Impact of Public Debt on Long-Term Interest Rates

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Abstract: In this paper, I have tried to answer whether higher public debt in advanced economies leads to rising long-term interest rates. First, I estimated the impact of public debt on long-term nominal interest rates on a sample of 18 advanced economies in the years 1950-2017 using a fixed effects model in various specifications. The effect of debt remained insignificant in all specifications. Second, with the help of a novel way of visualizing rolling-window regression inspired by [12], I have shown that the impact of public debt is in fact time-varying, and a positive significant effect is rather a hallmark of recent decades.

Keywords: Long-term interest rates, Public debt, Panel estimation, Rolling-window regression

JEL classification: H63, E43

1 Introduction

Does high public debt lead to higher long-term interest rates? Many authors have found a positive relationship between these variables (e.g., [2], [10], [13]). The reason why this relationship should hold may be, for example, due to the well-known crowding-out effect, or owing to the increase in the risk premium, which is the investor's response to a higher probability of default. In the current situation where public debts of advanced economies are growing at a rapid pace because of a pandemic, I consider my research question to be highly relevant.

The main objective of this paper is to examine the relationship between public debt and long-term interest rates in 18 advanced economies. I estimate the effect of public debt on long-term nominal interest rates on a whole sample of countries in the years 1950-2017 using a fixed effects model in various specifications. The impact of debt has remained insignificant in all specifications. I have also found that Euro area countries have long-term interest rates lower by more than 2 percentage points in average, but surprisingly, the impact of public debt on interest in these countries is positive - a 10 percentage point increase in debt is associated with an increase in interest rates of around 20 basis points.

Since several studies conducted on shorter time spans have found a relatively robust positive effect of public debt, I have hypothesized that the effect of public debt may be time-varying over a long period of time, which may affect estimates on long-term samples. Although the time varying effects of public debt have been studied by several authors (e.g, [3], [4]), they have used relatively short periods and arbitrarily chosen lengths of time windows. In this paper, I address these shortcomings and estimate 1922x2 regressions (for nominal and real interest rates respectively), which cover all periods between 1950-2017 and all possible time windows with a minimum length of 5 years. With the help of a novel way of visualizing rolling-window regression inspired by [12], I have shown that the impact of public debt on interest rates is in fact time-varying over a long period of time and a positive significant effect is rather a hallmark of recent decades.

2 Literature Review

There are mostly two main theoretical reasons why higher public debt and government deficits should lead to higher interest rates. The first argument comes down to the so-called crowding-out effect, which is based on the reasoning that expansionary fiscal policy displaces private investment and results in a lower equilibrium capital stock, which is associated with a higher marginal product of capital, and thus higher real interest rates [2], [5]. The second reason is the channel of uncertainty, where higher public debt may increase the default risk, which may lead to a higher risk premium and higher bond yields [6], [10].

[2] find a significant impact of fiscal variables on long-term nominal interest rates in a panel of 16 OECD countries between 1960 and 2002. The effect of the primary government balance is negative and linear, while effect of public debt is non-linear. If a country has a public debt of 119% of GDP (such as Italy in 2002), an increase in debt of one standard deviation leads to an increase in nominal yields on 10-year government bonds of 86 basis points[1]. Nevertheless, the same shock to government debt in a country with a 58% public debt-to-GDP ratio (such as the USA in 2002) leads to an increase in nominal interest rates of only 10 basis points. Among other things, [2] observe that an increase in total government debt in OECD countries leads to an increase in bond yields, suggesting some interconnection between advanced economies.

[6] addresses the impact of fiscal policy on interest rates in the context of the European Monetary Union (EMU). The main objective of his paper is to test whether expansionary fiscal policy in one country affects interest rates in that country alone, or if spatial effects are present. [6] confirms both hypotheses with the estimated effect being higher for the latter, suggesting strong spillovers through an interest rate channel among fiscal policies of the EMU countries. In economies with high public debt, the dynamics as well as the stock of public debt have a stronger impact on domestic interest

[1] [2] point out that in their sample, one standard deviation of public debt to GDP is equal to 26 percent, which is a rather significant change.

rates. According to [6], his findings on significant spillovers between EMU countries are an argument in favor of rigorous enforcement of the rules of the Stability and Growth Pact.

