€	330€ - 870€
Measures (3)	-	-	330€ - 870€
Measures (4A a 4B)	210€	315€	360€

Source: processed by author

Under these agreements, aid totaling more than € 2.1 billion has been distributed. This amount supported about a third of jobs in the economy. This support also indirectly affects the subsequent category, namely poverty, as 16.3% of the population of Slovakia is currently at risk, which represents 872,000 people. [9] This is documented

by data from the Statistical Office of the Slovak Republic. „*The most poor people are in the Banská Bystrica and Prešov regions, almost 400,000 people. As a result of the new coronavirus pandemic, another 20,000 to 50,000 people may be in this category*” [18] assumes economic analyst FinGO.sk.

## 2 Hypothesis

In order to compare the results, we chose a procedure where we will compare the situation without state intervention with the situation that has taken place. For this purpose, we set two hypotheses.

**"H0"** - will try to analyze the situation if this financial assistance did not come and the situation would be solved only by existing instruments. This scenario is realistic and will also take into account the rate of potential transfer of workers from sectors affected by the pandemic to less vulnerable sectors. It means how the structure of the economy will change, especially the decline in services at the expense of production, or services provided explicitly electronically. From this we derive the rates of poverty and unemployment.

**"H1"** - will try to analyze the situation after the introduction and acceptance of pandemic assistance. We will assess the impact on the structure of the economy and try to derive the effectiveness of the funds spent in relation to the productivity and behavior of workers. Specifically, we will try to find out whether the financial support, so to speak, without consideration, did not cause an attempt to try to bend the system to the individual benefit of companies or individuals.

## 3 Data and methodology

The analyzes will be based on data from Eurostat, SILC, and the Statistical Office of the Slovak Republic, we will display the poverty and unemployment rate over time during the period under review and estimate a positive and negative scenario of their development in the absence of this financial assistance. By comparing them, we created scenarios of how the situation could have developed if the pandemic had not occurred at all (Scenario No. 1), where we assumed that the level of the unemployment rate would be constant and oscillate around 5%. Subsequently, the situation (Scenario No. 2), where the current situation is captured, according to the data of the Academy of Sciences of the Slovak Republic and in our analysis, we take into account data from the records of the total number of available job seekers. This selection is about 1% higher and better reflects the number of people who may be at risk of income shortages and thus their inability to meet their basic needs. In other scenarios (3,4,5). see Tab. No. 4, we considered data on the amount of support, its duration and especially the number of affected persons as the basis for estimating the development of unemployment, without support. The total number of persons varied in individual months, for the sake of simplification we created quarterly data, the sum of data in individual months. We assumed that support per individual was the basic unit of the job at risk. It is clear from the Ministry of Labour data how many jobs were supported in individual periods and



these data created a picture of the number of laid off employees, ie. we assumed that each supported job would be canceled, respectively. workers are made redundant as the employer does not have the means to pay them. Subsequently, we created three more scenarios where we reduced this number due to the fact that not all employees would be laid off by the employer, at the same time we considered that some of the employees in the affected sectors would be employed in another unaffected sector. These are the following scenarios. Scenario 3 sets a threshold of 65% of supported jobs, which represents the rate of increase in unemployment in the absence of state assistance. We have described it as medium and assume that the real state without pandemic support could oscillate somewhere around the curve it represents. In Scenario 4, we set a limit of 90% of supported jobs, which is a pessimistic variant, where the inflexibility of the market and the strict attitude of employers to economic reality, falling sales, unwillingness to take risks, because there was no known time to re-exercise their activity, reluctance to accept calls to upgrade your business, e.g. transition to the online environment. Subsequently, in scenario No.5 we set a limit of 35% of supported jobs, we called it optimistic and it talks about the situation if the offered opportunity would be used to structurally change the current functioning and adapt to new trends or the creation of new jobs.

Table 3: Overview of scenarios and their calculation methodology.

Scenario	Scenario description	Calculation	Explanation
Scenario 1	Status quo - absence of a pandemic	UN-level constant 5% $U_n = A$	UN - constant at the level of the unemployment rate before the pandemic
Scenario 2	The fact that occurred according to the data Statistical office	UN - constants at the level of the recorded rate $U_oZ$ $U = A + Bx$	Inherited end data from statistics accepted as fact * own calculation and individually determined limit for examining the consequences
Scenario 3	filling of graves to the extent 2/3	$U = A + Cy$	
Scenario 4	filling of graves to the extent 9/10	$U = A + Dy$	* own calc.
Scenario 5	filling of graves to the extent 1/3	$U = A + Ey$	* own calc.

UoZ - job applicant

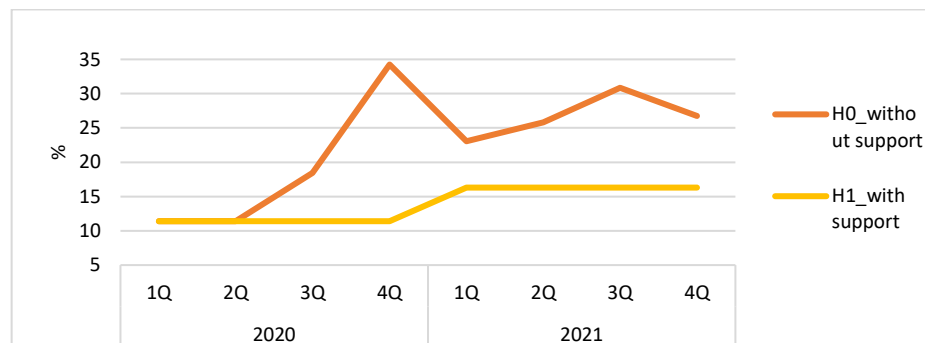
A – constant, Bx- linear function of increase or decrease in the existence, y – total number of jobs supported in the relevant quarter, Cy – function that comes out as 65% (C=0,65) from “y”, Dy – function that comes out as 90% (C=0,90) from “y”, Ey – function that comes out as 35% (C=0,35) from “y”

When output, it was necessary to take into account that due to the duration and at the same time to the different rate in the individual waves, the actual scenario may develop across several scenarios, ie. it can start in 65% to move in the summer to 35% followed

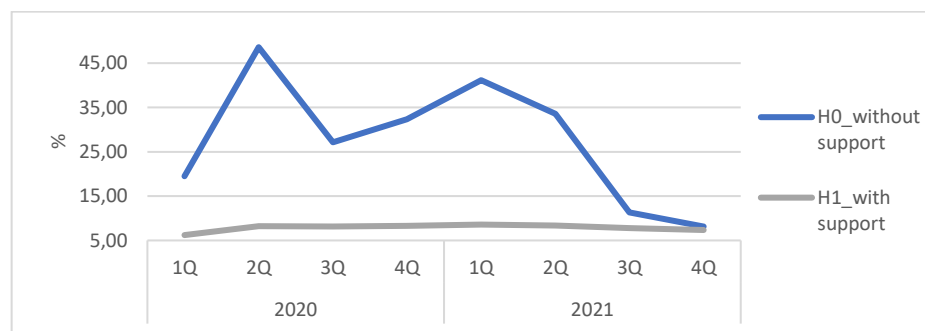
by a lockdown to 90% and again to a lower one. We created our own data file from the source data of the affected institutions, above which we subsequently processed data for individual scenes according to the above equations.

## 4 Results

The main goal was to estimate the difference in development in situations without and with state support. We obtained data for H1 from available sources of the Statistical Office of the Slovak Republic and Ministry of Labour, as they are known, they capture the state that occurred. We had to estimate the data for H0 on the basis of indirect data, which represent the number of supported jobs in individual months. In the relevant graphs, we want to point out the maximum possible rate that could have occurred, provided that 90% of all supported cities will be unchanged during the period under review. In the case of the unemployment parameter, we proceeded in such a way that we considered all supported jobs as terminated employment, and in (figures 1 and 2) we see the situation that captures the course of individual waves and the maximum possible impact on this monitored parameter. With these extreme scenarios, we point out the justification of state interventions in the economy in the form of pandemic aid.

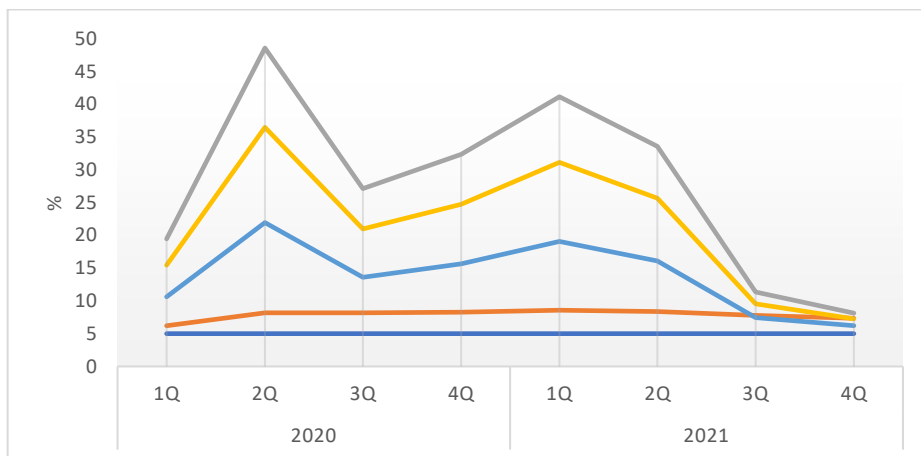


**Fig. 1.** Estimated development of poverty, Source: processed by author according to data from Slovak Statistical office (2022)



**Fig. 2.** Estimated development of unemployment, Source: processed by author

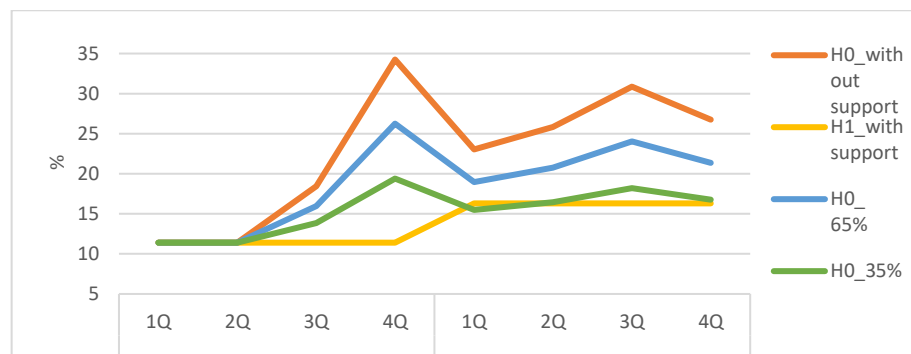
If pandemic aid from the state did not come, in this pessimistic scenario, the development of unemployment would increase by 3 to 4.5 times the current unemployment rate, which means that the average value of the unemployment rate in the observed period would be 27%. As for the poverty rate, after taking these two scenarios into account, we got the following results. The poverty rate would increase compared to the officially measured by 4-7%, which represents an increase of a maximum of 360 000 persons compared to the current level of 872 000 persons. Of course, the reality could be different from the extremely pessimistic forecast, so we estimated the reduced-impact scenarios as follows. In Graph No. 4 "Development Scenarios", we estimated the individual measures according to the above-mentioned scenarios No. 3 (65%) and No. 5 (35%) and the results are as follows. In scenario No. 3 (65%), the situation with unemployment would represent 2 to 3.5 times the current unemployment rate, which means that the average value of the unemployment rate in the observed period would be 21%. In scenario No. 5 (35%), the unemployment situation would represent 1.3 to 2.7 times the current unemployment rate, which means that the average value of the unemployment rate in the observed period would be 14%. Graphical representation is given in (figure 3)



**Fig. 3.** Unemployment scenarios, Source: processed by author

Regarding the individual scenarios for the poverty parameter, we proceeded as follows. The source data are in table no. 5 and for our chosen scenarios no. 3 (65%) the results are as follows. The poverty rate would increase compared to the officially measured by 2.5 - 4%, which represents an increase of a maximum of 220 thousand. persons compared to the currently measured level of 872 000 persons. In scenario No. 5 (35%) we recorded the following results. The poverty rate would increase only slightly compared to the official measure, it would even decrease slightly in the decline of the wave, but here we need to point out that the official poverty rate is set once a year and therefore our quarterly values distort this result. However, if we take into account the new poverty rate calculated by us of 14.7% with the year 2020 (11.4%), we recorded

an increase of 3.3% there, but we also compare it with the average figure set for 2021 (13.8%). in this scenario, the increase is only 0.9%, which represents about 47 thousand. persons. Graphical representation of this course is expressed in (figure 4).



**Fig. 4.** Scenarios of poverty development, Source: processed by author

## 5 Conclusion

The results show that the economy and job structure in the Slovak Republic is significantly affected by the pandemic, especially in the area of services, in the absence of state intervention, there would be mass redundancies at the level of 10 percent, in the version of the pessimistic scenario almost 40%. Although this situation would be temporary and could be largely served by the "unemployment insurance" fund, there could be a situation that after the economic recovery, the recruitment process would be lengthy and rigid, e.g. by the fact that employees during the protection period would react sufficiently inflexibly to the needs of the labor market. Therefore, we subsequently confronted our results with the reality on the labor market by looking at the data of the largest job portal in the Slovak Republic profesia.sk. As follows from the fact, the year 2021 was a record year in the number of jobs offers offered, its number was almost 300000. [3] The opinion of the management of this portal evaluated this as a situation where, as a result of an external shock, structural changes occurred in the labor market that have no parallel in history and indirectly described it as the digital age of the labor market. This means deepening globalization in the labor market and introducing teleworking as a new standard. These data are also confirmed by various economic studies. [1] This situation is also confirmed by our analysis, as in the fourth quarter of 2021, the parameters we monitored represent a return to the new normal, the existence of supported places is only in the area of hotels, restaurants and tourism. These are sectors that are still inaccessible to citizens due to pandemic measures, resp. only available in limited capacity. A separate category consists of artists. The results we find should be examined in more detail over time, whether and what changes in the structure of jobs have occurred, what has it brought to individuals and how have they dealt with it in terms of the need for a change in job description? It is necessary to take a closer look at whether the scenarios created by us were well estimated and provided

informative data for comparison in the future, when verified data for the full years 2021 - 2023 will be known. and employees who were actually affected and caused aid or created a negative externality in the form of inadequate aid. In any case, our knowledge is that it was appropriate to provide this support in the given situation, as we avoided social unrest. The state would find it more difficult to coordinate pandemic measures, as individuals could prioritize the need to survive over the risk of infection and loss of health or life, which would exacerbate the pandemic situation. The important question is whether, have we not moved the problem to the future? We will have to repay the funds thus obtained and the pandemic may recur regularly.

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# Behavioural Economy Perspective on Decision-Making of the Location of the Company

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**Abstract.** The paper brings insights on business localization mainly from descriptive theories, which, in contrast to the ideal state, study the reasoning of decision makers as human beings. These are inherently fallible and subject to a large variety of factors that normative theories are not yet able to encompass. The article builds on previous work, published under the title Deciding on the location of the company, where the authors describe classical theories while also placing the topic in the context of behavioral economics research. This paper takes a behavioral science perspective only and discusses in more detail selected behavioral theories and their potential contributions to the understanding of firm location decision-making processes.

**Keywords:** behavioural economy, decision-making, location

**JEL classification:** E70, E71

## 1 Introduction

Behavioral theory of firm location is a relatively young branch of the study of behavioral economics. Traditional economists often view behavioral economics as a contrast and critique of traditional theories. However, our work is not intended to replace normative models. We aim to enrich classical economic theory with new insights, to contribute to the development of economic and management science, and to stimulate out-of-the-box thinking by researchers in these fields. We will not mention classical theories of localization in our text, as they have been and are the subject of research by many from the academic community, and we provide an overview of them in our previous work, which we refer to in the text. Our work is concerned with how business

owners actually choose locations for their businesses. Publications that take into account the behavioral aspect and use a descriptive approach are still not enough in this area and therefore our paper is mainly theoretical in nature. Using inference, based on empirically acquired insights from behavioral economics, we show how these insights can contribute to shedding light on the decision-making process of where business owners actually locate their businesses.

## **2 The Place of Behavioral Economics in the Theory of Enterprise Localization**

At present, companies use mostly prescriptive approaches to business location or at least strive to do so. This is an approach based on classical or non-classical economic theory. But decision-making is not a computer-driven process. It is not based only on the visible, the tangible and the quantifiable. In the past, authors have seen the problem of location from different perspectives such as location, organizational zoning or from the perspective of the passage of time (Table 1). Ketokivi et al. adds a behavioral economics perspective to the perspectives of authors from the last century and calls this perspective a decision perspective (Ketokivi et al. 2017). Bringing psychology and economics together, newer concepts of decision theory are emerging that describe and explain the decision-making process in real-world terms. Descriptive directions in decision making, as part of behavioral economics, describe how the decision-making process actually takes place in real-world conditions. They can also be used by analogy in the study of the decision problem of business location.

The fundamental shift of behavioural theories from classical economics is the different understanding of rationality and irrationality (Friedman et al. 2004). The decision to locate, regardless of the quantity and quality of the methods used, their accuracy, complexity, simplicity or complexity, is ultimately made by humans. The first three perspectives described above are academic paradigms that focus on how scientists think about location decisions. But how do managers think about it. Do managers really analyze and evaluate location factors? Which factors are considered? How many at a time? Ketokivi (2017) expressed 4 concerns when using classical approaches.

Many empirical research articles assume that managers consider locational factors to be perfectly rational and are able to examine their importance either one by one or by contrasting them. Brush et al. for example, asked managers to explain the extent to which a given factor (e.g., tax considerations) influenced the location decision (Brush et al. 1999). When asking questions such as "How important are tax considerations in location decisions?" The question itself guides the authors to address it by considering some type of cost, and this can be misleading if the goal is to understand the decision itself. Much of the research on location does not really address decisions, but rather the general factors that lead to them.

Another problem relates to the level of analysis. How much information about location decision making can be obtained at a general, abstract level that ignores the micro-level context? A single firm can make hundreds of different location decisions for



hundreds of different products (Gray et al. 2013). Therefore, in order to understand the positioning decision, it would be necessary to examine the positioning decision for a specific product, and whatever factors are examined should be examined in the context of that specific product.

A third concern is the application of econometric techniques. The standard practice of formulating an econometric regression model forces the researcher to model the effects of exogenous variables independently or through simple (linear) interactions. But in authentic decision situations, it is almost certain that the interactions are much more complicated than the models are capable of capturing. Perhaps in one case, one factor (e.g., tax laws) wins out over the others; in another case, several factors may have a joint effect (e.g., proximity to markets and access to skilled labor); in yet another case, one factor pulls in one direction, but two others pull in opposite directions (e.g., a region may offer cheap labor, but the distance to markets is great). The literature on localization rarely addresses such trade-offs, tensions, and conflicts.

The fourth concern is that we are working with premises rather than facts. If the goal is to understand authentic decisions, we must take into account the fact that decisions are made by boundedly rational agents who base decisions on "factual assumptions" (i.e., beliefs) rather than facts (Simon 1997). The difference is fundamental.

The importance of the knowledge of behavioural economics and descriptive approaches to decision-making is precisely that their knowledge allows decision-makers to avoid "irrational decisions", to understand that even competitors may not behave rationally and to approach a more accurate picture of the economic reality in which managers act. The most important empirically acquired insights from behavioural economics that are directly relevant to the decision to locate a business are presented in the Results of the work section

**Table 1- Perspectives on the investigation of enterprise localization**

<b>Perspec- tive</b>	<b>Focus</b>	<b>Keywords and con- cepts</b>	<b>Theoretical foundations and empirical research</b>
Location	Site-specific factors. For example, labour costs and tax incentives.	Agglomeration economies; comparative advantages; factors of production; locational pulls	Badri et al, 1995 , Belderbos and Sleuwaegen, 2005 , Bhatnagar et al, 2003 , Brush et al, 1999 , Ellram et al, 2013 , Feldmann and Olhager, 2013 , MacCarthy and Athirawong, 2003 , Yoshida, 1987
Organisa- tion	The internal structure of the firm and the roles that different functional units have in the company's organisational network.	differentiation; factory networks; firm-level factors; integration; organization of interdependencies; organizational roles	Ferdows, 1989 , Ghoshal and Nohria, 1989 , Howells, 1990 , Khurana and Talbot, 1998 , Maritan et al., 2004 , Rugman and Verbeke, 2001 , Schmenner, 1982b , Vereecke and Van Dierdonck, 2002 , Vereecke et al., 2006
Time	The impact of location decisions on key company processes such as purchasing and delivery. Time is an essential parameter	turnaround speed; lead time; quick response production; time-based competition	Blackburn, 2012 , Contreras et al., 2012 , de Treville et al., 2014 , Ferdows et al., 2004 , Fine, 1998 , Fine, 2000 , Holweg et al., 2011 , Suri, 1998 , Stalk, 1988
Decision making	Understanding the actual decision, empirical consistency, does not give preference to any theoretical approach.	bounded rationality; decision making; information processing; decision making	Bromiley, 1986 , Cyert and March, 1992 , Dean and Sharfman, 1993 , Marucheck and kol., 1990 , Menda and Dilts, 1997 , Mills et al., 1998 , Simon, 1997

Source: own processing according to (Ketokivi et al. 2017)

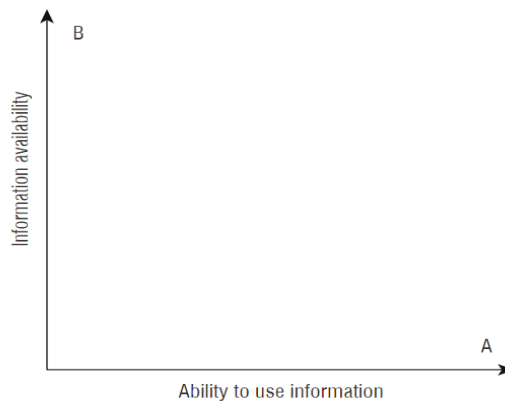
### 3 Results of the work

Amos Tversky began to work on behavioral decision theory issues as early as 1948. Tversky used experiments to show that people estimate right-probabilities differently from the way expected utility theory describes them. Together with D. Kahneman, they began to investigate some phenomena in agents' decision making such as anchoring, availability, and overconfidence. Building on Simon's unspecified findings that people may use so-called heuristics that represent unification of a decision in a complicated situation (Simon and Newell 1958), Tversky and Kahneman successively detailed in their papers common heuristic reasoning procedures and the deviations from rationality that were associated with these heuristics (Tversky and Kahneman 1974). The publication of research on systematic deviations from elicited a response from scholars in economics and management. Several authors have incorporated these findings into theories of firm localization.

#### 3.1 Pred matrix

The theory of bounded rationality was later used by A. Pred (Pred 1967). The behavioral matrix he formulated linked the availability of information, the investor's ability to process information, and the "profitability" of the chosen business location. The general rule is that the more information (or information processing ability) a decision maker has, the more profitable the location one chooses, *caeteris paribus*. A modified version of the Prior Matrix is shown in Figure 1. Point A represents *homo economicus*, who has perfect information and perfect ability to use it to choose the optimal location solution. All other decision makers make suboptimal decisions, and the *ex-tribe* is at point B, where the producer has little information and poor ability to process it, so he chooses a bad location that may result in a loss.

**Figure 1 - Pred matrix**



*Source: PRED, Allan, 1967. Behavior and localization, foundations of geographical and dynamic localization theory. Part I, 1967.1.2*  
**Perception of space**

Even a few years before A. Pred, D. Lowenthal (1961) argued that everyone has their own personal geography, which can be considered as a picture of the world, dependent on where they live, their previous experiences and knowledge (Lowenthal 1961). One can know almost nothing about distant places and at the same time know much more information about one's local area than can be ascertained from available sources. In 1960 K. Lynch published a book, *Image of the city*, in which he discussed how people remember and perceive elements of urban space. He asked participants in a research study to draw a map of the city in which they lived and found that different people's maps of the same cities varied in terms of the level of detail and objects captured. When he combined the maps together he got a picture of the city as people perceived it. Lynch argues that space is perceived by all the senses at the same time and these perceptions store fragments in the memory that later when we need to recall a place portray the space subjectively (Lynch 1960). Lynch's findings and mental maps offer new insight into the issue of business location. The mental map incorporates the emotion of the place. For example, a mental map of a particular location could greatly help retailers to attract customers and increase in-store traffic due to the location of the store.

### **3.2 Mental maps**

P. Gould's 1966 work can be considered as a superstructure of Lynch's mental maps (Gould 1966). The title of his work *On mental maps* is slightly misleading, since it is more about preference maps. Gould investigated the influence of spatial perception on spatial decisions and found that many of the decisions people make are related to the way they perceive the space around them and from different evaluations of some parts of it.

### **3.3 Heuristics in localization**

We have already suggested that people "facilitate" their decision-making with certain shortcuts - heuristics. In this subsection we will outline in more detail, using inference, how these shortcuts can influence localization decisions.

Representational heuristics are related to the equation of similarity with truth-probability by humans. According to this heuristic, humans believe that the probability that an object from category A belongs to category B is greater the more similar A is to B (Kahneman et al. 1982). Determining probability in disambiguation processes requires more than appealing to similarity and involves performing complex operations. Humans may be subject to these heuristics when making localization decisions, and are likely to do so. People may judge the suitability of a particular locale for a business by the density of other businesses in or around that locale. On the other hand, these heuristics could lead to the exclusion of initially considered locations due to a stereotype referring to the class to which they belong, such as a neighborhood or city considered

polluted, unfriendly, expensive, or otherwise. In both examples, the failure to refer to evidence in the form of data, including statistics and facts, is neglected in the decision-making process (Sabat and Pile-wicz 2019).

The availability heuristic is another decision-making shortcut whose influence on the decision to locate a business can be deduced quite easily. This shorthand in judgment is related to a person's assessment of the frequency and probability of certain phenomena through the ease with which circumstances or examples appear in one's mind to which one can refer when making a decision (Kahneman 2003). According to the availability heuristic, inference is based on the psychological availability and ease of use of decision patterns that have occurred more frequently. As a result, relying on the availability of examples that already exist in a person's mind leads to biased decisional consequences of these heuristics in the choice of the location of a venture (Sabat and Pilewicz 2019). This may relate to locations that the individual making the decision knows well through other experiences, such as place of birth, place of residence, or place of work, and satisfaction with the decision that leads to the choice of a well-known location. Thus, he may prefer a location to which he simply has more emotions attached or about which he has more information, despite its inappropriateness, rather than objectively assessing all options on the basis of the same objective factors.

