



## An Expanded and Updated Analysis of the Federal Debt's Effect on Interest Rates

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This report expands on a standard empirical estimation of the relationship between federal deficits and debt and long-term interest rates. It follows closely a 2019 long blog post by Ernie Tedeschi, which is itself an update and extension of Francis Warnock and Veronica Caccac Warnock (2009). Using data from September 1981 to May 2022, we find that a 1 percentage point increase in the federal debt-to-gross-domestic-product ratio is associated with an increase of nearly five basis points in the long-term interest rate. This is a larger effect than generally found in the literature and double what the Congressional Budget Office uses in its budget projections, which we attribute to our more complete specification of Federal Reserve policy.

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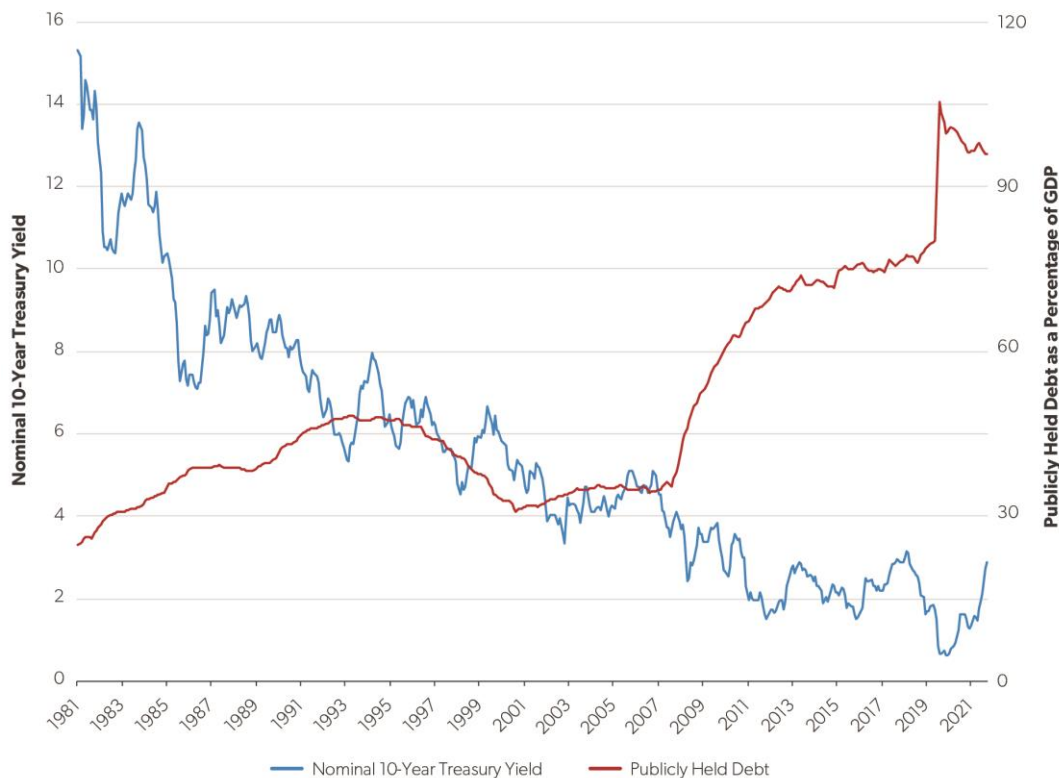
Although it might seem obvious that higher deficits would cause interest rates to rise as the federal government competes with the private sector and state and local governments for funds, there are both theoretical and empirical reasons to question this relationship.

According to Robert Barro (1974), if there are extensive networks of intergenerational transfers and if it is recognized that larger deficits imply higher taxes for future generations, then households would increase their savings to match those obligations, blunting any causal relationship between deficits and interest rates. Most economists, however, believe this theory is extreme in its assumptions of long-horizon rationality (Blanchard 1985). But recent basic empirical observations do challenge the asserted positive association of interest rates with budget deficits.

