Effect of Public Debt on Equity Prices

Marvin Henry
Pace University

With the growing debt harbored by the United States becoming harder to sustain, one believes it is imperative to research the effect of increases in public debt and events related to debt management policy on our financial system. In fleshing out this relationship, this paper can supplement the literature surrounding the development of nations through marketable debt products, the behavior of our financial markets and proper public debt management. This study considers the rationality of the market, as it is influenced by this exogenous variable over time, and how that relates to an equity's price movements. Utilizing a vector-autoregression and structural vector-autoregression estimated with OLS, I will determine how events related to public debt affect equities.

Keywords: public debt, treasury, rationality, equity price, vector-autoregression, structural vector-autoregression, impulse response function, Granger Causality

INTRODUCTION

At the beginning of January 2023, the United States national debt broke a record 31 trillion dollars which is a tremendous amount; however, in a few months or even weeks the country's debt levels will round the corner at 34 trillion dollars. With the nation still recovering from the 2008 recession, economic shocks of the pandemic, and multiple global conflicts over this year, the country's debt has increased by about 2 trillion dollars. The International Monetary Fund notes that the US is not the only country with a national debt problem; the world's public debt levels have tripled since the 1970s, reaching about 92% of the global gross domestic product, and private debt since the 1960s has tripled to nearly 147% of GDP (Gasper et al., 2023). With world governments having spending habits equivalent to "a spendthrift teenager with their first credit card" (Financial Times, 2023), to what extent do our institutions' spending habits have on other economic forces, functions, and markets?

To answer this question, one must first consider what obligations are accounted for in the national debt. According to the Treasury, the US national debt is the amount of money the government had to borrow to cover any outstanding expenses incurred over time. Therefore, when the spending within the fiscal year exceeds the available tax revenues, the Treasury would need to borrow to pay off those obligations. One method the Treasury uses to borrow money is auctioning government securities called Treasuries. US Treasuries are financial instruments with a set interest rate that fluctuates due to changes of the federal funds rate target and competition with other securities offered in the market. Treasuries can have varying maturities and fit into three broad groups: bills that represent maturities that start at 4 weeks to 52 weeks, notes represent maturities that start at 2 years to 10 years, and bonds that have maturities of 20 years or 30 years.

With the assistance of sales of these marketable securities, the Treasury can gain quick liquidity to manage some of their obligations. The Treasury can also sell nonmarketable securities like savings bonds instead (*Fiscal Data explains the National Debt*, 2023). However, selling government securities comes with an increase in the public debt since the Treasuries sold have an interest rate attached to it, which becomes an obligation to pay off later. Raising the public debt limit would allow the Treasury to increase the supply of Treasuries by selling those securities on the market. This action would add to the public debt, so from the standpoint of public debt management, is using our debt to finance our debt a good idea? With interest payments composing a large amount of the US national debt can this method for handling obligations influence our economy? This prompts this study on national debt and how it affects other economic variables, especially since marketable government securities play a role in our present financial markets. Furthermore, as of October the Treasury spent $89 billion to maintain US debt, which is about 19% of total federal spending (Fiscal Data explains the National Debt, 2023). This raises more questions about public debt management and whether selling government securities is a reasonable long-term solution to satisfy obligations.

LITERATURE REVIEW

Considering the multiple economic forces that can be established as links for which public debt can affect our financial markets, this study will focus on the effects of rational expectations. Rational expectations theory illustrates that expectations are affected by the amount of public information available for use and that would affect how the market prices certain goods and services as theorized by Muth (1961). Information, a scarce resource not wasted by the economy, can be the effect of exogenous variables like the news. It can then be inferred that exogenous shocks affect prices in unforeseen ways.

News concerning the consumer price index and unemployment has influenced stock prices contemporaneously, and the effect dissipates hours after the information was released (Jain, 1988). Comparably, surprise changes in inflation would have some marginal effect on equity prices, indicating that unanticipated information would have a large effect on equities (Schwert, 1981). In short, information affects the expectations about different products by either increasing or decreasing the possible outcomes theorized by market participants; in other words, possible outcomes are conditional on the public set of information and expectations are conditional on the outcomes generated from the information accumulated. Through the application of rational expectations, the results will supplement this literature by exploring the theoretical effect of information and rational expectations caused by the aggregate national debt.

