The Economic Impact of Carrying Government Debt on Interest Rates

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Abstract

This paper examines the relationship between government debt and interest rates using a dataset of 124 countries. The effect of debt on interest rates is established in a number of ways including differentiating between OECD and non-OECD countries as well as exploring the long-term effect of a shock to debt. Prior research has done similar studies on the United States as well as with other countries, and the OLS equation used in this study is similar to studies done on the United States. I use an OLS regression model that also includes time and country fixed effects to control for natural differences in interest rate climate between countries in each set as well as the difference in interest rates over time. I find that for every 1% increase in debt/GDP for OECD countries there is a 0.09% increase in interest rates, significant at the 1% level, and that there is a decrease of 0.05% for non-OECD countries, also significant at 1%. A panel VAR model is also used with debt/GDP as the impulse variable and interest as the response, and I find that a 11% increase in debt leads to a 2% increase in interest rates between 5-10 years after the shock.

Keywords

Interest Rates; Government Debt; OECD vs Non-OECD; Fiscal Policy

JEL Codes

E43; E62; E50; E52

I. Introduction

Since the mid 20th century, the United States national debt has grown significantly, with the total number topping $33 trillion in September of this year. This has led to a Debt-GDP ratio of 124.41%, with that number being just 55.84% in the year 2000. Higher levels of spending on defense, social programs as well as relief for the COVID-19 pandemic have raised alarm bells for many as the debt/GDP ratio is reaching levels not seen since World War II.. Debt and government spending have been widely discussed in recent news in regards to the upcoming presidential election, as foreign aid has been an extremely partisan issue with rising conflict abroad.[1] Interest rates have also been a significant topic in recent news, as the Federal Reserve has had to increase rates significantly in order to reduce inflation brought on by supply shocks due to the pandemic and other geopolitical factors. While the battle against inflation has been cooling down in recent months, these are issues that are not just limited to the United States, as economies across the world have been facing similar struggles regarding high public debt and interest rates. Government debt and interest rates are two hot topics in economic news, and my research will attempt to establish a relationship between the two. The question that my research will be answering is: what is the relationship between government debt and interest rates, and how will current debt situations affect world economies? We will examine previous data on government and interest rates while controlling for a variety of factors including but not limited to inflation and government spending. We also examine data from a wide variety of both OECD and non-OECD countries to attempt to establish a difference in the effect of debt. This methodology contributes to existing literature in multiple ways. First, my research incorporates more recent data, and most importantly, data including the COVID pandemic. As this event had

[1] "Taxes, Tariffs and Debt: Investors Start to Fear the Presidential Election", Wall Street Journal, April 2024

an extremely significant impact on world economies, there is a possibility that previously observed relationships between debt and interest rates could have changed significantly over time. Additionally, my research takes a more direct view at the difference between developed and developing countries in an attempt to draw conclusions about a general trend in the relationship and the differences that occur in different types of economies.

II. Background

Previous studies that have included a methodology similar to the OLS model that I will be implementing have mostly focused on solely United States government debt and interest rates. Eric M. Engen and Glenn R. Hubbard (2004) examine previous econometric analysis concerning the relationship between debt and interest rates as well as included new econometric analysis using a regression equation that includes control variables such as growth rate of GDP, real oil prices, and a measure for equity premium. Similarly, Edward Gamber and John Selinski (2019) focus solely on U.S. data and include a similar methodology to that of Engen and Hubbard. They use a general equilibrium model in order to establish how interest rates react to not only government debt, but also the type of fiscal policy that is in effect at the time of interest rate movement. They use a similar reduced-form regression equation as Engen and Hubbard, but include projected control variables in their equation. They use a 5-year ahead projected value for debt/GDP provided by CBO, and use their own projection for 5-year ahead expected interest rates by using the end-of-month 10 year rate for each period that the debt/GDP projection is published. These papers share similarities with my research in that I will be using similar explanatory variables and methodology as each of them.