[10] examine the impact of public debt on interest rates in both linear and non-linear model specifications based on panel estimates in 31 advanced and emerging economies during the period 1980-2008. They suggest that a 20-percentage point increase in public debt to GDP increases total interest expenditure as a share of GDP by 0.8 percentage points in G-20 economies and by about 1.7 percentage points in advanced G-20 economies. The authors also regard the initial fiscal position, institutional and other structural conditions, and spillovers from global financial markets as important determinants in the relationship between fiscal variables and interest rates.

Endogeneity is a major problem in estimating the impact of fiscal variables on interest rates. Let us suppose the economy is in a recession. Automatic stabilizers respond to the phase of the business cycle, increasing government deficits and debt. At the same time, however, expansionary monetary policy is pushing rates down in response to the recession. For this reason, fiscal deficits may be negatively correlated with long-term interest rates, which contrasts with the standard economic theory [11]. [11] deals with the problem of endogeneity by using projected values instead of actual values of the variables. He conducts his analysis on data for the United States, using 5-year debt and deficit projections from the Congressional Budget Office (CBO) as explanatory variables, and 5-year forward rates on 10-year government bonds as a dependent variable. By means of this approach, he gets rid of other influences on variables and largely eliminates the problem of endogeneity. [11] finds that an increase in the projected deficit to GDP of 1 percentage point is associated with an increase in the forward rate by 22 basis points. An increase in the projected public debt to GDP by a percentage point results in an increase in the forward rate by 3-4 basis points. A significantly lower impact of public debt on forward interest rates is discovered from the panel data analysis by [7]. Based on their estimates, 1 p. p. increase in gross government debt-to-GDP ratio raises forward long-term interest rates by 2.5 basis point when the increase in debt is financed entirely from abroad, and only 0.8 basis point with domestically financed new debt. They conduct this study on a sample of 10 advanced economies during the 1990-2010 period [7].

According to [13], when analyzing the determinants of long-term interest rates, it is important to distinguish between short-term and long-term effects. In recent decades, there has been a long-term declining trend in interest rates in advanced economies. For this reason, it is appropriate to draw a distinction between factors affecting the long-term trend and those that explain short-term fluctuations. Following this logic, [13] uses cointegration methods which can address these problems. He analyzes annual observations on a sample of 22 developed economies during the years 1980-2010. The main finding is that in the long run, an increase in public debt to GDP of 1 percentage point increases long-term interest rates by about 2 basis points. In the short run, the change in public debt to GDP, the change in the money market rate and the change in inflation have a substantial effect on the change in long-term interest rates.

[8] examine the relationship between government debt and real GDP growth through the real interest rate channel. The growth of public debt to GDP may lead to increased

doubts about the ability to repay accumulated debt, which increases the risk premium, and thus real interest rates. An increase in real interest rates can, therefore, translate into a reduction in interest-sensitive expenditures, thereby slowing down economic growth. To examine this hypothesis, they employ a panel VAR model with 31 countries of the European Union and the OECD between 1995 and 2013. [8] do not find the presence of Granger causality in the direction from public debt to interest and real growth. However, they discover reverse causality in the direction from growth to debt, where the interest rate acts as a transmission channel.

This paper may contribute to the current state of knowledge in two ways. Firstly, by examining the effect of public debt on nominal long-term interest rates over a long time span (1950-2017). Secondly, by properly addressing potential time-varying effect of public debt.

3 Methodology and data

In the analysis I use a database from [9], which contains data on macroeconomic and financial indicators for 18 advanced economies in the period 1870 to 2017. Given the goal of this paper, I have decided not to use the whole sample for two reasons: the quality of the available data for the observed variables is lower for older data, and it is not possible to draw conclusions from the late 19th century data, which could have a bearing on contemporary economic policy decisions. Based on this consideration, a sample of the post-war period (1950-2017) is used. I use data for the following countries: Australia, Canada, Finland, Germany, Japan, Norway, Spain, Switzerland, USA, Belgium, Denmark, France, Italy, Netherlands, Portugal, Sweden, UK, Ireland.