Another aspect that would have to be considered when formulating rational expectations concerns the structure of the economic systems that could influence the participants' behavior. The researcher can then infer that information about the structures that occupy the economy would also produce some expectations, since pricing models attempt to capture the expectations using the information that is currently available that would arbitrarily limit the scope of the possible outcomes theorized based on the set of public information (Muth, 1961). So, monetary and fiscal policy effects should also have a proxy when formulating the possible outcomes concerning a specific security. There is literature that documents effects of unanticipated monetary policy on equity prices, showing that there are substantial effects on equity prices when the target rate for monetary policy has not been modeled for (Bernanke and Kuttner, 2005). Indicating that monetary policy can substantially affect stock prices in the short term, and adjusting the federal funds rate target has been shown to be effective in stimulating economic development as well. So, when considering the effects of public debt on equity prices, it becomes imperative to model that intertemporal relationship between securities and monetary policy to better comprehend its behavior. Additionally, the study of these macroeconomic variables would prompt the investigation of these behaviors and the investigation will help comprehend this link.

Fiscal policy can also contribute to the shift of expectations as that would entail the debt management policies that Congress determines. Increasing the debt limit would enable the Treasury to sell more securities, and that would theoretically shift the expectations of those participating in both the bond and equity markets as they would anticipate an inflow of US government securities into the financial system.

Congress could also suspend the debt limit and allow for more borrowing, following a period there would be an adjustment to the debt limit to compensate for the spending in that period. Then the increase of the supply of Treasuries would affect the value of Treasuries themselves and since there are goods that are substitutable in the market those securities would be affected as well (Roley, 1982). With changes in the supply of US Treasuries, the term structure of the existing and future securities could shift investor sentiment towards certain goods and services that are substitutes or complements of US Treasuries.

There exists literature that documents the changes in the supply of some financial instruments that leads to becoming more valuable. As seen by Krishnamurthy and Vissing-Jorgensen (2012), their findings revolving around the characteristics of US treasuries where they document changes in Treasury supply affecting different yield spreads. Treasuries are highly liquidity instruments, and it has been found to be comparable to the medium of money and its own supply affects its value. The conclusion that was reached is that when the supply of Treasuries is low those securities are valued higher and the phenomenon is reversed when the supply of Treasuries are high (Krishnamurthy et al, 2012). Results found determined a one standard deviation in average treasury supply lowers Treasury yields by about 77 basis points relative to Baa-rated corporate bonds. For long-term treasuries a one-standard-deviation decrease in the supply of long-term treasuries would raise the price of long-term safety by about 40 basis points. The attributes of safety and high liquidity lead investors to have higher valuations of Treasuries creating this unique demand for riskless assets and making those assets more valuable. Expanding the stock of riskless assets reduces risk premia, raising riskless rates and affecting the returns on equities (Gomes and Michaelides, 2008) indicating that increasing the supply of Treasuries would have effects on the equity premiums and affect the dependent which is an aggregate index.

That shift in investor sentiment could induce the investor to make certain decisions, investor sentiment constitutes beliefs about cash flows and investment risks that are not justified by the facts at hand (Baker and Wurgler, 2007). This would complicate the effect of rational expectations surrounding specific securities, and the fluctuation of investor sentiment could affect those asset values. The fluctuations of sentiment that breeds uncertainty surrounding those securities, there would be a negative correlation in the returns between equities and bonds (Connolly et al, 2005). Data shows that investor sentiment would affect stock prices that are harder to value or arbitrage, and these are highly volatile securities with the underlying institutions that have the potential to be profitable but are still trying to grow (Baker and Wurgler, 2007). Comparably, more stable companies with returns like bonds would not be affected by the shifts of sentiment, as their models would be better accustomed to handling the shifts of investor and consumer sentiment due to experience.