My research differs in methodology in that I will be expanding the scope of these two models to include multiple countries rather than focusing on solely the United States. As I further

my research and expand my model, I expect that the equation will likely emulate the methodologies of these papers, as their equations are fairly direct and capture the relationship I am examining well. As far as the results of both papers are concerned, they reach similar conclusions despite using different methodologies. Engen and Hubbard estimate their regression using multiple methods including both a simple linear regression as well as a vector autoregression. The use of multiple methods of regression is an interesting tactic that the authors use, and it helps them to form a clear and meaningful conclusion by comparing and contrasting the results of each method. Following the discussion of their empirical findings, the authors conclude that the collective relationship between debt and interest rates that they find using the bulk of their empirical data is that for every 1% increase in government debt, long-term interest rates will increase by 3 basis points. Gamber and Selinski instead use a general equilibrium model to estimate their regression equation, and incorporate two samples of data. The first is data from January 1976-August 2007, and the second period is from January 1976-June 2017. This is done in order to account for the massive shock that occurred during the Global Financial Crisis of 2008-2010. Their regression results in a similar relationship, as they estimate that a 1% increase in government debt will result in an increase of 2.1-2.9 basis points for interest rates. However, an aspect that they also consider is fiscal policy, which is something that the first paper does not account for. They conclude that when fiscal policy is in favor of private capital at the time of increased debt, the effect on interest rates will be mitigated, and vice versa for when fiscal policy includes fewer incentives to invest. While the results of these two papers provide a meaningful baseline for the research that I will be conducting, there are some limitations that I will expand on. As discussed previously, I will be expanding the scope of the model by including multiple countries in order to establish trends between developed and developing countries. I

believe that this is a significant expansion of some of the ideas that are present in these studies and will contribute more to the understanding of how public debt and interest rates interact.

While the previous two papers focus solely on the United States, there have also been previous studies that examine multiple countries using similar methodologies. Noriaki Kinoshita (2006) uses panel data from 19 OECD countries to determine the relationship between debt and interest rates from both a theoretical and empirical perspective. While my research will be strictly empirical, the theoretical model does provide some insight into how interest rates and debt react to both each other and external factors. The author incorporates the country's birth rate into the model and concludes that when birth rate is relatively high, government debt affects interest rates through a crowding out effect in which physical capital is replaced partially by debt. David Turner and Francesca Spinelli (2013) utilizes a similar dataset that Kinoshita does. They use panel data from 22 OECD countries and target the interest rate growth differential's relationship with government debt. This methodology is slightly different from the previous studies I have discussed, and I believe that it is relevant to my research in that it provides some alternative methods to quantify the relationship I will be discussing. They define the growth differential as the difference between the interest rate on 10-year bonds for each country's government and the OECD estimate of nominal potential growth. These papers both use alternative methods than the methods that I will be using, but their use of panel data will be similar to the structure of my data. In terms of the methodology of each study, Kinoshita uses an equation that is similar to previous studies but is slightly more stripped down. She uses only two explanatory variables: debt/GDP and government consumption/GDP. The data that she collects are from the time period of 1971-2004, and two regressions are performed with both net government debt and gross government debt as the measure for the ratio. In the first stage, she

finds that for both net and gross debt, the beta coefficient for consumption/GDP is statistically significant. She also finds that when regressing for the coefficient on debt/GDP, a 1% increase in debt/GDP leads to an increase of 20-25 basis points for interest rates. However, once country fixed effects are controlled for, this effect significantly reduces to 4-5 basis points per 1% increase. Turner and Spinelli utilize a significantly different empirical model to estimate their results, with explanatory variables including a measure for inflation volatility, slope of each country's yield curve, and a proxy for the "global savings glut". This proxy variable is used to measure each country's indebtedness, and is the primary indicator that they are solving for. They run a regression using a dataset from 1980-2012, analyzing their equation for both internal and external public debt. They find that when government debt is entirely domestically financed, a 1% increase in government debt leads to an increase in interest rates by 2-2.5 basis points. However, they find that when government debt is externally financed, there is an amplified effect and that a 1% increase in government debt leads to a 3.5-5 basis point increase in interest rates. Each of these papers use varying methods to reach the same desired relationship, and find similar results. While differing explanatory variables and methodologies are used between two studies by Kinoshita and Turner and Spinelli, their results fall within the same range as each other and the two papers discussed previously.

