Fiscal Consequences of the US War on COVID*

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Abstract

Post War on COVID-19 Interest rate rises and inflation imposed losses on federal creditors and motivated the Fed to transfer interest rate risk from private banks to itself. We describe budget-feasible paths for market values of US Treasury debt associated with projections of taxes and expenditures. We compare prospective paths of US federal taxes, expenditures, interest payments, and debt in the post-COVID period to paths observed after big surges in government expenditures during two twentieth-century US wars. Government expenditure/GDP surges in past US Wars had permanent components that were accompanied by permanent rises in tax collections/GDP ratios. Although part of the War on COVID expenditure/GDP surge has endured, so far tax collections haven't risen relative to GDP. The evolution of those two ratios will determine future debt/GDP ratios.

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We know that we're on an unsustainable path fiscally.

Federal Reserve Chair Jerome Powell[1]

In general, the path of interest rates does matter to the deficit and the sustainability of fiscal policy. President Biden is committed to a sustainable fiscal policy. I am sure that if the fiscal outlook worsens some, the budget will be adjusted.

Secretary of Treasury Janet Yellen[2]

1 Who Pays and How

When applied to fiscal policy, "sustainable" is an ambiguous adjective. It can mean "budget feasible" in the sense that prospective paths of government expenditures, tax collections, government indebtedness and debt servicing costs, and revenues collected through inflation taxes and financial repression satisfy intertemporal government budget constraints.[3] It can also mean that those paths are politically tenable in the sense that current and future democratic processes will ratify them. It is widely believed that the *status quo* fiscal policy paths inherent in existing federal legislation will put US government debt on an explosive path that no one wants, possibly including prospective purchasers of that debt. So when Secretary Yellen says that the Biden administration is committed to a sustainable policy, she might be saying that President Biden recognizes that *status quo* paths are likely somehow to be adjusted. But what adjustments to government expenditures, tax collections, government indebtedness and debt servicing costs, and revenues collected through inflation taxes and financial repression will the US polity ultimately choose? We don't know. To frame some possibilities, this paper describes recent US monetary-fiscal choices in light of precedents set by our country's responses to two earlier surges in government expenditures.

In a pattern recognition exercise that compared US government finances during the "War on COVID" with World Wars I and II, Hall and Sargent (2022) observed that, as percentages of total revenues, sources of federal revenue were:

	taxes	bonds	money
World War I	20.8	74.6	7.0
World War II	30.2	46.0	10.1
COVID-19	4.0	38.1	45.1

During each episode, the federal government financed its expenditures mostly by issuing interest-bearing debt and non-interest-bearing money rather than collecting taxes. During World Wars

[1] Ip (2023).
[2] Duehren and Pipe (2023).
[3] Our having read Bassetto et al. (2021) prompts us to write budget constraints, plural.

I and II, the federal government predominately issued interest-bearing debt instead of money. During the War on COVID-19, it mostly issued money. Compared with World Wars I and II, the US raised an even smaller percentage of GDP by war-time taxes.

If explicit taxes are not levied during a war, someone is bound to pay sooner or later, either through higher taxes, reduced expenditures, or "rescheduling" promised debt servicing.[4]. Who is likely to pay for the US War on COVID? A plausible guess is federal creditors.[5]

- Losses to creditors coming from inflation and rising interest rates are borne by holders of longer-term Treasury securities, not by short-term lenders to the Fed.
- Bondholders have already suffered capital losses.
  - Holders of long-duration government bonds have faced the largest losses.
  - Banks and other depository institutions that have borrowed short term to finance long-term loans have absorbed significant losses.
- The Federal Reserve's COVID Quantitative Easing Program, inaugurated in March 2020, has transferred much interest rate risk to itself. Due to its decisions that raised the Federal Funds rate over 500 basis points between March 2022 and today, the Fed's borrowing costs now exceed the income that it earns on its portfolio of Treasury and mortgage backed securities. Now each month the Federal Reserve incurs losses on its portfolio. In 2022, rising yields on longer-term debt caused the Fed to incur over $1 trillion in unrealized losses on its asset portfolio.
- After past big expenditure surges, government spending as a share of GDP rose permanently. Projections by the Congressional Budget Office forecast that government spending will rise permanently above its pre-COVID share of GDP.
- In a departure from those earlier big expenditure surges, the CBO projects that the federal government will run run primary deficits for the foreseeable future.

To set the stage, two figures from Hall and Sargent (2022) compare the time paths of the consumer price index (CPI) and the cumulative returns earned by a representative creditor to the US Treasury.

In figure 1, we compare the natural log of the US price level for the 12 years after the start of World War I with a period of the same length after the start of World War II. For each war, we normalize the price level by the transformation $100 \times (\log P_t - \log P_{\text{start of war}})$, so a series records

[4] "Rescheduling" is a euphemism for "defaulting".

[5] We say federal creditors rather than Treasury creditors because, in addition to the Treasury selling securities to the public, the Federal Reserve borrows on behalf of the federal government from banks in the form of interest-bearing reserves and money markets in the form of reverse repurchase agreements.

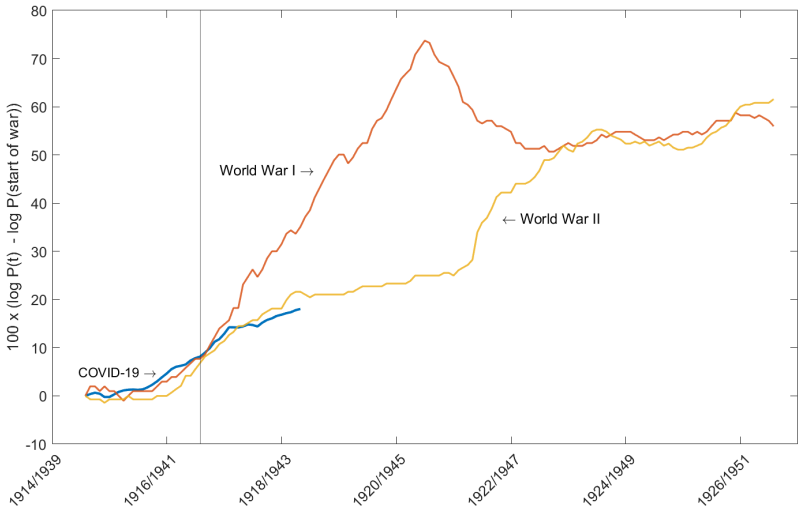


Figure 1: Natural Log of Consumer Price Index During and After Wars

This figure displays $100 \times (logP_t - logP_{\text{start of war}})$, where P_t is the CPI for All Urban Consumers, NSA. Ticks on the x-axis correspond to January for the 1914 to 1926 period and March for the 1939 to 1951 period. For the COVID-19 war, the series begins January 2020 and ends September 2023.

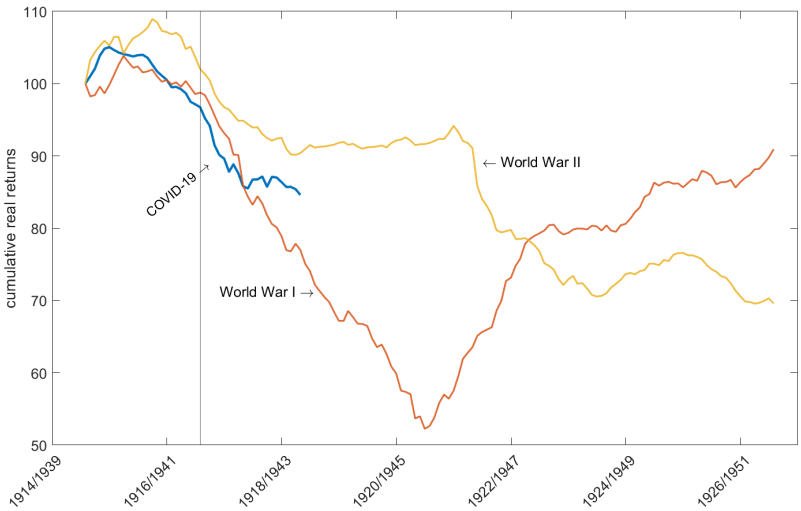


Figure 2: Real Value of $100 Portfolio of Treasury Securities Invested at Starts of Wars

This figure reports the cumulative real values coming from continually reinvesting in a value-weighted re-balanced portfolio of all outstanding US Treasury securities of an initial investment of $100 at the start of each war. Ticks on the x-axis correspond to January for the 1914 to 1926 period and March for the 1939 to 1951 period. For the COVID-19 war, the series begins January 2020 and ends September 2023.

cumulative percentage changes in the price level after the war's start. The blue line reports the log of the price level for the 44 months following COVID-19. The vertical black line at December 2021 demarcates the end of the War on COVID-19.

This figure confirms how the price level rose during both world wars. After World War I, the price level peaked in 1919 at more than 70% higher than its pre-war level. The price level subsided during the deep but short 1920-1921 depression but remained about 55% higher than its 1914 level ten years after the war.

After World War II, price and wage controls postponed price level increases. A surge in the price level accompanied the lifting of price controls in 1946. For both twentieth-century world wars, the price level stood at roughly 55% higher between 7 to 12 years after the war. This enduring increase in the price level contributed to low real returns, as we now show in figure 2.

Each line in figure 2 reports cumulative real values coming from continually reinvesting in a value-weighted re-balanced portfolio of all outstanding US Treasury securities, starting with an initial investment of $100.[6] Although real values of the Treasury's portfolio initially rose during both twentieth-century world wars, as the price level rose, real returns fell. For the post-World War I period, rising interest rates drove bond prices down so that by June 30, 1920, long-term bonds traded 10 to 15% below their par value. Combined with a higher price level, these low bond prices contributed to cumulative real losses of nearly 50% to federal bondholders. A reduction in the price level and decreased interest rates in the early 1920s helped boost the value of the Treasury's portfolio; but even by 1926, the value of the Treasury's portfolio had still not returned to its pre-war value in real terms.

Mindful of the post-World War I experience, Treasury officials reduced interest rate risk by fixing bond yields during World War II. That kept nominal returns on the Treasury's portfolio low and stable during the 1940s, but movements in real returns mirrored movements in the price level. As a result, by 1951, the Treasury's portfolio was worth only 70 percent of its pre-war value.

Blue lines in figures 1 and 2 report the price level and cumulative returns for the COVID-19 period. During the first two years of the War on COVID-19, the price level increases tracked those of the two prior world wars; however since June 2022, growth in prices has slowed. Cumulative real returns on the Treasury securities during the first three years since the outbreak of COVID tracked closely the sharp losses incurred during World War I.

[6] The real value at time t is $100 \times \prod_{s=\text{start of war}}^{t} \frac{1+r_{s,s+1}}{1+\pi_{s,s+1}}$, where $r_{s,s+1}$ is the nominal net return on the portfolio between month s and $s+1$ and $\pi_{s,s+1}$ is the inflation rate between month s and $s+1$. Thus, the units are start-of-war dollars.