The anchoring heuristic introduces the notion of a reference point that an individual learned first during a previous decision process. As a result of these heuristics, the final outcome of the decision-making process adapts to the values or reference-points that were considered in the first steps of the decision-making process, often with incomplete information (Kahneman 2003). Reference-points influence the quality of the decisions made. If they consist of hearsay, informal information or are not based on thorough analyses, they negatively affect the final decisions. In business location decision making, these heuristics are concerned with anchoring the process of inference on unconfirmed, underlying assumptions and using them as the baseline in the decision-making process.

Kahneman and Tversky's arguments cast a negative light on heuristics as the origin of errors and mistakes. Some authors reject this approach to heuristics. G. Gigerenzer argues that heuristics do not always lead to worse decisions, or that people use heuristics only because of a person's limited cognitive abilities. According to G. Gigerenzer, the use of less information and fewer real-world computations leads to time-saving benefits, which heuristic decision making enables (Luan et al. 2019). G. Gigerenzer emphasizes the benefits that these heuristics bring. The penetration, however, is that heuristics, whether positive or negative, allow us to understand how the decision-making process takes place in real-world settings.

## **4 Discussion**

The significance of the above findings seems to be even greater nowadays due to the increasing importance of the so-called soft factors of enterprise location (Domański and Libura 1986). This leads to the question whether, given the decline in the importance of traditional factors, which are becoming commonplace almost everywhere as a result

of globalization, the availability of information and new technologies, the decision to locate a business will not increasingly be the result of a subjective image of space in the minds of a few key decision-makers? Let us not forget that it is not only businesses themselves that decide where to do business, but also the state and political power in the country that guide these decisions in space. In a space that may not reflect economic reality. In a space that may be the subjective idea of the decision-maker. A brief overview of the findings of behavioural economics for the area of business location is presented in Table 2.

**Table 2 - Significant insights of behavioural economics in the theory of localisation**

<b>Author</b>	<b>Year</b>	<b>Contribution</b>
H. Simon	1955	A general model of bounded rationality that applies to firm location decisions as well.
K. Lynch	1960	Mental map research - emphasizing the importance of elements, space is subjective because people remember different elements.
P. Gould	1966	Spatial preference maps - Gould explored the attractiveness of residential locations, but his method can also be applied to firm location theory.
A. Pred	1967	As a result, he fit a model of bounded rationality to the theory of firm location in the Pred matrix. He further described the imitation effect of firms' location decisions.
G. Tornquist	1970	He points out the diminishing role of transportation as a location factor and the high need for personal contacts and information exchange between enterprises.
M. Hurst	1974	He proposed the Hurst matrix and suggested that firm location decisions are influenced by economic and non-economic factors.
F. Hamilton	1975	Suggests the importance of the general perception of the environment as a location that is the result of a trade-off between different sets of interests.

**Source:** own processing according to (Sabat and Pilewicz 2018)

At a time when business intelligence systems can surgically calculate costs and benefits accurately given a wide variety of hard decision factors, we find the above insights of behavioral economics to be extremely beneficial and worthy of further exploration.

In economic science, behavioural economics opens up a space for qualitative investigation of seemingly traditional theories such as the localization of the firm. Our paper aims to encourage economists to broaden their knowledge with this perspective and to find the courage to abandon classical methods of investigation. The topic offers a wide scope for conducting empirical experimental studies, which we consider as a means of bridging the existing gap between research and managerial practice.

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# The Role of Personality Traits in Investment Decisions of Young Adults

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**Abstract.** This paper studies the relationship between the Big five personality traits, socio-economic characteristics and the investment choices of young adults. The data used in the analysis was obtained from a survey which aimed to identify individual's personality traits, risk aversion and preferred investment strategy. To estimate the effect of personality traits, risk aversion on individual's investment strategy we used a probit model. The results show that personality traits and certain socio-demographic variables influence individuals' choice of preferred investment strategy. We find that more extroverted people were identified as more likely to diversify their investments, however, people more open to new experiences came out as more conservative in their investments. Considering individual socio-economic characteristics, men chose a conservative investment strategy with a lower probability than women. Also, marital and employment status were found to statistically significantly affect preference towards a conservative investment strategy.

**Keywords:** Personality traits, Investment decisions, Behavioural finance

**JEL classification:** *D91, D14, G11.*

## 1 Introduction

According to behavioural economics, individuals do not always act optimally, and their choices and decisions deviate from rationality. This is may be due to several reasons – people do not have access to all relevant information, they can make decisions that are normatively unacceptable and are subject to behavioural biases, which can lead them to make sob-optimal decisions. The behavioural approach points out that these irrational decisions are not random but systematic (i.e., the heterogeneity in their behaviour may be due to, for example, genetic predisposition, previous experience and the like). The behavioural approach is essentially an interdisciplinary approach which has penetrated several areas of economics and other social sciences, and has attracted

significant attention in finance, where it contributed to the birth of behavioural finance. Behavioural finance examines the psychological factors that affect investment decisions of individual as well as institutional investors. In addition, behavioural finance studies behavioural biases and factors that affect investment decisions and subsequent investment returns.

The behavioural approach also focuses on studying and analysing the behaviour of individual investors on the financial market. Individual investors often act under the influence of behavioural biases that can lead them to make investment mistakes. In a situation where more and more individuals are investing in companies' equity and on the stock market, it is very important to understand their behaviour and actions. The transaction costs associated with investing are lower than ever before, and because information is freely available online, trading in assets is very simple. As the cost of entering the stock market has decreased in recent years and the number of individuals investing in equities has increased, many individuals take the opportunity to actively trade with a low collateral requirement.

Retirement savings are also a global trend (e.g., the second pillar savings in Slovakia or the so-called 401-plan in the USA). This type of investment is often carried out in cooperation with the employer, when the employer sets up accounts for each employee. The future returns on this investment then vary depending on the amount of the investment, but also on how investors manage their portfolio. However, individual portfolios are often not efficient enough, which then causes a problem in terms of the final pension and the amount saved for retirement.

Individual investors can choose to invest themselves or delegate their investments to external asset managers. In the case of delegation, it is also possible to speak of double delegation, where firstly individual investors (i.e., pension savers) delegate their investment decisions to pension fund managers and then the managers of these funds either invest directly or delegate the investment to external managers.

In our study, we analyse, whether the personality traits – extraversion, agreeableness, conscientiousness, nervousness and openness to experiences – socio-economic characteristics and risk aversion affect investment decisions of young adults. Young adults have a long investment horizon in front of them, therefore it is important that they manage their finances and investments correctly, so that they do not forego gains for their future pensions. We carry out the analysis using the data from a survey carried out among a sample of young adults which measures the individual personality traits, risk aversion and collects information on respondents' socio-economic characteristics.

The paper is structured as follows: first, we review the relevant literature; then, we discuss the data and the methodological approach used to estimate the relationship between studied variables and investment decisions of individuals. In the following section, we present and evaluate the results of the data analysis. Finally, we discuss the results and conclude the paper.

## 2 Literature review

Behavioural finance highlights that individuals do not always act optimally, and their choices often deviate from rationality. According to the behavioural approach, this is for several reasons, e.g., because people do not take into account all available information, they make decisions that are normative and socially acceptable, even if they are not in their best interests. In this regard, significant attention is paid to the attitudes of individuals towards risk and the factors that affect it. In their work Kahneman and Tversky (1991) showed that individuals are loss averse. They showed that people feel a loss about twice as much as a return of the same value, as higher investment risk is associated with a higher probability of loss. Therefore, much of the research in behavioural finance focuses on analysing the factors that influence individuals' attitudes to risk.

Similarly, myopic loss aversion occurs when an investor feels more the losses than profits and tends to frequently evaluate and monitor his or her investment results. Based on an experimental approach, Thaler et al. (1997) concluded that investors who received more frequent feedback on the performance of their investments were less likely to take risks and therefore forgo an appreciation in the value of their investments. The aversion to short-term losses suggests that excessive information and performance monitoring of an investment portfolio is associated with higher risk aversion and lower portfolio performance.

The behaviour and decisions of individuals are also influenced by the ways in which the available options are presented to them (so-called framing). The concept introduced by Kahneman and Tversky (1979) into behavioural economics has gained great acclaim in their work on prospect theory which has found widespread application in practice. Framing has been used in various situations (e.g., when designing retirement savings investment strategies) and it has led to positive outcomes in various areas (e.g., in improving the collection of taxes, when letters with information that most people pay taxes has been sent to taxpayers). An important finding is also the aversion to loss, which documents that people consider loss to be more painful than a benefits of the same size, and therefore they will try to avoid such loss. Behavioural science also points to the influence of social norms on the behaviour and decision-making of individuals (Ariely, 2008). If members of a group, such as work teams, family or friends behave in a certain way or have a certain belief, their friends and family will behave similarly and have similar values.

The aim of behavioural economics is to improve predictions by forming more realistic assumptions about individuals' behaviour and also to specify how individuals' economic decisions can be improved. This effort is usually based on behavioural interventions and nudging. A better understanding of the causes of individuals' irrational behaviour and behavioural biases they are subject to, can help economic agents make better decisions.

Some studies (e.g., Benartzi and Thaler, 2001) show that individual investors often invest in the company in which they are employed or in the pension funds of this company. Both factors expose investors to idiosyncratic location risk, which is also likely to be correlated with their career prospects. This trend in the behaviour of

individual investors can be explained by the aversion of individuals to the unknown and their inclination to the known. These studies show that many investors use investment strategies that are very simple, such as assigning  $1/N$  savings to each of the  $N$  available investment options, regardless of the nature of the investment options (Benartzi and Thaler, 2001).

Behavioural finance also studies for instance the role of personality traits, demographic factors such as age, education, gender, income and marital status in investment decisions of individuals. Jaggia and Thosar (2000) examined the relationship between the investment horizon (the age of the investor) and the willingness to take risks. The results of the expected utility model simulation showed that the willingness to take risk decreases with the length of the investment horizon (i.e. with the age of the investor). In their study, Watson and McNaughton (2007) also pointed to a significant positive relationship between age and the level of risk aversion. Therefore, in the empirical analysis of risk aversion, the age of an individual is usually controlled for.

Eckel and Grossman (2008) showed that women's and men's investment behaviour shows systematic differences in risk attitudes – the authors showed that women have a greater risk aversion than men. Eckel and Grossman (2008) argue that it is important whether men and women systematically differ in their choices against risk. If women are more sensitive to changes in risk than men, this attitude should influence all aspects of their decision-making, including career choices and investment decisions.

Similarly, empirical studies by Watson and Robinson (2003) and Larsson and Säv-Söderbergh (2010) document that women have a higher risk aversion. The higher risk aversion can be explained by the fact that women usually have a lower income than men and have longer life expectancy (Hersch, 1996). Other studies that have shown that women have a higher aversion to financial risk than men include Palvia et al. (2015) and Hoang et al. (2019). Palvia et al. (2015) examined gender differences in the context of US banking during the Great Recession. They found that banks with women in management positions assessed the risk that a given bank faced more conservatively. The departments led by them held a higher level of equity, thus reducing the likelihood of bankruptcy during the financial crisis.

Mayfield et al. (2008) examined the influence of personality characteristics (extraversion, agreeableness, conscientiousness, nervousness and openness to experience) (Goldberg, 1992) on short-term and long-term investing. The authors found that more extroverted individuals tend to invest in the short term. On the other hand, individuals with higher nervousness were shown to avoid short term investments and instead invest in the long run. These results also suggest that individuals who are risk averse do not tend to invest in the long run, but rather prefer short term investments. Moreover, Mayfield et al. (2008) showed that people who are more open to experience are more likely to focus on long-term investment activities (however, this personality trait was not statistically significant when it came to short-term investing).

In studying the determinants of financial risk tolerance by individuals in financial decision-making, Pinjisakikool (2018) used the Big five personality traits to examine their impact on household financial behaviour and their financial risk tolerance. The results of this study show that all five personality traits significantly predicted the

degree of financial risk tolerance and at the same time, as instrumental variables, were able to indirectly predict the financial behaviour of households.

Aumeboonsuke and Caplanova (2021) investigated the determinants of financial risk tolerance in the financial decisions of individual investors, focusing on its determinants, especially on the influence of personality traits using Goldberg's personality model and mindfulness on individuals' risk aversion. This factor analysis shows that pleasant and emotionally stable people are less risk averse, while people characterized by conscientiousness and openness are significantly more risk averse. Analysis of the interaction between attention and risk aversion suggests that more susceptible individuals tend to be more risk averse. In addition, the attentive state of mind has an important mediating role between personality traits and risk aversion. Although research suggests that emotional stability has a direct negative effect on risk aversion, on the other hand, it has a significant positive effect on mindfulness, which has a statistically significant positive effect on risk aversion. The authors also note that older people and women have a higher risk aversion, men and married individuals have a lower risk aversion.

### 3 Data and methodology

In this section, we outline the data, methodology and the empirical approach used to analyse the relationship between personality traits and socio-economic characteristics on investment decisions of young adults. In particular, we focus on studying whether individuals in our sample choose a conservative or a diversified, more risky, investment strategy.

#### 3.1 Data

To obtain data, we conducted a research in the form of a questionnaire survey. The aim of the survey was to identify the personality traits and socio-demographic characteristics of the participants and their choice of investment strategy.

The sample size is equal to 100 responses, most of them representing students and young adults. Table 1 provides an overview of the sample characteristics. The data shows that almost 61 percent of the survey participants are represented by women. The average age of the respondents is approximately 26 years, so the sample is representative mainly for young adults. Given the growing importance of investing at a young age, it is important to analyse and examine the investment decisions of this age group and to identify possible behavioural biases in their behaviour that may affect their investment decisions in general, but also affect their future retirement savings.

**Table 1.** Sample characteristics.

	Col. 1 Proportion [in %]	Col. 2 Average/number
<b>Gender</b>		

<i>Woman</i>	60.8	
<i>Man</i>	39.2	
<b>Marital status</b>		
<i>Single</i>	80.4	
<i>Married /living together/cohabitation</i>	19.6	
<b>Level of education attained</b>		
<i>NA</i>	5.88	
<i>Bachelor</i>	31.4	
<i>Master</i>	49.0	
<i>PhD</i>	13.7	
<b>Educational background</b>		
<i>NA</i>	5.88	
<i>Technical science</i>	9.8	
<i>Humanities</i>	3.9	
<i>Social science</i>	76.5	
<i>Natural science</i>	3.92	
<b>Employment status</b>		
<i>Unemployed</i>	64.7	
<i>Employed</i>	35.3	
<b>Average monthly income [in eur]</b>		
<i>NA</i>	23.5	
<i>Less than 500</i>	29.4	
<i>501-1000</i>	23.5	
<i>1001-2000</i>	15.7	
<i>2001-3000</i>	3.92	
<i>3001-5000</i>	1.96	
<i>More than 5000</i>	19.6	
<b>Average age</b>		25.98
<b>Number of students</b>		94
<b>Sample size, N</b>	<b>100</b>	

*Source: Author's own calculations.*

As can be seen from Table 1, 49 percent of respondents are master's degree students, while bachelor and doctoral students represent 31.4 percent and 13.7 percent of the sample respectively. About 6 percent of respondents noted that they were not enrolled in university studies.

Data also shows that the vast majority of respondents have an education in the social sciences (e.g., economics, political science, psychology). Almost 10 percent of participants have an education in technical sciences, approximately 4 percent of respondents have academic background in humanities as well as in natural sciences.

35 percent of respondents stated that they were employed full time, which means that some students work full time while studying. The remaining 65 percent of respondents noted that they were unemployed, however, some of them were employed part-time.

Given that the majority of the sample was represented by students, it could be assumed that their income is limited. Data in Table 1 however shows that 23.5 percent of respondents do not have an active source of income. Almost 30 percent of respondents had an average monthly income of less than 500 euros, while more than 41 percent of respondents had an average monthly income of more than € 1,000, and more than 19 percent of survey participants noted that they earned more than € 5,000 per month. However, it is important to note that the sample includes respondents from several countries where the average income may be higher than in Slovakia.

It is important to also note that the data are not representative of the overall population of savers, since students and young adults have the largest representation in the sample. There is also a dominant representation of women in the sample. However, the aim of the research was not to carry out a representative analysis, but to examine characteristics that influence young people's investment decisions.

### 3.2 Methodology

To identify and measure individual's personality traits we used Goldberg's Big Five personality traits – i.e., conscientiousness, agreeableness, neuroticism, openness to experience, and extraversion (Goldberg, 1990; 1992). Since its inception, Goldberg's Big five personality concept has been widely used in research in psychology, but also in other social sciences (Gow et al., 2005). Number of researchers have used it to examine the influence of personality traits on decision-making in both economic and non-economic areas. Examples of such studies are Aumeboonsuke and Caplanova (2021), Sahinidis et al. (2020), Müller and Schwierien (2020) and Pinjisakikool (2018).

The respondents of our survey were asked to evaluate the statements related to each of the personality traits on a scale from 1 to 5, with 1 being a very inaccurate statement and 5 a very accurate statement. In addition, we also measured the level of risk aversion by using a risk profile assessment consisting of 10 multiple-choice questions. The measurement of risk aversion was focused on attitudes towards alternative investments with different levels of risk. An investor who is not prone to risk would prefer a lower risk option (i.e., a more conservative, lower return investment strategy).

The methodology and empirical strategy used to estimate the causal relationship between personality traits and individuals' preferred investment strategies is based on the model specified below. To take into account the nature of the data, we analysed them using a relevant analytical tool (the so-called survey tool) in the STATA program.

Since the dependent variable is a binary variable that has a value of 1, if an individual chooses a conservative investment strategy, otherwise it is equal to 0, we will analyse the empirical data using the probit regression method:

$$Pr(i \text{ conservative}) = \delta + \theta_1 E_i + \theta_2 C_i + \theta_3 A_i + \theta_4 N_i + \theta_5 O_i + \theta_6 Risk_i + \sigma X_i + \varepsilon_i \quad (2)$$

Where the dependent variable indicates whether the individual is a conservative investor,  $E_i$  is the measure of extraversion of the individual  $i$ ,  $C_i$  is the measure of conscientiousness,  $A_i$  is the measure of agreeables,  $N_i$  is the measure of nervousness and  $O_i$  is the measure of openness to experience and  $Risk_i$  is the measure of risk aversion of individual  $i$ .  $X_i$  is a vector of control variables including gender, age, marital status, average monthly income, employment status, level of education attained, and binary variable that acquires a value of 1 if the individual has background in social science, and 0 otherwise.  $\varepsilon_i$  is the standard error.

Based on the existing studies in this area, we expect that some of the Big five personality traits will statistically significantly influence the investment decisions of individuals. For example, we expect extroverted people to be less inclined to invest conservatively. In addition, we assume that socio-economic characteristics will also statistically significantly affect the investment decisions of individuals in our sample.

## 4 Results

In this part we present the estimation results based on the methodology outlined in the previous section.

Table 2 summarises the estimated results of the relationship between personality traits, individual characteristics and the chosen investment strategy, i.e., whether they choose a conservative or less conservative investment strategy.

As can be seen from Table 2, individuals who are more extroverted are less likely to engage in a conservative investment strategy and are more likely to diversify their investment portfolio and invest in more risky assets. However, this estimate is weakly significant at the 10 percent level of significance. Openness to experience statistically significantly influences respondents' choice of investment strategy. People who are more open to new experiences are more likely to prefer a conservative investment strategy, while this relationship is significant at the 10 percent level of statistical significance.

**Table 1.** The impact of the Big five personality traits and individual characteristics on the choice of preferred investment strategy.

<i>Dependent variable – preferred investment strategy</i>	Col. 1
<i>Extraversion</i>	-0.0928* (0.0491)
<i>Conscientiousness</i>	0.110 (0.0993)
<i>Agreeables</i>	-0.0166 (0.0590)
<i>Nervousness</i>	-0.0858 (0.0738)
<i>Openness to new experiences</i>	0.141* (0.0739)



<i>Risk aversion</i>	0.130 (0.136)
<i>Gender (1=woman)</i>	-1.619*** (0.534)
<i>Age</i>	-0.00941 (0.0229)
<i>Married/living together/cohabitation</i>	1.049* (0.599)
<i>Education degree</i>	-0.477 (0.305)
<i>Employed</i>	1.024* (0.535)
<i>Average monthly income</i>	-0.356 (0.238)
<i>Student of social science</i>	0.502 (0.589)
<i>Constant</i>	-2.211 (3.201)
<b><i>Sample size, N</i></b>	<b>100</b>

*Source: author's own calculations.*

*Note: Standard errors are in parenthesis.*

*\*, \*\*, \*\*\* statistically significant at 10, 5 and 1 percent level of statistical significance.*

The results in Table 2 show that gender is statistically significant at the 1 percent level. In particular, the results show that men are less likely to engage in a conservative investment strategy than women. Men are more likely to keep their funds in a diversified portfolio than women, which is also in line with the findings of other research and trends observed in investment strategies of men and women.

The results also show that respondents living in a marriage or living in a household with other people are more likely to invest conservatively, however, this estimate is statistically significant at 10 percent level of statistical significance. This may be due to the fact that married people have to think not only about their income or loss, but also about their family. Therefore, in order to prevent or mitigate financial losses that could affect them, they prefer to choose a conservative investment strategy.

Individuals who are employed are also shown to be more likely to engage in a conservative investment strategy than unemployed individuals (this estimate is significant at the 10 percent level of significance). This finding is not in line with our expectations, so the reasons for this conclusion need to be analysed in more detail in future studies.

Overall, in line with our expectations, we found that certain personality traits statistically significantly affect young adults' investment decisions. In addition, we found that socio-economic characteristics influence preferred investment strategies of individuals, i.e., whether they choose to invest conservatively or whether they choose to diversify their portfolio in more risky assets.

## 5 Discussion and conclusion

The research showed that individuals are influenced by personality characteristics and socio-demographic variables in relation to their preferred investment strategy.

When making investment decisions, we found that extraversion and openness to new experiences influence the choice of investors' portfolio statistically significantly. More extraverted people are less likely to invest in a conservative portfolio and are more likely to diversify their investments. On the other hand, people who are more open to new experiences are more conservative when it comes to investment decisions.

Considering socio-demographic characteristics, the results show that men are less likely to choose a conservative investment strategy than women. Family and employment status also statistically significantly and positively effect individual's preference over a conservative investment strategy.

Understanding the impact of personality traits and individual characteristics on investment decisions can help us understand the reasons why individuals often do not make optimal investment choices. This can help policy makers identify appropriate behavioural nudges and interventions that could be used to make individuals behave more rationally, for example, in the context of pension savings. Given that the vast majority of developed countries are facing or already experiencing population aging, improving pension investment decisions of individuals can enable individuals to have higher investment returns as well as lower the burden on public finances.

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# Nanotechnology: Neuromarketing and the Use of Nanotechnology and its Potential

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**Abstract.** The purpose of the paper is to clarify the issues of nanotechnology, its origin, and its progress, as well as its use and importance in the future. The paper focuses on the potential use of nanotechnology in many directions, primarily in neuromarketing. Neuromarketing is an evolving field that studies the human brain, and consumer behavior and nanotechnology represent one of the possibilities for research and implementation of solutions in this field in the future. The combination of nanotechnologies and neuromarketing can create an area that offers new possibilities, scientific answers, and technological innovations that have not yet been identified. We created an online questionnaire to identify nanotechnology awareness in the Slovak republic.

**Keywords:** nanotechnology, neuromarketing, neuroscience, neuromarketing research

**JEL classification:** *M31, M39*

## 1 Introduction

Every single piece around us consists of atoms, which are not visible to the naked eye. Atoms are used by nanotechnology to research very small parts, and then in the application part, we use these small parts to solve specific problems. It's basically technology, engineering, and science at the same time. We can apply nanotechnology in various research areas such as physics, chemistry, biology, neuroscience, and the like. The beginnings of the nanometer were first described by Richard Zsigmondy, a Nobel laureate in the chemistry category when in 1925 he described and introduced nanometer terminology. He was the first to measure particle size. Specifically, he measured gold colloids using a special microscope (Hulla, JE, Sahu SC., 2015).

Several decades later, the mention of nanoscience and the use of nanotechnology took place at a conference in California in 1959. Physicist Richard Feynman described

how it was possible to manipulate and control individual atoms and the molecules themselves. The idea was developed ten years later and conditioned the emergence of the term nanotechnology. The name was used by Professor Norio Taniguchi in his study. In 1981, 22 years later, after Feynman's speech, nanotechnology itself began to be used. By using a modern tunneling microscope, it was able to examine individual atoms. We call it the beginnings of modern nanotechnology (NNI, 2022).

It is very difficult to realize how small the atoms and individual parts are. To clarify the problem, we are talking about one nanometer, which represents one billionth of a meter. In mathematical terms, it is  $10^{-9}$  meters. For example, a thumb-sized object is 25,400,000 nanometers (NNI, 2022).

### **1.1 Nanotechnology**

When we are talking about nanosciences, we can call it a sequence of phenomena and manipulation of materials on an atomic, molecular and macromolecular scale. Nanotechnologies are attracting great interest from investors around the world. Governments and organizations set aside a huge amount of funding to fund such development and scientific research. On the other hand, we also know opponents who talk about nanotechnologies as not entirely safe industries. We include many industries and scientific disciplines in the category of nanotechnology where we use different procedures, materials, tools, devices, approaches, and the like. Nanotechnologies actually study very small parts and particles and break down the whole into miniature parts, which we then investigate. Thanks to new possibilities and technologies such as the tunneling microscope or the atomic microscope, nanoscience has moved to a very high level and has spread to various areas of our lives. We also use nanotechnology to create elements for computer chips. Computer chips and CD and DVD drives have been operating at the nano level for quite some time. The future of nanosciences will increasingly focus on shrinking individual parts and increasing storage capacity for computer chips and other technologies used in a wide range of electronics, the automotive industry, and so on.

The application of nanotechnology in medicine appears for a significant part of the overall use of nanotechnologies globally. Scientists and doctors can use nanotechnology to treat specific parts of the body where it is needed. This means that, for example, chemotherapy treatment is only possible locally at the designated site, not on the patient's entire body. Such a revolutionary possibility can improve the treatment itself and its course (Hays A. S, Robert J. S., 2013).

With research into central nervous system (CNS) disorders, neuroscientists and scientists in the field of nanotechnology have found that by combining the concepts of neuroscience and nanotechnology, we can obtain much better results in the treatment of various disorders and diseases. Researchers agree that conventional methods, such as drug delivery, are not always sufficient. Using nanotechnology, scientists can apply ingredients that increase availability, increase the penetration of molecules and parts, and even with very low side effects. All these facts speak of great advances in

neuroscience and nanotechnology itself. Invasive procedures and applications of microchips are becoming interesting areas of neuroscience, nanotechnology, and neuromarketing as well as related areas of research. nano-devices directly into the body or brain (Cetin, M et al., 2012).