DATA

The data is a time series that observes multiple variables over time across 20 years from January 1, 2001 to December 31, 2019. The target variable is the values of public debt. Instead of using daily public debt data, I cleaned for debt values on Friday to eliminate weekends from the dataset. The data cleaning process occurred in R, and public debt values that exceeded one trillion would be presented in a scientific notation format due to the software. To eliminate the scientific notation, the data was transformed from dollars to millions by dividing the nominal value by one million, allowing for a better interpretation of data. The main dependent variable was the weekly averages of the Russell 2000 Index, which contains the 2000 companies offered on the secondary market that meet the market capitalization requirements established and maintained by the London Stock Exchange Group.

The dependent variable helps to proxy the effect of public debt on small-cap companies and the index values are presented as weekly averages. Orienting the data in a weekly format allows efficient modeling of the effects of public debt on equity prices. Weekly averages allow for the market to respond to rising debt, providing a realistic illustration of how small-cap companies are affected over time. Other data included are weekly average interest rates for US 10-year Treasury notes and the Moody's Baa Corporate Bond Index that measures the market yield of corporate bonds. 10-year Treasury yields help proxy for the general effect of US Treasuries on the stock values of small-cap companies.

Additionally, future prices for 10-year treasuries are included in the dataset. The nominal values for all these variables were adjusted for inflation using the 2015 consumer price index (not including food and energy). The rates are approximated using the Fisher formula:

$$r = 1 - \frac{(1 + \emptyset)}{(1 + \pi)}$$

where the nominal rate is divided by the inflation rate for 2015, that makes the adjusted for inflation interest rate.

TABLE 1
SUMMARY STATISTICS

Statistic	N	Min	Median	Max	St. Dev.	Mean	Pctl(25)	Pctl(75)
Baa Yields	979	0.683	1.465	2.706	0.424	1.447	1.064	1.714
Treasury Yields	979	-0.159	0.472	1.288	0.392	0.517	0.169	0.853
Federal Funds Rate	979	-0.625	-0.285	1.471	0.588	-0.097	-0.594	0.154
Russell Index	979	139.273	320.137	715.328	151.617	361.719	242.731	479.903
Public Debt	979	2,325,175.000	5,446,211.000	9,538,516.000	2,264,998.000	5,460,890.000	3,289,290.000	7,492,488.000
Futures Prices	960	102.642	119.896	134.942	8.657	119.205	111.939	126.246

Public Debt and Russell are adjusted for inflation using 2015 Core CPI and the rates are adjusted using the exact formula to by subtracting 1 from the quotient of the nominal and expected inflation

Public Debt data came from the Treasury Data Source. Baa yields, Treasury Yields, Funds Rate comes from FRED. Future Prices and the Russell Index came from Bloomberg

METHODOLOGY AND RESULTS

Prior to the Vector Autoregression (VAR) and Structural VAR(SVAR) the relationships between macroeconomic forces were analyzed using large-scale structural simultaneous models. It was found that these models could not forecast the numerous unprecedented events, which was considered a big failure that affected many of the macro-econometric models. Sims then suggested the VAR model as a replacement for large scale macroeconomic studies over time in his paper *Macroeconomics and Reality* in 1980, touting that the VAR had greater success then the simultaneous equations systems but had an issue with instantaneous correlations in the error terms and observable variables. Then the SVAR allowed for those correlations to be disentangled by placing restrictions on the VAR equations (Amisano and Giannini, 1997). Before discussing the SVAR, the VAR is a multivariate modeling method that allows for a vector of at least two time series variables, this methodology allows for a certain number of lags that can be determined using an information criterion function (Stock and Watson, 2011).