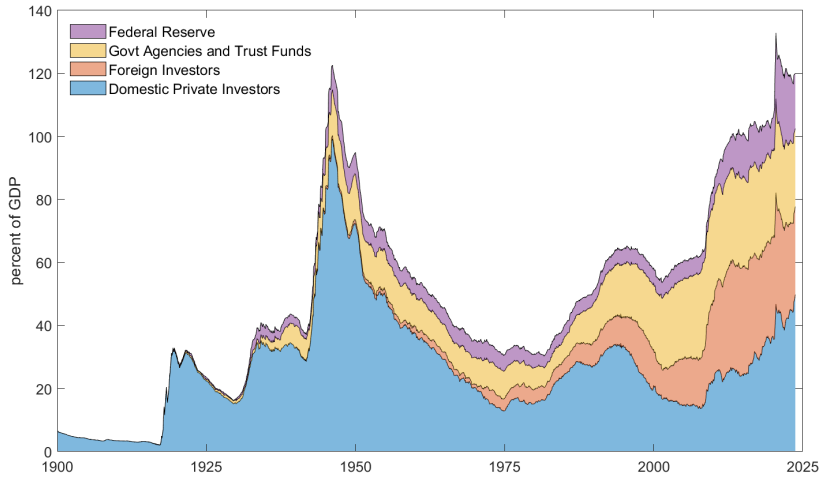


Figure 3: Par Value of US Treasury Debt by Ownership as Percents of GDP: 1900 to 2023

2 Government Budget Arithmetic

The federal government's nominal budget constraint at time t is:

$$G_t + r^B_{t-1,t} B_{t-1} + (A_t - A_{t-1}) = T_t + (B_t - B_{t-1}) + r^A_{t-1,t} A_{t-1} + (M_t - M_{t-1}) + OM_t \tag{1}$$

where

$$\begin{aligned}
G_t &= \text{Government outlays, net of official interest payments} \\
B_{t-1} &= \text{Nominal market value of interest-bearing government debt held by private} \\
&\quad\ \text{investors at the end of } t-1 \\
r^B_{t-1,t} &= \text{Nominal value-weighted return on government debt between } t-1 \text{ and } t \\
A_t &= \text{Private assets purchased by the Federal Reserve} \\
r^A_{t-1,t} &= \text{Nominal return on Fed-held private assets between } t-1 \text{ and } t \\
T_t &= \text{Tax receipts} \\
M_t &= \text{Federal Reserve credit} \\
OM_t &= \text{Funding by Other Means}
\end{aligned}$$

Funding by Other Means includes IMF dollar deposits and letters of credit to the IMF, changes in special drawing rights certificates issued to Federal Reserve Banks, and net activities of various federal loan programs.

To measure real returns realized by bondholders, we make three adjustments to the US Trea-

sury's accounts of debt outstanding and interest payments. To include only government debt held by private investors, both domestic and foreign, we net out holdings by the Federal Reserve and Government Agencies and Trust Funds. In figure 3, we decompose the par value of the total public debt outstanding as a share of GDP from January 1900 to September 2023 into these four ownership classes. Section 4.1 tells classes of creditors that own US Treasury debt. Second, we use promised payment streams and bond price data from Hall et al. (2022) to construct a market value measure of Treasury debt. The market value takes into account differences between interest rates and coupon rates at the time the debt is issued, as well as changes in interest rates and repayment probabilities after bonds were issued; it answers the question: how much would the government pay if it were to repurchase the entire portfolio of privately held debt at current market prices? Third, we measure interest payments on the debt, $r_{t-1,t}$, by the value-weighted return on the portfolio of US Treasury debt. This measure differs from the US Treasury's series of *Interest Expense on the Debt Outstanding*, an accounting measure that reports the sum of coupon payments on Treasury notes and bonds and the accrued interest on zero-coupon Treasury bills.[7]

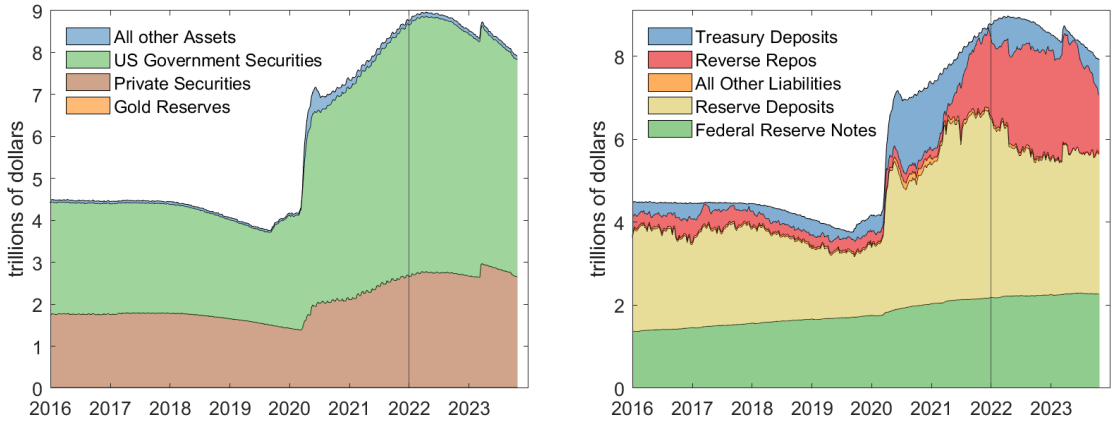
We make a further adjustment to account for the Federal Reserve's purchase of Treasury securities and private assets and its expansion of liabilities to pay for these purchases. Panel 4a shows how Federal Reserve holdings of Treasuries and private assets (largely mortgage backed securities, denoted MBS) surged in the second quarter of 2020 when the Treasury issued $2.8 trillion in new debt and private investors sought liquidity. The Fed increased its holdings of Treasuries and MBSs by $1.8 trillion. The Fed continued purchasing assets until mid-2022.

Fed liabilities increased in tandem. Panel 4b indicates that bank reserves (tan) and Treasury deposits (blue) jumped. For about a year after March 2020, bank reserves grew fast as the Treasury gradually drew down and spent its deposits at the Fed. But in March 2021, growth in bank reserves slowed markedly while reverse repurchase agreements (reverse repos) (red) directed toward money market funds accelerated rapidly. Reverse repos function as reserve accounts at the Fed and reflect that now the Fed borrows from money market funds as well as from banks. The Fed pays interest on reverse repos, though at slightly lower rates than on bank reserves.

In October 2008, the Federal Reserve began paying interest on reserve deposits, effectively making them perfect substitutes for interest-bearing Treasury debt. To recognize that change in Fed operating procedures, the green line in figure 5 graphs the sum of the market value of the privately held Treasury debt and interest-bearing reserve deposits and reverse repos at the Federal Reserve, i.e., a sum of the tan and red areas in panel 4b. Counting reserves at the Fed and the Fed's reverse repo positions as interest-bearing debt increases the ratio of privately-held federal debt to GDP from 69.6% to 89.7% as of June 30, 2023.[8]

[7] In the Appendix of Hall and Sargent (2021), we explain in detail the relationship between par and market values of government debt and the relationship between returns on the portfolio of Treasuries and the Treasury's measure of interest payments.

[8] We record interest-bearing reserve deposits and reverse repos at the Federal Reserve at their face or par values.



(a) Assets

(b) Liabilities and Capital Account

Figure 4: Federal Reserve Balance Sheet: 2016-2023

The vertical line denotes December 31, 2021.

The green line overstates federal interest-bearing debt held by private investors because the Fed used some of the revenues generated by issuing those reserve deposits to purchase private assets. To adjust for that, the light blue line in figure 5 plots the market value of the privately-held Treasury debt *plus* reserve deposits and reserve repos at the Federal Reserve *minus* Federal Reserve holdings of privately issued securities (i.e., the brown area in panel 4a). The gap between green and light blue lines measures reserve deposits that are "backed" by private securities, a component of Fed open market operations that brings to mind a "real bills" doctrine written into the original 1913 legislation that created the Fed.[9]

The Fed serves as the US Treasury's fiscal agent, so its interest-bearing reserve deposits and reverse repos are ultimately backed by the full faith and credit of the US federal government. For that reason, we include them (net of private asset purchases) in one of our measures of the interest-bearing federal debt; however unlike securities issued by the Treasury, these liabilities of the Federal Reserve neither count as part of the national debt nor against the statutory debt limit.

3 Post-COVID Changes in Debt/GDP

From December 2019 to September 2023, the par value of privately-held Treasury debt increased by \$6.6 trillion from \$14.9 to \$21.5 trillion. If we add the Federal Reserve's interest-bearing reserve deposits and reverse repos and net out cash balances held by the Treasury, we learn that federal

[9]Sargent and Wallace (1982) present an historical account of and peculiar perspective on the real bills doctrine.

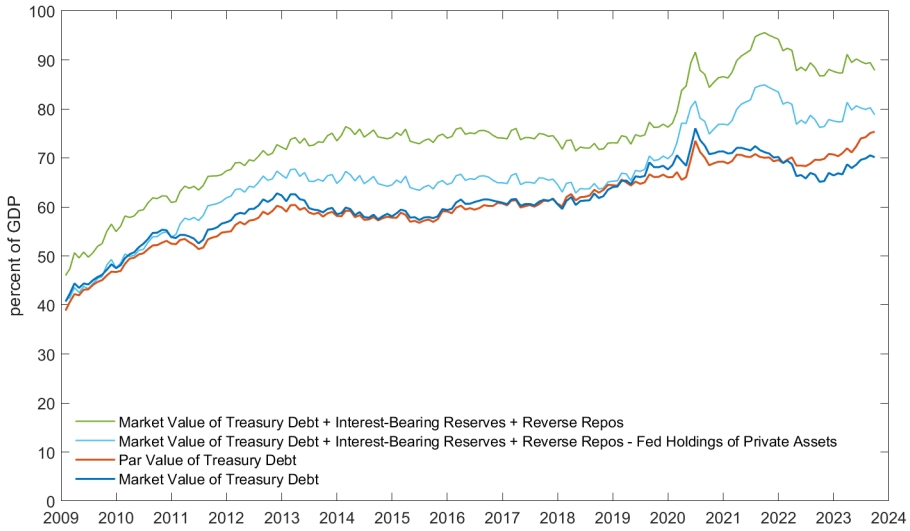


Figure 5: Par and Market Values of Treasury Debt Held by Private Investors

All series are net of Treasury cash balances.

debts rose from \$16.4 to \$25.7 trillion.