In the future, nanotechnologies are expected to enable more efficient approaches to production in any field, using less raw materials and energy. Most nanotechnologies are not expected to pose any new risks to humans or the environment. Concerns about the development of nanotechnologies are also conditioned by the fact that these are new technologies. Of course, the question arises as to who benefits most from the use of nanotechnologies, but it must not be forgotten that nanotechnologies should first and foremost solve problems (Dowling, Ann. P, 2004), (Ferreira, L. et al., 2008).

The combination of neuroscience and nanotechnology was revolutionary. The advancement of ever more sophisticated technology has resulted in many discoveries and scientific findings throughout neuroscience and the future of neuromarketing as well. Nanotechnologies are currently helping new diagnostic and therapeutic methods, as well as the use of drugs, regeneration of damaged nerves, neuroprotection, neuroimaging, and neurosurgery. For neuromarketing purposes, neuroimaging in conjunction with nanotechnologies is revolutionary for future research. Searching for new directions of application of nanotechnology will be necessary and key for future research. It is remarkable what nanotechnology is predicted to be able to do (Kumar, A., et al., 2017).

## **1.2 Neuromarketing**

"Neuromarketing uses neuroscience to expose consumers' subconscious decision-making processes. Neuromarketers study brain and biometric responses as well as behavior to understand and shape how consumers feel, think, and act." (NMSBA, 2021).

It is not possible to observe exactly the interrelationships and influences in consumer behavior by traditional research methods. Neuromarketing originated naturally through development, research, and technological progress. Until then, it has not been possible to look into the human brain and observe the individual connections and functions that are related to shopping behavior and decision-making. Thus, a link has been established between the biological and social sciences, which lays a solid foundation for future neuromarketing processes and research. The basic research outputs of neuromarketing include finding out what product/service is desirable and popular. How the design of a given product influences consumer behavior and decision-making. Subsequently, we can observe the strength and importance of the brand and awareness of the brand, the way of internal (brain) and external reactions of respondents. With neuromarketing, we continue to track the impact of our ad campaigns, videos, and promotions themselves. We find out how the given promotions and marketing activities affect emotions and to what extent they are attractive, concise, and able to attract. The subject of research can also be deciding between several alternatives of advertising or campaigns, where we can use a sample of respondents to

obtain relevant data, which will then decide on the future success of the advertising campaign. Among other research options applied to consumer behavior, we advise observations and findings on the price of products and services through neuromarketing research. Price is one of the key success factors, especially when launching a product/service, but also during individual product phases and cycles. Therefore, one of the ways to find out the optimal price of products and services is to use neuromarketing research. If we can use neuromarketing research to identify at least one component of the marketing "four P's" we can talk about a big step forward in marketing research with the connection and application of research with real business. If consumers behave in the same way and have common and similar patterns of behavior, we dare to say that neuromarketing can recognize these patterns and then define the interrelationships and connections that can be applied in practice. However, many factors affect the quality and relevance of research results. One of them is the size of the research sample.

Neuromarketing is conditioned by the support of a specialist who examines and evaluates the information obtained from physiological and neurophysiological reactions. Jerry Zaltman of Harvard University first used the term neuromarketing in 2002. We use various methods to investigate reactions such as eye, face, skin reactions, or internal processes measured by electroencephalography (EEG is a basic diagnostic neurophysiological method based on sensing the electrical activity of the brain electrodes.), cognitive evocative potential (ERP measures the brain's response to a stimulus) and functional magnetic resonance imaging (fMRI) of brain activity. It should be noted that the mentioned research methods represent a revolutionary way of looking into neurological processes based on stimuli and the influence of the environment. Comprehensive results could not be achieved only based on inquiries, interviews, and surveys in the given issue (Shared, A.; Tanusree, D., 2015).

Neuromarketing can be used in marketing research to gain a deeper understanding of what consumers prefer, and what motivates them and can even help marketers gain insight into why consumers make choices. Today, neuromarketing is done through something called a Brain-Computer Interface (BCI). BCI is a communication path through which an external device receives information from the central nervous system. One of the most common BCIs used in marketing research is the EEG, which is connected to an external BCI system so that the neuro-marketer can see the output (Mridha, M.F., et al., 2021).

An EEG device measures electrical activity in the brain. When connected to an external BCI system, based on the EEG, it reveals patterns that can tell the neuro-marketer whether an individual is happy, sad, frustrated, distracted and many other emotions. In addition to EEG, many other physiological tools can be used in marketing research. For example, neuro-marketers have used functional magnetic resonance imaging (fMRI) to track activity in certain areas by measuring blood flow in the brain. Other neuro-marketers prefer less invasive measures such as eye tracking. This information helps neuro-marketers decide whether it's a good idea to run or change a

given ad. Why is neuromarketing research better than traditional marketing research? As psychologist Daniel Kahneman described, the human brain has two operating systems: System 1 and System 2. System 1 is automatic, effortless, and accounts for about 98% of our thinking. System 2, on the other hand, is conscious—it's deliberate, controlled, and only makes up about 2% of our thinking. When it comes to decision-making, Kahneman argues that System 1 almost always dominates over System 2, meaning that System 1 usually determines our behavior and decision-making (Kahneman, D. 2011).

### **1.3 Nano-neuromarketing**

K. Eric Draxler says that nanotechnologies will evolve to a certain point where they will be able to build new physical structures in progressive stages - from nanometers, through micro-levels to macro-levels (Draxler, E. K., 1986).

Nanotechnologies are currently used in neuroscience to obtain neurophysiological signals. These signals are obtained to clarify the emotional states of individuals. Sophisticated algorithms are used here that can detect specific neurological and physiological patterns of behavior concerning different emotions. Opportunities for nano marketing research:

- the opportunity to use nano marketing technologies to measure emotional states in real-time
- use of small, portable nano-marketing devices
- measure neural and biophysiological signals using nano-marketing devices and technology
- combine laboratory experiments with everyday life tests involving nano-devices
- ensure the moral, social, and ethical requirements of nano marketing research
- balancing advanced nano marketing techniques with moral, social, and ethical requirements (Mileti, A. et al., 2016).

Modern nano-devices have functions that can record and measure the desired signals, all remotely. With the help of these modern devices, we can monitor the current state of heart rate, brain activity, respiratory rate, muscle activity as well as other external movements and conditions (Brown, L. et al., 2010).

The use of nano-devices in marketing research and the study of consumer behavior consists in measuring the brain activity of the respondent as well as other physiological conditions. The aim is to get relevant results and reveal emotional states that arise during shopping decisions or in everyday life. For example, the Electroencephalography (EEG) method, is very often used for such research (Balanou, E. et al., 2013).



One of the most accurate methods we can use in neuromarketing research is the fMRI method of imaging the respondent's brain activity. This is the most advanced research method, which on the other hand has its disadvantages. It is mainly the size of the equipment, the fact that the equipment must be placed in a special room (laboratory), is not portable and therefore the research must take place in an isolated environment that is not a natural environment for the customer, respondent, or research group. One of the main reasons for the use of nanotechnology in the field of neuromarketing is their properties as well as the possibility to use them anywhere and especially in the customer's natural environment. These devices can recognize several physiological and neurophysiological activities and signals of the respondent (Fernandes, M.S., et al., 2010).

Currently, brain activity can be modified and controlled using optogenetics - neurotechnology. We can explore the possibilities of neural activities and perform neural computations, which represents a huge advance in neuroscience. Optogenetic research has focused on neocortical, striatal, and hippocampal networks, revealing new possibilities for the neurophysiology of memory, executive processing, learning and perception. It is important to mention that optogenetic applications have shown enormous potential for revealing the behavior of human nervous systems as well as basic cognitive functions. Such findings help not only in medicine but also provide comprehensive knowledge for neuromarketing research. Optogenetic mapping of neural circuits can take neuromarketing to a new level (De Vittorio et al., 2014).

#### **1.4 Ethical aspects of neuromarketing using nanotechnology**

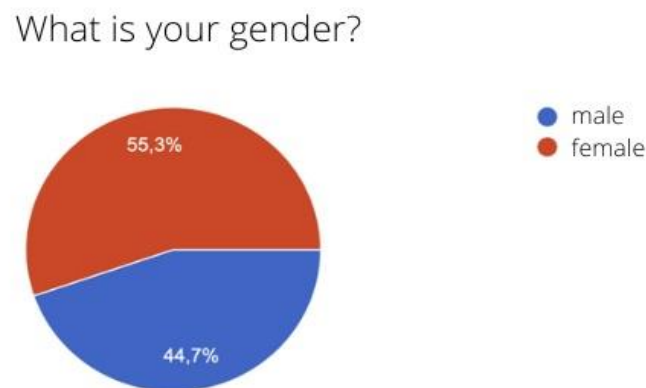
The basic standards and codes of ethics to be followed in nano marketing research using nanotechnology include:

- Voluntary consent of all research applicants
- Benefits from research outweigh risks (on the part of research subjects)
- Research should focus on the good of society and be of benefit to society
- The ability of research participants to withdraw/cancel participation, before or during the research
- It is necessary to avoid injury to candidates or any injury
- Researchers must have the necessary qualifications to carry out the research
- The human rights of researchers need to be respected
- Also pay attention to the mental health of research applicants and do not expose them to stressful situations (NMSBA, 2022).
- Medical research protects the life, health, privacy, and dignity of human research participants/subjects over the interests of society
- The necessary measures must be taken to protect the interests of human subjects from harm
- The importance of the objectives must outweigh the inherent risks and burdens on participants - no abuse, no harm to human health

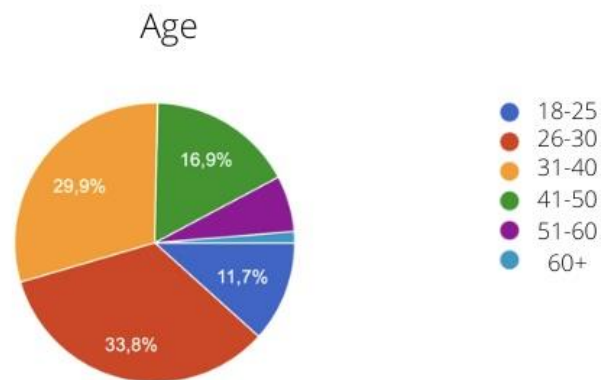
- Research must be clearly formulated and submitted for approval with a clear ethical statement
- Respondents must volunteer and be informed of the implications of the research
- Scientists, research participants, and all other parties have ethical obligations that must be clearly defined.
- Compensation for participation damage and fairness for all involved (Bulley, C.A., et al. 2018).

## Results and Discussion

From May to June 2022, we realized a survey of 77 respondents that focused on a general overview of nanotechnologies and their applications. The survey was realized in the google forms platform for creating surveys. Link: <https://forms.gle/xxN5g5vCd6yiEBGj6> The survey was realized in the Slovak language for easy understanding and consisted of 4 main and two secondary questions about the age and gender of the respondents. As we mentioned, a survey was created for Slovak respondents, which means that the structure of questions and results was in the Slovak language. Below the graph, we can find explanations of the results.

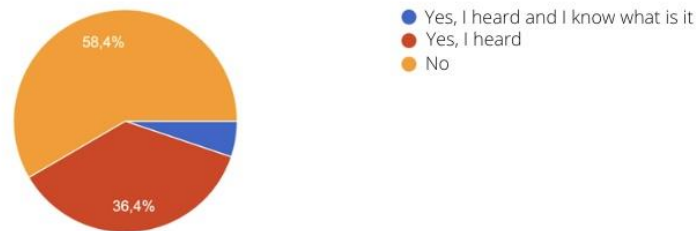


**Figure 1:** Percentage ratio between males and females participating in our research. Source: Own elaboration based.



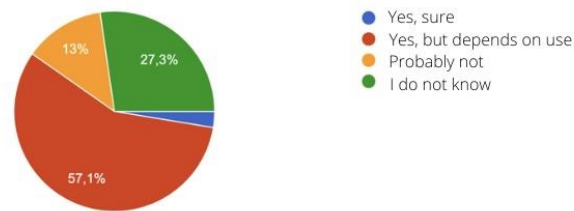
**Figure 2:** age structure of respondents. The group of respondents aged 26-30 years has the largest representation. The second largest group of respondents is between 31 and 40 years old. The group of respondents consists of a wide age range. Source: Own elaboration based.

Did you hear about nanotechnologies yet?



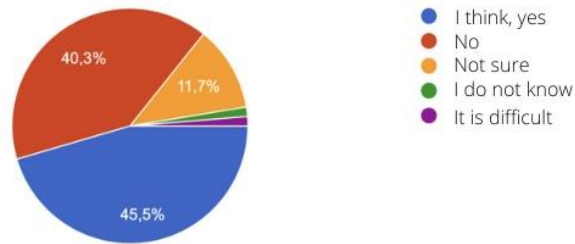
**Figure 3:** Did you hear about nanotechnologies? The majority of respondents, up to 58.4%, said they had never heard about nanotechnology. This percentage indicates weak awareness of the potential of nanotechnology. 36.4% of respondents said they had only heard of nanotechnologies. This means they could no longer explain how they work, what they are used for, and what they mean. Unfortunately, only 5.2% of respondents said they know what nanotechnologies are and understand their meaning and use. Source: Own elaboration based.

Do you think that nanotechnology improves life and helps people?



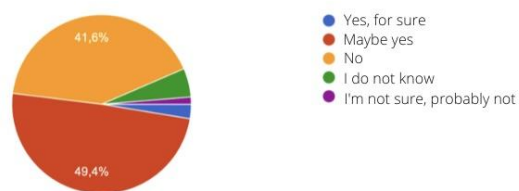
**Figure 4:** Do you think that nanotechnology improves life and helps people? Most respondents, 57.1%, said: it depends on their use. This means that nanotechnologies can be used for right and wrong purposes. 27.1% of respondents said they could not answer the question. 13% of respondents said they thought nanotechnology was not improving life around us. Only a skeptical 2.6% of respondents said they thought nanotechnology was improving life around you. Source: Own elaboration based.

Do you think that nanotechnology is dangerous for humans and can be misused for other purposes?



**Figure 5:** Do you think that nanotechnology is dangerous for humans and can be misused for other purposes? The largest share, with 45.5% of respondents said that nanotechnologies could be dangerous to humanity and could be misused for some bad ideas. On the other hand, 40.3% of respondents said they thought the opposite. More than 11,7% of respondents could not answer the question. Source: Own elaboration based.

If nanotechnology could help/heal your problem/disease, would you try this option?



**Figure 6:** If nanotechnology could help/heal your problem/disease, would you try this option? The largest percentage of respondents, up to 49.4%, said they would try (doubt) this method of treatment or problem-solving. On the other hand, 41.6% of respondents would never try this method in the form of nanotechnology. The other respondents could not answer the question. Source: Own elaboration based.

## 2 Conclusion

Nanotechnology creates the division of the whole into small parts, using their potential and miniature size. We currently use nanoscience and nanotechnology in

many areas that improve life and solve problems. Whether it's microchips used in devices, life-saving medicine, or various scientific fields and research to help us understand problem areas. Such an area is also neuromarketing, which examines for example consumer behavior, shopping, and the whole process of decisions making in online and offline space. The combination of nanotechnology and neuromarketing creates a new area of possibilities that have not been possible before. We can use imaging devices allow us to show, for example, parts of the human brain and individual processes that take place deep into the brain. Indeed, some neuro-devices are not sufficiently capable of recognizing and recording brain activity deeply rooted in its structure. Simply put, they only examine the surface reactions and signals sent by the brain toward the surface of the cerebral cortex or skin. However, nanotechnologies allow much more. The possibility of importing small parts into human brain microchips that can work independently in the human body and obtain relevant data that they use only for neuromarketing research is unique. Nanochips in the human brain, for example, are also being developed by San Francisco-based Neuralink Co., founded by Elon Musk. The nano-chips that the company is developing are used for real-time communication between the brain and a computer, or communication between two independent chips implemented in the human brain. We can help solve neuroscience issues, reach data for marketing research and consumer behavior, and of course for medical purposes. The part of the paper also includes the online research created in the online form. For the paper, we set up a hypothesis that should clarify awareness of nanotechnology, and identify the main fears but on the other hand, identify the potential and breakpoint of rejection and acceptance of the nanotechnologies. The results and hypothesis of the research were partly surprising because most respondents did not know the concept of nanotechnology, respectively. she had no information about this topic. The results of the research, stand for that the awareness of nanotechnologies in Slovakia is still very weak. Credibility in nanotechnology is also part of it, with a large proportion of respondents stating that nanotechnology can be misused for purposes other than those designed. Nevertheless, a larger percentage of respondents would like to try nanotechnology and its solution in case of problems or diseases. The statement is that in the event of a positive increase in the chances of either treatment or problem-solving, people are willing to approach the application of nanotechnology and its use.

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# The Consumer Surplus Line Integral Revisited

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**Abstract.** The consumer surplus line integral is a concept which has helped shed some light upon the consumer's welfare changes due to changes in product prices and/or changes in the consumer's income. The main objective of this article is to derive the consumer surplus line integral making use of the divergence theorem as well as Green's theorem. This approach enables the interested reader to come up with other line integrals with the same value. To our knowledge, this is one of the very first direct applications of the two theorems in economics. A partial objective is to summarize the fundamental ideas, definitions and theorems from a branch of vector calculus dealing with curves and line integrals. Therefore, the target audience of the article consists of not only economists studying the consumer's surplus, but also of quantitative-minded economists seeking for new research methods.

**Keywords:** Consumer's Surplus, Vector Calculus, Line Integrals

**JEL classification:** C60, C69, D11

## 1 Introduction

Vector calculus plays an important role in natural sciences, namely in physics. Some of the most fundamental laws of nature, such as those of electromagnetism described by Maxwell's equations, are formulated making use of the notions like the gradient, divergence, curl and the Laplacian or the line, surface and volume integral as well as theorems such as the divergence theorem, Green's and Stokes' theorem. Yet its direct use in economics is somewhat meager. This comes as a surprise since most branches of mathematical analysis alone, including fractional, stochastic and time-scale calculus, or ordinary and partial differential equations, have successfully been employed in economics. An even better reason why one could expect the use of vector calculus in economics is the fact that vectors and matrices show up quite often in economic models. For instance, the Leontief input-output analysis could benefit from a direct application of vector calculus.



Notwithstanding the above, there is one line of economic research which utilizes some of the aforementioned techniques to analyze changes in the consumer's surplus and his/her utility. The study was pioneered by [6]. A line integral is derived which can be used (under certain assumptions) to calculate the change in the consumer's surplus should a price (or a set of prices for multiple products) change. Even though the integral is derived in a straightforward manner, it can also be obtained by an application of Green's theorem, which also provides a wider range of admissible integrands for the line integral.

Therefore, the objective of this article is to derive the consumer surplus integral making use of Green's theorem, which would be one of the very first direct applications of the theorem in economics. A partial objective is to summarize the main ideas, definitions, and theorems of a part of vector calculus analyzing curves and line integrals. The target audience of the article consists of economists working with the consumer surplus integral as well as quantitative-minded economists seeking for new methods. In Section 2 we provide the reader with the review of pertinent literature. Section 3 provides some of the fundamental definitions, theorems and ideas of vector calculus. In Section 4, the consumer surplus integral is derived, and the results are discussed in Section 5.

## **2 Literature Review**

As has already been mentioned, the concept of the consumer's surplus can be traced back to [6]. The concept alongside with the "Marshallian triangles" was later popularized by [9]. A major pertinent contribution was made by [7] and his notion of compensating variations. Some of the very first formulations of the consumer line integral can be found in [8] and [12].

Since the discussed integral is of a vector field (or in other words, it is orientable and can, therefore, depend upon the integration path), it is important to study the assumptions under which it is path independent. This is in part done in [14]. A concise treatment of the issue can be found in [3]. The authors make a summary of the fundamental theory of path independence for line integrals. Some of the other properties of the consumer surplus line integral are studied in [4].

The consumer surplus line integral has found numerous applications in the discrete choice theory. For instance, [10] introduces the concept of random compensating variation and proves its equivalence with a line integral. The results of the paper are analyzed and applied even more, for instance in [5].

## **3 Curves, Line Integrals and Green's Theorem**

In this section, we provide an overview of the basic concepts of vector calculus. A rigorous mathematical treatment thereof can be found in [1], [2] and [11]. A less rigorous approach is taken in [13].

**Definition 1.** Let  $n \in \mathbb{N}, n > 1$  and  $\phi: \mathbb{R} \supset [a, b] \rightarrow \mathbb{R}^n, t \mapsto \phi(t) = (\phi_1(t), \dots, \phi_n(t)), \phi \in C([a, b], \mathbb{R}^n)$ . Then the set  $\mathcal{K} := \phi([a, b]) = \{x \in \mathbb{R}^n : \exists t \in [a, b] : x = \phi(t)\}$  is called a curve in  $\mathbb{R}^n$ , the function  $\phi$  its parametrization and  $t$  a parameter.

In simple terms, a curve is a continuous image of a compact interval. An economic example of a curve is a price-consumption curve, which can be parametrized with the price of a given good.

An exotic example of a curve is the Hilbert space-filling curve. Owing to this example, some more properties need to be studied before we delve into line integrals.

**Definition 2.**  $\mathcal{K}$  is called a regular curve if  $\phi \in C^1([a, b], \mathbb{R}^n)$  and its derivative never vanishes.

This definition simply states that a regular curve is a smooth curve without spikes (if the curve described the position of a fly in time, this would imply that the fly cannot change the flight direction discontinuously).

**Definition 3.**  $\mathcal{K}$  is called a Jordan curve if at least one of its parametrizations  $\phi$  is bijective. Moreover,  $\mathcal{K}$  is called a closed Jordan curve if  $\phi(a) = \phi(b)$  and  $\phi$  restricted to  $(a, b)$  is bijective.

A Jordan curve is such a curve which does not cross itself. From here on, we require that every curve we analyze be a piecewise regular (meaning it can be partitioned into regular curves) Jordan curve or a piecewise regular closed Jordan curve.

**Theorem 4.** If  $\phi \in C^1([a, b], \mathbb{R}^n)$  is a Jordan parametrization of a Jordan curve  $\mathcal{K}$ . Then the length of the curve can be computed as follows:

$$\mathcal{L}(\mathcal{K}) = \int_a^b \|\phi'(t)\| dt \quad (1)$$

*Sketch of the proof.* We can approximate the length of the curve by summing up lengths of line segments connecting points on the curve:

$$\mathcal{L}(\mathcal{K}) \approx \sum_{i=1}^n \|\phi(t_i) - \phi(t_{i-1})\| \quad (2)$$

Since  $\phi$  is assumed continuously differentiable, we can apply the mean value theorem to obtain:

$$\mathcal{L}(\mathcal{K}) \approx \sum_{i=1}^n \|\phi'(c_i)\| \Delta t_i, c_i \in (t_{i-1}, t_i) \quad (3)$$

Taking the limit, we get the desired result. ■

It ought to be noted here that we have just sketched an informal proof of a weaker theorem than Theorem 4 which states how to compute the length of a parametrization, not the curve. As it turns out, however, the length of a Jordan curve is independent of its Jordan parametrization.

The following concept of a function of the curve length (also referred to as arc length) is of great importance when studying line integrals.

**Definition 5.** Let  $\phi \in C^1([a, b], \mathbb{R}^n)$  be a Jordan parametrization of a Jordan curve  $\mathcal{K}$ . Then we define a function  $s: [a, b] \rightarrow \mathbb{R}, t \mapsto \int_a^t \|\phi'(\tau)\| d\tau$ .

For every admissible  $t$ , the function  $s(t)$  measures the length of the Jordan curve  $\mathcal{K}$  up to  $t$ . Since the integrand is a continuous function, we can find the differential of  $s$  in the form:  $ds = s'(t)dt = \|\phi'(t)\|dt$ . Also note that if  $\mathcal{K}$  is of finite length on a bounded interval, then  $s$  is of bounded variation on the interval. We are now ready to define the line integral of scalar as well as vector-valued functions.

**Definition 6. (Line integral of a scalar function<sup>1</sup>)** Let  $\mathcal{K} = \phi([a, b]) \subset \mathbb{R}^n$  be a Jordan curve of finite length with its regular Jordan parametrization  $\phi$ . Let  $f: \mathbb{R}^n \supseteq D(f) \rightarrow \mathbb{R}$  such that  $\mathcal{K} \subset D(f)$ . Then a line integral of the scalar function  $f$  along the curve  $\mathcal{K}$  is defined as follows:

$$\int_{\mathcal{K}} f(x) ds := \int_a^b f(\phi(t)) s'(t) dt = \int_a^b f(\phi(t)) \|\phi'(t)\| dt \quad (4)$$

If  $\mathcal{K}$  is closed, the following notation is sometimes used:

$$\oint_{\mathcal{K}} f(x) ds \quad (5)$$

As can be seen, the line integral is defined as a Riemann-Stieltjes integral with respect to  $s$  (which in this case is of bounded variation, as already noted). Geometrically, it

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<sup>1</sup> Sometimes referred to as a line integral of the first kind.

measures the area between a curve  $\mathcal{K}$  and the graph of a function  $f$  defined along the curve.

**Definition 7. (Line integral of a vector-valued function<sup>2</sup>)** Let  $\mathcal{K} = \phi([a, b]) \subset \mathbb{R}^n$  be a Jordan curve of finite length with its regular Jordan parametrization  $\phi$ . Let  $F: \mathbb{R}^n \supseteq D(F) \rightarrow \mathbb{R}^n, x \mapsto F(x) = (f_1(x), \dots, f_n(x))$  such that  $\mathcal{K} \subset D(F)$ . Then a line integral of the vector-valued function  $F$  along the curve  $\mathcal{K}$  with its parametrization  $\phi$  is defined as follows:

$$\int_{\phi} F(x) \cdot dx = \int_a^b F(\phi(t)) \cdot \phi'(t) dt = \sum_{i=1}^n \int_a^b f_i(\phi(t)) \phi'_i(t) dt = \int_{\phi} \sum_{i=1}^n f_i(x) dx_i \quad (6)$$

If  $\mathcal{K}$  is closed, the following notation is sometimes used:

$$\oint_{\phi} F(x) \cdot dx \quad (7)$$

The notation indicates that this line integral is in general not independent of the parametrization (it can be shown that it gives the same result for equivalent regular Jordan parametrizations, but different orientations impact the sign). Later in the next, however, we write  $\int_{\mathcal{K}} F(x) \cdot dx$  when the orientation is given.