VARs assume the variables modeled are stationary values that either are integrated to some unit root *d* or have passed some formal test of stationary like the Augmented-Dickey-Fuller Test. Before modeling the equations, the researcher tested and ensured all the variables were stationary or transformed the data to first differences for the variable(s) in question. The study also modeled the endogenous variables using non-stationary data to demonstrate the differences in the computed causality of the VAR models. The coefficients were estimated using the Ordinary Least Squares method (OLS) and the best model was determined by calculating the maximum log-likelihood of getting the dependent variable. When modeling VAR models the analyst would have to consider whether the variables can be considered to have endogeneity or exogeneity. A test that can uncover the endogeneity of a variable and prove its significance to the study at hand is the Granger causality test. Granger causality tests allow the researcher to determine whether the regressors have predictive content or Grager-causes that variable (Stock and Watson, 2011);

this case uses the causality test to determine if 10-year Note yields and Baa corporate bond yields have some predictive elements for the Russell 2000.

Making use of a VAR (2), the first and second lags of each variable are considered, and the VAR model being used is a reduced-form VAR that illustrates each variable as a linear function of its lags and the lags of other variables and assumes its error term is serially uncorrelated (Stock and Watson, 2001):

$$\mathrm{A}(Treasury, Baa, Russell)_t = \alpha_0 + \sum_{k=1}^{2} \psi_{1k} \mathrm{A}_{(t-1)} + \sum_{k=1}^{2} \theta_{2k} \mathrm{A}_{(t-2)} + \varepsilon_t \quad (1)$$

These equations allow the researcher to explore the endogeneity between these variables above, then utilizing the Granger test to search for causality in each linear function it determined how the variables would be ordered in the SVAR and structuring of the matrices. Constructing these models involves picking out variables that use economic theory and explain relations between the variables of interest; when it comes to this study, utilizing a well-developed theory and accumulated research determined the models for these variables.

A SVAR model is employed, allowing the researcher to structure restrictions using matrices, these matrices help to model contemporaneous relationships between different macroeconomic variables. To effectively model the intertemporal relationships, the *AB* model is employed as illustrated by Lütkepohl(2005) allows one to consider the restrictions of both the *A* matrix and *B* matrix simultaneously. *A* matrix denotes the instantaneous relationship between the observable variables, allows for a lower triangle structuring that can depict a causal ordering where y_{1t} would have an instantaneous impact on all the other variables, and then y_{2t} would have an instantaneous impact on the other variables excluding y_{1t} and then so on (Lütkepohl, 2005). *B* matrix denotes the unexpected shock that comes from the relations between the observable variables and would be structured as diagonal values that can be used to determine the effect of a positive shock on a particular variable (Lütkepohl, 2005). The *AB* model combines the restrictions of the *A* matrix and *B* matrix to consider the simultaneous equations systems where:

$$A = \begin{bmatrix} 1 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 \\ a_{31} & a_{32} & 1 & 0 \\ a_{41} & a_{42} & a_{43} & 1 \end{bmatrix} B = \begin{bmatrix} b_{11} & 0 & 0 & 0 \\ 0 & b_{22} & 0 & 0 \\ 0 & 0 & b_{33} & 0 \\ 0 & 0 & 0 & b_{44} \end{bmatrix}$$

$$\mathrm{A}u_t = \mathrm{B}\varepsilon_t$$

which formulates for errors of the reduced form models rather than the observable variables, accounting for the shift from specified direct relations for observable variables to formulating relations for the shocks themselves (Amisano and Giannini, 1997). Through these matrices one can consider the errors of the variables themselves and then we consider the structural shocks that would affect that variable as well. Blanchard and Quah's study in 1989 utilized a SVAR using the AB matrix to model the macroeconomic fluctuations that affect a vector of variables. The results allow for several inferences about the graph, which help better comprehend the relationships between the variables.

Causality Tests

In Fig. 1, we notice a difference in causality among the tables that are different levels. Tables (1) and (3) show the causality test results using the previous section's models. The determines the causality of the variables that are non-stationary, or level data and it shows that both yields in the 10-year note and corporate bond can cause some of the variation in the data. With the probability of Chi^2 being below 0.01, it can be interpreted at the 1% significance level that both variables and their two lags have some predictive content for the Russell 2000 index at time *T*. This makes sense considering that investors would consider the substitutability between the bond market and the equity markets. When the available information concerning either market affects future expectations, the investor might switch to another market in an

attempt to arbitrage. That behavior from the investor would also be a shift in investor sentiment as information about future cash flows can influence the decisions of the risk-averse investor (Baker and Wurgler, 2007). With small market-capitalized companies, the demand shift would affect their prices and transitively affect the aggregate index.