The dependent variable in the analysis is the nominal long-term interest rate proxied by 10-year government bond yields. The primary source is the International Financial Statistics (IFS) database from the IMF. To control for the effects of monetary policy the short-term nominal interest rates are used which are captured using money market rates, the source of which is also the IFS database. The inflation rate is calculated as a year-to-year percentage change in the consumer price index, the primary source of which are statistical offices of individual countries. To capture the fiscal position, I used the primary balance to avoid the problem of reverse causality, as the total fiscal balance also includes interest payments. The public debt to GDP variable shows gross general government debt as a share of nominal GDP. Fiscal variables are obtained from various primary sources, which are described in detail in the database documentation by [9]. Cyclical position is captured by real GDP growth, which is calculated as the year-to-year percentage change in nominal GDP and deflated by the CPI. Real long-term interest rates are calculated as the difference between nominal interest rates and CPI inflation. The dummy variable Euro area takes on the value 1 since the country entered the Euro area. The period after the financial crisis is captured by the dummy variable, which has value of 1 since 2008 in all countries. None of the variables are differentiated, as stationarity is not a necessary condition for using a fixed effects estimator. All control variables are based on relevant empirical literature (eg, [2], [10], [13]). Table 1 shows summary statistics and Figure 1 shows the evolution of the average long-term interest rate and the average public debt to GDP. From this picture you can see long-term trends and several structural breaks, which justifies controlling for time-specific effect in panel regression.

Table 5: Summary statistics. Source: own calculations based on data from [9]

Variable	Unit	Obs.	Mean	St. Dev.	Min	Max
Long-term interest rate	Nominal, %	1,224	6.58	3.69	-0.36	21.50
Long-term interest rate	Real, %	1,224	2.17	3.67	-30.38	19.09
Short-term interest rate	Nominal, %	1,216	5.46	4.15	-2.00	21.27
Public debt	% of GDP	1,215	52.97	34.93	4.26	236.71
Primary public balance	% of GDP	1,220	-1.57	3.96	-15.92	20.08
CPI inflation	%	1,224	4.41	4.56	-6.87	37.88
GDP growth	Real, %	1,224	3.53	3.84	-12.81	35.31
Euro area	Dummy	1,224	0.16	0.36	0.00	1.00
Post 2008 crisis	Dummy	1,224	0.15	0.35	0.00	1.00

To estimate the impact of public debt on long-term interest rates, I use a fixed effects estimator with robust standard errors to autocorrelation and heteroscedasticity. The fixed effect model controls for an unobserved cross-sectional effect that is correlated with explanatory variables and is constant over time. The application of the fixed effects estimator is also supported by the Hausman test.

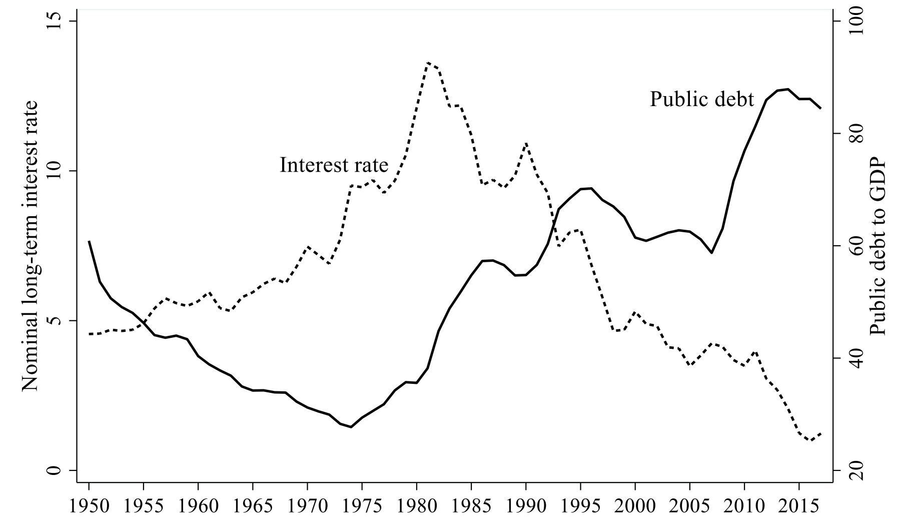

Figure 6: Evolution of average long-term interest rates and public debt to GDP in advanced economies. Source: own calculations based on data from [9]

4 Results

The panel data analysis is frequently employed in the estimation of the relationship between public debt and long-term interest rates (e.g., [2], [10], [13]), but these studies cover a maximum period of 30 years and do not include period after the financial crisis. To the best of my knowledge, the potential time-varying effect of public debt on long-term interests was addressed only by [3] and [4]. This paper will contribute to the literature in two ways: i.) by examining the long period of time since 1950 in advanced economies; ii.) by estimating the impact of public debt using rolling-window regression without an arbitrarily chosen length of time window.