While the *level of debt* increased nearly monotonically, the path of the *debt/GDP ratio* did not. Look at figure 5. The red line plots the ratio of the par value of privately-held Treasury debt to GDP.[10] This ratio rose from 66.0% in December 2019 to 73.5% in June 2020, then it fell to 68.5% in September 2020; during the next 27 months, it stayed within a band between 68.3% and 70.8%. Then, from December 2022 to September 2023, it increased from 70.7% to 75.4%

In December 2019, the market value of privately-held debt (the dark blue line) exceeded its par value by \$350 billion. The ratio of the market value of debt to GDP rose from 68.3% in December 2019 to 77.1% in June 2020, but it declined throughout 2021 and 2022. By December 2022, it was only 67.1%. Measured at its market value, the debt/GDP ratio was *lower* at the end of 2022 than it had been before the outbreak of COVID-19, and by September 2023, the market value of privately held debt was \$1.45 trillion less than its par value. Counting the Fed's interest-bearing reserve deposits and reverse repos as debt (see the green and light blue lines) increases the debt/GDP ratio for most of 2021 and then declines in early 2022.

We date the end of the War on COVID as December 31, 2021. We decompose the postwar decrease in the debt/GDP ratio that occurred in 2022 and the first three quarters of 2023 into contributions made by nominal returns paid on Treasury securities net returns paid on private assets, GDP growth, inflation, the primary deficit, and seignorage. We divide each term in

[10] All series in this figure net out Treasury cash balances.

	100 × Debt/GDP			Contributions					
	(1) 2021:12	(2) 2023:9	(3) change	(4) nominal payouts $r_t \frac{B_{t-1}}{Y_{t-1}} - r_t \frac{A_{t-1}}{Y_{t-1}}$	(5) real GDP growth $g_t \frac{B_{t-1}}{Y_{t-1}}$	(6) inflation $\pi_t \frac{B_{t-1}}{Y_{t-1}}$	(7) primary deficit $\frac{G_t - T_t}{Y_t}$	(8) money growth $\frac{M_t - M_{t-1}}{Y_t}$	(9) Other
COVID-19									
reserves $\subset M$	70.2	70.1	-0.1	0.6	-1.7	-4.9	6.2	10.0	-10.3
reserves $\subset B$	94.2	87.9	-6.3	-0.3	-2.3	-6.8	6.2	6.2	-9.3

Table 1: Decomposition of Post-War Changes in Debt/GDP Ratio

Other includes asset purchases, other means, the cross term, and the error term.

equation (1) by nominal GDP, which we denote Y_t. After rearranging terms, we get:

$$\begin{aligned}\frac{B_t}{Y_t} - \frac{B_{t-1}}{Y_{t-1}} &= \left(r^B_{t-1,t}\frac{B_{t-1}}{Y_{t-1}} - r^A_{t-1,t}\frac{A_{t-1}}{Y_{t-1}}\right) - g_{t-1,t}\frac{B_{t-1}-A_{t-1}}{Y_{t-1}} - \pi_{t-1,t}\frac{B_{t-1}-A_{t-1}}{Y_{t-1}} \\ &\quad + \frac{G_t - T_t}{Y_t} - \frac{M_t - M_{t-1}}{Y_t} - \frac{OM_t}{Y_t} + \left(\frac{A_t}{Y_t} - \frac{A_{t-1}}{Y_{t-1}}\right) \\ &\quad -(\pi_{t-1,t} + g_{t-1,t})\left(r^B_{t-1,t}\frac{B_{t-1}}{Y_{t-1}} - r^A_{t-1,t}\frac{A_{t-1}}{Y_{t-1}}\right) \qquad (2)\end{aligned}$$

where $g_{t-1,t}$ denotes the net growth rate of real GDP, and $\pi_{t-1,t}$ denotes the net inflation rate.

The left side of equation (2) records the change in the debt/GDP ratio. The first term on the right side is interest payments on government debt net interest received on the Federal Reserve's holdings of private assets as a share of GDP. The subsequent two terms record decreases in the net debt/GDP ratio contributed by real GDP growth and inflation. The following four terms are the primary deficit, Federal Reserve credit, other means, and purchases of private assets by the Federal Reserve as shares of GDP. The final term is a cross-product of two growth rates.

Columns (1) - (3) of table 1 summarize changes in the debt/GDP ratio during 2022 and the first three quarters of 2023. Columns (4) - (9) report our decomposition into components attributable to (i) net nominal interest payments, (ii) GDP growth, (iii) inflation, (iv) the primary deficit, (v) money growth, and (vi) the sum of asset purchases, other means, the cross term, and a residual.

The first row of table 1 is the market value of privately-held Treasury debt net Treasury cash balances (figure 5, dark blue line); the Fed's holdings of reserves and reverse repos are counted as money. Under this assumption, the debt/GDP ratio essentially unchanged, falling from 70.2% to 70.1%. In the second row, we count these Fed liabilities as interest-bearing federal debt (figure 5, green line). Under this accounting convention, the debt/GDP ratio fell from 94.2% to 87.9% from the start of 2022:Q1 to the end of 2023:Q3. This reduction was driven by

1. Capital losses that resulted in negative returns on Treasury debt. As we document below, the 2022 nominal return on the portfolio of US Treasury securities was -9.3%. These negative

returns were partly offset by the Fed's having increased the interest it pays to banks on reserves from 0.15% in December 2021 to 5.08% in June 2023 together with increases in the Fed's holdings of reverse repos.

Decomposing the returns, losses to private-holders of Treasury securities reduced the debt/GDP ratio by 3.3%; offsetting these losses were Fed payouts on reserves and reverse-repos (1.2%) and losses on the Fed's holdings of mortgage-backed securities (1.8%). Overall, net returns account for 5% of the reduction.

2. Real GDP growth. Real GDP grew 2.9% for the past seven quarters, accounting for 37% of the reduction.

3. Inflation. The GDP deflator increased by 8.8%, accounting for 108% of the reduction.

Offsetting these three contributions, the federal government ran a primary deficit and the Federal Reserve decreased Fed credit (i.e., the money supply), so the three factors sum to more than 100%. Had the federal government run a balanced primary budget, the debt/GDP ratio at the end of the second quarter of 2023 would have been 81.7% instead of 87.9%.

Two important drivers of the postwar reduction in the debt/GDP ratio were rising inflation and negative returns. In the next section, we examine their impact on federal bondholders in more detail.

4 Fiscal Consequences of Inflation

We use two measures of inflation. In our table 1 decomposition of the debt/GDP ratio, we measure inflation using the GDP deflator. In figures 1 and 2, we report inflation in the nonseasonally adjusted CPI for all urban consumers. Both measures started registering big price level increases in the second half of 2020. That had two adverse consequences for federal creditors.

1. Directly, it imposed real losses on bondholders and other owners of promises to future government payment streams.[11]

2. Indirectly, it caused the Federal Reserve to raise interest rates, triggering falls in prices of Treasury and other fixed-income securities.

In this section, we describe losses incurred by three classes of creditors: foreigners, US banks and other depository institutions, and the Federal Reserve. We also measure the sensitivity of the market value of Treasury debt to changes in interest rates.

[11] One important exception is Social Security payments which are indexed to inflation.

4.1 Who Lends to the US Treasury?

Figure 3 decomposed the par value of the total US Treasury debt outstanding as a share of GDP from January 1900 to September 2023 into four ownership classes: the Federal Reserve, Government Agencies and Trust Funds, foreign investors, and domestic private investors. Before World War I, domestic private investors nearly all US Treasury debt, mostly by national banks. As federal borrowing requirements grew over time, US Treasury debt broadened and deepened. Treasuries are now widely held both at home and abroad.

As we report in table 2, by the end of 2022, of the over $31 trillion in total debt outstanding (measured at its par value), 17.2% was held by the Federal Reserve, 21.9% was in government accounts and trust funds, 23.4% was held by foreign investors, and 37.5% was held by domestic private investors. For these last three ownership classes, we describe some important holders.

- Of the $6.9 trillion in Treasury debt held by government agencies and trust funds, over 75% is held by three trust funds: the Social Security Old Age, Survivors and Disability (OASDI) Trust Fund, the Department of Defense Military Retirement Fund, and Office of Personnel and Management Civil Retirement Funds. These funds hold mostly nonmarketable debt.

- Of the $7.3 trillion in Treasury debt held by foreigners, 1/3 is held inside Japan, Mainland China, and the United Kingdom.

- Within the class of domestic private investors, US banks and other depository institutions hold $1.7 trillion of US Treasuries, about 5% of the total outstanding debt.

4.2 Losses on US Treasury Securities

In response to the COVID inflation that began in the second half of 2020, starting on March 17, 2022, the Federal Reserve initiated a sequence of increases in the Federal Funds Rate, eleven so far, that have raised the target rate from 0-0.25% to 5.25-5.50% in early October 2023.

Figure 6 plots the Effective Fed Funds Rate, the Award Rate on Reverse Repurchase Agreements, and the yield on Treasuries at a 10-year constant maturity from January 2000 to early October 2023. Evidently, the Federal Reserve twice set the Fed Funds Rate to near zero, once in December 2008 in response to the financial crisis and again in March 2020 in response to the COVID-induced business shutdowns. During the last three quarters of 2020 and throughout 2021, the effective Fed Funds rate stayed between 0.06% and 0.10% in 2021. It rose from 0.8% in December 2021 to 4.41% in December 2022. On October 4, 2023, it was 5.33%. The award rate on reverse repurchase agreements moved in tandem with the Fed Funds rate.