Over the past 15 years or so, interest rates (10-year Treasury bond yields) have fallen while federal deficits and debt outstanding have grown enormously, as depicted in Figure 1. Interest rates now lag behind the economy's growth rate. The Great Recession of 2008–09 and the recent pandemic recession of 2020 are part of the explanation, but these are temporary effects, and, at least as of this writing, interest rates are still relatively low by historical standards. Either the interest rate–deficit relationship no longer holds or several other factors are at play.

Among the basic economic factors that could explain recent low interest rates are low economic growth and an aging population. Indeed, simple growth models show a tight positive relationship between the rate of economic growth and real interest rates, so slower productivity and labor force growth, as observed in recent years in the US and

**Figure 1. Rising Debt, Falling Interest (1981–2022)**



Source: US Office of Management and Budget; Board of Governors of the Federal Reserve System; and Federal Reserve Bank of St. Louis.

globally, will lead to lower interest rates, especially with low inflation.

An aging population—the consequence of falling birth rates and increased longevity—will also likely result in higher savings rates, as more households prepare and save for retirement and to pay the high insurance premiums and uninsured medical and long-term care costs of advanced old age. Higher savings rates increase the supply of funds, which, when combined with stable or falling demand for funds arising from moderate capital investment in a slow-growth economy, will lead to lower interest rates.

Another potential factor is the large and growing foreign demand for safe US debt, particularly coming from Asia. China, Japan, and South Korea are all experiencing rapidly aging populations; growth is slowing in Japan; Chinese savers are experiencing unreliable social insurance programs; and China and India face the need for stable reserve

assets. For some foreign investors, the risk from fluctuating exchange rates to holding dollar-denominated assets is also driving demand for US debt.

Lower financial risk may be another factor in a declining term premium and hence low long-term nominal and real interest rates. Similarly, expectations of lower inflation in the long term relative to the short term would decrease long-term rates further.

Finally, Federal Reserve monetary policy has also likely played an outsized role in lowering long-term interest rates in recent years. The Fed has kept the federal funds and other short-term rates low for extended periods and announced its intention to do so, thereby leading directly to low long-term rates. Moreover, it has conducted unprecedented quantitative easing policies whereby it buys large amounts of long-term Treasury debt, presumably also lowering long-term interest rates.

**Table 1. Estimates of the Effect of Publicly Held Debt on Long-Term Interest Rates in Basis Points**

Eric Engen and Glenn Hubbard (2004)	Thomas Laubach (2009)	Edward Gamber and John Seliski (2019)	Ernie Tedeschi (2019)	Christopher Cotton (2021)	Our Estimate
2.8–4.7	2.9–5.2	About 1.5–2.4	4.21	4.3	4.5

Note: Christopher Cotton (2021) uses a different approach using high-frequency responses of interest rates to fiscal surprises. Source: Authors.

## Past Empirical Analysis

Francis Warnock and Veronica Cacadac Warnock (2009) modeled 10-year Treasury yields as a function of inflation and economic growth expectations, current policy rates, variation in rates, cyclically adjusted deficits, and foreign official purchases of US federal debt. Using data from January 1984 through May 2005, their ordinary least squares estimate implied a 1 percentage point increase in the federal deficit is associated with a 14 basis point increase in the long-term interest rate. They imposed the constraint that the coefficients on the federal funds rate and inflation expectations sum to one on the assumption that Treasury yields are nonstationary and co-integrated. We will do the same.

Ernie Tedeschi (2019) extended this analysis through December 2018, added variables for growth in the dollar and change in the elderly population, and found that a 1 percentage point increase in the structural federal deficit suggests an 18 basis point increase in the 10-year yield. Tedeschi found essentially an invariant result when he used the five-year-ahead Congressional Budget Office (CBO) projection for the deficit.<sup>1</sup> In one version of his model, Tedeschi re-specified the equation to use the stock of federal debt and the stock of federal debt held by foreigners, both as a percentage of gross domestic product (GDP).

Table 1 presents his and other estimates from past literature and our updated estimate. Of note, Edward Gamber and John Seliski (2019) find a smaller impact of debt, about 2.5 basis points, an estimate the CBO used in long-term projections.