4.1 Main estimation

I estimated the impact of public debt on interest rates using a fixed effects model, which was applied to panel data from 18 advanced economies in the period 1950-2017. The dependent variable is long-term nominal interest rate proxied by 10-year government bond yields and the base specification uses common control variables capturing economic development. The results of the panel regression estimates are shown in Table 2. The models (1) and (2), where the basic control variables are used, the impact of public debt is statistically insignificant and the direction of the effect of the control variables is in line with theoretical expectations. The models (3) and (4), I at least partially addressed the endogeneity problem using two-stage least squares regression. Lagged values of the public debt to GDP were used as an instrument, but the impact remained insignificant in this case as well. I was also unable to demonstrate the non-linear effect of public debt on nominal interest rates (columns (5) and (6)), which several authors found in OECD countries [2] or in a mixed sample of emerging and advanced economies as well [10]. According to my estimates, membership in European Monetary Union (EMU) reduces nominal 10-year government bond yields by about 2 percentage points in average, which may be associated with lower exchange rate risk and a significant decline in the risk perception of countries from the financial markets, which is also supported by [3]. This effect remains significant even though I am controlling for the period after financial crisis, when the policy-rate hits the zero low bound. The impact of public debt on long-term interests is statistically significant in the Euro area countries and results in rising interest rates (10 p. p. increase in public debt leads to higher interest rates by about 20-25 basis points), which contradicts the findings of [13], who found the negative impact of public debt on real long-term interest rates in EMU. The debt crisis in the Eurozone, where interest rates have risen significantly in several countries due to problematic sovereign debt financing, is a possible explanation (however, only Ireland and Portugal are significantly affected countries in the dataset used).

Table 6: Panel regression estimates, 18 advanced economies, 1950-2017. Source: own calculations based on data from [9]

Dep.: Nominal long-term interest rate	(1) FE	(2) FE	(3) 2SLS	(4) 2SLS	(5) FE	(6) FE	(7) FE	(8) FE	(9) FE
Short-term	0.7116[a]	0.5875[a]	0.7099[a]	0.5858[a]	0.7112[a]	0.5900[a]	0.6940[a]	0.5745[a]	0.6676[a]

interest rate	(0.028)	(0.038)	(0.028)	(0.038)	(0.028)	(0.038)	(0.034)	(0.034)	(0.040)
CPI inflation	0.0707^{c}	0.0663^{c}	0.0667^{c}	0.0614^{c}	0.0730^{c}	0.0663^{c}	0.0656^{c}	0.0731^{c}	0.0681^{c}
	(0.034)	(0.035)	(0.035)	(0.037)	(0.034)	(0.035)	(0.035)	(0.037)	(0.03)
Real growth	0.0004	0.0040	-0.0013	0.0027	0.0016	0.0044	-0.0121	0.0036	-0.0236
	(0.017)	(0.0140	(0.016)	(0.014)	(0.015)	(0.013)	(0.014)	(0.014)	(0.014)
Primary balance	-0.1372^{b}	-0.0945	-0.1447^{b}	-0.1005	-0.1356^{b}	-0.0926	-0.1320^{b}	-0.0987	-0.1415^{b}
	(0.060)	(0.687)	(0.061)	(0.070)	(0.061)	(0.069)	(0.058)	(0.069)	(0.060)
Public debt to GDP	-0.0017	0.0022	-0.0030	0.0014	0.0016	0.0068	-0.0030	-0.0006	-0.0021
	(0.004)	(0.003)	(0.004)	(0.003)	(0.012)	(0.012)	(0.003)	(0.003)	(0.003)
Public debt to GDP					-0.0000	-0.0000			
squared					(0.000)	(0.000)			
Euro area dummy							-2.1071^{a}	-2.0896^{b}	-2.2023^{a}
							(0.566)	(0.772)	(0.563)
Euro area * Public							0.0211^{a}	0.0250^{b}	0.0258^{a}
Debt/GDP							(0.007)	(0.009)	(0.007)
Post crisis dummy									-0.8001^{a}
(2008-2017)									(0.227)
Constant	2.2638^{a}	2.494^{a}	2.3536^{a}	2.000^{a}	2.1521^{a}	2.354^{a}	2.5936^{a}	2.7012^{a}	2.7859^{a}
	(0.317)	(0.473)	(0.312)	(0.580)	(0.496)	(0.609)	(0.359)	(0.448)	(0.369)
Time dummies	No	Yes	No	Yes	No	Yes	No	Yes	No
Observations	1,206	1,206	1,187	1,187	1,206	1,206	1,206	1,206	1,206
R-squared	0.8305	0.8604	-	-	0.8306	0.8605	0.8366	0.8649	0.8404
Countries	18	18	18	18	18	18	18	18	18