Along with the increases in inflation and the Fed Funds rate, long-term rates rose throughout 2021, 2022, and 2023. The yield on Treasuries at a 10-year constant maturity rose from a low of

Creditor	Par Value (in billions)	Percent of Total
Federal Reserve	$5,398.1	17.2%
Gov't Agencies and Trust Funds	6,867.5	21.9
OASDI Trust Fund	2,830	
DoD Military Retire Fund	1,355	
OPM Civil Service Retire Fund	1,007	
Foreign Investors	7,318.7	23.4
Japan	1,076.3	
China	867.1	
United Kingdom	654.5	
Domestic Private Investors	11,763.0	37.5
Depository Institutions	1,715.8†	
Total	$31,347.3	100%

Table 2: Treasury Debt Ownership: December 2022

† Flow Funds, Table L.210 (sum of lines 25-28, 53)

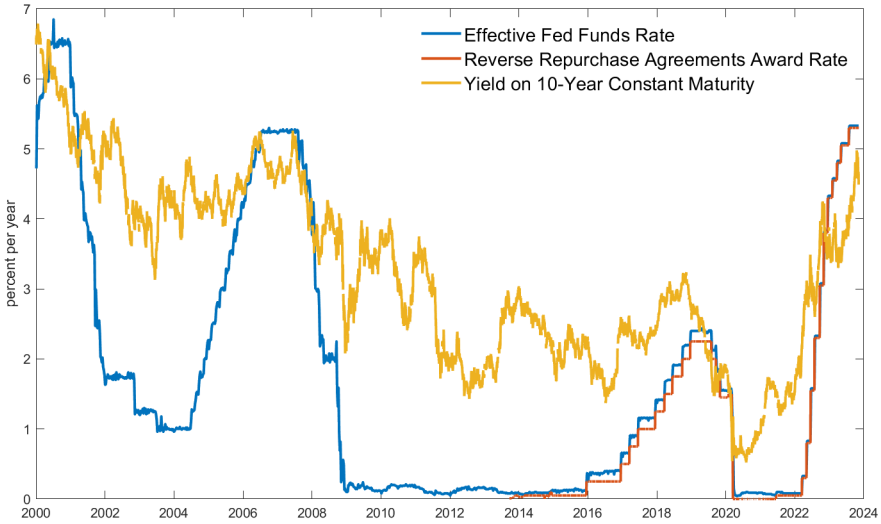


Figure 6: Effective Federal Funds Rate, Reverse Repurchase Award Rate, and Yield on US Treasury Securities at the 10-Year Constant Maturity

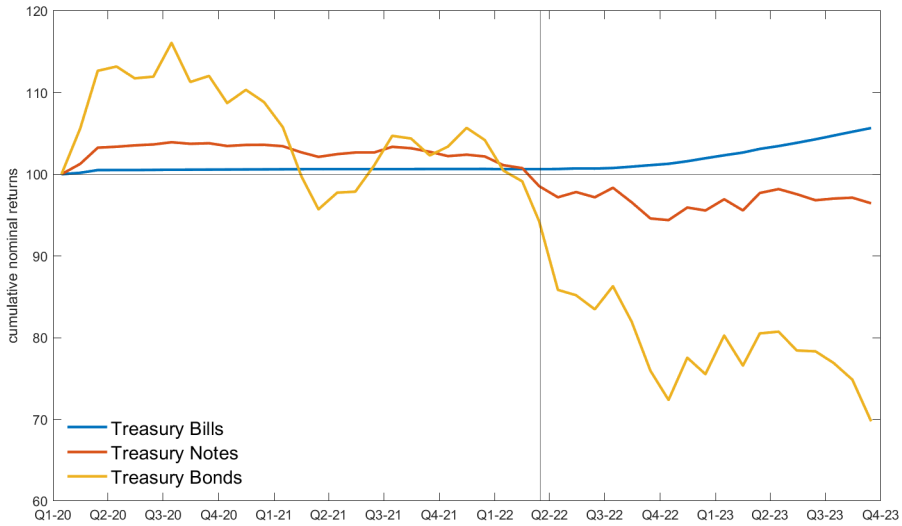


Figure 7: Cumulative Nominal Returns on Treasury Bills, Notes and Bonds

The vertical line denotes March 17, 2022, the date of the first increase in the Fed Funds rate.

0.55% in July 2020 to 4.73% in early October 2023. This increase in interest rates throughout the term structure resulted in capital losses on a wide range of bondholders.

We compute ex-post returns for marketable Treasury securities for 2021, 2022, and the first 9 months of 2023, for which we have prices from the CRSP database. Annual nominal returns categorized by Treasury security type were:

	2021	2022	2023 (ytd through 9/23)
Bills	0.05%	1.30%	3.63%
Notes	-1.38	-6.47	0.92
Bonds	-4.26	-27.51	-7.64
TIPS	5.79	-10.42	-0.25
total value-weighted return	-1.37%	-9.31%	-0.10%

A bond price is more sensitive to changes in interest rates, the longer its duration. Consequently holders of long-term Treasury bonds incurred much larger losses than holders of short-term Treasury bills.[12] Starting with an initial investment of $100 on January 1, 2020 and With continuous reinvesting of proceeds, figure 7 plots cumulative nominal returns on Treasury securities by security type. Since the Fed began raising the Fed Funds rate, long-term Treasury bondholders

[12]These returns are consistent with Vanguard ETF and mutual fund returns. Consider the annual returns of the following four funds for 2021, 2022, and the first three quarters of 2023:

have lost 25% of their initial investment. A US government creditor who held a representative value-weighted portfolio of the US Treasury securities earned a -1.4% and -9.3% return on their holdings during 2021 and 2022, respectively. Figure 2 indicates that these COVID-era losses are comparable to the losses Treasury creditors incurred after World Wars I and II.

To portray differences between our mark-to-market accounting and the Treasury's accounting note that in 2022 the US Treasury reported spending $774,679 million in gross interest payments on Treasury Debt Securities. Dividing this number by the gross par value of US Treasury debt at the end of June 2022 to compute a "rate of return" yields:

$$100 \times \frac{\$774,679}{\$30,568,581} = 2.53\%.$$

Official accounting measures of debt and interest payments neglect capital gains and losses, a consequential omission today.

4.2.1 Losses by Foreigners

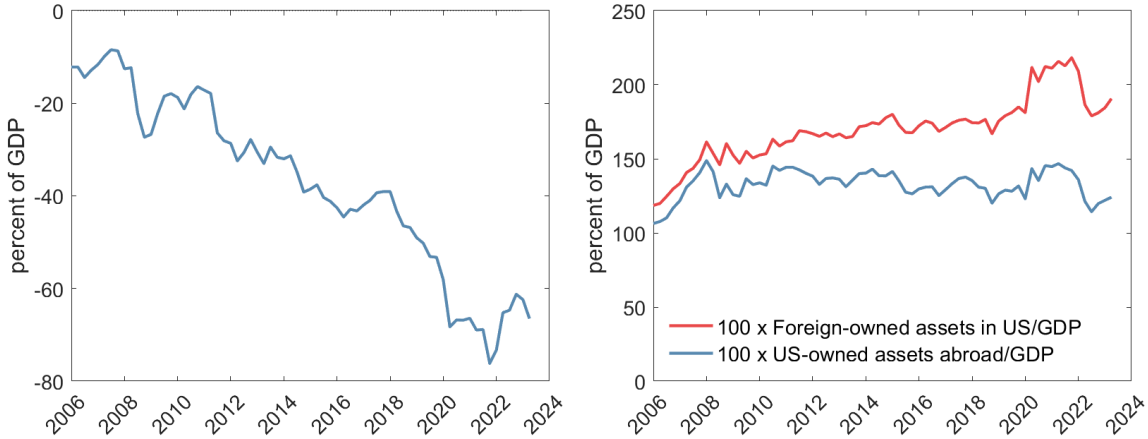
Capital losses imposed on foreigners helped improve the US net international investment position (NIIP) in 2022. Panel 8a shows that, despite running a current account deficit of 3.7% of GDP during 2022, as percents of GDP, the US NIIP rose from -77.7 at the end of 2021 to -63.3 at the end of 2022. Panel 8b shows that this improvement came from a fall in the value of US liabilities that was larger than a fall in the value of US assets.

Table 3 provides details by reporting components of the change in US liabilities. In 2022 US liabilities excluding financial derivatives fell $5,898.8 billion. Because the value of foreign-owned US assets fell by $7,622.3 billion, this drop occurred despite foreigners having purchased $1,515 billion of US assets. The drop in values of long-term debt securities accounted for $1,838.5 or 24% of the total change. Foreigners sold $37.4 billion in US Treasury bills and purchased $413.4 billion in US Treasury bonds and notes despite having incurred $844 billion in losses on these long-term securities. Those capital losses represent 11.5% of the $7,318.7 billion in par value of Treasury securities held by foreigners in December 2022.

4.2.2 Depository Institutions Losses

Table 2 indicates that in December 2022 commercial banks and other depository institutions held $1.7 trillion in Treasury securities (about 5% of the gross outstanding stock). Figure 9 plots total

	2021	2022	2023 (ytd through 9/23)
Ultra-Short Term Treasury (VUSB)	-0.43%	0.12%	3.27%
Mid-Term Treasury (VGIT)	-2.57	-10.67	-0.58
Long-Term Treasury (VGLT)	-5.03	-29.44	-8.06
Inflation Protected Securities (VIPSX)	5.56	-11.95	-0.91



(a) NIIP (b) Assets and Liabilities

Figure 8: US Net International Investment Position and Assets and Liabilities, Percent of GDP

Source: BEA, US International Investment Position

		Attributable to			
	Total Change for 2022	Financial Transactions	Price Changes	Ex-rate Changes	Other
US Liabilities	-$5898.8	$1,515.8	-$7,622.3	-$105.9	$313.6
Short-term debt securities					
Treasury bills and certificates	-37.4	-37.4	0	0	0
Other short-term securities	94.6	96.5	0	-1	-0.9
Long-term debt securities					
Treasury bonds and notes	-395.7	413.4	-844.0	0	34.9
Other long-term securities	-577.2	445.8	-994.5	-55.3	26.8

Table 3: Change in US Liabilities and Select Components for 2022 (in billions of dollars)

Source: BEA, US International Investment Position, 4th Quarter and Year 2022, Table 2

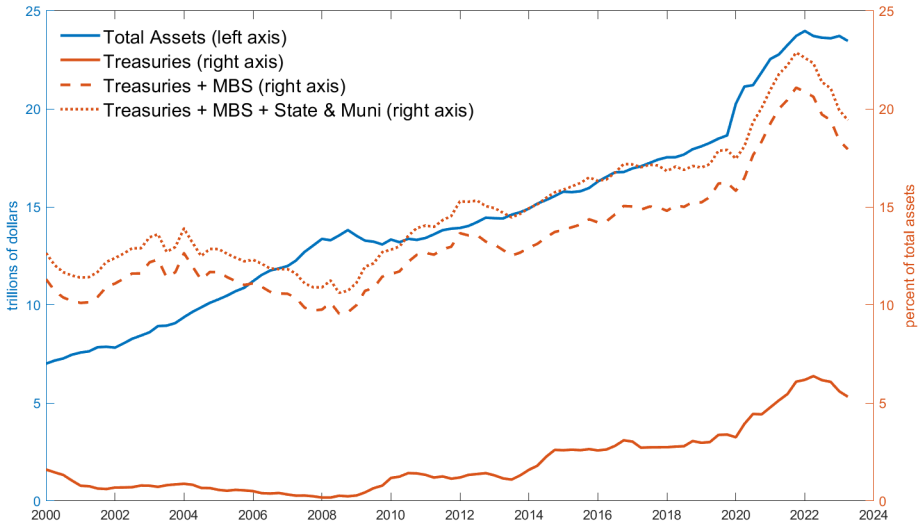


Figure 9: Total Bank Assets (left axis) and Bank Holdings of Treasuries, Mortgage Backed Securities, and State and Municipal Bonds as Percents of Total Assets (right axis)

Source: FDIC, Assets and Liabilities of FDIC-Insured Commercial Banks and Savings Institutions.