We use one of Tedeschi’s main specifications, in particular the version using the current federal debt stock; expand the period of analysis to September 1981 through May 2022; and add a variable for the holdings by the Federal Reserve of long-term Treasury debt to consider the impact of quantitative easing. We also report statistical significance robust to autocorrelation, provide a decomposition chart to visualize the distinct impacts on interest rates predicted by our model, and discuss how debt’s impact on long-term rates has changed in the past 20 or so years.

## Model and Analysis

Explicitly, we model interest rates as the following:<sup>2</sup>

$$\begin{aligned}
 fcm10_t = & \alpha_1 inf10_t + \alpha_2 fed3m_t + & (1) \\
 & \alpha_3 infsprd_t + \alpha_4 growth1_t + \alpha_5 rp_t + \\
 & \alpha_6 usd_t + \alpha_7 ph\_debt_t + \alpha_8 fed\_debt_t + \\
 & \alpha_9 foreign\_debt_t + \mu_t,
 \end{aligned}$$

where  $fcm10$  is the 10-year Treasury yield;  $inf10$  is a 10-year inflation expectation;  $fed3m$  is the three-month Treasury yield;  $infsprd$  is the difference between one- and 10-year inflation expectations;  $growth1$  is the one-year real GDP growth expectation;  $rp$  is the 10-year Treasury yield risk premium, calculated as a rolling 36-month standard deviation;  $usd$  is the one-year change in the Real Broad Dollar Index;  $ph\_debt$  is publicly held federal debt;  $fed\_debt$  is Treasury securities held by the Federal Reserve; and  $foreign\_debt$  is the foreign-held US debt, as measured in month  $t$ .

<sup>1</sup> This is noteworthy as the number of observations severely drops as the CBO usually publishes these projections only twice a year, compared to 12 data points a year in the prior specification.

<sup>2</sup> The data used are publicly available. Quarterly variables are interpolated to monthly.

**Table 2. Estimates of Determinants of Long-Term Interest Rates, 1981–2022**

Variable	Model 1	Model 2	Model 3
Three-Month Treasury Rate Minus 10-Year Inflation	0.572 (0.046)***	0.481 (0.046)***	0.407 (0.042)***
One- and 10-Year Inflation Spread	-0.644 (0.248)**	0.079 (0.269)	0.100 (0.260)
One-Year Real GDP Growth Expectation	-0.009 (0.085)	0.171 (0.100)	0.191 (0.106)
10-Year Yield Risk Premium	7.054 (0.817)***	6.563 (0.788)***	6.313 (0.851)***
Change in Broad US Dollar	-0.012 (0.011)	-0.000 (0.010)	0.008 (0.011)
Publicly Held Debt	0.008 (0.004)	0.025 (0.006)***	0.045 (0.007)***
Change in Population Age 65 or Older	-2.241 (0.416)***	-1.835 (0.344)***	-1.293 (0.423)**
Securities Held by Federal Reserve Banks		-0.153 (0.033)***	-0.165 (0.032)***
Foreign-Held Debt			-0.057 (0.015)***
N	489	489	489

Note: Newey-West standard errors are reported in the parentheses. \*  $p < 0.05$ ; \*\*  $p < 0.01$ ; \*\*\*  $p < 0.001$ .  
Source: Authors' calculations.

Consistent with past literature, we assume there is no contemporaneous reverse causal effect of interest rates on independent variables due to the general sluggishness of these macro variables. We also provide estimates from three distinct models to emphasize the impacts of quantitative easing and foreign-held debt.

Incorporating the constraint that the coefficients on  $fed3m$  and  $inf10$  sum to one, we obtain the following:

$$\begin{aligned}
 fcm10_t - inf10_t = & \alpha_2(fed3m_t - \\
 & inf10) + \alpha_3 infsprd_t + \alpha_4 growth1_t + \\
 & \alpha_5 rp_t + \alpha_6 usd_t + \alpha_7 ph_{debt}_t + \\
 & \alpha_8 fed_{debt}_t + \alpha_9 foreign_{debt}_t + \mu_t.
 \end{aligned} \tag{2}$$