FIGURE 1
CAUSALITY TESTS

1)

Granger Causality(Level)				
Dependent	Explanatory	Chi^2	df	Prob > Chi^2
Treasury Yields	Baa Yields	3.796	2	0.150
	Russell Index	6.0222	2	0.049
	All	6.5361	4	0.163
Baa Yields	Treasury Yields	28.571	2	0.000
	Russell Index	28.412	2	0.000
	All	88.841	4	0.000
Russell Index	Treasury Yields	0.79221	2	0.673
	Baa Yields	8.0595	2	0.018
	All	16.455	4	0.002

2)

Granger Causality(Differenced)				
Dependent	Explanatory	Chi^2	df	Prob > Chi^2
Treasury Yields	Baa Yields	0.76347	2	0.683
	Russell Index	2.0994	2	0.350
	All	2.6611	4	0.616
Baa Yields	Treasury Yields	23.138	2	0.000
	Russell Index	24.622	2	0.000
	All	81.449	4	0.000
Russell Index	Treasury Yields	2.4142	2	0.299
	Baa Yields	4.7582	2	0.093
	All	5.2012	4	0.267

3)

Granger Causality(Level)				
Dependent	Explanatory	Chi^2	df	Prob > Chi^2
Federal Funds Rate	Treasury Yields	12.455	2	0.002
	Russell Index	16.001	2	0.000
	All	18.856	4	0.001
Treasury Yields	Federal Funds Rate	5.1676	2	0.075
	Russell Index	5.9662	2	0.051
	All	7.9115	4	0.095
Russell Index	Federal Funds Rate	4.8312	2	0.089
	Treasury Yields	11.715	2	0.003
	All	13.199	4	0.010

4)

Granger Causality(Differenced)				
Dependent	Explanatory	Chi^2	df	Prob > Chi^2
Federal Funds Rate	Treasury Yields	3.6718	2	0.159
	Russell Index	5.2271	2	0.073
	All	11.395	4	0.022
Treasury Yields	Federal Funds Rate	0.09305	2	0.955
	Russell Index	1.9172	2	0.383
	All	1.9893	4	0.738
Russell Index	Federal Funds Rate	4.169	2	0.124
	Treasury Yields	0.33661	2	0.845
	All	4.6116	4	0.330

Tables (1) and (2) tests Granger causality on the models introduced in the methodology section earlier, (1) uses data that was left undifferenced comparably (2) uses data that was differenced. The data was differenced only once as the data was defined as stationary after being differenced once. Tables (3) and (4) tests Granger causality on models that relates the changes in the federal funds rate (FFR) the variable Treasury Yields is actually for the prices of 10-year Treasury futures contracts

$$\mathrm{B}(\text{Federal Funds Rate}, \text{Treasury Yields}, \text{Russell Index})_t = \alpha_0 + \sum_{k=1}^{2} \psi_{1k} \mathrm{B}_{(t-1)} + \sum_{k=1}^{2} \theta_{2k} \mathrm{B}_{(t-2)} + \varepsilon_t \qquad \text{(a)}$$

Table (2) and (4) are the Granger causality tests that assessed the VARs with differenced or stationary values and contrasted heavily with the causality discovered in the first table. It can be interpreted from the probability of Chi^2 in (b) that corporate bond yields have causality that is significant at the 10% level for the Russell 2000 but there was no causality on any level of significance for the 10-year note on the Russell 2000. Both tables (1) and (2) depict the 10-year note and the Russell 2000 index having causality for Baa corporate bond yields that is significant to the 1% level. That can indicate that the performance of both small market-cap companies and US Treasuries can affect the Baa corporate bond yields. That would make sense as stocks are riskier investments with more volatility than fixed-income assets like corporate bonds and Treasuries.