Robust standard errors in parentheses
a: $p<0.01$, b: $p<0.05$, c: $p<0.1$

4.2 Time varying effect of public debt

The results of the panel regression in advanced economies on the whole sample of data did not confirm a significant positive impact of public debt on nominal long-term interest rates. However, this finding is not in line with the majority literature (e.g., [2], [10], [13]). These studies used very similar model specifications, but differed in the sample of countries, time period ([10] - 31 developed and emerging economies in the period 1980-2008, [13] - 22 developed countries in the years 1980-2010, [2] - OECD countries in the two periods 1960-2002 and 1975-2002) and [13] also in the estimation technique (PMG estimator). Given that, I have estimated the relationship between public debt and nominal interest rates over the longest time span in the relevant literature, but the estimates may be biased if the relationship between the variables has changed significantly over time.

I estimate the impact of public debt on the long-term nominal interest rate in the base specification (column (2) in Table 2) with time dummies and using a fixed effects estimator. Unlike standard rolling-window regression, where the author chooses the length of the period arbitrarily, in this case I estimate the model for all possible periods between 1950 and 2017, with a minimum time span of 5 years. For one specification, I therefore estimated 1922 regressions. The resulting estimates of the beta coefficients for public debt can be seen in Figure 2 on the left, with each circle showing an estimate of the effect of public debt in the period, the beginning of which is on the y-axis and the end on the x-axis. For example, the circle at the bottom right shows the estimated impact of debt on the whole sample between 1950 and 2017. Figure 2 on the right shows the statistical significance of the coefficients, with the white circles showing a non-significant effect (as with the estimates in previous section, robust standard errors were used).

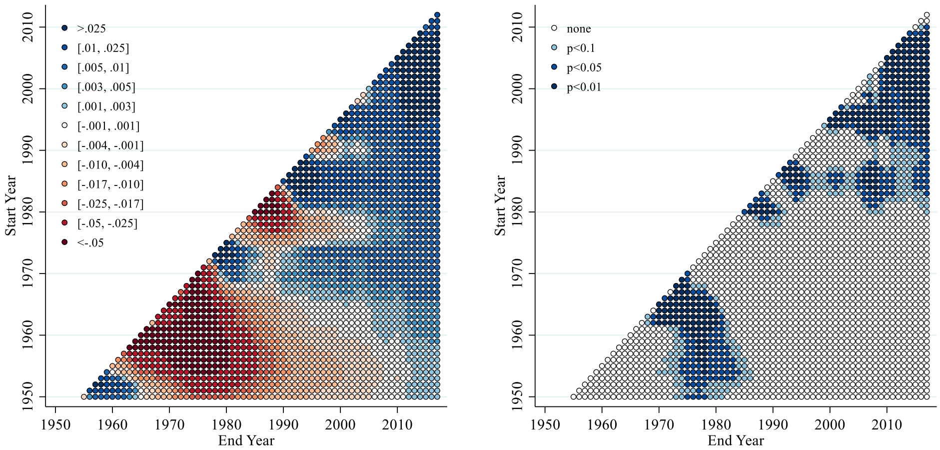

Figure 7: Rolling-window estimates, Dep.: nominal long term interest rates. Source: own calculations based on data from [9], visualization inspired by [12]