Previous studies have also implemented alternative approaches to representing the relationship between debt and interest rates that are similar to the panel VAR method that I will use. Qureshi and Liaqat (2019) use a panel VAR model on 123 countries using data that covers the period from 1990-2015. Their dependent variable is external debt, which includes both public and private debt and they use a vector of various explanatory variables that are all treated as endogenous in this methodology. Similarly, Jacobs et al (2020) use a panel VAR approach to 31

EU and OECD countries with interest as the impulse variable and public debt to GDP and growth rate as response variables. This differs from the approach that I will take in that I will instead observe shocks to debt and their impact on interest rather than a shock to interest. However, the methodology is still similar to both of these studies in that I will be using a large set of data that includes many countries. Qureshi and Liaqat differentiate multiple regressions by country income, and find varying results depending on the development stage of the country. They find that external debt growth has an adverse effect on GDP growth for all countries in the dataset, but that there is actually a positive effect on income growth for low to middle income countries. They also find that there is a negative impact of GDP growth on debt growth across the board. The final effects that this paper estimates differ from the effect that I wish to exemplify in that they are using GDP growth and income growth instead of interest rates, but the methodology and equations that they use influenced my approach to panel VAR significantly. Jacobs et al. conclude that there is a causal link between economic growth and public debt, but that there is not a reverse relationship between debt and economic growth. During their analysis they consider the relationship between debt and interest rates and find that there can be variation between the effects of debt and interest rates. There were some cases in which the real interest rate remained constant at a very low level, but that other countries experienced major effects to interest rates from moves in public debt. Although this paper focuses solely on EU and OECD countries, the fact that they saw a significant difference in the way that interest rates can be impacted by debt motivated my decision to further investigate how interest rate effects can be different by using a larger dataset that includes OECD and non-OECD countries.

My research will combine aspects from each of the previous papers and will add to the existing literature in multiple ways. I will use a regression equation and methodology that is

similar to the first two papers that analyze the United States only, using variables that they use as explanatory variables for interest rates. However, I will expand the scope of these models to include a variety of countries as conducted in both Kinoshita (2006) and Turner and Spinelli (2013). I believe that this will capture the best of both worlds in a way, as I am using a more narrowed down approach that is applied to a much broader range of countries. One drawback of the studies that use panel data from multiple countries is that they focus solely on OECD countries, which are categorized as more industrialized and likely fall into the developed category. The papers that use panel VAR approaches are similar to the research that I will conduct in which I use a methodology that is influenced by the way that they used panel data. Qureshi and Liaqat (2019) use a large dataset containing over 100 countries like the dataset that I use, but they do not specifically look at the relationship between debt and interest rates. Jacobs et al. (2020) do conduct a panel VAR that examines this relationship throughout their broader study, however they only observe OECD/EU countries. I wish to study the differences between developed and developing countries, as this will help to add further understanding as to the real relationship between debt and interest rates. By incorporating data from countries in all stages of development as well as combining the two main approaches used in the existing literature, I will be able to fully illustrate how government debt and interest rates interact with each other, and how this relationship evolves throughout each stage of development.

III. Data Discussion

The data that I use for my analysis comes from two main databases, which are compiled then compiled together. This data comes from the International Financial Statistics (IFS) database provided by the IMF, as well as from the Historical Public Debt Database (HPDD) provided by the IMF. All variables that I use are recorded annually from the years of 1980-2023,

since consistent data from pre-1980 is scarce, especially for non-OECD countries. There are 124 countries included in this dataset, which leads to 5,500 observations across all variables that I include. The dependent variable that I am estimating for is interest, which I measure as the interest rate on each countries' treasury bills. This is done to account for differences in monetary policy autonomy across countries, since some countries do not set their own federal interest rates. Explanatory variables include inflation, government spending, GDP, GDP per capita, unemployment, and debt. Inflation is measured as Consumer Price Index, as this is the most widely used indicator for inflation. Government spending is measured as a percentage of GDP, as is debt. Debt is the main explanatory variable that I base my analysis on, and the debt number that is being compared to GDP is total federal debt. Additionally, GDP is measured as log millions of each countries' domestic currency to avoid a large skew in the regression results. Summary statistics for each of these variables are as follows:

VARIABLES	(1) N	(2) mean	(3) sd	(4) min	(5) max
IR_Tbills	2,719	9.025	11.13	-0.661	274.5
Debt	4,404	54.50	37.87	0.821	344.3
GDPpc	5,119	12,913	55,518	31.32	1.944e+06
Gov_Spend	2,437	17.22	5.996	3.913	56.96
Unemployment_Rate	2,637	7.913	5.808	0.109	56.71
Inflation_Rate	4,739	20.03	212.3	-16.86	11,750
log_GDP	2,958	27.02	3.561	-0.764	36.25

IV. Methodology

The main way that I estimate the relationship between interest rates and debt is via the OLS regression below:

$$I_{it} = \beta_0 + \beta_1 \pi_{i,t-1} + \beta_2 S_{it} + \beta_3 G_{it} + \beta_4 c_{it} + \beta_5 u_{i,t-1} + \beta_6 O_{it} + \beta_7 D_{it} + \beta_8 (O_{it} * D_{it}) + \zeta_{it} + \delta_{it} + \varepsilon_{it}$$

where $\pi_)$ is lagged inflation, S is government spending, G is log GDP, c is GDP per capita, u is lagged unemployment, O is an indicator variable for whether a country is an OECD country, D is debt/GDP, ζ is country fixed effects and δ is time fixed effects for country i at time t. Country and time fixed effects are included to capture the overall effect of debt while controlling for natural differences in interests over time and across countries, which allows for a direct comparison between the two sets of countries. Lags are used for both inflation and unemployment, as interest rates will not be affected by current inflation and unemployment data, since policies are made using data from the prior period, so lags are used to capture this. Additionally, the OECD variable and interaction term are included to allow for analysis of the differences between effects across different types of countries. This equation is my primary method of analysis that I will discuss in more detail in the next section.

Alternatively, I also estimate a panel VAR model to illustrate how a shock to debt affects interest rates. The equation for this model is as follows:

$$\Delta I_{it} = \alpha_i + \beta_{it} \Delta D_{i,t-1} + \gamma_{it} \Delta I_{i,t-1} + \varepsilon_{it}$$

where ΔI_{it} is the change in interest rate for country i at time t and $\Delta D_{i,t-1}$ is the shock to debt in the previous period that leads to the change in interest. I use this alternative method for multiple reasons. First, the panel VAR is able to more accurately predict dynamic changes in interest as a result of the debt shock over time, rather than a static coefficient as in OLS. Additionally, there could be some simultaneous causality between debt and interest rates that the OLS equation may not be able to account for but the panel VAR eliminates. Overall, I choose to use both this method and the OLS method as a way to fully estimate the effects of debt both statically and dynamically.

V. Results and Discussion

The first set of results that I will discuss are the results from the OLS regression, which are below:

VARIABLES	(1) IR_Tbills	(2) OECD Interaction	(3) Fixed Effects	(4) Fixed Effects and Interaction
lagged_inflation	0.485***	0.486***	0.312***	0.316***
	(0.0162)	(0.0161)	(0.0155)	(0.0155)
Gov_Spend	0.128***	0.186***	0.600***	0.648***
	(0.0412)	(0.0404)	(0.0754)	(0.0770)
log_GDP	-0.00956	0.0816	-0.193	-0.942
	(0.0763)	(0.0789)	(1.138)	(1.163)
GDPpc	-0.000123***	-0.000101***	0.000218***	0.000199***
	(1.36e-05)	(1.36e-05)	(2.88e-05)	(2.95e-05)
lagged_UE	-0.101***	-0.0978***	-0.125**	-0.124**
	(0.0331)	(0.0330)	(0.0544)	(0.0541)
Debt	0.00505	0.0191***	0.0621***	0.0894***
	(0.00500)	(0.00704)	(0.00888)	(0.0131)
OECD_x_Debt		-0.0207***		-0.0482***
		(0.00742)		(0.0171)
OECD	0.371			
	(0.484)			
Constant		0.179	-8.423	15.65
		(2.623)	(34.64)	(35.52)
Observations	879	879	879	879
R-squared	0.593	0.597	0.805	0.807