So, corporate bonds would be a proper substitute if an investor wants to diversify their portfolio with products related to private companies while keeping their exposure to risks low. Additionally, the liquidity and risk premia offered by Treasuries would affect the demand for corporate bonds and the valuation of those securities. With the investor considering that Treasuries are highly liquid and riskless that would affect the investors' expectations on adjacent securities in which they can invest. Equities would provide

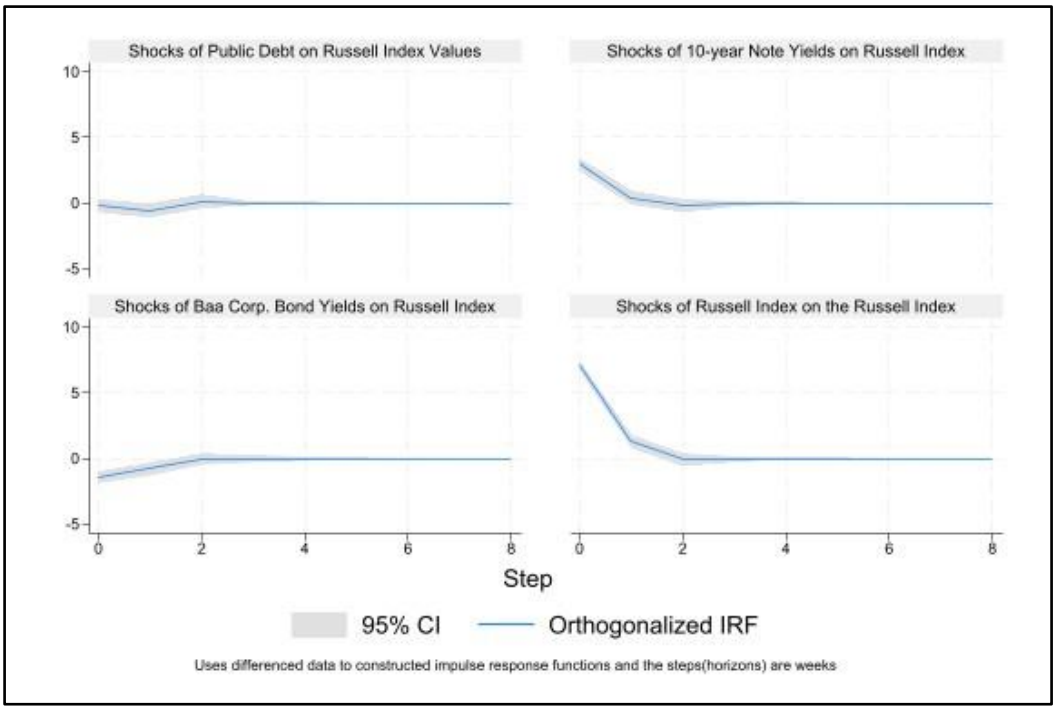
returns that compensate for the risk that investor would be exposing themselves which include the macroeconomic risk and the idiosyncratic risks. Jain (1988) noticed that the releases of macroeconomic reports would affect the stock prices within