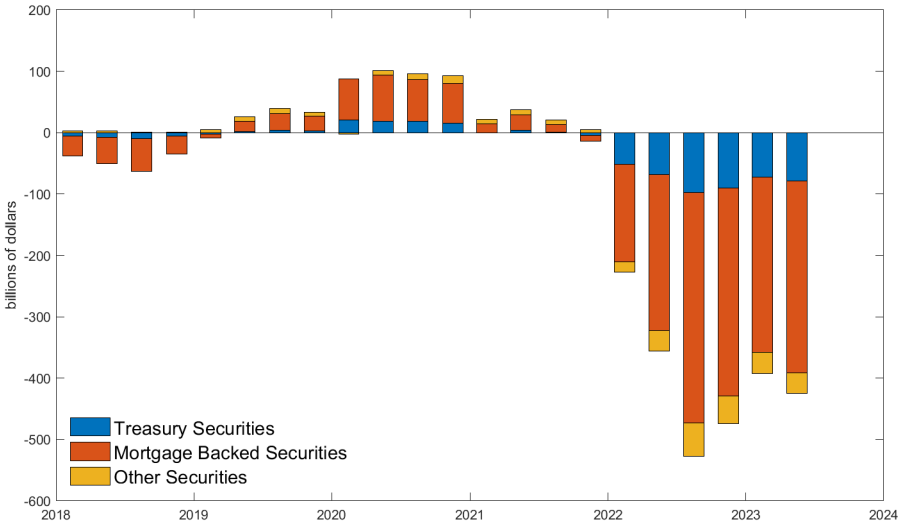


Figure 10: Unrealized Gains and Losses at Commercial Banks and Other Depository Institutions

Source: FFIEC, Call Reports, Schedule RC-B.

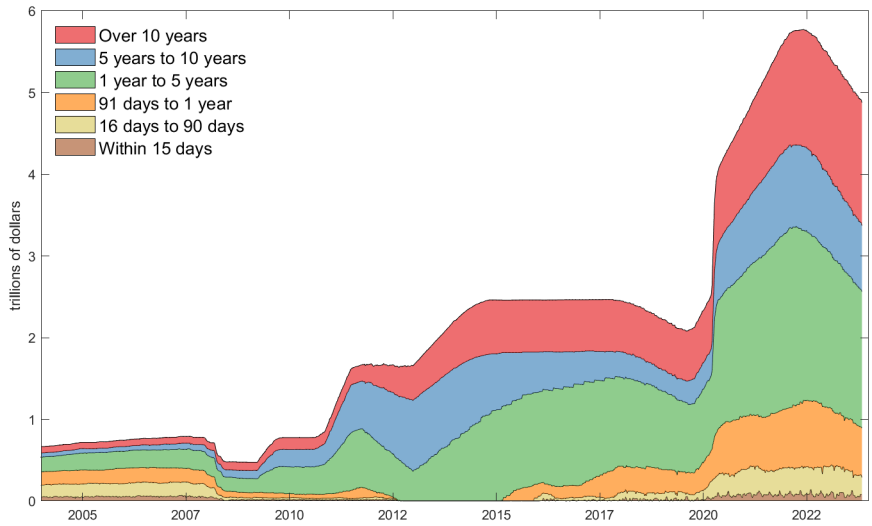


Figure 11: Maturity Structure of the Federal Reserve's Holdings of Treasury Securities

bank assets (left axis) and bank holdings of Treasuries, mortgage-backed securities, and state and municipal bonds as shares of total bank assets (right axis). In mid-2020, the US Treasury began distributing payments to many individuals and businesses as instructed by the CARES Act. That coincided with a noticeable 2020 surge in total assets at commercial banks and saving institutions as many individuals and businesses deposited their CARES Act benefits into bank accounts. Banks increased their holdings of Treasuries and mortgage-backed securities as shares of their total assets.

Those mortgage-backed and Treasury securities lost value in 2022 and 2023. In figure 10, we plot unrealized gains and losses recorded by bank call reports. For the second quarter of 2023, unrealized losses on bank balance sheets totaled $424 billion. Of these losses:

- $79 billion were on US Treasuries,
- $312 billion were on residential and commercial mortgage back securities, and
- $33 billion were on government agency debt, asset-backed securities, and state and municipal securities.

Jiang et al. (2023a) detected only limited banks' purchases of hedges that would have offset these losses. Jiang et al. (2023b) find that the market value of the US banking system is $2 trillion lower than recorded by book values and that almost 190 US banks would become insolvent if half of their uninsured depositors were to withdraw their deposits. This situation sets the stage for our next subsection.

4.3 Losses to the Federal Reserve

Table 2 indicated that the Federal Reserve held $5.4 trillion in Treasury securities as well as its $2.6 trillion of mortgage-backed securities in December 2022. Since then Fed has reduced its holding of Treasuries to $4.8 trillion, and its holdings of MBSs to $2.5 trillion as it gradually shrinks the size of its balance sheet. Figure 11 plots the maturity structure of the Federal Reserve's holdings of Treasury securities and thereby elaborates information presented earlier in the green-shaded area in panel 4a. Evidently, the Federal Reserve's portfolio of Treasury securities has tilted toward longer-term issues, notes, and bonds. Treasury bills comprise a relatively small share.

The Federal Reserve's holdings of Treasury securities in December 2021 and 2022 and September 2023 (in billions of dollars) were

	Dec 2021	Dec 2022	Sept 2023
Bills	$326.0	$291.2	$244.1
Notes and Bonds	4,846.5	4,702.4	4,220.1
TIPS	383.2	377.4	365.4
Floating-Rate Notes	24.3	27.2	17.7
Total	$5,580.1	$5,398.1	$4,847.4

Goodfriend (2014) asserted that the Federal Reserve runs a "bond market carry trade" strategy by investing the proceeds of overnight borrowing to finance purchases of long-duration Treasury securities. Unlike some cautious private hedge funds, the Fed has not hedged any of the interest rate or duration risk. So long as the interest rate on overnight loans remains below the coupon rates on its long-term bonds, this approach makes money. But figure 6 shows that by raising the overnight interest rate over this past year, the Fed has raised its own cost of funds. Starting in early September 2022, the Goodfriend's "Fed hedge fund" began operating at a loss as its borrowing costs have exceeded earnings from its portfolio of Treasury and mortgage-backed securities.[13] The Fed's earning remittances to the Treasury have turned negative.[14]

The liability side of the Fed balance sheet records earning remittances due to the US Treasury. When the Fed operates at a loss, the Treasury does not transfer income to the Fed; instead, the Fed accounts for the stock of these losses as a deferred asset; it is an accounting measure that the Fed anticipates paying off when its "hedge fund" is again profitable. As of October 4, 2023, this deferred asset stood at -$107.3 billion.[15]

[13] Levin et al. (2022) discuss impacts of higher interest rates on the Fed's expanded balance sheet.

[14] The Federal Reserve earns income primarily from interest earned on the securities it holds and from its provision of services to banks and government agencies. The Fed's expenses consist mainly of interest payments to banks, operating expenses, and miscellaneous other items. Its earnings net of expenses are distributed in one of three ways: 1) remittances to the Treasury; 2) as dividends to member banks; 3) as earnings retained in the Reserve Bank's surplus account; or else are 4) recorded in other comprehensive loss (in accordance with standard accounting procedures).

[15] As we can see in figure 4, the Fed's balance sheet is a little less than $8 trillion currently.

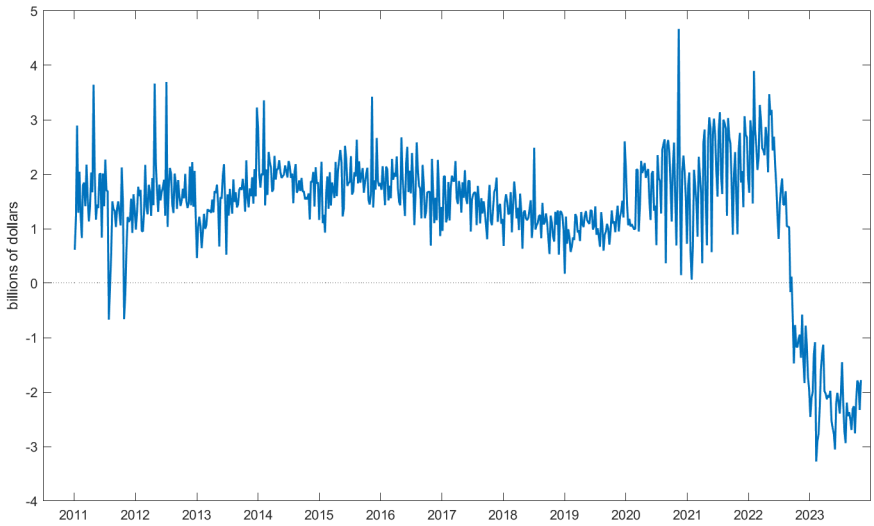


Figure 12: Federal Reserve Earnings Remittances Due to the US Treasury

After September 14, 2022, rather than reporting the accumulated stock of losses as a deferred asset, we plot the first difference of the series.

Figure 12 plots the Fed's earnings remitted to the Treasury. Strangely, the Fed's balance sheet records its remittance to the Treasury as a *flow* when it is positive but as a *stock* when it is negative. To adjust for that peculiarity, we take first-differences of the Fed series starting September 14, 2022. Since then, the Fed has lost between \$1 and \$3 billion each week, and losses are growing. They are not counted as federal expenditures and are not recorded in the federal budget deficit.

Along with private banks, the Federal Reserve has substantial unrealized losses on its balance sheet. Table 5 of SOMA (2023) records that in 2022 the Fed incurred \$1,080.4 billion in unrealized losses. By the end of 2022, the Fed's portfolio of Treasury securities had \$672.8 billion in unrealized losses. The Fed has another \$407.7 billion in unrealized losses on its MBS holdings, nearly all of which have maturities longer than ten years.[16] The market value of the Fed's Treasury portfolio fell between 12.0 and 12.5% in 2022.

In spring of 2022, three midsize US banks failed, Silicon Valley Bank, Signature Bank, and First Republic.[17] When they understood that the large unrealized losses on these banks' assets were worth less than their liabilities, depositors exercised their options to withdraw funds. The

[16]These unrealized losses have no effect on the Fed's recorded income or remittances to the Treasury unless it sells the securities and the losses are realized.

[17]A fourth bank, Silvergate Capital Corp, volunteered to self-liquidate but will likely liquidate with positive equity.

Federal Deposit Insurance Corporation (FDIC) took over the three banks and almost immediately agreed to insure all depositors, including those over the prior limit of $250,000.