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

First, the coefficients for debt provide interesting information regarding the relationship between debt and interest rates for my study. The coefficients are all statistically significant at the 1% level except in column 1, which is the regression in which the OECD interaction term as well as fixed effects are excluded. The coefficients are positive in each of the subsequent columns, which is consistent with the existing literature. However, the magnitude of the coefficients is much smaller than expected. The largest coefficient comes from column 4, which is the regression with both fixed effects and the interaction term and its value is only 0.0894, which indicates that a 1% increase in debt/GDP leads to a 0.089% increase in interest. Another interesting result comes from the coefficients of the interaction terms in columns 2 and 4, and it could also help explain the results for the debt coefficients. The two interaction coefficients are

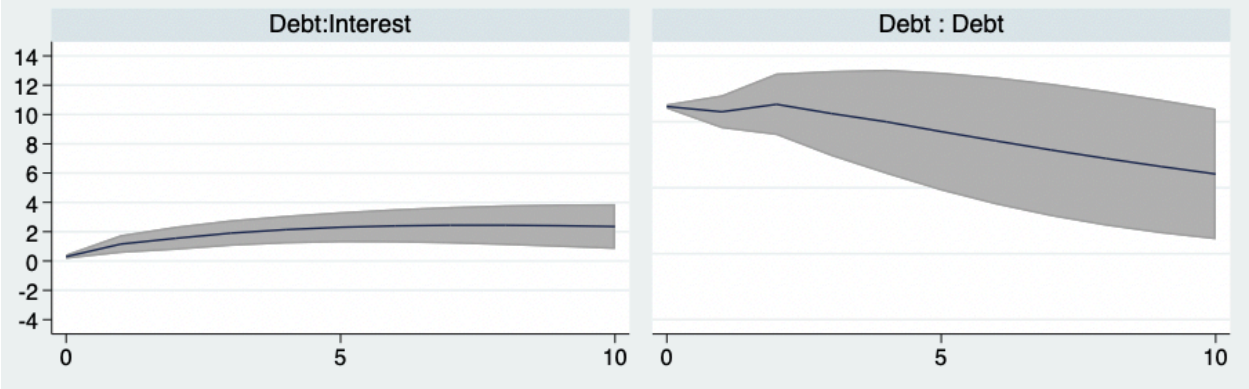
both statistically significant at the 1% level, and are negative. This indicates that non-OECD countries experience a decrease in interest rates when debt increases, which is the opposite relationship compared to OECD countries. This could be due to a variety of factors including differences in the monetary policy structures of OECD countries. For example, non-OECD countries may respond to an increase in debt by decreasing interest rates to stimulate investment, while OECD countries may respond in the opposite fashion. Additionally, this could be due to the perceived risk by foreign investors. High public debt may be a warning sign to investors in OECD countries and a sign of fiscal irresponsibility, while high public debt is more likely to be perceived as necessary for non-OECD/developing countries. These are only potential explanations and cannot definitively be concluded as a result of this study, but it is extremely interesting to note that there seems to be an opposite effect of debt/GDP on interest rates between OECD and non-OECD countries.