As the following sequence of steps indicates, there is a relation between the line integrals of the first and the second kind:

$$\begin{aligned} \int_{\phi} F(x) \cdot dx &= \sum_{i=1}^n \int_a^b f_i(\phi(t)) \phi'_i(t) dt = \int_a^b \left( \sum_{i=1}^n f_i(\phi(t)) \frac{\phi'_i(t)}{\|\phi'(t)\|} \right) \|\phi'(t)\| dt = \\ &= \int_{\mathcal{K}} F(x) \cdot \frac{\phi'(t)}{\|\phi'(t)\|} ds \end{aligned} \quad (8)$$

At the very end of this section, let us formulate two important results of vector analysis, namely the divergence theorem and its consequence Green's theorem, which will be used in the next section.

**Theorem 8. (The divergence theorem in  $\mathbb{R}^2$ )** Let  $B \subset \mathbb{R}^2$  be a compact set with a piecewise smooth boundary  $\partial B$ . Let  $F(x, y) = (f_1(x, y), f_2(x, y))$  such that  $f_i \in C^1(B, \mathbb{R}), i = 1, 2$ . Then

---

<sup>2</sup> Sometimes referred to as a line integral of the second kind.

$$\iint_B \nabla \cdot F \, dx dy = \oint_{\partial B} F \cdot v \, ds \quad (9)$$

where  $v$  is the outward unit normal vector (the path is oriented anticlockwise) and  $\nabla \cdot F := \frac{\partial f_1}{\partial x} + \frac{\partial f_2}{\partial y}$  is the divergence of a vector-valued function.

**Theorem 9. (Green's theorem)** Let  $B \subset \mathbb{R}^2$  and  $f_1(x, y), f_2(x, y)$  have the same properties as in the previous theorem. Then for any anticlockwise-oriented parametrization  $\phi$  of  $\partial B$

$$\iint_B \left( \frac{\partial f_2}{\partial x} - \frac{\partial f_1}{\partial y} \right) dx dy = \oint_{\phi} f_1 dx + f_2 dy \quad (10)$$

#### 4 Derivation of the Consumer Surplus Integral

In this section, we derive the consumer surplus line integral making use of Green's theorem. Let us consider a continuously differentiable demand function  $f: \mathbb{R}_+ \rightarrow \mathbb{R}_+, p \mapsto f(p) = q$ . Let there be an increase in the price from  $p_1$  to  $p_2$ . The problem is to calculate the change in the consumer's surplus denoted by  $T$ . It is quite evident that the change is the shaded area in Figure 1.

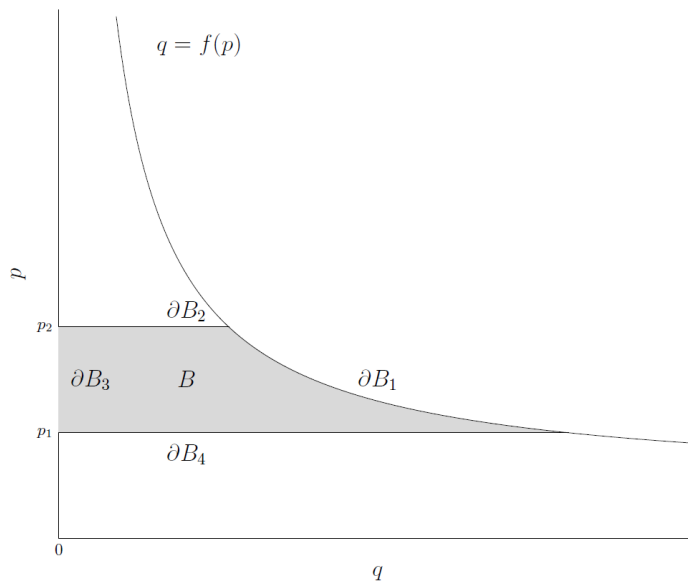


Figure 1 The Consumer Surplus Line Integral  
Source: Own illustration

It can immediately be noticed that the area can be calculated as the following integral:

$$T = - \int_{p_1}^{p_2} f(p) dp \quad (11)$$

This integral could be thought of as a line integral along the price-consumption curve, which could be parametrized with the price. The change in the consumer's surplus can also be calculated as the following double integral:

$$T = - \iint_B 1 dq dp \quad (12)$$

where  $B = \{(q, p) \in \mathbb{R}^2: p_1 \leq p \leq p_2 \wedge 0 \leq q \leq f(p)\}$ . Making use of Fubini's theorem, we can rewrite the double integral as an iterated integral:

$$T = - \int_{p_1}^{p_2} \left( \int_0^{f(p)} 1 dq \right) dp \quad (13)$$

Evaluating the inner integral would yield Equation (11). Observe that the set  $B$  with its boundary  $\partial B$  satisfies the assumptions of Green's theorem. Therefore, we can look for a continuously differentiable vector-valued function  $F(q, p) = (f_1(q, p), f_2(q, p))$  such that  $\frac{\partial f_2}{\partial q} - \frac{\partial f_1}{\partial p} = 1$ . One of the first candidates which come up is the following vector-valued function:  $F = (0, q)$ . According to Green's theorem, we obtain:

$$T = - \iint_B 1 dq dp = - \oint_{\partial B} 0 dq + q dp \quad (14)$$

As can be seen in Figure 1, the boundary can be split into four parts in the following manner:

$$\partial B = \bigcup_{i=1}^4 \partial B_i \quad (15)$$

These sets are pairwise disjoint except for a finite number of points. Therefore, thanks to the additivity of the line integral, we can write:

$$- \oint_{\partial B} 0 dq + q dp = - \sum_{i=1}^4 \int_{\partial B_i} q dp \quad (16)$$

Let us notice that the only potentially non-zero integral of all four integrals is along  $\partial B_1$ . Along  $\partial B_3$ ,  $q$  is identically zero, so the whole integral is zero. Along  $\partial B_2$  as well as  $\partial B_4$ ,  $q$  is no longer zero, but the price does not change along these lines, therefore,  $dp = 0$ . We can parametrize  $\partial B_1$  quite naturally since it is a graph of a function. We let  $p = p \in [p_1, p_2]$  and  $q = f(p)$ . The differentials are as follows:  $dp = dp$  and  $dq = f'(p)dp$ . Hence, we get the desired result:

$$T = - \int_{p_1}^{p_2} f(p) dp \quad (17)$$

This integral is then extended in the literature for the case when multiple prices change. Under certain assumptions, the resulting line integral does not depend upon the integration path and can therefore be evaluated as a line integral along line segments. These assumptions are quite restrictive (see [14]) or [3]).

Using our approach which relies upon Green's theorem, we could derive other line integrals the value of which is equal to that of the integral given by Equation (17) just by selecting a suitable vector-valued function and/or a different anticlockwise regular Jordan parametrization.

One could also use the divergence theorem to derive the integral (which should not come as a surprise since Green's theorem is its consequence). In that case, one might consider  $F = (q, 0)$ . The outer unit normal vectors for  $\partial B_2$ ,  $\partial B_3$  and  $\partial B_4$  are  $(0 \ 1)$ ,  $(-1 \ 0)$  and  $(0 \ -1)$ , respectively. Therefore, the only potentially non-zero integral is once again the one along  $\partial B_1$ . The outward unit normal vector there (considering the same parametrization used in Green's theorem) is equal to  $\frac{1}{\sqrt{(dp)^2 + (f'(p)dp)^2}} (dp \ -f'(p)dp)$  and  $ds = \sqrt{(dp)^2 + (f'(p)dp)^2}$ , so in the end we get the same integral.

## 5 Conclusion

In this article we have derived the consumer surplus line integral making use of Green's theorem as well as the divergence theorem. This approach enables readers to come up with numerous line integrals with the same value by selecting a suitable vector-valued function and a parametrization.

As far as we know, this is one of the very first direct applications of the two theorems from vector calculus in economics. In our opinion, vector analysis has the potential to be successfully employed in economics just like it has been employed in physics for nearly two centuries. Vector-valued functions, albeit rarely used in economics, can describe many real-world economic processes. One might consider, for instance, a vector-valued function the inputs of which are factors of production, and the output is a vector with elements equal to the production of industries in the economy. One step further from this example is the reformulation of the Leontief input-output model. The

curves in this setting could be curves joining points in the production space corresponding to different prices of the factors of production.

Another possible area of research where vector calculus might prove beneficial is regional economics. Vector-valued functions in this case could assign to each point in space (which might represent a country, a city, or even more abstract structures) a vector of pertinent economic indicators.

There are more examples as to how vector calculus could help economists study and tackle real-world economic phenomena. However, delving into more detail is way beyond the scope of this contribution (or any single article).

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# Post-Pandemic Sources of Inflation Dynamics in USA and Europe

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**Abstract.** In the context of so-called Great Moderation of the last decades characterized by relatively low and stable inflation rates are the post-pandemic inflation rates of late 2021 and early 2022 relatively elevated. Economic theory and intuition points to the set of inflation dynamic drivers of the real and possibly monetary character. The high inflation rates have negative economic and social consequences; however, the sources of inflation dynamic determine the adequate monetary policies. The goal of this paper is to analyze theoretically sources of inflation dynamics as the set of real and monetary variables. It seems that on the real side are inflation drivers in USA and Europe of similar nature, on the contrary on the monetary side. The crucial distinction between the inflation dynamics caused by monetary factors in USA and Europe is the extent of QE program and the transmission of the program. Therefore, we conclude that it is plausible, that post-pandemic inflation dynamic in Europe is mainly driven by raising energy and food prices, whereas in USA also with fiscal over-expansion, however more rigorous analysis is needed to take stated conclusion as factual.

**Keywords:** Inflation, Transmission of monetary policy, Monetary policy

**JEL classification:** C51, E31, E47

## 1 Introduction

The greater aggregate demand of the economy than its aggregate supply causes inflationary pressure called demand-pull inflation. Economists describe this phenomenon as the state when too much money are chasing too few goods. However, also the side of supply is very essential in analysis of the inflation dynamics. Subdued supply of goods and services - shocks on the side of costs for companies - create inflation pressure as well. Therefore, shocks leading to reduction of supply of goods or services, fall in productivity, rising prices of commodities, destruction of capital or supply shortages can create inflation dynamic.

The main problem in analysis of inflation dynamics is to find the right set of variables which describe inflation dynamic. We will review the literature to find the set of regressors which are useful in empirical analysis of inflation dynamics.

## 2 Literature Review

To review different sources of inflation dynamics we are looking at the side of demand as well as side of supply. Demand driven inflation seems to relate to aggregate disposable income and wealth relative to product. On the other hand, supply driven inflation seems to relate to dynamic of the product in the economy.

To represent the money-prices link we can use the P-Star model based on the quantity theory of money. Hallman et al. (1991) state that the long-run link between money and prices is found when the velocity of M2 is represented as a mean-reversion process. The similar argumentation based on the assumption of stability of M2 velocity and operation of economy near the potential is found in Hallman and Anderson (1993). P-Star model logic is found appealing also in in the papers of Kiptui (2013), Czudaj (2011), Gerlach and Swennson (2003), Scheide and Trabandt (2000), Moosa (1998) and Kool and Tatom (1994). P-Star model based on the quantity theory of money seems to present plausible theory of demand driven inflation. The arguments of Blanchard, Domash and Summers (2022) based on the analysis of Beveridge Space show that combination of low unemployment rate and very high vacancy-to-unemployment ratio in USA suggest labor market overheating as well as substantial increase in natural unemployment rate. Blanchard (2022) describes four main forces behind inflation, labor market tightness, price shocks and their first-round effects on inflation, second-round effects reflected in other prices and nominal wages and fourth driving force is “de-anchoring”. Author argues that headline numbers for inflation in the eurozone and United States are roughly similar, however behind those numbers lie important differences.

Domash and Summers (2022) describing different signals about the degree of slack of labor market in the U.S., since the outset of Covid-19 pandemic and they arguing that their analysis of labor market in USA suggest that labor market tightness is likely to contribute significantly to inflationary dynamics in the USA. Bolhuis and Summers (2022) compare past and present inflation in USA to better contextualize the current run-up in inflation, they support the view that current inflation levels are much closer to past inflation peaks than what would be otherwise suggested by the official inflation series. In the analysis conducted in the 2021, Koester et al (2021) compare inflation dynamic in the United States and euro area. They observe that substantial part of the strong increases in inflation and the upside inflation surprises over 2021 can be attributed to special factors that are likely of the temporary nature. However, they remark that for a more permanent increase in inflation, price pressures usually need to become more broad-based and need to reflect increasing labor cost pressures.

Since 1960's was the Phillip curve the prominent model describing the connection between domestic rate of unemployment and wage inflation. Peneva and Rudd (2015)

think that the effect of wage growth on inflation makes at least intuitive sense. However, according to Feldstein (2015) the link between wages and prices can be offset by lower prices of oil as well as appreciating domestic currency. Forbes (2019) argues that globalization has meaningful impact on the dynamics of CPI inflation over the last decade, however had a more moderate effect on core inflation and wages. To argue that globalization affects dynamic of inflation is not new, after all, since the 1970's Gordon (1977 and 1985) highlighted the necessity to supplement the Philips curve framework to account for global prices of oil. The war in Ukraine which started in 2022 seems to create shock for energy prices, especially for Europe. Oil embargos of 1970's are in some sense similar events to import embargo of Russian oil in 2022. Still, the labor market activity and the overall Covid-19 fiscal stimulus play critical role in assessing the drives of inflation dynamics. For example, Summers (2022) describing the USA economy where the income was running short by \$50 billion a month because of the COVID-19 pandemic, whereas the government injected \$150 to \$200 billion a month into the economy. According to Summers (2020) is therefore not surprising that the overstimulation of the U.S. economy led to an overflow of demand, which has generated inflation. Kinlaw et al (2022) apply a Hidden Markov Model to identify inflation regimes and employ an attribution technique based on the Mahalanobis distance to identify determinants of inflation, their analysis reveals that as of February 2022, the most important determinant of the recent spike in inflation in USA was spending by the federal government.

### 3 Data and Methodology

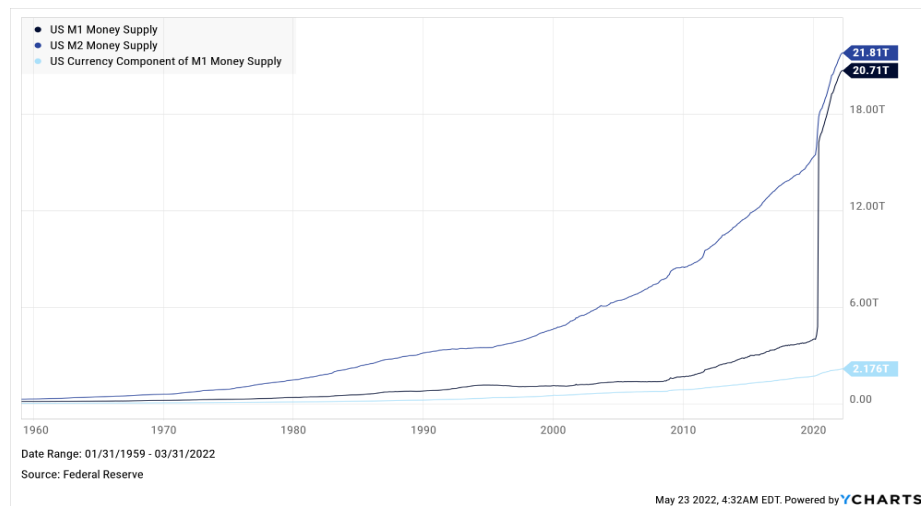
The complexity of the inflation dynamics in the short and long run does not allow to describe inflation as purely a monetary phenomenon, i.e. a situation where "too much money chases too little goods". Inflation is a more complex phenomenon, so it is necessary to combine the demand side (demand-driven inflation) with factors acting on the supply side. For the USA, such factors are clearly wages, the price of imports and energy prices. However, the demand side is important as well, especially in the case of imbalances in the rate of growth of money supply and product.

From the review of the literature, relative rate of change (represented by the slope of the curve) of wages, import and energy prices, money and product is important determinant of inflation generating process. Therefore, we will analyze the data graphically and try to infer imbalances in their rate of change.

From the perspective of the demand side and in line with the quantitative theory of money, we define the parameters M (money supply), V (velocity of money), P (average price level) and Y (real output) as in (1):

$$P = \frac{V}{Y} M \quad (1)$$

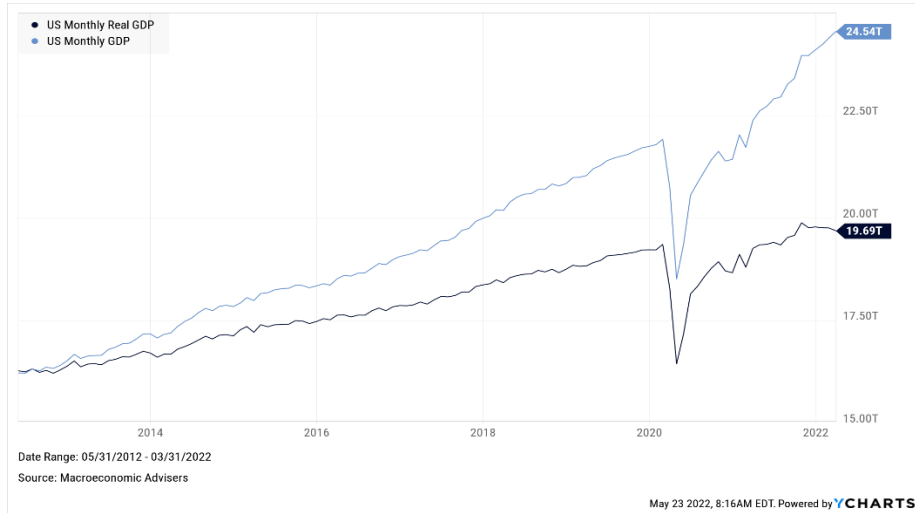
We analyze the individual parameters of the model graphically. We measure the money supply by monetary aggregates. The speed of money circulation cannot be observed explicitly (but it may be computed) and the concept of real product corresponds to real GDP. The change in the average price level is inflation. In the following section, we will graphically display and analyze the evolution of the elements of the equation (1).



**Fig. 1.** Monetary aggregates (M1, M2) and currency component of M1.

Since 2020, we have observed a significant increase in the monetary aggregate M1 and M2 (approximations of the M component of the relation (1)). The M1 monetary aggregate has been redefined by the Federal Reserve System (Regulation D, Reserve Requirements). The new regulation incorporated into M1 the new components of money previously contained in M2 (but not M1). Savings deposits and checkable deposits, which limited the choice of depositors (to less than 6 transactions per month). Under Regulation D, restrictions no longer apply to savings account transactions, and therefore savings accounts may be included in more liquid forms of money (M1).

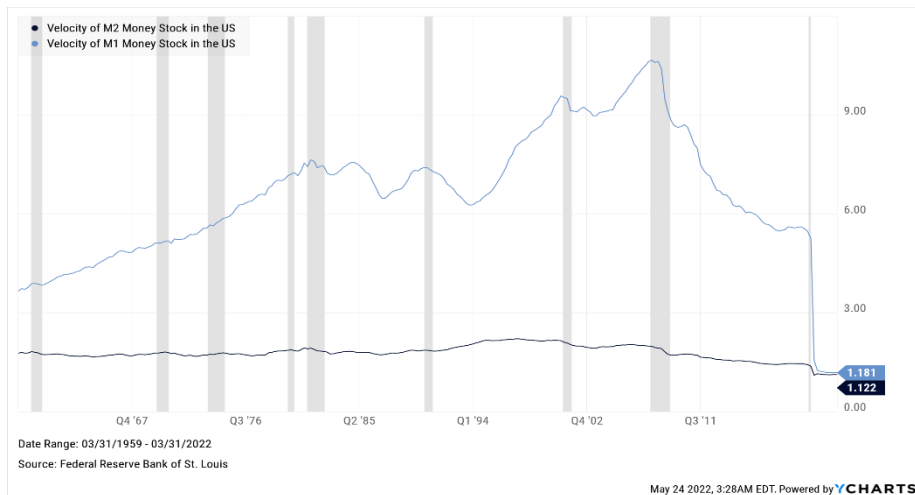
The slope of M2 and M1 is after 2020 significantly higher than in the previous decades, which indicates significantly higher rate of money growth since the early 2020.



**Fig. 2.** US Monthly Real GDP and Nominal GDP.

The description of the product dynamic from relation (1) is an important component determining the dynamics of inflation. The declining pace of real GDP growth in the inflationary period suggests weakening consumption. According to Fig. 2., nominal GDP is growing but real GDP is declining during 2022. We can also see significant rebound of GDP during 2020. Real GDP is roughly on its long-term trend.

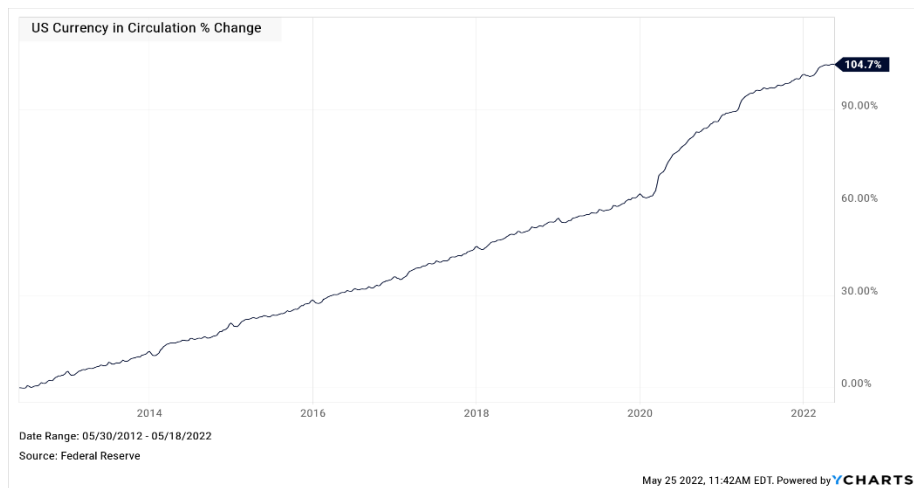
We still need to analyze the development (variable  $V$ ), i.e., the velocity of money from relation (1). In Chart 4, we observe the instability of the money circulation rate of the monetary aggregate M1.



**Fig. 3.** Velocity of M1 and M2.

Until 2008, the M1 had a growing character, and during the recession period, velocity tended to decline. In other words, the periods associated with a decline in product are associated with a decline in the velocity of money circulation. The 1970's are associated with oil shocks, the oil embargo began in 1973 and caused a series of recessions. The size of the M1 fell sharply during the Great Recession (2008), when the QE program was launched in the USA. Subsequently, the M1 velocity fell sharply in 2020, since parts of the M2 monetary aggregate were divided into M1. The money in circulation of the broader monetary aggregate M2 also slowed down, reaching the level of only 1,122 at the end of 1Q 2022.

The declining velocity of M1 and M2 suggests that there are elements of money that do not enter the real economy. It is money that is not subject to exchange and the economic context suggests that these money represents the reserves of commercial banks from the sale of bonds to the central bank within QE.



**Fig. 4.** USA Currency in circulation (% change)

The accelerating pace of money growth in the circulation since 2020 is causing inflationary pressure. Balances in the central bank's government account grew significantly during 2020 as money was used to help citizens during the Covid-19 pandemic.

In addition to the monetary side of inflation in the US, we also observe supply-side inflationary pressures caused by rising costs (wages, commodities) and insufficient supply of goods.

## 4 Conclusion

The paradigm of low inflation observed from the beginning of QE in the US (2008) to the outbreak of the US pandemic (2020) seems to be disrupted by the greater interconnectedness of budgetary and monetary policy, reflected in the fiscal over-expansion in terms of direct transfer payments to US citizens. Relatively high post-pandemic inflation rate in the USA of the late 2021 and early 2022 may be, therefore partly monetary phenomenon.

Unlike previous QE programs before 2020, the liquidity from the purchases of government bonds by the Federal Reserve System in 2020 was directed directly to the real economy due to fiscal spending. To support the conclusions here, there is the need for more rigorous, mathematical description of inflation dynamics. Therefore, the results of this paper should rather be taken as informative than factual.

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# Attention and Volatility in Renewable Energy Stocks

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**Abstract:** Under the Efficient Market Hypothesis stock prices should reflect only the fundamental information relevant to the company in question. If other, such as behavioural factors affect the stock price, then this discrepancy should be resolved by the means of arbitrage traders. In our study we look at the effect of retail trader attention on the volatility of renewable energy companies' stocks. We find that attention, measured by Google Trends, is a good in-sample predictor of next day volatility for a given company's stock. We later try to explore this anomaly in an out-of-sample study.

**Keywords:** Volatility, Behavioural finance, Volatility modelling, HAR

**JEL classification:** G10, G14, G17

## 1 Introduction

With the deepening of the sustainable development concept, the clean energy industry has proliferated in recent years. Given the rapid expansion of the renewable energy industry, the performance of the renewable energy companies in financial markets has attracted increased attention from policymakers and investors. With recent rise of retail investment activity and popularity of ESG topics among the wider public, renewable energy investment is likely to be the retail market's favourite play.

Investor sentiment affects the attitude toward financial assets and investment decisions, and it is widely used as a behaviour factor in financial research. Behavioural finance suggests that investors and markets are not fully rational, and that investors are influenced by their biases and cognitive errors. It is comprised of two main components: psychology, which explains the fallibilities in human behaviour, and limits to arbitrage, which argues that in an economy of rational and irrational traders, irrationality could have a sustained and significant impact.

In this paper, we model volatility of available stocks in the renewable energy sector of SP500 and investigate the relationship between investors' attention and stock

price volatility. Given that markets are to a large degree efficient and any leftover mispricing is often quickly discovered and exploited, we would expect that investors' attention should not play a significant role if any. Although, many authors were able to find pricing anomalies, most do not persist much longer after they are published. What can be thus said is that markets are efficient in the long run and any departure from the optimal price of assets is eventually corrected. The time it takes to arbitrage away mispricing due to sentiment is largely driven by the relative strength of the opposing forces that drive stock price away and towards its intrinsic value. As arbitrageurs face limitations on the amount of capital and risk they can deploy, mispricing can persist for a surprisingly long time. As the adage says: "markets can remain irrational longer than you can remain solvent". Historical example of such situation is the GameStop episode where traders driven by somewhat arbitrary desire to gamble grouped fanatically around the Wallstreet bets forum and decided to bid up price of certain stocks to multiples of their rational value. Due to the market frictions such as limited ability to short GameStop, as well as lack of risk appetite to intervene by the informed traders, the stock of GameStop was significantly mispriced for longer than an efficient market should allow. This shows that although sentimental investors can not prevail over the whole stock market, they can still contribute to local inefficiencies by rising volatility and driving asset prices away from fundamentals.