Impulse Response Functions

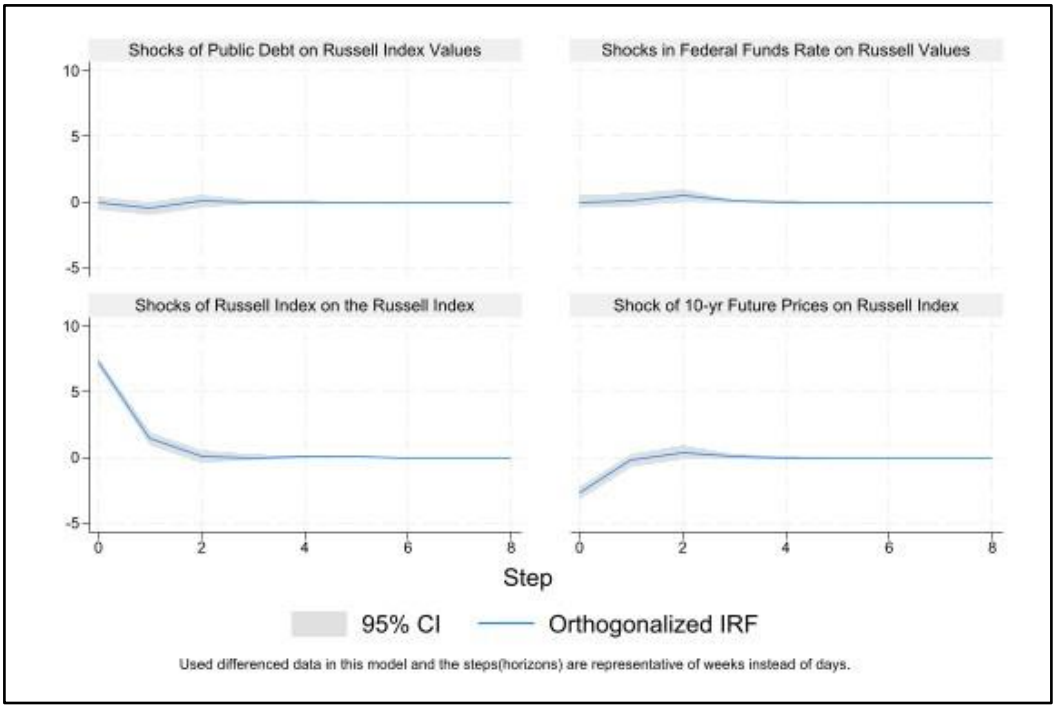
Impulse response functions allow the researcher to determine the effect of a one standard deviation shock and then can further assess whether structural changes of that variable affect the response variable. In Fig. 2, public debt has no instantaneous effect on the Russell, so public debt does not directly influence the price of shares for small-cap companies in the immediate short term. Public debt not directly affecting index prices makes sense since the only way it could affect the markets is through the supply of marketable government securities.

FIGURE 2
IMPULSE RESPONSE FUNCTIONS

(1)



(2)



These are impulse response functions (IRF) which estimate the effect of a standard deviation of shock on a response variable. Below are the Structural VAR(1)'s used to for IRF's:

$$\mathrm{E}(\text{Public Debt, Treasury Yields, Baa Yields, Russell Index})_t = \alpha_0 + \sum_{k=1}^{2} \psi_{1k} \mathrm{E}_{(t-1)} + \varepsilon_t \quad (1)$$

$$\mathrm{Z}(\text{Public Debt, FFR, Treasury Futures, Russell Index})_t = \alpha_0 + \sum_{k=1}^{2} \psi_{1k} \mathrm{Z}_{(t-1)} + \varepsilon_t \quad (2)$$

Treasury yields can influence the price of the Russell, indicating that Treasury yields have a contemporaneous effect on stock prices. Connolly et al (2005) notes a negative relationship between the returns of bonds and equities at times of high volatility. Changing the supply of Treasuries would affect the yields and intuitively decrease those securities' prices. Furthermore, with the returns of bonds and equities moving in directions, an increase in yields for Treasuries would be complemented with the fall of the returns in the stock market and the values of the shares would rise.

The demand for riskless, and relatively cheap securities would increase as the supply increases and investors in the stock market looking for safe investments can find it in the bond market. The rational expectation about Treasuries is that the bondholder would always get paid regardless of the US breaching the debt ceiling. That information in the public sphere would reduce negative expectations surrounding US treasuries and prompt the risk-averse investor to enter the bond market over the stock market.

CONCLUSION

Based on the results of the impulse response functions and the Granger causality tests, more research is required to determine the full effect public debt can have on equity prices. Based on the shocks shown in the IRFs, we can draw the connection to the public debt ceiling leading to a standard deviation shock to the equity values of small market-capitalized companies. For every increase to the debt ceiling, which allows the Treasury to sell marketable securities and fulfill obligations, equity price values are affected in the short term. Assuming the investor desires a highly liquid and riskless security, purchasing Treasuries would allow the investor to get steady returns and would be exposed to little risk overtime. With the demand for

treasuries increasing, the demand for the equity market would begin to sink due to the highly valued government security. To determine the direction of the effect that raising the debt ceiling would have on the equity markets requires more study. However, this attempt to model the effects of the debt ceiling provided a perspective to understanding the public debt issue and can lead to solutions for the future.