To head off more bank runs, the Federal Home Loan Banks (FHLB) began accepting mortgages as collateral for high-interest loans to commercial banks, thus joining the Fed as lender of last resort. In addition, the Federal Reserve started a Bank Term Funding Program (BTFP) through which it makes loans up to one year maturity to banks and other depository institutions in exchange for collateral in US Treasuries, US agency securities, and US agency mortgage-backed securities that it does not mark to market. In a significant break from longstanding discount window policy that had adhered to a "Bagehot rule" that "seeks to value securities collateral at a fair market value estimate," the Fed will now value the collateralized assets at par under the BTFP.

Banks quickly signed up for this new Fed lending facility: figure 4a indicates that the Federal Reserve's balance sheet increased in size by nearly $400 billion in two weeks. This increase was driven by an increase of $300 billion in private securities discounted by the Fed and by an increase of $60 billion in Treasury securities held by the Fed under repurchase agreements. The Fed used increases in bank reserves and reverse repurchase agreements to acquire these additional assets.

By valuing collateral at par, the Fed has created an asymmetric payoff that encourages banks to employ a "Hail Mary" strategy analyzed by Silber (2021): the Fed provides troubled banks an incentive to gamble for resurrection by buying high-coupon long-duration Treasury bonds whose values swing dramatically with changes in interest rates. If long-term rates fall, the banks will earn capital gains; but if interest rates continue to rise, these bonds will incur capital losses that the banks will pass off to the Fed and the FDIC.

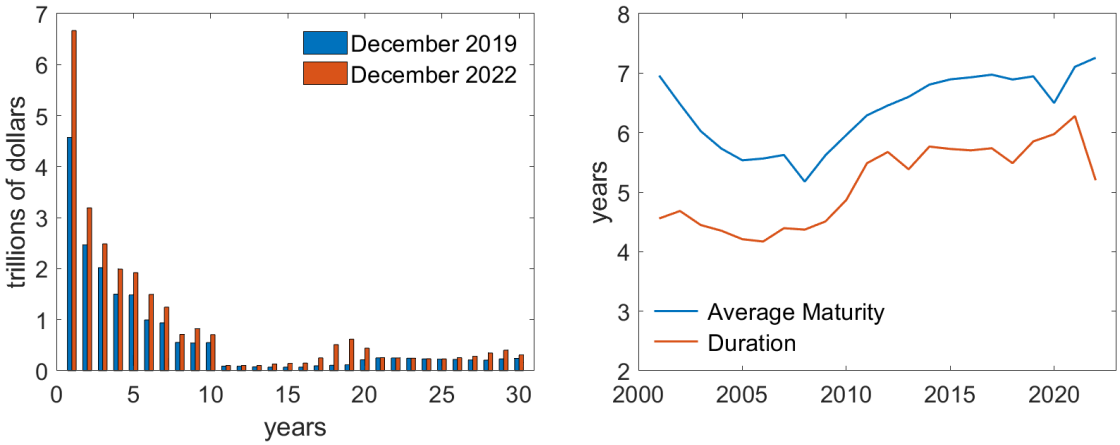
4.4 Sensitivity of Bond Values to Interest Rate and Inflation Risks

Prices of long-term bonds are more sensitive to interest rate changes than are prices of short-term bonds. Let's look at the maturity structure of the Treasury's portfolio of outstanding securities. Figure 13a reports dollars (both coupon and principal payments) that the Treasury has promised to pay its creditors each year for the subsequent 30 years as of December 2019 and December 2022.[18] At almost all maturities, the number of dollars promised by the Treasury increased over the COVID period.

To measure the sensitivity of the market value of Treasury debt to changes in interest rates, we construct two statistics that summarize the debt service profile. Figure 13b plots the modified Macaulay's duration, denoted by D^*, and the average maturity of the Treasury's promised cash-flows (both coupon and principal payments) on December 31 of each year.[19] For the most recent

[18] In figures 13a and 13b we use marketable debt held by the public, which includes debt held by both private investors and the Federal Reserve. Thus we exclude nonmarketable debt, such as savings bonds, and debt held by government agencies and trust funds.

[19] We treat principal and coupon payments symmetrically. The US Treasury typically reports the average maturity



(a) Debt Service Profile: 2019 and 2022

(b) Average Maturity and Duration

Figure 13: Debt Service Profile, Average Maturity, and Duration of Marketable Treasury Debt held by the Public.

Debt Held by the Public includes debt held by private investors and by the Federal Reserve. Duration is the modified Macaulay duration. Both series are measured annually at the end of the year.

three years, the values of these two series along with implied yields to maturity were:

	December 31 of		
	2020	2021	2022
average maturity (in years)	6.499	7.105	7.258
modified duration (in years)	5.974	6.278	5.200
yield to maturity (percent)	0.827	1.281	3.675

Although the average maturity of the debt rose in 2022, durations fell as yields increased; in general, the duration of a promised cash flow and the sensitivity of its price to interest rate risk are lower when yields across maturities are higher.

To measure the impact on the market value of Treasury debt from a one basis point (or 0.01 percentage point) parallel shift in Treasury yields across all maturities, we use a textbook formula that relates changes in the yield to maturity (Δy) to change in bond prices:

$$\frac{\Delta P}{P} = -D^* \times \Delta y. \tag{3}$$

At the end of 2021, a one basis point increase in the yield would have led to a 0.062% decrease in the market value of the debt. Using formula (3) provides back-of-the-envelope estimates for

of just its promised principal payments; see for example, Table FD-5 of the *Treasury Bulletin*. Hence, our measure of average maturity is longer than the Treasury's measure.

the decrease in the market value of the Treasury's portfolio of marketable securities of -2.7% and -15.0% in 2021 and 2022 respectively.[20]

The Federal Reserve's holdings of Treasuries are tilted toward the longer end of the maturity spectrum. In December 2022, $17.8 trillion in marketable notes and bonds were outstanding. The Fed owned $4.7 trillion or 26.5% of these. Through its purchases of long-term Treasuries and mortgage backed securities, the Federal Reserve has transferred duration risk from private investors to itself, an important aspect of the Fed's quantitative easing program.

Table 1 indicates that in 2022 the reduction in the debt/GDP ratio due to inflation more than offset increased borrowing necessitated by the primary deficit.[21] An opportunistic government gains from using surprise inflation to reduce its debt/GDP ratio rise with the duration and size of its debt. Private investors have incentives to understand that. Missale and Blanchard (1994) describe how investors who fear confiscatory surprise inflations can respond to prevent governments from issuing long duration debt. Nevertheless, panel 13b shows that although the duration of the US Treasury portfolio has declined recently, it remains high relative to what it was before 2010.

5 Taxes, Spending, and Debt

We compare paths of spending, taxes and debt during and after the US War on COVID to paths during and after other major US wars. We detect patterns that endure from the early 1800s to the 1980s:

- During times of peace, the US federal government covered its ordinary expenditures with taxes.
- During four large wars – the War of 1812, the Civil War, World War I, and World War II – the US mostly just issued debt.
- During each of these four big wars, taxes increased but much less than spending.
- Although both expenditures and taxes fell after each of these big four wars, taxes stayed high enough to sustain post-war primary surpluses.
- After all four of these big wars, as fractions of GDP expenditures failed to return to their pre-war levels. Instead, the federal government grew during each of these four wars and

[20] In section 4.2, we reported losses for the aggregate Treasury portfolio of -1.3% and -9.3% in 2021 and 2022 respectively.

[21] Hall and Sargent (2022) estimate that inflation accounted for 71% of the post-World War II reduction in the debt/GDP ratio; but, in 1945 a much larger share of the debt held by private investors consisted of longer-term Treasury notes and bonds than is the case today.

stayed higher permanently. Thus, over the last 230 years, wartime federal expenditures always had both temporary and permanent components. And so did taxes

Some, but not all, of these patterns prevailed during the War on COVID.

- The federal government paid for the large unexpected surge in expenditures in 2020 and 2021 mostly by borrowing. But unlike those earlier big wars, at least so far taxes have not been increased enough to sustain a post-war primary surplus.
- Consistent with historical patterns, the CBO (2023c) projects expenditures as a share of GDP will be permanently higher from 2023 to 2033 than they were prior to the pandemic. Inconsistent with historical patterns, tax revenues as a share of GDP are not projected to increase relative to pre-pandemic levels.
- In early June 2023, President Biden signed into law the Fiscal Responsibility Act of 2023. The law suspended the debt ceiling until January 1, 2025. Despite the reductions in proposed spending contained in the law, for the next ten years, the federal government will run primary *deficits* – not *surpluses*.
- In sharp contrast to US history, CBO (2023c) projects that the par value of federal debt as a share of GDP will increase – not decrease – over the next ten years.

5.1 Permanent Component of Expenditure Increases

In figure 14, we plot US federal government receipts and expenditures from 1790 to 2033. During the War of 1812, the Civil War, World War I, and World War II government spending rose while taxes increased much less. Hence, these wars were largely financed by issuing debt and printing money. As Hall and Sargent (2022) documented, taxes only accounted for 20.8% and 30.2% of the revenue that the US raised to fight World War I and World II, respectively.

After each of the four big wars, government spending fell while tax revenues remained elevated, so the government ran a primary surplus for many years. These primary surpluses were used to service debt incurred during the war. These patterns are broadly consistent with the optimal response from a Barro (1979) tax-smoothing model to a *temporary* government spending shock.

Those wartime spending shocks were not just temporary. Large US wars have been followed by enduring changes in the size and composition of government spending and taxation. As can be seen clearly in figure 14, the War of 1812, the Civil War, World War I, and World War II were followed by permanent rises in federal expenditures as fractions of GDP. More generally, Edwards (2014) examined 11 US wars and estimated that for every $1 increase in wartime spending, the US federal government spent another $0.50 (in present value) over the following 80 years on transfer payments and in-kind benefits provided to veterans and their spouses and other survivors.[22]

[22] Rothbard (2017, chs. 12-13) described forces that contributed to outcomes during and after World War I.

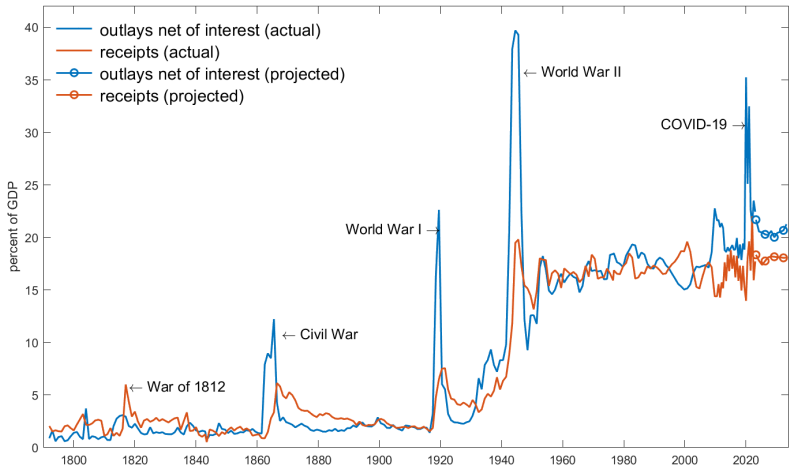


Figure 14: US Federal Government Expenditures and Receipts: 1790 to 2023.