Being cognisant of the localised effects that noise traders have on the markets, we focus our study on the burgeoning field of renewable energy which we believe have been and will continue to occupy retail investors' attention. If noisy traders are sufficiently present in this industry, they may be able to tilt the balance of arbitrageur vs noise trader such that stock prices are considerably moved away from their intrinsic value. As a result of this we would expect to find excess volatility that could be to some extent related to the investors sentiment measured by their attention. A large amount of literature provides evidence that investor sentiment has an important impact on the financial market. However, only a few studies have discussed the influence of investor sentiment on clean energy stock so far.

### **3 Literature review**

Early studies of stock returns established that economic and fundamental company information explain only a small part of their variance (Shiller (1981), Leroy and Porter (1981), and Roll (1988)). Several studies point to the role of noise traders and find that their impact is greater than information regarding company's cashflows or dividends. For example, Campbell and Kyle (1988) attributes the level of unexplained volatility to the interaction between informed and noise traders. Noise traders are able to drive prices due to the risk aversion of the informed investors. Foucault et al. (2011) uses the natural experiment provided by French stock market trading costs to show that retail investors have a positive effect on the volatility of stock returns. Given the contribution of noise traders on the stock market volatility, numerous researchers started to become interested in predicting noise traders' actions. Measures that approximate noise traders are for example past volatility and price moves, stock market news and related company information and particularly retail traders' activity such as reading and searching for news including posting on stock forums. Traders' attention to the changes in prices and

news can be directly measured by looking at the number of times a certain website is searched for. Google lends itself to be an excellent source of information on such activity.

Da, Engelberg and Gao (2011) were among the first to use Google search frequencies as a measure of investor attention. They find that Search Volume Index is similar but different to previously used attention proxies and that it is much more direct measure of attention that is likely attributed to retail investor. Their study finds that an increase in SVI predicts increase in stock prices in the next 2 weeks. Furthermore, Dimpfl and Jank (2011) find a strong relationship between realized volatility and the stock search queries for the stock name. The causality runs in both directions, both high volatility leads to increase in search queries and increase in queries leads to increases in subsequent volatility.

Vlastakis and Markellos (2012) relate information demand measured by Google trends and supply from Reuters, they conclude that variations in information demand appear to have a significant effect on the realised volatility of individual 30 NYSE stocks and the overall market. Andrei and Hasler (2015) find that volatility increases quadratically with attention and uncertainty.

Audrino et al. (2020) looks for the predictive ability of sentiment and attention in a realised volatility model. They find that in a regression where they control for a range of economic and financial predictors variables such as attention measured by search frequencies for 'stock market' and related keywords is correlated with increase in realised volatility. They also note that wider group of searched keywords had more statistically significant effect compared to the individual company keywords. Ballinari et al. (2022) look at the effects of investor attention with respect to the time of announcements and report that investors' attention impact on volatility is conditional on the timing and events surrounding it. This study shows that the effect of Google searches is not linear and is at times is much more impactful, particularly when the attention is coupled with market announcement.

## **4 Data**

We investigate the relationship between investor/ trader behavioral features linked to attention and the stock market volatility. Attention has been historically indirectly measured by market volume, turnover and news and while volume might be the natural candidate to link investor attention and volatility, several studies, such as Brooks (1998) and Donaldson and Kamstra (2005) show that it does not improve the accuracy of volatility forecasts. Furthermore, news as an alternative measure is mostly irregular and may underly a considerable publication lag. Recent publications use internet message postings (Kim and Kim, 2014), Facebook users sentiment data (Siganos et al., 2014) or search frequencies (Vozlyublennaiia, 2014) to assess the influence of retail investors attention on the stock market. Among these studies, Da et al. (2011), Vlastakis and Markellos (2012) and Andrei and Hasler (2013), suggest that Google search volume is a driver of future volatility. With respect to the aforementioned literature, we chose to use Google Trends as a proxy for investor attention.

Regarding our choice of data, we collected investor attention data from Google Trends website and volatility was estimated based on the daily hi, low and close stock

prices. Google trends was used to collect time series of data points that tell us the number of searches for specific keywords that are related to the company's stock price. For example, we downloaded daily number of searches for the word “Enphase energy share price” in the US between the years 2018 and 2021. Google gave us the time series of relative daily number of times that people searched for this keyword. As Google provides only a limited number of daily searches, we had to deploy a linking procedure to obtain the time series of sufficient length. The volatility of individual stocks was downloaded as daily realized volatility during the trading days for the given stocks. The volatility data was then merged with the Google search data by date. Lagged variables for both Google Trends and volatilities were created in order to obtain the variables we need for the regression.

The companies that we tested were all renewable energy companies from the SP500 index. These companies were selected by being part of both SP500 and renewable energy indices such as S&P Global Clean Energy Index (SPGTCLN), Wilderhill ECO (ECO), Wilderhill NEX (NEX). We chose to focus on renewable energy as we feel that it is a sector that is favored by the retail traders and thus may provide answers for solving behavioral biases in studying volatility.

## 5 Methodology

To find the relationship between volatility and investors' attention we use a simple OLS regression using a HAR model.

### 5.1 OLS

In statistics, ordinary least squares usually abbreviated as OLS is a type of linear least squares method for estimating the parameters in a linear regression model. OLS chooses the parameters of a linear function of a set of explanatory variables by the principle of least squares by minimizing the sum of the squares of the differences between the observed dependent variable (values of the variable being observed) in the given dataset and those predicted by the linear function of the independent variable.

### 5.2 HAR

A rapidly growing body of literature has documented improvements in forecasting financial return volatility measurement using various heterogeneous autoregression (HAR) type models. Most HAR-type models use a sum of components to mirror the daily, weekly, and monthly averages of the volatility process, but they ignore model specification uncertainty. Although there are more complex models such as stochastic jump diffusion volatility models, we chose to use the HAR due to its parsimony and generality. Furthermore, HAR model has become a standard in modelling high frequency realized volatility data and thus is a prime choice in our study.

The model that we use has the following specifications:

$$V_t = \beta_0 + \beta_1 V_{t-1} + \beta_2 V_{t-5} + \beta_3 V_{t-22} + \beta_4 GT_{t-1} + \epsilon_t$$

As the distribution of the residuals was not Gaussian, we used log transformation to all our variables. After the transformation we run a number of tests to make sure the OLS conditions are satisfied:

Breusch-Pagan test

```
lmtest::bptest(regression)
```

White's test

Shapiro-Wilk normality test

```
sresid <- MASS::studres(regression)
```

```
shapiro.test(sample(sresid,5000))
```

To run the regression and estimate parameters we use the statistical language R.

```
regression <-  
lm(log(ENPH_joint$VI.H1)~log(ENPH_joint$VI.L1)+log(ENPH_joint$VI.L5)+log(E  
NPH_joint$VI.L22)+log(ENPH_joint$est_hits.L1 + 1))
```

The regression analysis was run using the following stocks Enphase Energy Inc, SolarEdge Technologies Inc, Consolidated Edison Inc, Tesla and NextEra Energy Inc. The keywords that we used are “[company name] + stock price”.

## 6 Results

In order to quantify the relationship between investors' behavioral biases and the stock market, we estimate the impact of investors' attention (measured by Google trends) on the next trading day volatility of company's stock price. In addition to the attention variable, we also use a number of lagged volatilities as regressors. We include the full set of results for all the control variables along with the residual statistics for the reader's content.

We use individual company regression results to make a general argument about investors' attention in the renewable sector. Stocks were chosen based on their presence in renewable energy indices and SP500 index. This choice was motivated partly by the data availability, but mainly by design not to introduce selection or other bias in the regression. We are aware of potential limitations in our approach arising from the small sample size and we aim to improve on this in the future iteration of our study where we consider renewable energy companies from a wider index such as SP1500.

The results of the individual regressions are the following:

**Enphase energy (Enphase energy stock price)**

Coefficients:					
	Estimate	Std. Error	t value	Pr(> t )	
(Intercept)	1.53215	0.30664	4.997	6.60E-07	***
log(ENPH_joint\$VI.L1)	0.32078	0.02667	12.026	2.00E-16	***
log(ENPH_joint\$VI.L5)	0.28080	0.03674	7.642	4.03E-14	***
log(ENPH_joint\$VI.L22)	0.19724	0.04108	4.801	1.75E-06	***
log(ENPH_joint\$est_hits.L1+1)	0.02967	0.01636	1.814	0.07	.
Residuals:					
Min	1Q	Median	3Q	Max	
-3.4861	-0.5274	-0.0393	0.4758	3.4360	

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.78 on 1351 degrees of freedom (Multiple R-squared: 0.3137, Adjusted R-squared: 0.3117 F-statistic: 154.4 on 4 and 1351 DF, p-value: < 2.2e-16

**SolarEdge (SEDG stock price)**

Coefficients:					
	Estimate	Std. Error	t value	Pr(> t )	
(Intercept)	1.37191	0.25941	5.289	1.40E-07	***
log(SEDG_joint\$VI.L1)	0.30941	0.02427	12.751	2.00E-16	***
log(SEDG_joint\$VI.L5)	0.28685	0.03316	8.651	2.00E-16	***
log(SEDG_joint\$VI.L22)	0.20593	0.03706	5.557	3.20E-08	***
log(SEDG_joint\$est_hits.L1+1)	0.02733	0.01360	2.010	0.0446	*
Residuals:					
Min	1Q	Median	3Q	Max	
-2.17664	-0.53613	-0.03266	0.47596	3.12643	

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.7635 on 1639 degrees of freedom. Multiple R-squared: 0.3202, Adjusted R-squared: 0.3185, F-statistic: 193 on 4 and 1639 DF, p-value: < 2.2e-16

**Consolidated Edison (ed stock price)**

Coefficients:					
	Estimate	Std. Error	t value	Pr(> t )	
(Intercept)	0.55703	0.14211	3.92	9.20E-05	***
log(ED_joint\$VIL1)	0.27570	0.02345	11.755	2.00E-16	***
log(ED_joint\$VIL5)	0.37422	0.03412	10.968	2.00E-16	***
log(ED_joint\$VIL22)	0.22046	0.03543	6.223	6.07E-10	***
log(ED_joint\$est_hits.L1+1)	0.01962	0.01168	1.681	0.093	.
Residuals:					
Min	1Q	Median	3Q	Max	
-2.04447	-0.44162	-0.01835	0.43094	2.21640	

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.6754 on 1796 degrees of freedom. Multiple R-squared: 0.4263, Adjusted R-squared: 0.425, F-statistic: 333.6 on 4 and 1796 DF, p-value: < 2.2e-16

**NextEra Energy (NEE stock price)**

Coefficients:					
	Estimate	Std. Error	t value	Pr(> t )	
(Intercept)	0.71159	0.15088	4.716	2.59E-06	***
log(NEE_joint\$VIL1)	0.35079	0.02313	15.165	2.00E-16	***
log(NEE_joint\$VIL5)	0.27645	0.03193	8.657	2.00E-16	***
log(NEE_joint\$VIL22)	0.21385	0.03424	6.246	5.26E-10	***
log(NEE_joint\$est_hits.L1+)	0.03703	0.01333	2.777	0.00555	**
Residuals:					
Min	1Q	Median	3Q	Max	
-2.03082	-0.48436	-0.01791	0.43063	2.78464	

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1 Residual standard error: 0.7053 on 1796 degrees of freedom. Multiple R-squared: 0.4345, Adjusted R-squared: 0.4332, F-statistic: 344.9 on 4 and 1796 DF, p-value: < 2.2e-1

**Tesla (TSLA stock price)**

Coefficients:					
	Estimate	Std. Error	t value	Pr(> t )	
(Intercept)	1.26163	0.21190	5.954	3.14E-09	***
log(TSLA_joint\$VIL1)	0.34887	0.02306	15.126	2.00E-16	***
log(TSLA_joint\$VIL5)	0.25974	0.03151	8.242	3.22E-16	***
log(TSLA_joint\$VIL22)	0.18191	0.03400	5.35	9.91E-08	***
log(TSLA_joint\$est_hits.L1+1)	0.05845	0.01802	3.244	0.0012	**
Residuals:					
Min	1Q	Median	3Q	Max	
-2.04298	-0.51044	-0.04577	0.48033	3.03337	

Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.7423 on 1796 degrees of freedom. Multiple R-squared: 0.4074, Adjusted R-squared: 0.4061, F-statistic: 308.7 on 4 and 1796 DF, p-value: < 2.2e-16

The above regression results tell us about the relationship between estimated daily volatility of stock returns for a given stock and the amount of Google searches represented by the Google Trends index. The dependent variable is estimated daily realized volatility of stock price and explanatory variables are estimates of lagged daily, weekly and monthly realized volatilities of the stock price and the lagged daily Google trends index of the given stock-related search keyword. As the variables used in the regression are transformed to be logs, we can interpret the coefficients as elasticities: one percent increase in the Google Trends index for the search keyword “TSLA stock price”, given the control variables, on average, is associated with 0.058 percent increase in the rise of volatility of Tesla stock on the following day. This result is statistically significant at 99 percent confidence level. Similarly, for Enphase Energy, Solar Edge, Consolidated Edison and NextEra Energy we find small positive relationship between Google trends and their next day volatilities that is significant but at lower confidence level.

**6.1 Discussion**

The topic of attention and stock volatility has been studied for over 20 years now. It is widely believed that volatility in stock prices is best modelled as an autoregressive



function of past volatilities rather than fundamental information. Despite this there have been attempts to explain volatility using attention variables. Some of these studies claim to find little or no relationship, others are slightly more positive. For example, Audrino et al. 2021 finds that Google trends predict volatility however the size is somewhat insignificant. Our study corroborates Audrino's finding of significant effect. Similarly, the size of the effect is somewhat small and thus may not be exploitable by a volatility trader looking for an edge in modelling. This result is also described in a related study looking at the Google searches and stock returns, where Bijl et al. 2016 find a significant effect of attention on returns, yet a trading strategy based on this approach is deemed not to be profitable when transaction costs are taken into account.

## 7 Conclusion

Behavioural economics and finance is not yet a completely explored field of science. In this paper we wanted to shed some light on the role of attention of retail traders as well as test a more general hypothesis about the relationship between behavioural factors and volatility. We chose to use investors' attention and its effects on volatility as this is a non-fundamental variable that provides a relatively well-measured proxy for several biases such as recency bias, and others. The analysis was centered around renewable-energy stocks which enables us to test secondary hypothesis regarding this sector of the stock market. We believe that both the choice of attention measure and renewable energy sector are correlated with retail investor interest and thus contain a higher percentage of sentiment-driven retail investors. As pointed out in the literature review, past studies point to retail investors being more prone to behavioural biases and thus a favourable sample for our study.

The regression analysis has shown that in most cases there is a statistically significant effect between the number of searches for the company stock price and the size of the company's price volatility the day after. On average we found that roughly 1% rise in the number of searches leads on average to 0.03 % rise in the volatility of the stock. This shows that a rise in the attention of retail investors leads on average to heightened volatility in the price of the stock the following day. Due to the sample size of our study, we can be fairly sure that this effect does not arise due to other events such as fundamental changes in the company performance. The coefficients on the Google trends variable were either 95% or 99% significant and we thus can also exclude the possibility of this effect arising purely by chance. Our finding has a number of applications in the risk management field by expanding the classic HAR model with daily data on attention. And last but not least, it also contributes to the volatility modelling literature.

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# Use of the Kaplan-Meier Estimator in Actuarial Science

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**Abstract.** There are many reasons why an insured person lapses (cancels) his policy. Lapse risk is one of the main risks, which is also defined in Directive Solvency II. Lapse analysis can be performed by various statistical methods. In this paper, we illustrate the possibility of using survival analysis to calculate the lapse ratio. Survival analysis does not have to be used only in medical research but nowadays finds application also in economics e.g., actuarial science. We focus on the Kaplan-Meier estimator, the most used method of modeling survival times. In practice, not every insurance policy has to lapse, so survival times from these policies should be right-censored. The Kaplan-Meier method allows to include these censored observations in the model. We use R programming language to calculate Kaplan-Meier estimation for survival times and to plot survival functions. Since the Kaplan-Meier model is univariate model, we focus on the impact of sex on insurance policy lapses.

**Keywords:** Survival analysis, Kaplan-Meier estimator, R programming language.

**JEL classification:** C14, G22

## 1 Lapse analysis in Insurance industry

Survival analysis is one of the oldest statistical methods. It was originally created in the medical field, where the time from the beginning of the patient's treatment to his death was monitored. Later, this method found application in other areas, such as economics, demography, or insurance. Survival analysis can be characterized as a set of statistical methods and procedures for examining data, where the primary random dependent variable is the time of occurrence of a previously known event. Therefore, in survival

analysis we examine the length of time that elapses from the beginning of the event to its occurrence. This time can be defined as days, weeks, months, or years.

As we mentioned, one of the most frequently observed events that we can analyze is the death of an individual, i.e. time from birth to death. Survival analysis is the universal method of examining data, with which we can analyze various types of upcoming positive or negative events (illness, bankruptcy, liquidation of insurance claims, cancellation of insurance, and others).

The beginnings of survival analysis date back to the 17th century. This method was first used by Jan de Witt in 1671 in insurance to calculate the value of life annuities. In the next two centuries, scientists tried to explain the course of life respectively population mortality. At the beginning of the 20th century, the actuarial method of survival analysis was created. Paul Eugene Böhmer contributed to its creation. His work represents the revolution in the concept of survival analysis. However, his estimate of mortality rates remained forgotten for years, and in half a century, it was revised by Kaplan and Meier. Kaplan and Meier's contribution is considered one of the most important in the whole modern period of survival analysis. [4]

The insured person may terminate the life insurance policy for many reasons, such as high premiums, low financial returns, distrust of the insurance company, or he does not need to cover health risks anymore. If the client decides that he does not want to continue with the contract, this contract is canceled. The client will stop paying the premium, and if it has been agreed in advance in the contract conditions, the insurance company will pay the redemption value. A high cancellation rate, especially at the beginning of insurance, can affect the profitability of an insurance company. Therefore, a penalty charge in the life insurance sector in the first years of insurance has been introduced, which is gradually reduced during the insurance period (in the first years of insurance, for some products, this charge may be 100% of the insurance value). However, in some cases, it is advantageous to lapse the insurance policy.

Lapses are part of the insurer's risks that are not fully controllable. Therefore, the insurer should analyze and handle this risk. In practice, we encounter the calculation of the percentage of cancellation (lapse ratio), especially in the forecast of cash flows and profitability of products. In general, an insurer should know and quantify all its business risks. It is good to know after which period contracts have the greatest tendency to lapse and to predict the number of contracts in the portfolio for future periods. The loss caused by the lapse ratio is difficult to quantify. However, one option is to compare the cash flow with a 0% lapse ratio and with the calculated lapse rate.

Monitoring the lapse rate in the insurance company is essential in the calculation of the Solvency Capital Requirement according to the legislation – Directive Solvency II. The Solvency Capital Requirement (SCR) represents the required total value of the own funds of a European insurance or reinsurance company. The SCR must take into account all quantified risks to which these companies are exposed. It is the minimum amount of capital needed to cover potential losses that may occur during one year with a probability of 99,5%.

The SCR is calculated according to Solvency II as the sum of the basic capital requirement, the capital requirement for operational risk, and the adjustment for the ability to absorb losses of technical provisions and deferred tax liabilities. The basic

SCR is usually calculated once a year and covers at least the following groups of risks: non-life underwriting risk, life underwriting risk, health underwriting risk, market risk, credit risk, and operational risk. [3]

Article 105 of the Solvency II Directive defines the lapse risk as "the risk of loss, or of adverse change in the value of insurance liabilities, resulting from changes in the level or volatility of the rates of policy lapses, terminations, renewals, and surrenders". The lapse risk belongs to the sub-module of the life underwriting risk module, which is determined on the basis of a standard formula as [2]:

$$SCR_{life} = \sqrt{\sum_{i,j} Corr_{i,j} \times SCR_i \times SCR_j} \quad (1)$$

The individual combinations  $i$  and  $j$  represent combinations of the following submodules [2]:

- mortality risk,
- longevity risk,
- morbidity risk,
- life-expense risk,
- revision risk,
- lapse risk,
- and life-catastrophe risk.

One of the most common problems in data processing in survival analysis is censoring. Not for all subjects who enter the observation the event needs to occur during the research period. However, it would be wrong to exclude them from the analysis, as we would get skewed results. Therefore, the concept of censoring has been introduced. Thus, in these subjects, we observe not a survival time but a censored survival time. The censoring time determines time from the beginning of the observations to the last known mention of the subject. We also observe the censoring period for subjects who were excluded from the research for some reason.

It is important to distinguish truncation from censoring. When truncating data, we analyze only those subjects in which the monitored event occurred in the given interval  $(t_L; t_R)$ . We distinguish left-truncated data, in which we determine the time  $t_L$  and the time  $t_R = \infty$ . Right truncated data, where  $t_L = 0$  and determine the time  $t_R$ . Or left and right truncated data (we determine both time  $t_L$  and time  $t_R$ ). The person who overcame the event outside the time interval is removed from the research.

We define variable  $\delta_i$  as a censoring indicator, which takes value 0 if the event occurred during observation or 1 if we censor the survival time.

We discern three types of censoring: right, left and interval censoring.

Let  $C_i$  as a random non-negative variable representing the censored time for the corresponding  $i$ -th observation and  $T_i$  a random variable representing its survival time. Then we say that the time  $T_i$  is right-censored if  $C_i < T_i$ . On the other hand, if  $C_i > T_i$ , then the time  $T_i$  expresses the time of occurrence of the event in the  $i$ -th subject. Then the survival time of the  $i$ -th subject is defined by the variable  $U_i = \min(T_i, C_i)$  and the censoring indicator  $\delta_i$  ( $\delta_i = 1 \leftrightarrow U_i = T_i \vee \delta_i = 0 \leftrightarrow U_i = C_i$ ).

The reasons for using right censoring are:

- no event occurred during the observation before the end of the observed period,

- the observed subject voluntarily withdraws from the research or is excluded from it,
- during the observation other event than the one monitored occurs and the subject can no longer be monitored (e.g. death if we examine the effectiveness of the treatment) – this reason for censoring is also related to competing risks.

Let  $C_i$  as a random non-negative variable representing the censored time for the corresponding  $i$ -th observation and  $T_i$  a random variable representing its survival time. Then we say that the time  $T_i$  is left-censored if  $C_i > T_i$ . On the other hand, if  $C_i < T_i$ , then the time  $T_i$  expresses the time of occurrence of the event in the  $i$ -th subject. Then the survival time of the  $i$ -th subject is defined by the variable  $U_i = \max(T_i, C_i)$  and the censoring indicator  $\delta_i$  ( $\delta_i = 1 \leftrightarrow U_i = T_i \vee \delta_i = 0 \leftrightarrow U_i = C_i$ ).

Left censoring is used, for example in research where the recruitment of subjects takes a longer time, during which subjects are not monitored, and monitoring does not begin after the recruitment period has elapsed.

Let  $C_i$  as a random non-negative variable representing the censored time for the corresponding  $i$ -th observation in which the event did not occur and  $D_i$  is a discrete random variable representing the time when the investigated event first occurred. Then, if we denote  $T_i$  as the interval-censored survival time,  $T_i$  is in the interval  $C_i < T_i \leq D_i$ . An example of interval censoring is the analysis of virus infectivity within a population. A person who was negative at time C, tested positive at time D. Thus, the actual time of virus infection is in the range of the interval  $(C, D]$ .

It is important that the censored times  $C_i$  are independent of the survival times  $T_i$ .

## 2 Nonparametric methods for estimating the survival function

Survival analysis is used, among other things, especially in the field of medicine and epidemiology, where our point of interest is human life or health. This fact is difficult to describe by any given probability distribution. For this reason, there is a need to invent methods for calculating the survival probability that does not require any assumptions about the distribution of the random variable survival time  $T$  – nonparametric models.

In this chapter, we will define two methods for calculating nonparametric estimates of the survival function. First, we define the empirical survival function and then the best-known nonparametric method – the Kaplan-Meier estimate. In addition to the mentioned methods, there are other models for calculating the survival probability, such as the Nelson-Aalen estimate, the Breslow estimate or the Efron estimate [7].

### 2.1 Empirical survival function

We define the basic survival function as the probability that a person of age  $x$  will live to age  $x + t$  (survive another  $t$  years) [8]:

$$S_x(t) = P(T_x \geq t) = 1 - F_x(t) = 1 - P(T_x < t) \quad (2)$$

We assume a set of  $n$  observations, with no observation of survival time censored. Then the survival function (equation (2)) can be estimated using the empirical survival function  $\hat{S}(t)$ . Equivalently, we can estimate the empirical function of the survival distribution  $\hat{F}(t)$ .

Based on the equation (2), we express the empirical survival function as a complement to the empiric survival distribution function. Thus, as the probability that the observed subject will live to time  $t$  (its survival time will be greater than or equal to  $t$ ) [1]:

$$\hat{S}(t) = 1 - \hat{F}(t) = \frac{\text{number of observations with survival time } T \geq t}{n} \quad (3)$$

Estimation of the survival function by the empirical function is the simplest estimate, but it cannot be used if some data from the analysis are censored. For this reason, we do not encounter this estimate in practice. It serves only to simplify the calculations or to illustrate the basic knowledge of the issue of survival probability.

In the empirical survival function, we assume that its value is constant between two occurrences of the investigated events. Based on these facts, we say that the survival function is a step-by-step non-increasing survival time function  $T$ .

## 2.2 Kaplan-Meier estimate

The Kaplan-Meier estimate is the most widely used nonparametric estimate of the survival function. The authors presented this estimate in 1958 in their article “Nonparametric Estimation from Incomplete Observations”. As the name implies, this method can be applied to a data set, which also contains censored observations. The Kaplan-Meier estimate is a limited case of the mortality table method. [5]

We will create time intervals for the calculation while each interval will include only one time of occurrence of the event – death and death will always occur at the beginning of the interval. Furthermore, several persons may be subject to the event under investigation at the same time, and thus created intervals may not include only one death.

Suppose the survival times at which death occurred, i.e.  $t_1, t_2, \dots, t_k$ . Subsequently, we arrange these times from the shortest to the longest, so  $t_1 < t_2 < \dots < t_k$ . Each of these times represents the beginning of a time interval. However, our dataset may also include censored survival times  $t_{c1}, t_{c2}, \dots, t_{cm}$ . We have two options, either we will not consider censored times as the beginning of a new interval and will be part of the interval between two deaths, or we will create additional intervals at the beginning of which the survival time will be censored.