ACKNOWLEDGEMENTS

I am deeply indebted to my thesis advisor in the Economics department at Pace University's New York City campus. Dr. Mary Kaltenberg was instrumental in encouraging me to go beyond my limits of econometrics and provided much assistance in developing the idea behind this thesis. I am also grateful to Prof. Sam Baruch and Prof. Kier Hanratty in the Economics department for their unparalleled knowledge of our financial markets and econometrics. I would also like to single out a professor in the Computer Science department, Prof. Francis Parisi, for providing clarity on some of the statistical techniques used to complete this project. Thank you all for your help and I hope to receive guidance from you in the future.

I would like to express my deepest gratitude to my recently deceased father who funded my education. An immigrant parent who spent hours working to invest into my future, he was one of the primary reasons that I was able to go to Pace University. The investment that he put into my future will have an exponentially compounded return of knowledge, wisdom and confidence. Furthermore, these aspects will be utilized in my future career as a researcher and an academic. Thank you for the trust you had in me and thank you for being in my life.

REFERENCES

Amisano, G., & Giannini, C. (1997). From VAR models to structural VAR. In *Topics in structural VAR econometrics* (pp. 1–26). Springer-Verlag.

Baker, M., & Wurgler, J. (2007). Investor sentiment in the stock market. *The Journal of Economic Perspectives*, *21*(2), 129–151. Retrieved from http://www.jstor.org/stable/30033721

Blanchard, O.J., & Quah, D. (1989). The dynamic effects of aggregate demand and supply disturbances. *The American Economic Review*, *79*(4), 655–673. Retrieved from http://www.jstor.org/stable/1827924

Connolly, R., Stivers, C., & Sun, L. (2005). Stock market uncertainty and the stock-bond return relation. *The Journal of Financial and Quantitative Analysis*, *40*(1), 161–194. Retrieved from http://www.jstor.org/stable/27647190

Financial Times. (2023, June 2). *The world's public debt problem*. Retrieved from https://www.ft.com/content/c8f5ba07-1d74-4dce-a9b6-983e4e5380e1

Fiscal Data explains the national debt. (2023). *Understanding the national debt | U.S. Treasury Fiscal Data*. Retrieved from https://fiscaldata.treasury.gov/americas-finance-guide/national-debt/

Gaspar, V., Poplawski-Ribeiro, M., & Yoo, J. (2023, September 13). Global debt is returning to its rising trends. *International Monetary Fund*. Retrieved from https://www.imf.org/en/Blogs/Articles/2023/09/13/global-debt-is-returning-to-its-rising-trend#:~:text=Forces%20in%20debt%20trends&text=Global%20public%20debt%20tripled%20since,span%20between%201960%20and%202022

Lütkepohl, H. (2005). Structural VARs and VECMs. In *New introduction to multiple time series analysis* (pp. 358–400). Springer-Verlag.

Muth, J.F. (1961). Rational expectations and the theory of price movements. *Econometrica, 29*(3), 315–335. https://doi.org/10.2307/1909635

Reinhart, V., Sack, B., & Heaton, J. (2000). The economic consequences of disappearing government debt. *Brookings Papers on Economic Activity*, (2), 163–220. Retrieved from http://www.jstor.org/stable/2667358

Roley, V.V. (1982). The effect of federal debt-management policy on corporate bond and equity yields. *The Quarterly Journal of Economics*, *97*(4), 645–668. https://doi.org/10.2307/1885104

Stock, J.H., & Watson, M.W. (2001). Vector autoregressions. *The Journal of Economic Perspectives*, *15*(4), 101–115. Retrieved from http://www.jstor.org/stable/2696519

Stock, J.H., & Watson, M.W. (2011). Introduction to time series regression and forecasting. In *Introduction to econometrics* (3rd Ed., pp. 516–569). Addison-Wesley.