Outlays are net of official interest payments. 1790-2010 annual by fiscal year; 2011-2022 monthly data aggregated to 6-month periods. Outlays and Receipts from 2023-2033 are computed using CBO (2023c) projections.

Table 4 reports average spending and revenue as shares of GDP for the pre-war, war, and post-war periods for four large US wars. The table confirms impressions gleaned from figure 14. After each major war, government spending as a share of GDP (G/Y) increased relative to pre-war values. This pattern will likely continue post-COVID.

Federal financing of the War on COVID shares some, but not all, patterns detected across previous wartime expenditure surges. In the War on COVID, taxes have accounted for only 4.0% of the total revenue raised, a far smaller share than was raised in prior wars. To think about prospects after the War on COVID, we rely on the analysis of the Congressional Budget Office (CBO) and the Office of Management and Budget (OMB) to project paths of taxes, expenditures, and debt.

On February 15, 2023, the CBO released its *Budget and Economic Outlook: 2023 to 2033*. Assuming as it must that current laws governing taxes and spending do not change, the CBO projects that for the next ten years, federal government expenditures (net of interest payments) will average more than 20.6% of GDP, up from 19.2% of GDP prior to COVID.[23] Likewise, the CBO projects that revenue as a percent of GDP will increase relative to its pre-war level. However, in contrast to previous wars, the CBO projects that revenues will be lower than expenditures. So the CBO projects that the federal government will run primary deficits.

[23]These percentages incorporate the adjustments the CBO made to its projections in June after the signing of the Fiscal Responsibility Act of 2023.

War Start - End (US entry -)	Fiscal Years†	G/Y			T/Y		
		prewar	war	postwar	prewar	war	postwar
War of 1812							
1812:6 - 1815:2	1812-1815	0.88	2.72	1.82	1.95	1.37	3.14
Civil War (Union)							
1861:4 - 1865:4	1861-1865	1.58	7.79	2.50	1.42	1.87	4.72
World War I							
1914:7 - 1918:11	1915-1919	1.88	9.10	3.17	1.94	3.30	5.03
(1917:4 -)	1917-1919	1.76	14.07	3.17	1.80	4.39	5.03
World War II							
1939:9 - 1945:8	1940-1946	8.21	25.43	14.00	5.52	12.89	15.86
(1941:12 -)	1942-1946	8.31	31.97	14.00	6.15	15.43	15.86
COVID-19							
2020:1 - 2021:12	2020-2021	19.18	29.02	20.60	17.12	17.05	18.14

Table 4: Average government spending net of interest payments and tax receipts as a percent of GDP for the five years prior to each war, for the war period, and for the ten years following the war.

The postwar numbers for COVID-19 are computed using CBO (2023a) and CBO (2023b)projections.

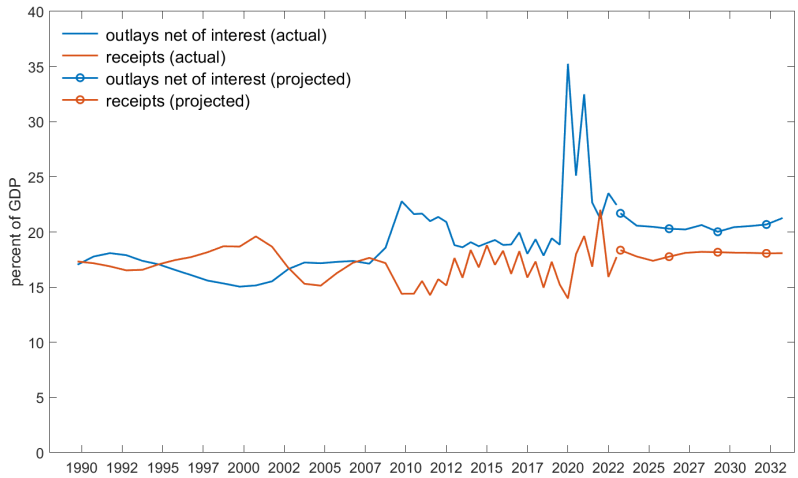


Figure 15: US Federal Government Expenditures and Receipts: 1989 to 2033.

Outlays are net of official interest payments. 1989-2010 annual by fiscal year; 2011-2023 monthly data aggregated to 6-month periods. Outlays and Receipts for 2024-2033 are from Table 1-1 of CBO (2023c) and Table 1 of CBO (2023b). GDP for 2023-2033 is from CBO (2023a).

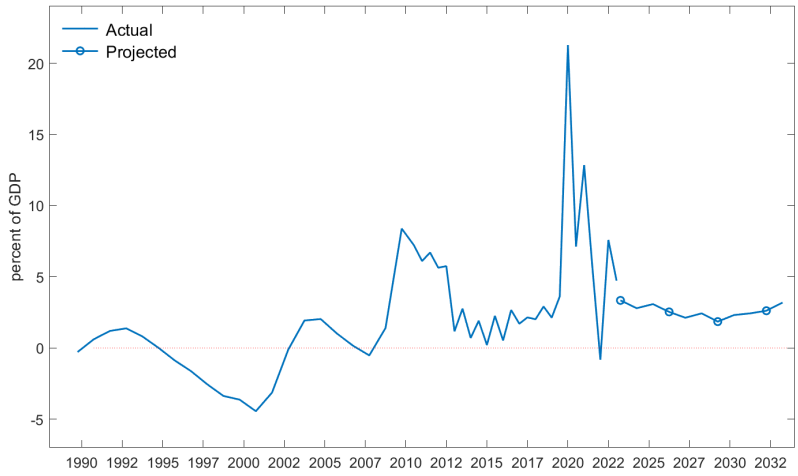


Figure 16: US Federal Government Primary Deficits: 1989-2033

1989-2010 annual by fiscal year; 2011-2023 monthly data aggregated to 6-month periods; 2023-2033 are computed using CBO (2023c) projections and Table 1 of CBO (2023b). GDP for 2024-2033 is from CBO (2023a).

5.2 Debt/GDP's Destiny

Prospective primary deficits are likely to cause the par value of US Treasury debt to increase over the next ten years. Some analysts forecast that the debt/GDP ratio will increase. The CBO's Table 1-3 of CBO (2023a) projects alternative measures of the debt/GDP ratio. Ominously, the CBO reports

> Debt held by the Public is projected to rise in relation to the size of the economy each year, reaching 118 percent of GDP by 2033 – which would be the highest level ever recorded. The Debt/GDP will grow beyond 2033 unless Federal laws governing taxes and expenditure are changed.

Let's assess this claim.

Debt held by the Public includes that held by the Federal Reserve. To align the CBO's projections with our analysis, we measure debt as *Debt held by the Public - Federal Reserve's Holdings of Debt Held by the Public*. The CBO's measure is very close to our measure of *Debt held by Private Investors*.[24] The dashed line in figure 17 projects a path of the market value of privately held debt as a percent of GDP that we constructed from projections of total outlays, revenue, net

[24]Since the CBO's measure of *Federal Financial Assets* is much broader than our measure of *Net Treasury Balances*, we do not net out either series from either measure of debt. Unlike our analysis earlier in this paper, we do not net out any asset holdings by the Federal Reserve or other assets held by the Treasury.

	100 × Debt/GDP			Contributions					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	2023:9	2033:9	change	nominal payouts $r_t \frac{B_{t-1}}{Y_{t-1}}$	real GDP growth $g_t \frac{B_{t-1}}{Y_{t-1}}$	inflation $\pi_t \frac{B_{t-1}}{Y_{t-1}}$	primary deficit $\frac{G_t - T_t}{Y_t}$	money growth $\frac{M_t - M_{t-1}}{Y_t}$	Other
COVID-19	75.3	93.5	18.2	30.9	-16.4	-17.1	25.3	-6.5	2.0

Table 5: Decomposition of Changes in Debt/GDP Ratio From CBO Projections

Other includes other means and the cross term.

interest payments, and Federal Reserve holdings of debt and forecasts of real and nominal GDP provided in the CBO's data supplements.

Table 5 decomposes these projections using equation (2).[25] The table asserts that the ratio of privately held debt to GDP will rise 18.2 percentage points from 75.3 in August 2023 to 93.5 in September 2033. Because primary deficits and payouts to Treasury creditors drive these projections, CBO forecasts for the nominal returns on US Treasury debt, real GDP growth, and inflation (as measured by the GDP deflator) affect them. The CBO forecasts that from 2023 to 2033, these series will grow on average at the annual rates below:

	average growth rate 2023-2033
nominal returns	3.6%
real GDP growth	1.8%
inflation (GDP deflator)	2.3%

Congress has constrained the CBO to measure US Treasury debt and interest payments by the accounting measure used by the US Treasury. Hence implicit in these forecasts are assumptions that the market value of the debt always equals its par value and that US creditors incur neither capital losses or nor capital gains on coupon-bearing debt. Those faulty conventions for accounting for interest costs induce errors in the CBO's Debt/GDP projections.

If one temporarily overlooks that misleading accounting convention and accepts the CBO's financing cost along with the CBO's projections for spending and tax revenues, we infer the following paths for the next ten years:

1. government spending, net of interest payments, will average 20.9% of GDP,
2. tax revenue will average 18.0% of GDP, and
3. nominal returns to bondholders will average 3.6% and inflation will average 2.3% implying a real return of 1.3% per year.

[25] We measure money growth by the change in the Federal Reserve's Holdings of Debt Held by the Public.

Accepting these projections at face value, Arslanalp and Eichengreen (2023) argue that there is little political or economic scope to change any of these three fiscal projections or the forecast of GDP and thus conclude that "high public debts are here to stay."[26]

But as mentioned above, we prefer not to constrain ourselves to use the CBO's faulty interest cost conventions and instead use the conventions to which macroeconomic and public finance theory direct us to use.[27] Thus, we find it enlightening to study the consequences of adjusting the CBO's calculations by correcting the misleading interest cost calculation that Congress imposes on the CBO. We do this to facilitate comparisons with previous post-war US fiscal adjustments, for example, with table 27.2 of Hall and Sargent (2021) where we calculated that high inflation and low nominal returns to bondholders accounted for roughly 45% of the post-World War II debt paydown.