In most time periods, the estimated effect of public debt on nominal long-term interest rates is insignificant. During the periods ending in the 1970s and 1980s, when nominal interest rates were highest due to persistently high inflation, the estimated impact of debt is even negative, but not robust as I shown in specification with real interest rates (Figure 3). Including later periods, the estimated effect is statistically insignificant, which changes from 1990 to the present, when the impact of public debt is positive. However, this reversal in the debt effect may be driven by the Euro area, in which the positive impact of debt has been confirmed in the previous section. One of the explanations may be the debt crisis, but this would not explain the estimates in the pre-crisis period, which are also mostly significant. If these estimates are driven by the Eurozone, then another possible justification may relate to the handing over of monetary policy conduct to the ECB. The Maastricht Treaty also enshrined the so-called no-bail out clause, which prevented other Euro area members from taking over debts. Together, these factors may have created the preconditions in which excessively high debts could lead to a higher risk of default compared to countries with sovereign monetary policy.

To verify the results of the rolling-window regression in Figure 2, in the next step I estimated the impact of public debt on real long-term interest rates. The control variables used, and the estimation method remain the same, except that in this case the inflation rate already contained in the dependent variable has been removed from the specification. Figure 3 shows that the estimates in this specification are consistent with previous findings. In this case, however, the impact of public debt on real interest rates is already significant in the periods beginning in the 1980s. The above findings confirm the hypothesis of the time-varying effect of public debt on long-term interest rates and show that the choice of period as well as the length of the time window is important in the analysis of this relationship. Estimates from recent decades suggest that public debt increases interest rates, but the robustness of this claim should be addressed in future research, for example, by better endogeneity addressing.

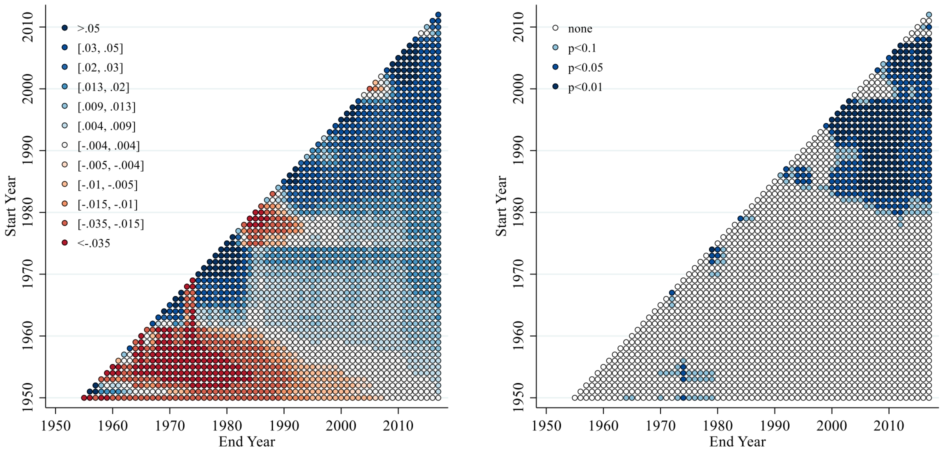

Figure 8: Rolling-window estimates, Dep.: real long term interest rates. Source: own calculations based on data from [9], visualization inspired by [12]

Conclusion

In this paper, I have tried to answer whether higher public debt in advanced economies leads to rising long-term interest rates. I estimated the impact of public debt on long-term nominal interest rates on a sample of 18 advanced economies in the years 1950-2017 using a fixed effects model in various specifications. The effect of debt remained insignificant in all specifications. I have also found that Eurozone countries have long-term interest rates lower by more than 2 percentage points, but surprisingly, the impact of public debt on interest rates in these countries is positive - a 10 percentage point increase in debt is associated with an increase in interest rates of around 20 basis points. Since the finding of an insignificant impact of public debt is contradictory with the majority literature, it is possible that estimates over such a long-time horizon may be biased by a change in impact over time. Then, I estimated rolling-window regression on all possible periods between 1950-2017 and the impact of public debt on nominal long-term interest rates has proved insignificant in most models. According to these findings, the significant and positive effect of debt is only characteristic of recent decades. These conclusions were also supported by estimating rolling-window regression with real interest rates as a dependent variable and it will be the task of further research to find out why[2].

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