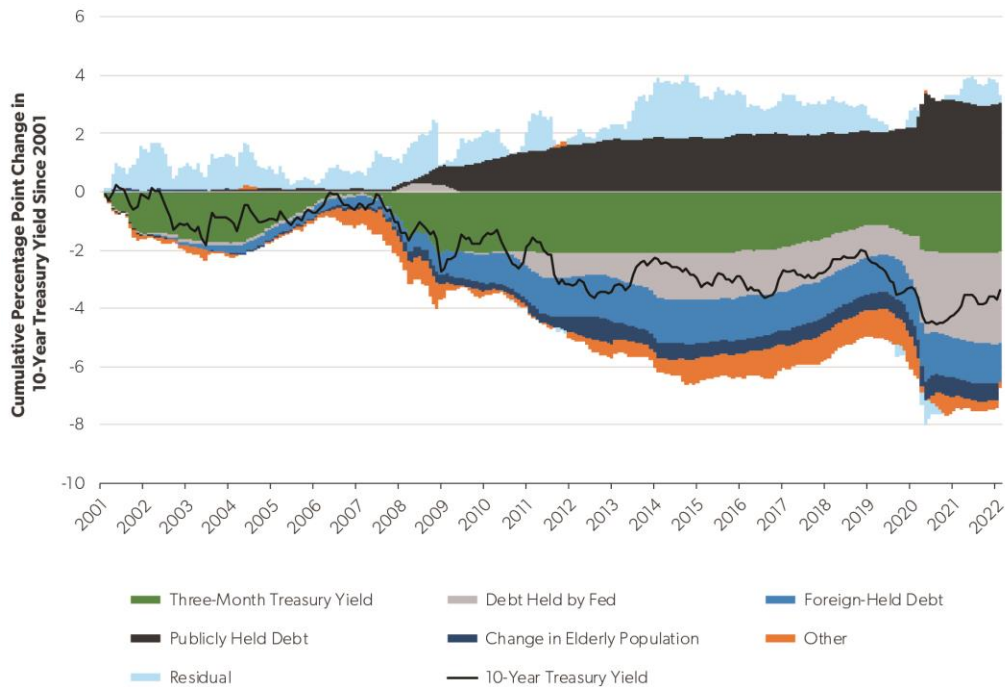
Table 2 presents three estimates derived from Equation 2, with Model 3 being our preferred specification, as it considers foreign demand for US debt and quantitative easing measures. We find, holding all else equal, a 1 percentage point increase in the publicly held debt-to-GDP ratio corresponds to a 4.5 basis point increase in the 10-year yield. This estimate is strongly significant.

Other interpretable, significant estimates are of an expected sign. Of note, increases in foreign holdings of debt and holdings by the Fed put negative pressure on the long-term interest rates. Gamber and Selinski (2019) estimate that 1 percentage point increases in the Fed's holdings of debt and debt held from abroad correspond to about 23 and eight basis point decreases in the long-term interest rate, respectively, holding all else equal in their specification. We estimate decreases of 16.5 and 5.7 basis points, respectively.

Finally, the aging population also exerts a downward pressure on long-term interest rates. Every 1 percentage point increase in the 12-month change in the share of the population over age 65—those in high savings years—coincides with a 1.024 percentage point decrease in the long-term yield.

A natural question to ask at this point is how these factors have affected interest rates in recent years. Figure 2 depicts the decomposed cumulative change in the long-term interest rate, derived from Equation 1, by the source of the change and plots the actual change. Our model suggests that rising debt has caused upward pressures on long-term interest rates (see the positive dark gray area), but that effect has been concealed by other changes,

**Figure 2. Decomposition of Estimated Change in the Nominal 10-Year Treasury Yield, January 2001–January 2022**



Source: Authors' calculations.

specifically decreases in the short-term yield, increases in foreign-held debt, quantitative easing, and, to a lesser extent, demographic changes.

Figure 3 addresses how the effect of debt on long-term rates has changed in recent years. For each month from January 2000 to May 2022, Equation 2 is estimated using the past 180 months (15 years) of data, and the coefficient on the debt-to-GDP ratio is plotted, along with a 95 percent confidence interval. In this period, the effect peaked at around 7.6 basis points and, recently, fell to its lowest at 4.3 basis points. The average over this period is 5.4 basis points. We speculate that this decline is due to a combination of the Federal Reserve's forward guidance policies, integration of global markets, and changes in geopolitical tensions, all of which are unaccounted for in our estimation.