Let  $t_0$  as the beginning of the research and  $t_1$  as the time of the first death, then the first interval will be in the range  $[t_0; t_1)$ . The next interval will be from the first time of the death to the second, i.e.  $[t_1; t_2)$ , etc. Suppose that just before a certain time  $t_j$  are alive  $n_j$  persons, where  $j = 1, 2, \dots, k$ . We further define  $d_j$  as the number of deaths at the time  $t_j$ . Then the probability of death in the short time interval  $[t_{j-\delta}; t_j]$ , where  $\delta$



represents a short time unit, can be estimated as  $d_j/n_j$ . And the corresponding probability of survival at time  $t_j$ :

$$\hat{p}_j = 1 - \frac{d_j}{n_j} = \frac{n_j - d_j}{n_j} \quad (4)$$

where

$$n_j = n_{j-1} - d_{j-1} - c_{j-1} \quad (5)$$

$c_j$  – number of censored observations.

The Kaplan-Meier estimate of the survival function is based on the product of the conditioned probabilities that a person will survive time  $t_j$  ( $t_j \leq t$ ) provided that he has lived to that time [6]:

$$\hat{S}(t) = \prod_{j:t_j \leq t} \frac{n_j - d_j}{n_j} \quad (6)$$

In the next chapter of the article, we apply theoretical knowledge to real data concerning the lapse of insurance contracts in an unnamed universal insurance company. In practice, we distinguish between two types of lapses, lapse without payment of redemption value and with payment of redemption value (full encashment). For the purposes of this article, we will not distinguish between these two types, but we will present overall lapses of life insurance contracts. It should be noted that the lapse analysis is not only applicable to insurance but also in the bank sector – the time during which the client remains in the institution.

### 3 Lapse analysis using Kaplan-Meier estimator

For lapse analysis, we use Kaplan-Meier nonparametric estimator described in chapter below. Our dataset consists of 2 451 life insurance policies, where the main insured risk is death. These policies were sold between 2000 – 2015. We observed 2 345 lapses and the remaining observations were right-censored. Our analysis was performed in R programming language with package “survival” [10].

Firstly, we split survival times into intervals with the same survival time for one or more observations. Then, we estimated survival probabilities with the Kaplan-Meier method. Table 1 shows survival probability for each year of policy duration. We also add 95% confidential intervals for survival probabilities. We focus on the first 10 years of policy durations.

**Table 1.** Kaplan-Meier estimator of survival probability

<i>Year</i>	<i>Number of policies at risk</i>	<i>Number of lapses</i>	<i>Survival probability</i>	<i>Lower 95% CI</i>	<i>Upper 95% CI</i>
1	1230	1221	50,18%	0,4824	0,522

2	789	441	32,19%	0,3039	0,3409
3	670	119	27,34%	0,2563	0,2916
4	570	130	22,03%	0,2045	0,2374
5	368	172	15,01%	0,1366	0,165
6	303	65	12,36%	0,1113	0,1374
7	264	39	10,77%	0,0961	0,1207
8	238	33	9,87%	0,0876	0,1113
9	190	15	8,75%	0,077	0,0995
10	135	36	5,18%	0,0434	0,062

Source: own processing

There is a significant probability (49,82 %) that the policy of this death insurance will lapse in the first year of its duration. This could be caused by the benefit of this insurance product – policyholders may lapse their policy in the first year without giving a reason. After 10 years, there are only 5,18 % of living policies.

On figure 1, we can see that the median survival time is 365 days (intersect of purple and pink lines). The survival function is a step function with step size  $\frac{\text{number of lapses}}{\text{number of policies in risk}}$  at a given time  $t$ , when a lapse occurs. At the beginning ( $t = 0$ ) probability of survival is equal to 1 (100 %), then survival probability decreases over time and at the end of the research survival probability is zero. The survival function is rapidly decreasing in the first year and after that the decrease is more linear. Dashed line on the figure represents confidential intervals (same as in table 1). We can also see some ticks on the survival function curve, this is caused by the censoring of observations.

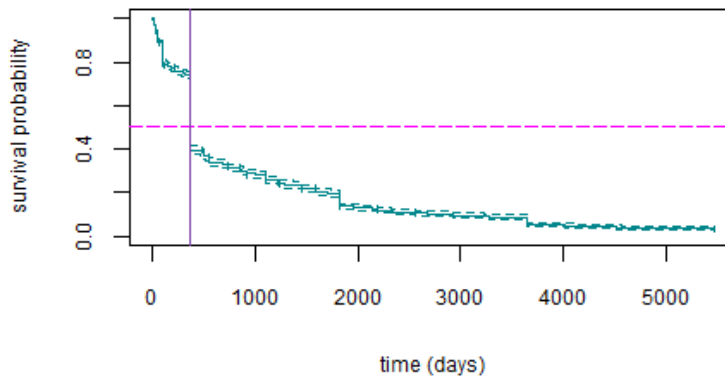
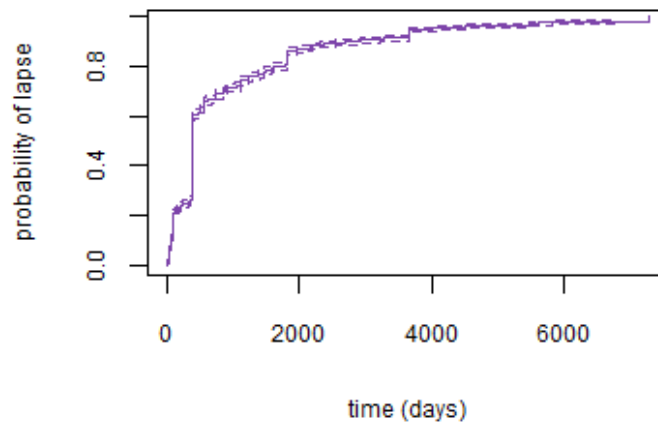


Fig. 2. Kaplan-Meier survival function. Source: own processing

The distribution function of time to lapse describes the cumulative probability of lapse for a policy. It is a complementary to the survival function (see formula 2). Since survival function is decreasing, the distribution function is increasing (figure 2).



**Fig. 2.** Cumulative distribution function of time to lapse. *Source: own processing*

The lapse ratio (yearly lapse ratio) used in cash-flow analysis of an insurance company to calculate technical reserve is illustrated in table 2 for each year of policy duration. It means that every year number of policies decreases by lapse ratio. Reserve is recalculated every year with a corresponding number of policies.

**Table 2.** Yearly lapse ratio

Year	Distribution function	Lapse ratio	Number of policies
0			100 000
1	49,82%	49,82%	50 180
2	67,81%	17,99%	32 190
3	72,66%	4,85%	27 340
4	77,97%	5,31%	22 030
5	84,99%	7,02%	15 010
6	87,64%	2,65%	12 360
7	89,23%	1,59%	10 770
8	90,13%	0,90%	9 870
9	91,25%	1,12%	8 750
10	94,82%	3,57%	5 180

*Source: own processing*

Suppose that our new portfolio of same death insurance coverage has at the beginning 100 000 policies and no other insurance policies are sold (hypothetical portfolio), in the table 2 we can see decreasing evolution of number of policies for each year (with assumption that no policies are mature, and no insured persons die in a period of 10 years).

Lapse analysis is very important because insurance company does not have to hold the reserve for all policies at time  $t = 0$ , but only for an appropriate number of policies. It is also important for calculation of SCR described in chapter 1.

In the next steps of our analysis, we focused on the influence of sex on insurance lapses. We can see in table 3 (columns 2 and 4) that men are more likely to lapse their death insurance policies than women (lower survival probability). The main difference is in years 2 – 10.

The cumulative hazard function represents the overall risk of event occurrence from the beginning to the given time  $t$ . [1] The hazard function could be in some cases greater than 1, this depends on the selected time unit. [6] A higher hazard function means a lower probability of survival.

Cumulative hazard function is calculated as [1]:

$$H(t) = \int_0^t h(u)du \quad (7)$$

where  $h(u)$  represents hazard function or as:

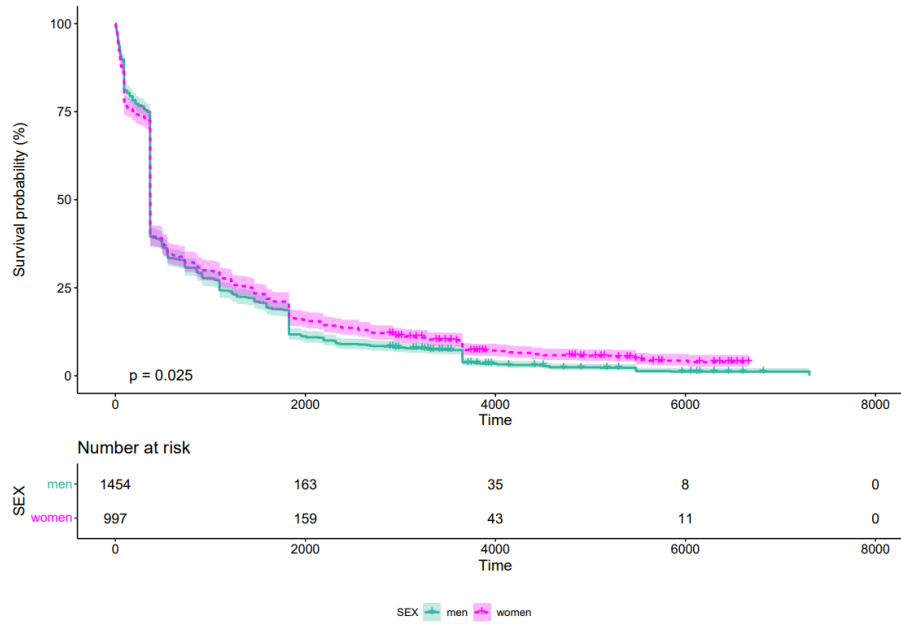
$$H(t) = -\log(S(t)) \quad (8)$$

**Table 3.** Kaplan-Meier estimator of survival probability for each sex

<i>Year</i>	<i>Men - Survival probability</i>	<i>Men - cumulative hazard</i>	<i>Women - Survival probability</i>	<i>Women - cumulative hazard</i>
1	50,00%	0,6183	50,45%	0,6201
2	31,77%	1,0446	32,80%	1,0224
3	26,13%	1,2383	29,09%	1,142
4	21,11%	1,4478	23,37%	1,3574
5	13,34%	1,856	17,45%	1,6318
6	10,52%	2,0851	15,05%	1,7777
7	8,94%	2,2464	13,44%	1,8894
8	8,04%	2,3514	11,42%	2,0493
9	7,53%	2,4164	10,52%	2,1304
10	5,60%	2,6808	8,95%	2,2855

*Source: own processing*

On the top of Figure 3 we can see the survival function for men (green curve) and survival function for women (pink curve). On the bottom, we can see the number of policies at risk for each sex. Survival functions for each sex are almost the same in the first year but slightly different from the beginning of the second year to the end of the research (see also table 2).



**Fig. 3.** Kaplan-Meier survival function for each sex. *Source: own processing*

For comparison of two or more Kaplan-Meier survival functions we used Log-rank test statistics which was compared with Chi-square test with one degree of freedom (number of compared survival functions – 1) [7]:

$$\text{Log - rank test statistic} = \frac{(O_M - E_M)^2}{E_M} + \frac{(O_W - E_W)^2}{E_W} \quad (9)$$

where  $O_{M/W}$  means observed survival time and  $E_{M/W}$  means expected survival time.

We defined two statistical hypotheses:

$$H_0: S_M(t) = S_W(t) \quad (10)$$

$$H_1: S_M(t) \neq S_W(t) \quad (11)$$

Based on test statistics and p – value, we reject zero hypothesis, so the survival function for men is significantly different from the survival function for women.

## Conclusion

Kaplan-Meier estimator is a useful statistical method to analyze survival times not only in medical research but also in the finance sector, especially in actuarial science. Kaplan-Meier method allows to work with censored observations and use the information about censored times. This is an advantage in contrast with other nonparametric methods. Since this model has easily interpretable results, this method can be simply explained to the public who does not have such knowledge in actuarial science.

In this article, we illustrate the use of survival analysis in the life insurance industry specifically in lapse analysis. We modeled the lifetime of insurance policies using the Kaplan-Meier estimator on a real dataset of death insurance policy from a universal insurance company. The main finding in model output is that 50 % of policies lapsed during the first year caused by policy benefit, which is the possibility of terminating the contract in the first year of insurance coverage without any reason. In our research, we found out that sex has a significant impact on policy lapses after the first year of insurance policy duration (men have a higher lapse ratio than women). This analysis could be extended by other survival analysis methods e.g., Cox semi-parametric regression model.

## Acknowledgement

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# Evaluation of Selected Slovak Bookstores Using Modern Management Analysis Tools

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## Abstract

The aim of the paper is to evaluate the current state of selected bookstores in Slovakia and to suggest possible recommendations and changes that the organization should apply, or to point out the established processes and procedures that bring economic prosperity to companies. In a dynamic world, every company needs tools and methods to increase business efficiency. High competition in the global market determines the need to find ways to be competitive. An important role of management is to know and identify actual trends that affect the company and to be able to respond adequately. This requires not only the knowledge and experience of management, but also a team of people who are not afraid of changes and their aim is to adapt to the requirements of the market as much as possible and thus increase the overall competitiveness of the company. In the first chapter of the paper, we have processed a brief theoretical basis in connection with the issue of modern management tools from home and abroad. Based on the studied knowledge, we analyze the impact of change management in selected companies and how social networks affect and are used by companies in Slovakia. We will also focus on how agile organizations can better respond to change and adapt more flexibly in unexpected situations, such as the current COVID-19 pandemic.

**Keywords:** management tools, bookstores, prognosis, DEA, efficiency

**JEL classification:** C58, M11, M21

## 1 Introduction

In today's world, there are several new challenges and obstacles that businesses face. Whether it is changes in economic conditions associated with declining confidence in markets and increasing pressure on natural resources, or significant changes in the demographics of customers and employees (Grover et al., 2018). Globalization not only results in a dynamic increase in competition, but the



globalization of markets for businesses brings a level playing field for access to information, resources, and technology. For this reason, companies need to respond to these new challenges in a truly flexible and efficient way if they are to succeed in the marketplace. It is essential that traditional business methods adapt to new changes and new market opportunities. The role of business managers is to continuously monitor these changes, evaluate them and react accordingly. The change in the business environment leads to the need to develop new management methods, techniques, tools, and procedures that enable organizations to adapt to current market trends (Settembre et al., 2021).

The basic idea of the process approach is that the reason for the company's low performance is inefficient internal processes that should change towards increased efficiency and higher added value for the customer. Many authors consider process management to be a real milestone for 20th century management (Sarraf – Nejad, 2020), Fuertes et al., 2020). Managers of different organizations use several methods and tools, but their final selection is a combination of several of these methods and tools and depends on many factors. Firstly, from the knowledge, skills, and abilities, but also from the personal attributes of the manager, as well as from his ability to lead a business and work team of people. In the past, there were times when modern approaches to managing an organization were applied only by the largest and most powerful companies and those who initiated and led change (Creel, 2019, Shaturaev – Bekimbetova, 2021).

Currently, their knowledge and use, is one of the essential requirements for survival in the market. In recent years, management methods and tools have become an increasingly integral part of the manager's work. These include efforts to increase revenue, improve quality and efficiency, introduce innovations, and plan for the future. Managers are constantly looking for relevant tools and techniques to increase the overall performance of the company. In today's fast-paced world, successful companies are those that can sense change and respond to it in an adequate way.

## **2 Analysis of the external environment**

We chose STEP analysis for the analysis of the external environment. Through this analysis, we will get closer to the company's surroundings in all its areas. We will discuss external factors affecting the company, which are not controllable from the company's position.

### **2.1 Political factors and legislative factors**

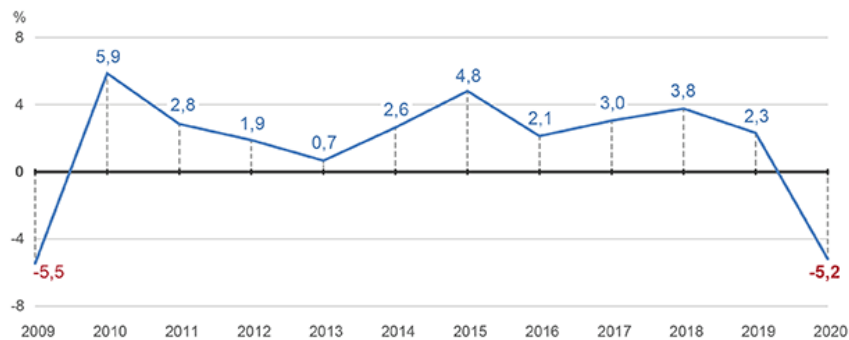
The bookstore provides its products and services in Slovakia, so it is primarily influenced by the political environment in Slovakia. Each country has its own specifics in terms of its laws, and each company should analyse and take these factors into account in strategic planning.

The impact of Brexit on the Slovak market in 2019 was not yet known, but it is certain that the worst option would be the departure of Great Britain from the EU without an agreement. Membership in the European Union is essential for Slovakia.

This also has many benefits for retail. The European single market, the free movement of workers, or even cheaper international calls. The political environment in 2020 was significantly affected by the parliamentary elections and election programs of individual political parties. A particularly new situation has arisen because of the COVID-19 pandemic, where anti-pandemic measures have significantly affected the lives of all people, businesses, including our bookstore. Since the curfew, the closure of operations, or the prohibition of selling another, or the regulation of the number of customers in stores, all this has had an impact on the company we have chosen. In this context, the largest package to improve the business environment and reduce the administrative burden in the modern history of Slovakia was approved, or a package of 115 measures from the workshop of the Ministry of Economy, which was to help and simplify business in Slovakia. From 1 January 2020, a reduced VAT rate of 10 % was applied to newspapers, magazines, and periodicals. The aim of this VAT reduction was to support traditional print media (Kubová, 2019).

## 2.2 Economic factors

In 2019, gross domestic product growth slowed more markedly. The decline in economic activity in 2020 was reflected in all four quarters, while the pace of decline slowed at the end of the year. A similar situation occurred in 2009, which is characterized as a period of financial crisis. For a closer look, the following figure shows the development of GDP in recent years.



**Figure 1 GDP development in Slovakia**

Source: Statistical Office of the Slovak Republic (2021)

The growth of the price level in the Slovak economy was at the level of 2.7 % in 2019, which is 0.2 % more than in 2018. Thus, Slovaks could afford more goods and services from their wages year-on-year than in 2018.

The Slovak Business Agency (2020) states that the labour market was able to generate new jobs in 2019 as well. The average number of persons employed in the national economy increased by 1.0 % year-on-year and unemployment in 2019 fell to its historical lows, as stated in the Report on the State of Small and Medium-Sized Enterprises in Slovakia in 2019.

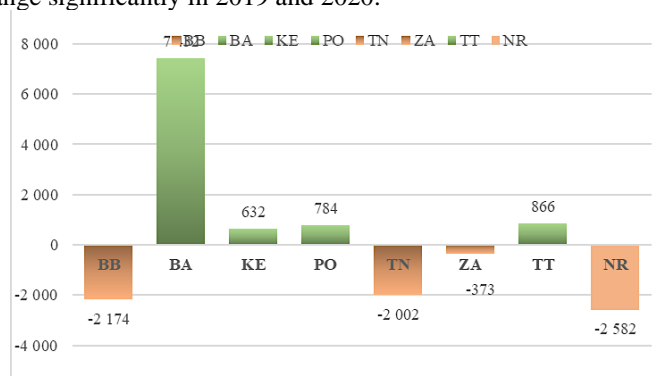
However, the year 2020 was completely different, unemployment rose to 6.7 %, at the end of the year there were 35,000 more unemployed year-on-year. The Statistical Office (SO) of the Slovak Republic informed about it at the beginning of March 2021 (2021). Unemployment has increased in all regions, but mostly in the eastern part of Slovakia, where Panta Rhei's stores are also located. The Statistical Office of the Slovak Republic (2021) states that the number of unemployed persons in the Košice Region increased by 9,700 to the level of 6,700 and in the Prešov Region by 7,400 to 50,400 persons. Both regions had the highest level of regional unemployment and recorded the highest increase.

The negative impact of the coronavirus pandemic is felt across sectors and has significantly affected the overall performance of the economy. Under the influence of restrictions, companies had to limit whether some would stop operating. Demand from customers also fell, which directly caused a drop in sales, and some companies had no choice but to further reduce their costs than lay off their employees. The loss of employment also caused changes in shopping behaviour; people had to re-evaluate their consumption. The situation on the labour market was deteriorating and, according to the Center for Labor, Social Affairs and the Family, the registered unemployment rate increased in April 2020 at the highest rate in history. The dynamics of unemployment growth gradually began to moderate in May and June. The obligation to work from home did not bypass the bookstore and almost all employees had to go to the home office.

### 2.3 Social and demographic factors

In the coming years, the Slovak market will have to cope with demographic changes that affect companies and the Panta Rhei bookstore (Dujava - Pécsoyová, 2020).

The number of inhabitants in some regions where bookstore stores are located did not change significantly in 2019 and 2020.



**Graph 1 Population difference in 2019 and 2020**

Source: Own processing according to the Statistical Office of the Slovak Republic (2021)

If we look at the difference in population, the highest increase was recorded in the Bratislava region. The change in the decline or increase in population also has an impact on bookstore sales.

The analytical team at Picodi.com (2019) also took a closer look at the preferences of readers in Slovakia and their shopping behavior in this segment literature and what are the consumer trends.



**Graph 2 Book formats preferred by consumers in Slovakia**

Source: Custom processing by Picodi.com (2019)

The year 2020 brought changes in various directions, which brought an increase in online shopping in several areas. This trend also applies to the sale of books themselves. Those who have not had a habit of shopping online have adapted and it is expected that in the coming years, online shopping, or the use of other alternatives to paper books will continue to grow.

## 2.4 Technological factors

The impact of technological changes is also clearly observable for the bookstore we have chosen. The book assortment is ideal for sale and promotion via the Internet or social networks. Progress is progressing and it is important to keep up. Having a perfect e-shop built is the key, especially if the competition is a few steps ahead of us. Technology also affects payment methods, which, even under the influence of the pandemic, have had to adapt better to the contactless method.

## 3 Research design

The collection of theoretical information was used at the beginning of the paper. We used data obtained from publicly available sources to analyse the effectiveness of individual bookstores' social networks. When forecasting sales, we collected historical data from the financial statements on the development of sales for the period from 2016 to 2019. We evaluated the data for the companies Panta Rhei and Martinus. In Excel, we used the data prediction function FORECAST.ETS., which based on the AAA version of the exponential adjustment algorithm predicted the development of sales based on data from the past (Tyrallis, et al., 2021). To compile a

clear model that considers the lower and upper limits of the forecast, we used the generation of visual output of the forecast. All graphs were created using MS Excel.

When analysing e-commerce tools, we analysed data from SimilarWeb. SimilarWeb is a site that provides web analytics services for businesses. We only worked with the free version, so we could only compare a limited number of indicators, in our specific case we used the data to compare traffic for the month of March 2021 within Panta Rhei and Martinus.

When processing the paper in the empirical part, we used the DEA method to evaluate the effectiveness of individual bookstores. The DEA method is a statistical method that evaluates our efficiency based on inputs and outputs. We performed the calculations within the analysis using MS Excel, where we chose the average number of photographic and video contributions within both monitored bookstores as inputs. We chose the average number of video views, the average number of "likes" per post, and the total number of followers (as of April 2021) as the outputs we want to streamline.

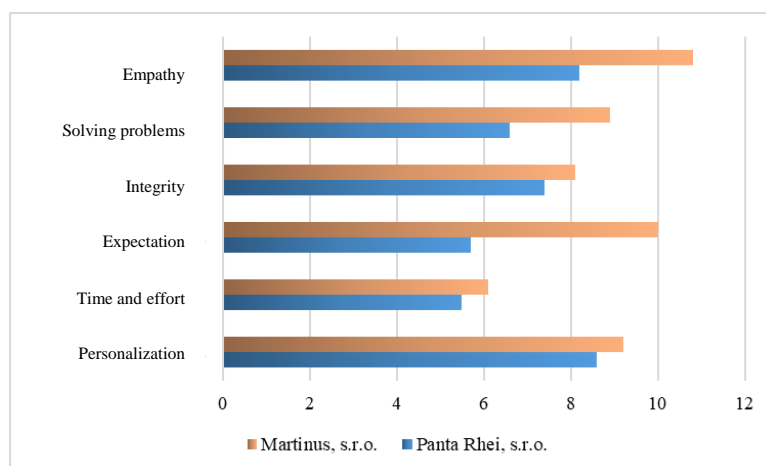
When calculating the DEA analysis, we used the MS Solver add-on, which works with changing decision variables; in our case, these were efficiency variables on individual Instagram accounts. Based on our chosen criteria, and the orientation of the model to maximize outputs, we have determined the limitations of maximizing outputs and minimizing inputs. We selected the appropriate solution method using a simplex algorithm and evaluated the achieved efficiency through a comparison of bookstores.

## **4 The Results and discussion**

If we want to improve processes and move the business further, to adapt to the current situation and market trends, we must identify the starting points, where the company is located, where it sees the potential for change and where it wants to get and what it needs.

The biggest competitor for Panta Rhei is the Martinus bookstore, s.r.o. The preferences of these brands among customers also indicate this. These findings were the result of a new study of KPMG's customer experience (2020) in Slovakia. For the second time, Slovak customers have chosen the Martinus online bookstore as their most popular brand, and the second place belongs to the Panta Rhei bookstore. The customer experience survey is an interesting study of the experience of Slovak customers with brands with which they are clients or who have interacted with them in the last six months. The statements of almost 2,100 respondents from all over Slovakia were evaluated using the unique Six Pillars methodology developed by KPMG Nunwood.

To compare these pillars and their values within the Panta Rhei and Martinus bookstores, we constructed a graph based on which we can illustrate the differences between the bookstores.



**Graph 3 Pillars and their comparison within the Panta Rhei and Martinus bookstores**

Source: Own processing according to KPMG (2020)

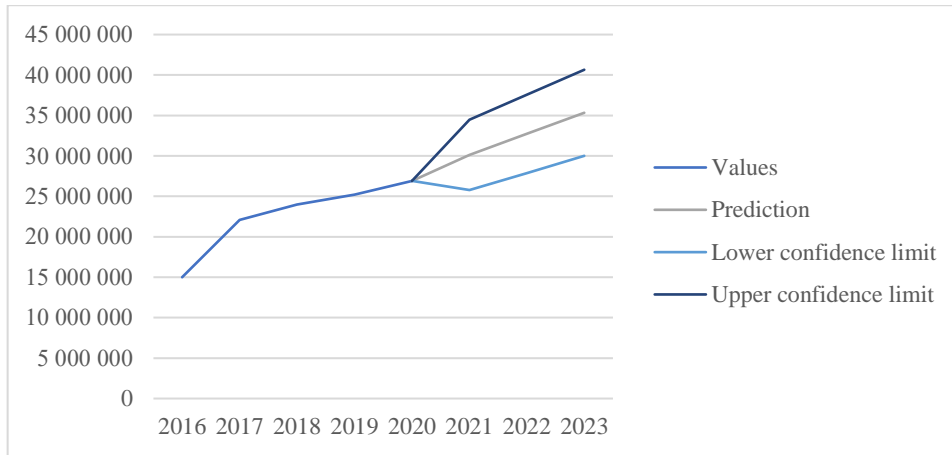
In every pillar, our biggest competitor - Martinus - has something on top. It should be mentioned that the survey was conducted on a sample of more than 2,000 respondents, which is not much, but enough to be able to imagine in which areas of customer perception our competitor is ahead of us.