The next set of results comes from the panel VAR model, and the first figure is the Granger causality test, which indicates whether one variable's impulse impacts the other in a statistically significant way:

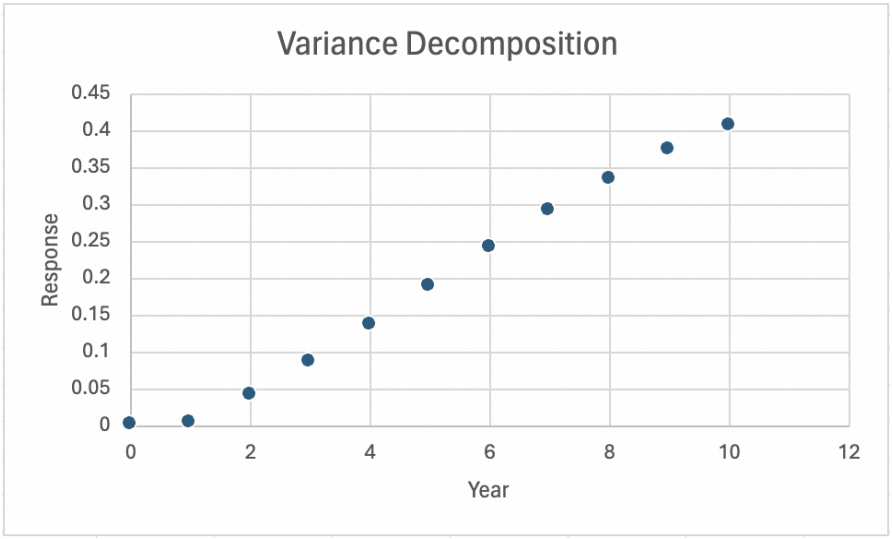
Granger causality Wald tests

Equation	Excluded	chi2	df	Prob>Chi2
Debt	Interest	4.118	1	0.042
Debt	ALL	4.118	1	0.042
Interest	Debt	3.548	1	0.060
Interest	ALL	3.548	1	0.060

These results indicate that the debt shock that will be discussed is statistically significant, with the Prob > Chi2 value being below the 5% threshold. Next, to exemplify the magnitude to which the debt shock affects interest rates, I compose an orthogonalized IRF graph:



The left graph indicates the response of interest due to the debt shock that is illustrated in the right graph. The y-axis is in percentage points, and the x-axis is in years. Therefore, the initial shock is roughly an 11% increase in debt/GDP, and the response of interest reaches a maximum of roughly 2%. The increase in interest is gradual, indicating that when debt increases suddenly there is a period before the full effect on interest is realized. The final part of analysis to illustrate the effect as estimated by this panel VAR is the forecast-error variance decomposition, which is illustrated graphically below:



This graph shows how much of the change in interest can be explained by the shock to debt in each of the years after the initial shock. Initially, the shock effect is fairly low, but as time goes on the change in interest is more than 40% due to the shock. This is consistent with the hypothesis I pose in the previous section, that there is likely to be a dynamic effect of debt on interest rates beyond the static effect that is captured by the OLS method.

VI. Conclusion

Overall, the two methods of OLS and panel VAR work together to establish the relationship between interest rates and debt. My OLS regressions indicate that when debt/GDP increases by 1%, there is a 0.09% increase in interest rates for OECD countries, and a 0.05% decrease in interest rates for non-OECD countries when fixed effects are included. The results for OECD countries are consistent with existing literature, as previous studies have found that there is a positive correlation between debt and interest rates, although the effect is larger. However, for non-OECD countries, this effect is contrary to the theoretical relationship, the reasons for which could be explained by differences in monetary policy structure or foreign perception of risk. This is a result that would be a candidate for further research, as one limitation of this study is that there is no way of telling the underlying reasons for this result. Further research could include examining the fiscal structure of the countries included in the non-OECD subset as well as their economic histories to attempt to deduce an underlying reason for this stark difference in effects. In addition to the static effect shown via OLS, the panel VAR I conduct shows the dynamic effect that a major debt shock has on interest rates. I find that a shock in the form of an 11% increase in debt leads to an increase in debt of 2%, and that this effect is gradual and does not fully reach its peak until between 5-10 years following the initial

shock. This could be consequential for fiscal policymakers, as the effect on interest rates is a factor that must be considered when deciding on government spending. The fact that there is a lingering effect of debt increases on interest rates should indicate to policymakers that while there may not be a significant immediate effect of debt decisions on interest rates, there could be unintended consequences in the future.

VII. References

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