## Conclusion

Until recently, many argued that growth in federal deficits and debt should not be a concern constraining US fiscal policy or the development of government programs because interest rates had

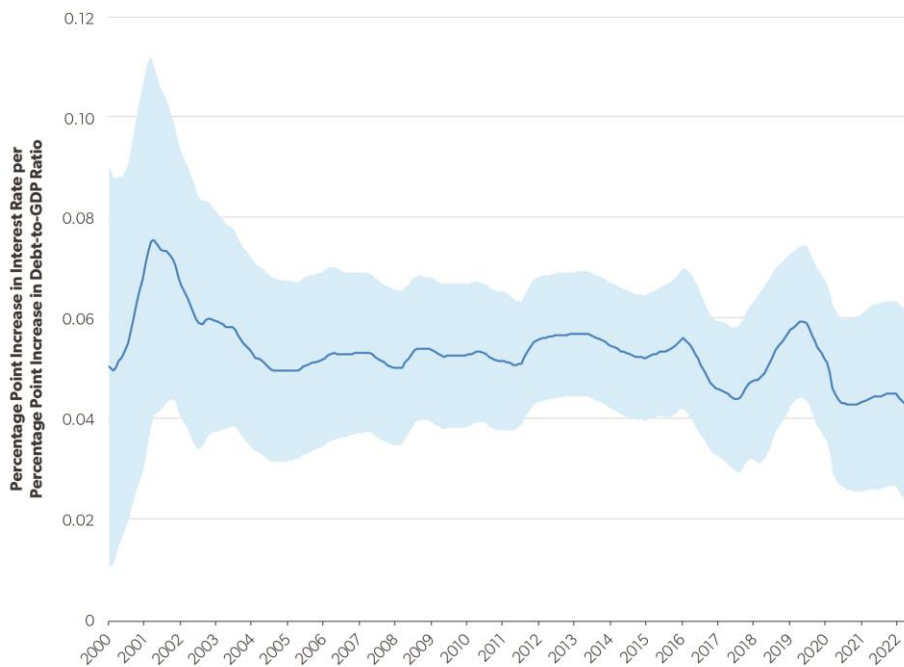
remained so low despite large increases in the deficit. Even those, such as Tedeschi, who acknowledged the long-term positive impact of government debt on interest rates emphasized that other factors, such as slow growth and productivity, monetary policy, demography, and foreign demand for US Treasuries, allowed the federal government to easily pursue countercyclical policy or finance policies fighting secular stagnation.

The recent intense bout of inflation, however, has caused some proponents of that viewpoint to recant. Indeed, there is an increased appreciation, supported by the results in this report, that the Federal Reserve Board's choice of highly accommodative monetary policy has played an outsized role in the low interest rates experienced in the past decade, with eventually adverse consequences to inflation. By our estimates, the scheduled quantitative tightening announced in May 2022 could raise long-term interest rates as much as 55 basis points by December 2023, assuming redemption caps are hit and holding all else constant.

Moreover, our results suggest that the CBO estimate on the federal debt's impact on long-term



**Figure 3. Rolling Effect of Publicly Held Debt on Interest Rates Using Data from Previous 15 Years**



Source: Authors' calculations.

interest rates is low by about two basis points per percentage point of debt to GDP, meaning the current-policy inexorable climb in deficits and debt may be underestimated by the CBO and long-term interest rates will be higher than projected. A rough estimate of this effect can be made using the CBO's July 2022 long-term budget projections (CBO 2022). Increasingly higher rates along the path and a rounded 6.0 percent interest rate in 2052 leads to a debt-to-GDP ratio of 235 percent in

2052 instead of the 185 percent in the CBO extended baseline.

Further, the CBO assumes a larger negative effect on interest rates of debt held abroad and by the Federal Reserve, meaning the CBO's underestimation of future debt to GDP is likely even more exaggerated. So higher debt, with all its risks and adverse consequences—and higher than even the CBO projected—is likely, unless there is a change in long-term fiscal policy and new government programs are more fully and permanently financed.

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