In this subchapter, we will compare and evaluate the processes within individual companies and evaluate the indicators of financial analysis.

#### **4.1 Prognosis of future development and current situation**

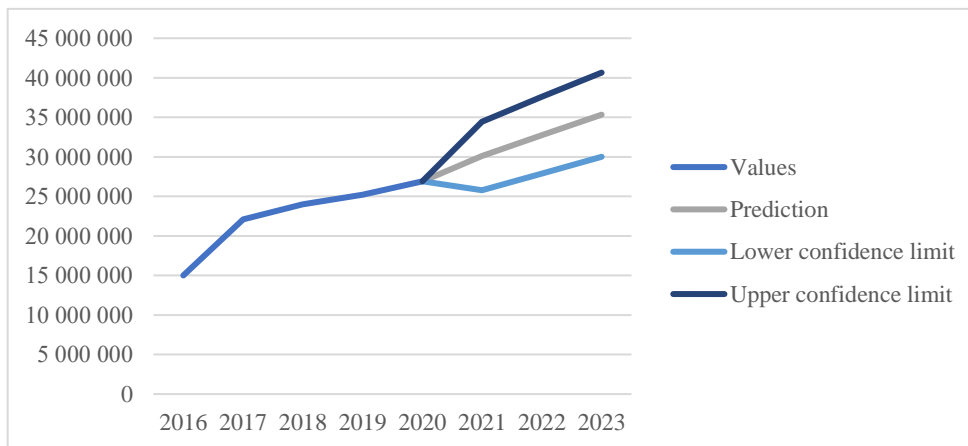
To forecast the development of sales, we used the function in Excel FORECAST.ETS, which calculated or predicted the future value of sales based on existing and past values.

The following chart shows the forecast of Panta Rhei's sales. As, based on data from previous years, there was an increase in sales every year, it could be expected that the increase in sales will continue in the coming years.



**Graph 4 Pantarhei bookstore revenue prognosis**  
Source: Own processing

From the graph we can see the trend of sales growth throughout the prognosis period. Such a forecast based on historical data could predict revenue developments based on an algorithm. However, this algorithm does not account for and does not consider unexpected threats and environmental influences. It is not possible to evaluate the sales of both bookstores based on this model. Such a forecast could be relevant if external conditions did not differ from those in previous years. However, we know that the crisis and the overall coronavirus situation have affected and continue to affect many sectors.



**Graph 5 Sales prognosis for Martinus bookstore**  
Source: Own processing

Even in the case of Martinus, it is possible to expect an increase in sales. We will find out whether the fair values at least approximately match those predicted by the model after the publication of the financial statements for 2020.

In April 2020, Panta Rhei announced that it had to lay off 30 employees during the first wave and dozens more in a later period, Bödök (2020), the owner of a bookstore network, said in an interview. The shortfall in sales at the beginning of the pandemic represented a loss of more than one million euros per month, mainly due to the nature of the costs, which are mostly fixed. Last year, sales increased in the second half of the year. This was mainly due to the increased interest in buying books through the e-shop. Despite large losses from the beginning of the year, the company expects an increase in sales in 2020. We will be able to verify whether this will really be the case by how much sales will increase and whether the prediction model has at least approached real values only after the publication of the company's financial results for the past year.

#### 4.2 E-shop efficiency analysis

After comparing the traffic of e-shops via SimilarWeb, we can state that the traffic in the case of Martinus in March 2021 is at the level of over two million visits, while in February there was a decrease to the level of 1.6 million visitors. In the case of Panta Rhei, the numbers are much less favourable and on average over the last three months, e-shop traffic is just under 400,000. We record the highest traffic at both bookstores, of course in December, when people buy the most books.

The COVID-19 pandemic had a major impact on Slovak e-shops. According to the E-shop Barometer (2020) survey conducted by KPMG in Slovakia in cooperation with ui42, up to six out of ten online stores saw an increase in sales during this period. The demand for books is increasing during the pandemic, and the Panta Rhei bookstore network is aware of this. Panta Rhei CEO L. Bödök also thinks that sales in 2020 will exceed those a year ago, which were almost 45 million euros.

It is understandable that the largest share of visitors to e-shops of bookstores is from Slovakia, as the second most common source of visits is from both e-shops from the Czech Republic.

*Table 1 E-shop traffic share by country*

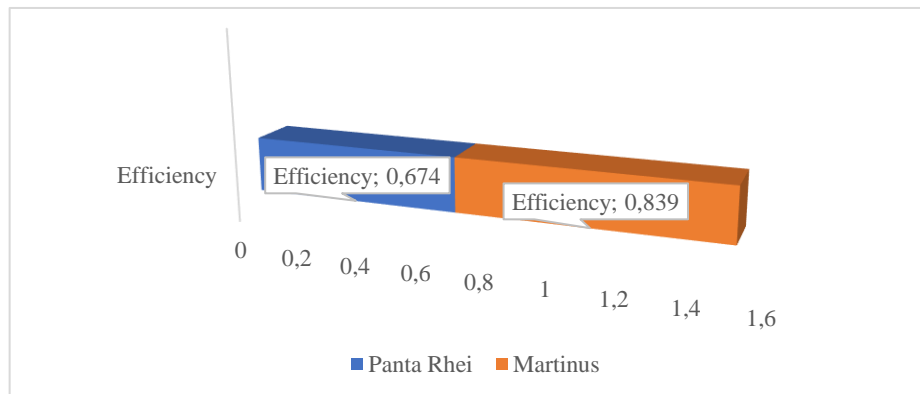
Panta Rhei		Martinus	
Slovakia	94,91%	Slovakia	93,22%
Czech Republic	2,84%	Czech Republic	2,44%
Hungary	0,47%	Germany	1,16%
Austria	0,41%	United Kingdom	0,62%
United Kingdom	0,28%	Switzerland	0,54%

Source: Own processing according to SimilarWeb (2021)

Subsequently, we evaluated the effectiveness between Panta Rhei and Martinus in the Instagram contribution activity. We used the DEA method - Data Envelopment Analysis. The data we used to apply this method are data freely available



from Instagram accounts. We selected the average number of photo posts and the average number of video posts as inputs, and we evaluated the average number of videos watched, the number of "likes" per post, and the total number of followers. The results of the DEA method gave us a result on efficiency on social networks, in this case on Instagram in favor of Martinus.



**Graph 6 Comparison of the effectiveness of the accounts on the Pantarhei and Martinus Instagram (%)**  
Source: Own processing

The efficiency of the Pantarhei is about half that of the competition. Martinus has managed to build a strong brand and awareness on social networks. This is evidenced by the number of people it has captured across various online platforms. For Pantarhei, this could be an inspiration and motivation to further improve its reach on social networks. From the results of the DEA analysis, we can also evaluate the recommendations that the solution proposes. To increase the effectiveness of Instagram, it is recommended to contribute the same amount of photo posts, which is currently 27 posts per month and increase the average number of video posts by 1 per month to 3. To make Pantarhei more effective, it is recommended to increase the total number of followers from the current value of 28 thousand, at least to the value of 42.8 thousand.

In the beginning of the quarantine in connection with COVID-19 Martinus did not hesitate and reacted, you can say immediately, to the situation so as not to lose contact with his customers. Celebrities have started reading fairy tales via stream on Instagram or via YouTube channel. Pantarhei has not gone in this direction and may also result in fewer followers.

The goal of both bookstores is to bring readers the experience and emotion of reading, but the road to success is sometimes fickle. Pantarhei and Martinus would never be where they are now if they did not invest financial resources and human capital in turning their vision into reality. Although their business philosophies are different and each of them build on different pillars in their common interest is to be prosperous companies.

Panta Rhei is an example of the fact that, despite not being a market leader and innovator, it is constantly growing. An important aspect in the success of companies is the human capital on which they rely immensely. It may be a cliché, but the empathy and willingness of employees comes first in customer ratings. The company builds on this and builds its authenticity, and it supports this with the idea, "people first, then money." Quality in terms of internal processes is essential if we want satisfied customers to return to the bookstore, not complaints and dissatisfaction on the part of consumers.

## 5 Conclusion

The business environment is characterized by the dynamics of changes that are constantly occurring in it. Globalization, internationalization, the virtual economy, all these concepts affect us every day and the world are changing due to these trends, we can say, minute by minute. The current environment in which we live requires the need to change and adapt traditional methods of management and business. The purpose of the final work was also to point out the fact that digitization and modern approaches and trends in business must apply to a company that wants to survive in the market and at the same time adapt to current events in the world (Bartik, 2020).

In today's world, every company, whether bookstore or chain store, must know how to use technology to its advantage. Even though Panta Rhei has been a stable bookstore for many years and has its own background, an unpredictable situation can arise, as occurred at the beginning of last year. Due to the measures, the companies had to close their gates and the employees suddenly stayed at home. If the company did not have any financial reserves and did not move the sale of books exclusively to the online space, sooner or later it would be liquidating for Panta Rhei. It is important to learn from crises and learn. The fact that Panta Rhei has been able to bridge over the period can be due to its customers, who have retained them through online shopping. It is in such a situation that the previous efforts to build a quality e-shop with all the support processes, which have now proved to be very important, have been fully demonstrated.

The result of the paper is a draft recommendation for Panta Rhei. Many of the recommendations are already well established in the bookstore, but we see the importance of continuous improvement as very important. The bookstore really relies heavily on its customer relationships and cares about preferences as well as feedback. Creating your blog is something new that could bring not only financial improvements to the bookstore, but especially the capture of a wider range and increase interest from customers. Compared to the obtained future value, the operating costs are really negligible.

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# Is Housing for Everyone?

## Comparative Analysis of Selected Regions in Slovakia

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**Abstract** The property market and cost of housing are in the spotlight recently, not only as a result of its gradual increase but also as a consequence of latest governmental activities declaring housing and public rental market support as one of its main priorities. This paper shows the property market and residential property prices in the context of households' disposable income across Slovakia and its sub-regions in the period 2012 - 2021. We see varying conditions between respective regions in terms of average income as well as property prices development. Average affordability index for each of Slovakian sub-regions is assessed combining these two variables. Our goal is to identify the most affected regions, outline an alternative approach for optimal support and investment allocation.

**Key words:** housing affordability, property prices, residential real estate market in Slovakia, regional differences, gross income, disposable income development

**JEL classification:** R31, R58

### 1. Introduction

In Slovakia, the real estate prices have been monitored since 2005 by the National Bank of Slovakia and since 2010 by the Statistical Office of the Slovak Republic too. Both institutions publish the prices per sqm, by respective residential segment (new or existing ones), regions, but also size and number of bedrooms. Besides those official statistical sources there are also some market participants also periodically publishing the market data – for example one of the most popular property websites [www.nehnutenosti.sk](http://www.nehnutenosti.sk) or some other companies managing their own analytical teams e.g. Bencont Investment or NARKS (National Real Estate Brokers Association).

After the 2006-08 boom the property market experienced certain freeze accompanied by slower transaction pace and overall price level stagnation as a consequence of the financial crisis. First signs of a recovery were witnessed back in 2014, since then the

property market has become year by year more liquid and vivid, indicating first signs of overheating in 2019 and later, when year-on-year price increases reached double-digit levels.

In this paper we analyse the property market development not only of its most liquid part – the capital city – but also in other regions of the country. Even the overall development shows the same (rising) trend across all analysed parts, there are some regional specifics as to the dynamics of the price development or certain income differences between the regional subareas.

Nevertheless, the real estate prices as such do not show clear picture without considering their macro economic context or their impact on the real living conditions across the population and households. Therefore, the property prices need to be considered also from the income perspective. Generally the following two approaches are usually applied - household's purchasing power is mostly used. Alternatively, an investment based approach may be employed – considering the property price from a rate of return perspective (investment based perspective).

The National Bank of Slovakia therefore periodically publishes real estate indices as HAI – the housing affordability index or the composite housing price index based on the UBS Swiss Real Estate Bubble Index. There are also other respected and broadly accepted measurement methods as e.g. Deloitte Property Index etc. In our paper we adopt the Deloitte's approach, however by slightly adjusting it to national and regional context. The index is calculated for all parts of Slovakia.

## 2. Residential property market development in Slovakia

With the exception of an interim decline during the post 2008 financial crisis period, the real estate prices have been rising since 2014 and reached a double-digit y/y values in recent years:

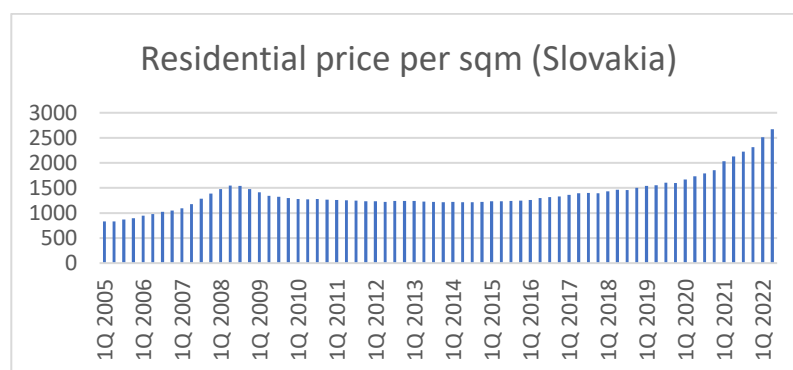


Fig. 1: Average price per sqm for the period 2005 – Q2 2022 (National Bank of Slovakia)

The chart shows average figures for the whole Slovakia; within this paper we analyze each of its eight subregions. Such price development was witnessed broadly and not only in the real estate segment; all asset classes experienced sooner or later a strong recovery period after the 2007/08 financial crisis effects were absorbed; mostly explained as a consequence of massive quantitative money easing policies of national banks willing to support economy and GDP growth.

However, in Slovakia – namely in the real estate market - there also some other major factors contributing to this market development.

## 2.1. Limited stock and new supply

New supply and delivery of additional residential stock seems to be extremely low in all parts of the country. In the most competitive market – the capital city – new yearly delivery hardly exceeds 1,3% of total stock, achieving 1,10% on average for the past 10 years. Slovakian regional cities suffer from even greater lack of competition and their situation is no better.

**Table 1:** Number of apartments in Bratislava, yearly increase in stock for the period 2011-20.

<b>Bratislava</b>	<b>2020</b>	<b>2019</b>	<b>2018</b>	<b>2017</b>	<b>2016</b>	<b>2015</b>	<b>2014</b>	<b>2013</b>	<b>2012</b>	<b>2011</b>
Stock	219 297	216 818	214 026	211 299	208 558	206 655	204 363	202 744	201 219	198 356
year-on-year change	2 479	2 792	2 727	2 741	1 903	2 292	1 619	1 525	2 863	
<i>in %</i>	<i>1,1%</i>	<i>1,3%</i>	<i>1,3%</i>	<i>1,3%</i>	<i>0,9%</i>	<i>1,1%</i>	<i>0,8%</i>	<i>0,8%</i>	<i>1,4%</i>	

Source: Statistical Office Slovakia

The following reasons are generally identified to be contributing to these very low figures: First of all, it is current status quo with respect to the permitting process. The World Bank, in its annual *Doing Business* report<sup>1</sup>, ranks Slovakia 146th with an average building permit issuance time of 300 days. The length and difficulty of receiving a building permit creates absolutely fundamental and determining barrier to the establishment of an effective competitive environment. Nonetheless, it is not only the building permit which causes a bottleneck in the new delivery; zoning as well as the environmental impact assessment process both take very long time and are easy to be disputed during the issuance phase, causing further delays in final granting and legal validity.

This whole topic has broader context, as it is directly related to the absence of clear urban-architectural rules and settings in the cities and deserves further special

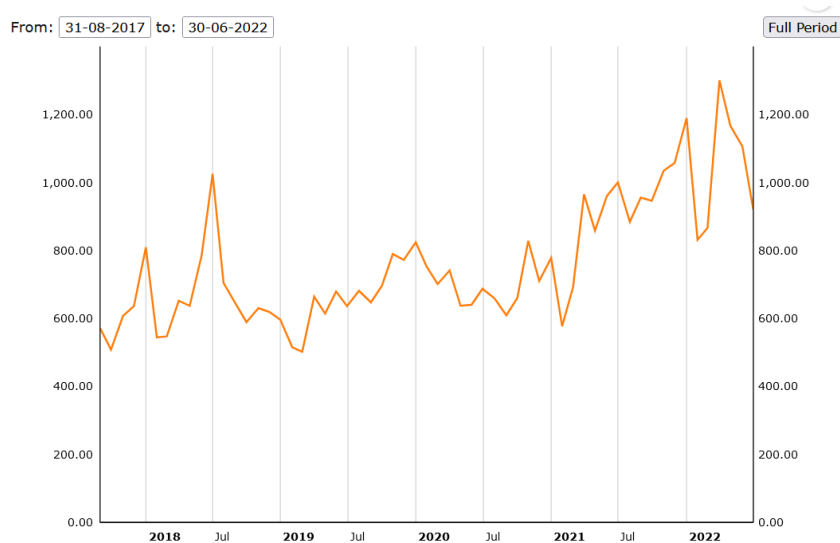
<sup>1</sup> <https://www.doingbusiness.org/en/data/exploretopics/dealing-with-construction-permits>

discussion. It is not only Slovakian specific though; the same situation has been a long-lasting struggle in the Czech republic and Poland too.

When it comes to additional reasons contributing to low competition and delayed supply, some other industry related aspects need to be mentioned. The real estate industry is a heavily capital demanding one. That creates natural barriers of entry for any aspiring competitors. Land bank aspect also gives advantage to traditional and local players over the newcomers even non-local ones.

## 2.2. Demand drivers

There are, however, also many factors fueling the overall demand and supply/demand imbalance. Firstly, the low interest rates environment. Extremely favorable loan conditions combined with low interest rates have contributed to much easier access to the loans also for households with lower income and caused massive lending boom. In combination with historically lowest unemployment rates, low equity requirement or high loan to value ratios (the LtV limitation was introduced in 2018), the overall demand soared dramatically.

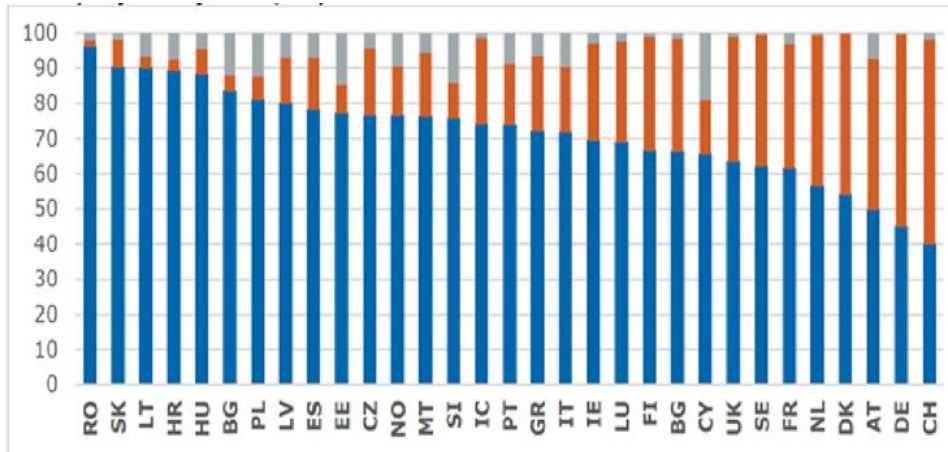


**Fig. 2:** Lending for house purchase excl. revolving loans and overdrafts, convenience and credit card debts. In millions €, monthly view for the period 31/8/2017 – 30/06/2022 (European Central Bank, Statistical Data Warehouse)

In larger cities some developers were reporting higher share of investment based demand in their new residential developments – share of new acquisitions based on investment purposes or free cash based acquisition - created additional demand acceleration.



The other major factor driving the demand is a strong preference for possessing own residential real estate - a very specific pattern for Slovakia. When it comes to the ownership preference, Slovakia holds the second place within the OECD countries with almost 90% share:



**Fig. 3:** Residential stock structure based on property ownership/rental in Europe (in %), blue – owned, orange – rented, grey – other (<http://www.oecd.org/social/affordable-housing-database.htm>)

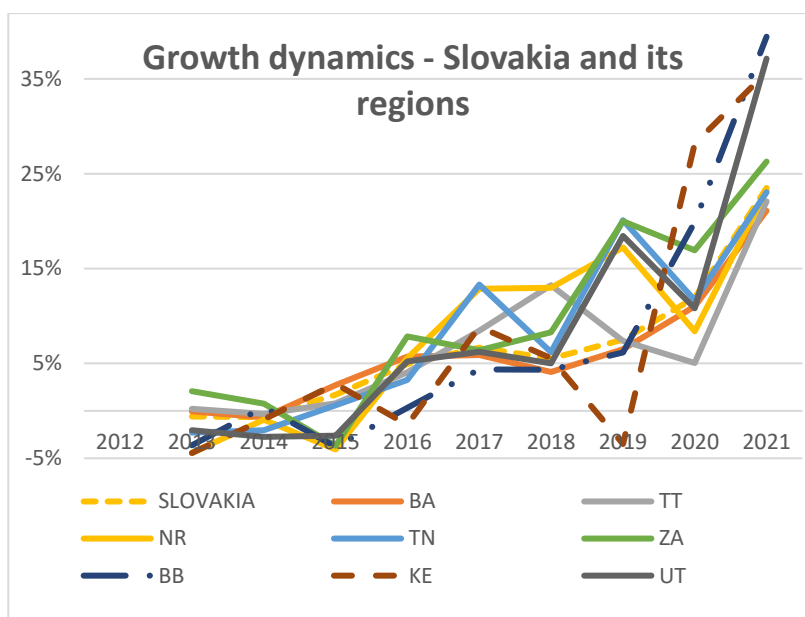
Reason for this phenomenon is not only in the mentality of the population, but to a large extent also in the absence of any state support and affordability of rental housing in general. Until now, this issue in the state policy has narrowed solely to the social housing - i.e. indirect assistance to the families facing financial shortage and so on (it should also be noted that this role has been conducted mainly by local governments). Rental housing in the sense of residential construction targeting the middle-class income segment, young families or flats supporting the job mobility of the Slovaks had been completely non-existent until July 2022. As a consequence, the housing need and demand can be satisfied only by new construction activity and owner-occupied residential segment.

There are also other factors, listed by local experts and industry observers, affecting the demand side - e.g. inflation-fear based purchases (especially in the period from 2020) or some sort of market greed caused by the sharp property price increase.

The scientific literature offers numerous research papers globally investigating the relations and determinants on the property market. As for foreign countries the Chinese market is very well covered (e.g. Peng, Shunfeng 2016), European context has been researched by Hervé (2014), Shida (2021) or a pan-European study issued by the Bank for International Settlement (2020). The central - European context is described by Fidrmuc, Senaj (2010) or Czech authors Votava et al. (2021).

### 2.3. Regional market development

Regional specifics have been seen also through different dynamics of respective regional property markets. While the overall price development progressed as shown in Figure 1, some Slovakian subareas witnessed slightly different trends.



**Fig. 4:** Regional growth dynamics for the period, year-on-year property price change during the period 2012 – 2021 (National Bank of Slovakia, own calculations)

Some of the regions (Košice and Banská Bystrica) saw different development compared to the majority of region, however a more surprising view is the average price level change. While whole Slovakia reached 76% (period 2012 to 2021), Žilina, Trenčín and Prešov (relatively weaker regions), ranked the three highest growth ratios, exceeded 95% watermark.

**Table 2:** Regional growth dynamics per region, increase in price 2012 and 2021.

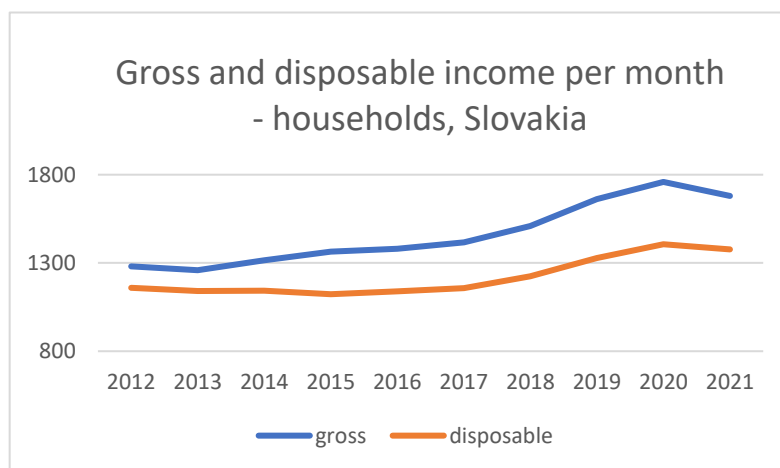
REGIONAL GROWTH DYNAMICS - PRICE PER SQM	
Region	2012 --> 2021 in %
ŽILINA	118%
TRENČÍN	97%
PREŠOV	96%
KOŠICE	85%

BANSKÁ BYSTRICA	80%
TRNAVA	77%
BRATISLAVA	70%
NITRA	63%
SLOVAKIA total	76,23%

Source: National Bank of Slovakia dataset, own calculations

### 3. Slovakia's labor market, gross and disposable income situation

Out of the Visegrad countries, Slovakia has long term suffered from high unemployment rate – reaching the double-digit level until 2014. Improving economic sentiment and growth affected also the labor market positively, as a result the unemployment rate dropped to 5,0 – 7,0% since 2018 on.



**Fig. 5:** Gross and disposable income per month – households, Slovakia, average for the period 2012 -2021. (Statistical Office of the Slovak Republic)

That development has positively materialized also into households' income situation. On average 2021 vs 2012 gross or disposable income soared by 31% and 18,7% respectively.

Different dynamics has been observed in respective regions; however the attention needs to be drawn to relative gains for the eight subareas:

**Table 3:** Disposable income of households, Slovakia and regions (disposable income in 2012 per month, disposable income in 2021 per month, difference 2012/2021 in %, *difference for the gross income values 2012/2021 in %, sorted*)

<i>region</i>	<i>disp 2012</i>	<i>disp 2021</i>	<i>disp 12 -&gt; 21</i>	<i>gross 12 -&gt; 21</i>
NITRA	1 051	1 347	28,16%	41,85%
TRNAVA	1 145	1 457	27,25%	41,83%
ŽILINA	1 190	1 436	20,67%	30,91%
BRATISLAVA	1 330	1 515	18,71%	31,07%
BANSKÁ BYSTRICA	1 060	1 249	17,83%	31,87%
PREŠOV	1 145	1 339	16,94%	25,33%
KOŠICE	1 156	1 332	15,22%	27,26%
TRENČÍN	1 229	1 361	10,74%	21,85%
SLOVAKIA	1 160	1 377	18,71%	31,07%

Source: Statistical Office of the Slovak Republic, own calculations,  
<http://datacube.statistics.sk/#!/folder/sk/1000424>

Respective regions have seen very different development in their growth - while the two best performing ones achieved 27% to 28%, the Trenčín region rose by 10,7% only. It needs to be noted that the Trnava region includes suburbs of greater Bratislava area. Especially in the past 10 years the outflow of the upper middle class segment seeking a living outside the city was happening, so the data for this area may be influenced by this aspect. (The growth rate in the Nitra region is not clear, may be explained by increased FDIs heading to this area during the past years.)

Generally speaking, the growth of property price level compared to the income growth dynamics is very different – while the slowest relative growth in the property market between 2102 - 2021 reached 70-77%, the labor market added maximum 27% of the relative income growth during the same period.

The same approach for inter-regional comparison returned the following figures:

**Table 4:** Slovakia and its regions. Relative gross income increase, disposable income increase, property price growth, disposable income and property growth difference. All figure for the period 2012 – 2021.

	<i>Gross income</i>	<i>disposable</i>	<i>prop price</i>
ŽILINA	30,91%	20,67%	118,07%
TRENČÍN	21,85%	10,74%	97,36%
PREŠOV	25,33%	16,94%	96,00%
KOŠICE	27,26%	15,22%	85,11%
BANSKÁ BYSTRICA	31,87%	17,83%	80,48%
NITRA	41,85%	28,16%	91,52%
BRATISLAVA	31,07%	18,71%	70,15%

TRNAVA	41,83%	27,25%	77,19%
SLOVAKIA	31,07%	18,71%	76,23%

Source: Statistical Office Slovakia, National Bank of Slovakia, own calculations, <http://datacube.statistics.sk#!/folder/sk/1000424>, <https://nbs.sk/statisticke-udaje/vybrane-makroekonomicke-ukazovatele/ceny-nehnutelnosti-na-byvanie/ceny-nehnutelnosti-na-byvanie-podla-krajov/>

Combining the previous views we came to some interesting results. For example the Bratislava region, having the highest residential price level, reached the slowest price increase witnessed and second lowest combined price/income growth. On the opposite, the Trenčín region with very low increase in wages and disposable income, recorded skyrocketing property growth of 97%, while still retaining the second lowest apartment price per sqm (1.297).

From the investment point of view also Žilina region was a good choice – it recorded the sharpest price increase of 118%. Even if accompanied with one of the highest disposable income increase, the final difference still even doubled unfortunately.

Generally, regional income/property price disparities have been observed in many other countries and regions and are well covered by the scientific literature (*i.a.*) – Germany (Bischoff 2011), Germany and UK (Blaseio, Jones 2019) or China (Cheong et al. 2020). The local context was thoroughly covered by a Czech study (Votava et al. 2021) analyzing eight factors and their impact on the pricing trends. This paper’s main aim is to compare Slovakia’s major subregions and their affordability ratios as a basis for further research.

#### 4. Discussion

For the final discussion on real housing affordability in Slovakia combining both income and price-based view need to be applied.

Out of the property indexes that are used worldwide we opted for the Deloitte Property Index, which is well accepted and comparable also with other countries or regions. The index computes number of gross income multiples needed for a 70 sqm large apartment purchase in respective country or region.

The gross value is generally applied in order to avoid bias deriving from countries’ different tax systems and their impacts on the disposable income figures. For a single country calculation, though, we include also the net figures as those describe more precisely the overall price burden.

**Table 5:** Deloitte Property Index, calculated for all regions. Typical apartment = a 70 sqm large apartment, multiples of yearly disposable and gross income for acquisition of typical apartment.

<i>Region</i>	typical apartment price	multiples of yearly income	
		disposable	gross
BRATISLAVA	197 798	10,88	8,69
KOŠICE	125 877	7,88	6,53
PREŠOV	110 190	6,86	5,71
ŽILINA	116 017	6,73	5,53
BANSKA BYSTRICA	96 554	6,44	5,26
TRNAVA	102 176	5,84	4,78
TRENČÍN	90 800	5,56	4,60
NITRA	82 048	5,08	4,16
<b>SLOVAKIA</b>	<b>152 308</b>	<b>9,22</b>	<b>7,56</b>

Despite relatively low income levels both Nitra and Trenčín regions keep the position of the most affordable regions from the housing point of view using the Deloitte methodic. Due to their very favorable starting position (2012 index of both circa 3,1) even the high property price increases in the past periods did not decrease the final housing affordability ratio.

So which region recorded the highest deterioration in the housing affordability over the period 2012-2021?

**Table 6:** Deloitte Property Index, difference in values for 2021 and 2012, own calculation.

	2012	2021	difference
<b>BRATISLAVA</b>	7,28	10,88	49%
TRNAVA	4,20	5,84	39%
TRENČÍN	3,12	5,56	78%
<b>ŽILINA</b>	3,73	6,73	81%
BANSKA BYSTRICA	4,21	6,44	53%
<b>KOŠICE</b>	4,90	7,88	61%
PREŠOV	4,09	6,86	68%
NITRA	3,40	5,08	49%

Source: previous data sources, own calculation

## 5. Concluding remarks

Since 2012 both categories – disposable income and property prices have seen gradual increase. As the dynamics of the income growth does not correspond with the property market dynamics, overall housing affordability deteriorated. Considering an intra-regional comparison, Slovakian sub-regions have also witnessed some disproportionate trends. As shown in the Table 4, Bratislava and Trnava region recorded lowest combined increase in property prices vs. disposable income increase; unlike to e.g. Žilina or Trenčín having higher unemployment rate for instance. There are also some other unexpected outcomes – Nitra, Trnava and Žilina being the winners of the 2012 - > 21 increase on the income side.

Therefore, more complex view need to be applied when assessing the real housing affordability or its progress particularly to control the effects of more contextual factors such as salaries, number of completed apartments per year, marriage/divorce rate, regional population growth, interest rates, construction activity etc. Moreover, it seems that many of the factors mentioned have different correlation effect through according to the related research.

The ruling coalition has included the law on rental housing among its priorities shortly after its formation. Respective law finally came into force on 1 July 2022. A housing affordability approach could and should be one of the decisive criteria for allocating the state support or its prioritization. Opposite to the expectations – not the traditionally less successful regions are the ones most affected; our analyses shows that the largest cities and economically strong regions suffer from sharpest housing affordability deterioration.

The main challenge for further research should also be the data collection and sorting of real estate submarkets. The most reliable source – the cadastral office had not been collecting and releasing any datasets until 2019. Besides that, the data is mostly available on a whole-region basis only – inputs for respective cities or subregions are not being collected by any governmental bodies. Those figures are watched by some private entities, though underlying micro datasets are not available for further statistical processing.

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# IFRS for SMEs and NGOs – Burden or Advantage

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**Abstract.** IFRS for SMEs is issued as standard for a while now. In Slovakia it is still not allowed to use officially for the legal official financial statements. IFRS for NGOs is even not proposed yet. Some SMEs and NGOs need to disclose their financial statements according to accepted international accounting standards or according to foreign accounting standards. Companies with foreign ownership represent less than 10% of all companies but provide more than 40% of net turnover. Legislative makers in Slovakia does not reflect to the market demand and trends by updating legislative what forces some SMEs to perform dual accounting, legal based on SK GAAP and unofficial based on IFRS. There are some concerns of IFRS for SMEs adoption in Slovakia which needs to be overcome and risks mitigated. This paper provides brief overview of arguments and reasonings to get IFRS for SMEs implemented in Slovakia. On examples of real NGOs, it is shown how dual accounting rises expenses and administrative burden. US GAAP also cover NGOs, while IFRS do not. Policy of both to converge each other provides hope that even IFRS for NGOs will be once proposed.

**Keywords:** IFRS, SME, NGO, accounting.

**JEL classification:** E44, J30

## 1. Introduction

In the very beginning it needs to be mentioned that officially there is nothing like IFRS for non-for-profit organisations (further as NGOs). IFRS are in place for a while now and they are still spreading to new theories, industries and even to a new type of companies. Disclosure of financial statements according to IFRS is, in general, required for listed companies worldwide. IFRS have been created for profit-driven companies and their attitude is to serve them as a guidance to disclose their financial positions and information understandable and comparable to wide range of international users. Therefore, with no doubt, implementation, and usage of IFRS among listed companies has its purpose, results, and advantages. Meanwhile the spread of IFRS showed that

even some companies which are not listed or publicly traded may be interested to voluntarily disclose their financial information according to international standards. Reasoning for such conduct may be for example: showing themselves to an international business partner, applying for an international financing scheme or grant or preparation to merge with another company in the industry, etc. Therefore, new standard IFRS for SMEs have been released (1). This standard, unlike other IFRS standards, is only one standard covering range of other IFRS standards. As its name shows, its purpose is to serve SMEs and it provides them simplified IFRS approach. IFRS for SMEs cannot be used for public interest companies – listed on public market or OTC market. (1) Unfortunately, IFRS for SMEs is not yet recognised by European Commission as accounting standard allowed to be used officially within EU boundaries. Also, not all issued IFRS standards are recognised within EU. Only those are allowed which are in official EU Commission regulation 1126/2008 (2).

Unlike IFRS, US GAAP is created not only for business companies but also for not-for-profit organisations. This is due to differences in American and European approach of financing NGOs and therefore need to disclose and report financial figures of NGOs to public, donors, and government (3). Because of some NGOs activities are financed from public sources or EU funds there is space for application of accounting standards for NGOs, that would provide similar advantages and benefits as IFRS. NGOs are organisations that are not meant to generate profit to their stakeholders. Their purpose is to serve for public benefit (4). Therefore, the question arises whether application of international accounting standards would be beneficial for the SMEs and for the NGOs, or it would be a burden for them. Current literature focus more on accountability (4) (5) than on implementation of unified accounting standards. This contribution is aimed to find the answer by analysing available data from Slovakia. It has to be mentioned that Slovakian legislation does not allow SMEs and NGOs officially to apply IFRS or any other accounting standards than Slovakian GAAP provided as law (6). Slovakian accounting act allows IFRS to be applied only for public interest companies and companies that meet volume-based criteria (6). Therefore, even an SME or an NGO is part of consolidation it must issue financial statements according to Slovakian GAAP and for the consolidation purpose according to IFRS (7). This can be achieved either by performing side to side accountancy, one based on Slovakian GAAP and second by IFRS. Or by correcting SK GAAP statements to IFRS statements. None of this is without an effort and the question is why there shall not be possibility to apply only IFRS as widely acceptable and widely spread standards than national GAAPs.

### **1.1 Dual accountancy performed by SMEs (and NGOs)**

SMEs which are part of the consolidation in many cases use holding's ERP system for their operation. This allows them not only to comply with the holding's policies, practices, and processes, but it also enables company to perform accountancy based on IFRS. For the purpose of creating consolidated financial statements, the booked figures in each entity of the same manner are taken and counted (7). Therefore, it is necessary to book all records in the same manner as the performer of consolidation. As the IFRS is transaction based accounting and Slovakian GAAP is generic accounting, there is

obvious difference between these two approaches. In case the SME is small with only little transactions it is possible and easier to just adjust SK GAAP financial statements to create statements for consolidation purpose. However, in many cases the final financial statements are not enough information source for users of financial statements as yearly figures are given late and may not be in time of making decisions. Therefore, it is often required to provide figures of SME also from within a financial year either by interim financial statements or by simple enabling mother company to use figures from SMEs ERP system. That financial information shall be of the same manner as the mother company, so they can be used within the holding for users of information to make decisions, or just to check performance of the SME. The same applies to NGOs of a foreign origin who are part of the consolidation.

Dual accountancy, nevertheless, it is required due to nature of the origin of the SME, its holders, its reporting requirements, and needs is performed at the edge of the law. According to Slovakian accounting act (6) it is not allowed to account outside accounting books. Accounting books are mentioned in in the act. The question arises whether if the SME performs accountancy in its accounting books according to the accounting act and also elsewhere according to IFRS it is considered as booking outside the accounting books or not as IFRS books are not mentioned in the act at all.

Result of the SK GAAP financial statement is used as a base for profit tax calculation. For big companies which are required or allowed by accounting act to perform only IFRS accounting, the result gained from IFRS statement are taken as a base for profit tax calculations. Therefore, the question is why SMEs who perform IFRS accountancy cannot use IFRS statements results also for profit tax calculations.

## **1.2 Concerns**

As the taxation and accounting is strongly bounded in Slovakia, and also elsewhere, the main concern is whether IFRS is suitable for determination of tax base. It is worth to mention that as IFRS is meant to be internationally consistent, there is also a movement to make profit taxation determination and reporting internationally consistent. One of such deeds is CCCTB (8), the approach of European commission to unify taxation within EU, which is still in the phase of proposal and development. Based on study, financial accounting and tax accounting shall be separated, as IFRS is based on principles rather than on strong rules (9). If the financial accounting and taxation will be bounded, there is still concern of tax motivated accounting (10). Purpose of accountancy shall not be tax calculation, but to show true financial status of the company to users who have not access to detailed information of the company, namely from outside of the company. Tax administration is one of the users of financial statements, however in 21<sup>st</sup> century of digitalization and AI, tax administration shall be capable to perform investigations, inspections, tax determinations using information from other sources then financial statements only, for example from digital exchange of business information (11). Financial statements for tax fraud determinations are not suitable as they are disclosed after the end of financial year, which is too late for this purpose. Supervisory authority for accounting in Slovakia is Tax authority which is also

supervisory authority for taxation. This speaks out for itself why in Slovakia taxation and accounting is so strongly bounded.

Another concern is that SK GAAP rules strongly dictate what must be booked on which account, list of account is part of the SK GAAP. Therefore, each company shall book each transaction in the same way. As mentioned before, SK GAAP is generic accounting which leaves gap for management accounting to step in to provide useful information regarding to transactions, processes, and business activities in the form useful for managers. Transaction based accounting is capable to provide more useful information in such cases than generic accounting. However, leaving generic accounting and switching to transaction-based accounting allow each entity to book same transactions slightly differently. Question is whether it is bad or good. If the companies tend to perform accountancy correctly, they shall have freedom to book transactions to provide as much useful information as possible, while companies who tend to pretend their financial position, do so regardless to which accounting rules are in place.

When concerning concerns there is also lack of personnel. Lack of personnel is an issue in almost any industry and is due to natural demography (12). In Slovakia, accountancy is free trade, what means it can be performed by any person, no matter of its education or knowledge. Because of strong legal requirement of performing SK GAAP only, there is education of accountancy in place mostly for SK GAAP. It is not a standard to provide IFRS education in common economic high schools and accounting courses, because there are not so much IFRS allowed companies. Therefore, to apply IFRS in practice it is required also to change mindset from generic booking to transaction booking. As it is not deeply educated topic, except in university, there is concern that accountancy based on IFRS in SMEs may not be performed correctly. Such risks may be mitigated by Audit. Audit is required only when company meet volume criteria what most of the SMEs do not meet. Voluntary audit is also possible. This risk may be also mitigated when company is part of consolidation and use holding's ERP which is set by mother company. In such cases most of the operational transactions are booked in the same manner in whole holding and therefore mother company may provide assistance and assurance that accounting is performed correctly. Mother company is subject to audit and consolidated statements are also subject to audit, mother company tend their subsidies to perform accountancy well. Lack of accountants may be partially solved by automatization of accounting (13).

IFRS as principles do not provide any forms of statements. They just mention what kind of information must be disclosed (14). Therefore, it is up to a company to display information in form useful for users. Every company shows their financial statements in different visualizations. Despite of it looks nice to read, it is not suitable for machine processing, what may be one of the reasons why legislative creators tend to be resistant to allow IFRS for SMEs. Anyway, such obstacle may be easily overcome by providing standardization of forms of financial statements. Standardization of statements does not comply with the IFRS idea that every company knows itself the best, so is capable to display its figures and information in financial statements in the best way possible. Standardization of forms of financial statements may be a step back. One shall mind that once the tax reporting and accounting get separated, there is no more need for

standardized forms, especially when AI is capable to read and withdraw information from the non-standardized statements in similar way than a human would do. Such approach requires more intense adoption of AI, but it can provide more useful information in financial statements. In the other hand, when holding's ERP is in use in an SME, then the SME may use the same form of statements than its mother company. Therefore, some form of standardization is in place always what makes and order in displaying disclosed information.

There are, for sure, much more concerns to consider. These are just those the most obvious. There is also convenience of supervisory authority which has much less effort with standardized information than unstandardized, no matter how this affects supervised companies financially and bureaucratically, even standardized information may not provide that much useful information than unstandardized would do.

## **2. To whom it may concern**

As already mentioned, SMEs which are part of consolidation are affected the most as they are forced to pretend extra expenses for dual accountancy. But how many of them are really affected. "SME represent more than 95% of all companies worldwide" (15). Yearly financial statements of Slovakian companies are public documents and are easily accessible in the register on internet for free. Despite of that there is lack of information whether a company is part of consolidation or not in standardised forms. This information shall be displayed in notes to the statements which are, for their nature, not standardized. Because there are more than 200k financial statements submitted a year in Slovakia alone, it requires an AI machine to read and evaluate all notes of financial statements. As we do not have such AI capability, we can just show percentage of companies with foreign ownership. Not every company with foreign ownership is part of consolidation. Foreign owners may be interested in financial statements compiled based on IFRS or IFRS for SMEs rather than on SK GAAP.

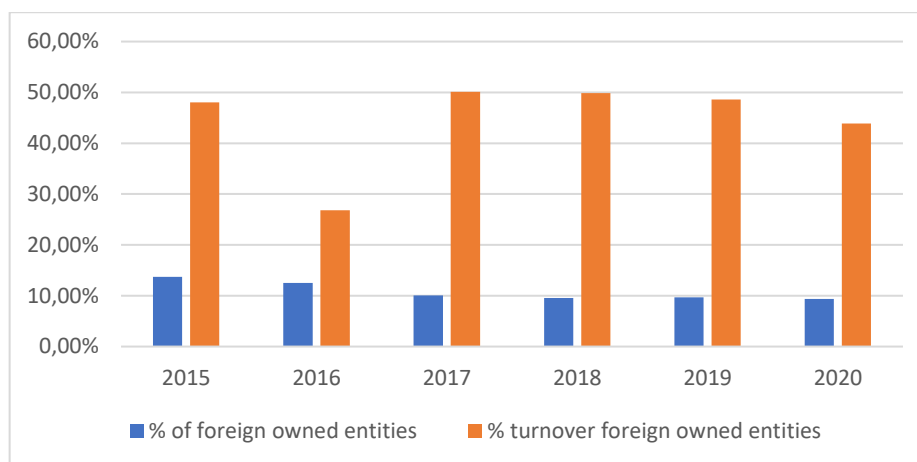


Figure 1. Percentage of foreign owned companies to total companies and percentage of foreign owned companies net turnover to total net turnover. Only data from non-defaulted and non-terminated companies were considered.

As shown in the Figure 1, the turnover of foreign owned companies to total net turnover is significant. This figure does not show the percentage of companies or their turnover which ones already disclose their financial statements according to IFRS. Only financial institutions must use IFRS and companies who meet at least 2 of these 3 criteria: Net turnover exceed 170 mil €, net assets exceed 170 mil € or average number of employees exceed 2000. These volume criteria are so significant that even few such companies change the figures in the graph. Number of foreign owned companies in 2020 was more than 19 000, what results that majority of the foreign owned companies are not those disclosing their financial statements according to IFRS.

Disclosing financial statements according to IFRS and performing accountancy according to IFRS may not be interested only for companies with foreign ownership, but also for companies granted EU Funds grants or any other foreign origin grants or subsidy. EU funds are project based fundings to provide finances to range of projects to help fulfil long-term EU policies. They are budgeted for periods of years and therefore could be used for long term projects. Money must be spent on approved project according to criteria. Spendings are subject to double check. Financing is usually via tranches and before any tranche, previous one must be reported and spendings checked by supervisory institutions, in Slovakia MIRRI. Part of the reporting are financial figures and disclosures. It is not required to report financial figures according to IFRS but doing so may provide greater assurance not only to MIRRI, but also to EU institutions. As this approach is hypothetical, we are not going to spend more space hypothesizing here.

Special case which is out of the focus of both scholars and governments are NGOs. One of the reasons is that NGOs does not generate taxable profit and therefore in many cases are not obliged to submit tax return. In Slovakia only those NGOs which submit tax return must also submit financial statements, which appear in public registry of

financial statements. Nevertheless, even NGOs must perform accountancy even their statements are not submitted. NGOs which are financed, granted, or subsidized from abroad must report to their foreign donors or sponsors according to foreign GAAP; to the USA according to US GAAP or according to (pseudo) IFRS. Because they do not submit financial statements nor tax return, it is almost impossible to determine their turnover or impact on GDP. Placing reporting burdens to NGOs shall not be the way as their purpose is to provide services to public benefit and most of them are small gatherings of ordinary citizens, no matter of their legal form, who pretend some common interest. The idea of this text is that if any NGO has need to perform accountancy according to international standards, it shall be allowed to do so. Current accounting act, as already mentioned, requires to perform accountancy according to SK GAAP. An NGO then must perform dual accountancy. NGOs with might be interested in performing accountancy according to international standards, if they already do not do so, are for example: international charities, churches, sport clubs, international schools, and their branches, etc.

The question arise why micro NGOs must perform accountancy at all. For example, in Slovakia, self-employees are allowed to perform only tax records consisting only cash-flow – no accountancy, but NGOs must perform simple accountancy even they do not have any users of their financial statements. Further research is needed to determine when NGO shall be released form the burden of performing accountancy at all and when it is necessary to do so at least for government reporting purposes. And if NGO must perform accountancy whether it shall be allowed to do it according to international standards only.

### 3. Methodology

To describe the extra effort which must be performed by an organisation, we analyse data of 2 real NGOs which operate in Slovakia. Both are of the foreign origin, and both are obliged to regularly report their financial figures to their parent organisation due to be the part of the consolidation unit. Because the data are protected by the law as secret, names and detection information are not disclosed in this paper. Rather labels as Organisation A and organisation B are used.

Brief information of the size of both organisations is mentioned in Table 1. Both are budget organisations therefore they do not generate any profit.

**Table 1.** Brief overview of both analyzed organization showing their turnover in 2021.

	Organisation A	Organisation B
Yearly turnover:	699 175 €	768 181 €
Out of which:		
Money from parent or sister organisations:	555 725 €	692 291 €
Money from government grants and subsidies:	107 550 €	2 240 €
Donations and gifts:	22 250 €	72 650 €
Revenue from rent	13 650 €	
Average no. of employees:	18	5



Average no. of volunteers:	20	22
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Organisation A reports their figures according to pseudo-IFRS standards based on the IFRS. Organisation A voluntarily let their official Slovakian financial statements to be audited. Organisation B reports their figures according to US GAAP.

### 3.1 Expense for dual accountancy

As both organisations must perform accounting according to Slovakian GAAP, they need to employ 1 full time employee (further as FTE) for accounting. Slovakian Accounting act allows to perform accounting by a supplier, but these organisations prefer to hire own FTE to do the task, because in case of supplying accounting services there still must be an administrative employee who would prepare the documents for an accounting supplier. This can be joined in 1 FTE who collects, prepare, book, and account all documents. As both organisations must also report to their parent organisations, according to parent GAAP due to consolidation and due to management accounting, they use parent organisation's ERP software for the task. ERP is given by a parent organisation for free. Even if it would not be free, usually NGOs has much less prices for such software than business companies. Accounting in foreign GAAP is performed in English, only digitally. Due to need to use English as standard, it needs to be reflected in higher salary. Comparison of yearly expenses can be seen in Table 2. SK GAAP is performed in paper, due to legal obstacles of digitalisation, such as need of 2 signatures. Foreign GAAP is performed digitally only, what means each paper document is scanned and attached into the software record.

Table 2 Yearly expense for performance of accounting

	1 FTE foreign GAAP accountant	1 FTE SK GAAP accountant	SK GAAP software	Office supplies due to SK GAAP	Penalties from SK Tax administration	TOTAL
Organisation A	24 000 €	18 000 €	600 €	850 €	60 €	43 510 €
Organisation B	24 000 €	16 500 €	600 €	1 250 €	30 €	42 380 €

As seen from the Table 2, the expense for foreign GAAP performance is 3.43% of turnover in organisation A and 3.12% in organisation B. Performance of SK GAAP is 2.79% in organisation A and 2.39% in organisation B. This however does not contain indirect expenses and effort such as HR, legal requirements, administrative requirements etc.

## 4. Conclusion

IFRS was not created for SMEs and NGOs at first place. Reporting needs of SMEs and NGOs to report and disclose their statements to the range of users exceeding borders of their operational address arise general need to unify accounting standards even of SMEs and NGOs. Statements of SMEs and NGOs must be readable and

understandable to the variety of international users of financial statements and financial information so they may stand strongly among the international competition or apply for fundings from abroad financial sources. To meet this goal, they have no other option in Slovakia, but perform dual accountancy: legal official one and (illegal) one based on IFRS that meets their reporting needs. Because IFRS is much broader than national GAAP and requires more expertise approach companies who choose to use them are doing so highly exceeding legal requirements. As briefly shown in this paper, accounting act in Slovakia is highly outdated and needs to be updated to comply with international accounting and reporting trends and needs. Solution is not only to update accounting act but also updating all other acts that affect accountancy. And educate accountants, businesspeople, and government institutions employees to switch from generic accountancy to transaction-based accountancy mindset. To meet this goal, separation of financial and tax accounting must come first. Further research and development are needed. As IFRS for SMEs is getting implemented worldwide, it is an advantage to watch what impact, positive and negative, it has in countries where it has been implemented recently.

Despite of issuing simplified IFRS for SMEs standard it is still not recognized by European commission. Regarding to NGOs, there is even not a proposal for such standard. Comparing it to US GAAP where standards are applicable also for NGOs, European NGOs may hope that policy of convergence between US GAAP and IFRS may bear fruit also in this area.

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