An assumption underlying the CBO's projections is that the Treasury will be able to issue increasingly large quantities of new Treasury debt while interest rates and inflation decline over the next ten years. If demand for Treasury debt becomes more price-elastic or if market forces or Congressional legislation eventually impose an upper bound on Treasury debt, something has to give: some components of the CBO's input paths must change. To proceed, we study how the CBO's projections would change under two sets of assumptions:

1. We retain the CBO's projections for inflation and real GDP growth but assume that bondholders will earn either low nominal returns of 2.25% each year or, in an alternative scenario, returns of 4.75% each year. The 2.25% nominal return matches nominal returns bondholders earned during the ten years immediately after World War II. The 4.75% nominal return matches the current yield on ten-year Treasury notes. We'll continue to project that inflation will average 2.3% so that under the 2.25% nominal return assumption, bondholders will earn negative real returns.

   Figure 17 presents our first set of reconstructed projections. Under the CBO's assumptions (dashed line), the debt/GDP ratio will climb to 94% by 2033. Under the high return assumption (dotted line), the debt/GDP ratio will rise to over 102% by 2023. Under the low return assumption (dotted line), the debt/GDP ratio stabilizes at just above 80.

2. We repeat the exercise assuming that inflation is 1% higher each year than the CBO's projects. We present the second set of projections in figure 18. Under the CBO's returns

[26] They question whether sufficient political support could be assembled to put in place financial repressions that would extract more seigniorage from government creditors. They also say, as pointed out by Missale and Blanchard (1994), that a low average maturity of federal debt in the hands of the public reduces government revenues yielded by a given unexpected inflation. Also see Aizenman and Marion (2011) and Hilscher et al. (2022). But Missale and Blanchard's force operates in both directions: Since the maturity structure is much shorter today than it was in 1946 (see figure 10 of Hall and Sargent (2022)), if the federal government must resort to inflating away part of the debt, the necessary inflation rate is much higher than it was in the late 1940s.

[27] Hall and Sargent (2011) describe accounting conventions from macroeconomic theory that we recommend and implement.

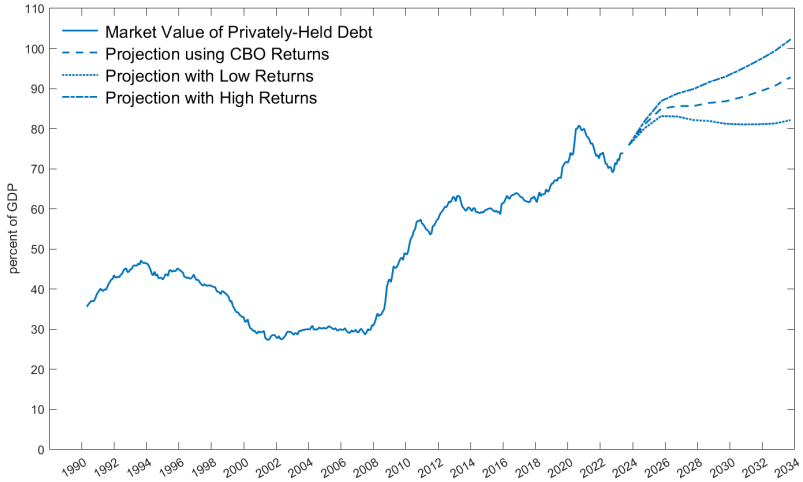


Figure 17: Market Value of Privately-Held Debt, Actual and Projected, as Percents of GDP.

Actual data are monthly through August 2023. The three projections are annual by fiscal year based on the projections and forecasts underlying CBO (2023c) and CBO (2023b).
Dashed line: Nominal return on the debt is the CBO's projection.
Dotted line: Nominal return on debt is assumed to be 2.25% per year.
Dash-dotted line: Nominal return on debt is assumed to be 4.75% per year.

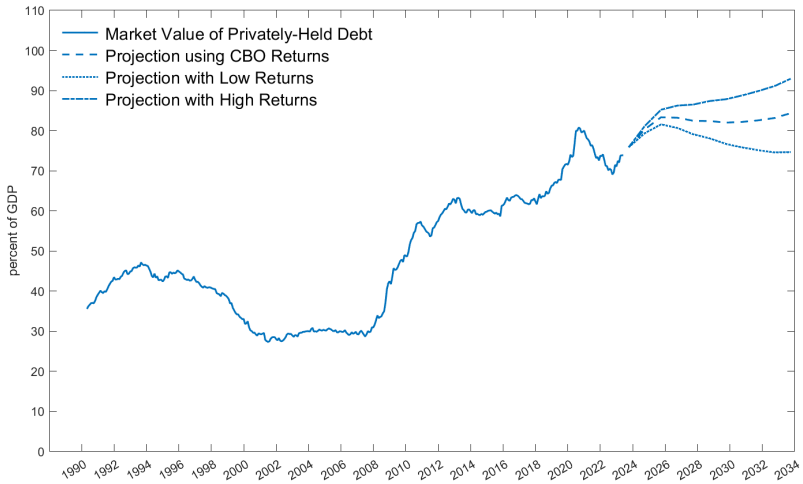


Figure 18: Market Value of Privately-Held Debt, Actual and Projected, as Percents of GDP Assuming Higher than Projected Inflation.

Actual data are monthly through August 2023. The three projections are annual by fiscal year based on the projections and forecasts underlying CBO (2023c) and CBO (2023b). All three projections assume inflation will be 1% higher each year than projected by the CBO.
Dashed line: Nominal return on the debt is the CBO's projection.
Dotted line: Nominal return on debt is assumed to be 2.25% per year.
Dash-dotted line: Nominal return on debt is assumed to be 4.75% per year.

(dashed line), the debt/GDP ratio climbs to only 85% by 2033. Under the high return assumption (dotted line), the debt/GDP ratio will rise to 93% by 2023; under the low return assumption (dotted line), the debt/GDP ratio will increase initially but then decline to 74%.

These back-of-the-envelope calculations illustrate a range of possibilities that flow from alternative plausible assumptions about the real returns that market outcomes will require the US Federal government to pay its bondholders. When we say "plausible," we mean consistent with some episodes in US history, e.g., those from which we extracted the 2.25% and 4.75% scenarios.

But maybe looking to historical US data in such alternative scenarios is misguided because "this time is different" and we are in uncharted waters. Since US bondholders and others now confront a situation in which the status quo for tax and expenditure sequences are widely (but not universally) regarded as unsustainable politically, we can't take for granted that patterns from the past won't be disrupted. Forecasting prospective US government debt/GDP is bound to provoke substantial disagreements among well-informed observers, inducing some to practice back-of-the-envelope political economy theorizing. Thus, Acalin and Ball (2023) argue that the post-World War II period is not a good guide to the current situation since, going forward, it is unlikely that the debt/GDP ratio will fall for the same reasons it did after 1946. The Economist (2023) concurs, stating:

> Yet inflation only reduces debt when it is unexpected. If bondholders anticipate fast-rising prices, they will demand higher returns, pushing up the government's interest bill. Persistent inflation helped after the second world war only because policymakers held down nominal bond yields in a policy known as financial repression. Until 1951 the Federal Reserve capped long-term rates by creating money to buy bonds. Later a ban on paying interest on bank deposits would redirect savings to the bond market.

6 Hearing Bond Markets

Various commentators have used rational expectations reasoning to infer from term structures of yields on US government bonds that the market anticipates that US monetary-fiscal authorities will soon bring inflation back to its target range of 2%. For example, on October 11, 2023, the 5-year breakeven inflation rate imputed from TIPS and nominal bond prices was just 2.20%. Inferences like these rely heavily on the rational expectations hypothesis that policymakers and market participants share a common statistical model that restricts the joint probability distribution of sequences of inflation, nominal bond yields, and other macroeconomic outcomes and inputs. While such rational expectations logic prevails throughout large segments of macro-finance, it is timely to remind ourselves that, for good reasons, two accomplished architects of rational expectations models (Goodfriend and King (2005)) chose *not* to interpret the Volcker disinflation with

a rational expectations model. Their thorough readings of FOMC transcripts and other sources left Goodfriend and King (2005) without a coherent description of an FOMC decision rule or evidence that the Fed thought systematically about designing one. They described disagreements and confusions about macroeconomic structures among FOMC members. They documented FOMC concerns that the market's expectations about inflation and other outcomes differed systematically and persistently from FOMC targets.[28] Disconnection of the market's forecasts from those of policy makers is impossible in a rational expectations equilibrium. These considerations led Goodfriend and King to abandon a rational expectations equilibrium concept in creating their model of a central banker striving to "acquire credibility." This is how Goodfriend and King (2005, p. 34) summarized their paper:

> In contrast [to what goes on in a rational expectations model], during the Volcker disinflation the Fed needed to acquire credibility for low and stable inflation. We studied this episode without having a firm understanding of Fed behavior, so instead we adopted an analytical strategy that focused on the interplay between inflation, expected inflation, credibility and real activity without specifying the monetary policy rule. We sought to document how the Volcker FOMC tried to acquire credibility: with an initial appeal to monetary targets as a nominal anchor, with new operating procedures designed to allow greater scope for short-term interest rates to be determined by market forces, and ultimately by employing an interest rate and reserve aggregate policy mix to work the actual inflation rate down. Our methodology for studying the disinflation without a firm understanding of the Fed's behavioral rule places us in a position similar to the public and the FOMC itself. To improve our understanding of the Volcker disinflation, it will be necessary to specify Fed behavior explicitly and to model the interaction of Fed policy with the dynamics of private sector beliefs about inflation. Requiring these beliefs to be consistent with the financial market data will allow a clearer understanding of the role of imperfect credibility in the Volcker disinflation.

Goodfriend and King combined an artfully parameterized inflation "forecast credibility gap" with an expectational Phillips curve and a Fisher equation. By intentionally not providing "microfoundations" for their "forecast credibility gap" equation, they offered a plausible way of quantifying a credibility gap. They calibrated their model to do a good job of approximating inflation, unemployment, and long and short term interest rate paths under the Volcker-led FOMC and inferred private sector beliefs about prospects for inflation. They called for more research about

[28] Goodfriend and King spotted "inflation scares" in high long-term interest rates that had disappointed the FOMC's intention that by pushing short term nominal interest rates *up* it could *lower* long term nominal interest rates by permanently lowering inflation rates. See Goodfriend (1993) for a definition of an inflation scare and a technique for diagnosing one.

sources of that imperfect credibility that challenged Volcker's FOMC and how the FOMC coped with it.[29, 30]

Silber (2012, Part III) presented a comprehensive account of Volcker's struggle permanently to lower US inflation that aligns with Goodfriend and King's. Silber recently offered an ominous comparison of discrepancies between current bond traders' market-revealed inflation forecasts and those of monetary policy analysts like himself and the opposite sign of such discrepancies that Volcker confronted. Silber (2023/07/18) fears that a "credibility gap" of opposite sign now threatens the Fed.[31]

[29] By incorporating reputation sustainability, King and Lu (2022) designed a model to explain Volcker's struggle to bring down inflation without abandoning rational expectations. Sargent (2022) discussed a couple of other approaches to formulating "imperfect credibility."

[30] Much of Bernanke's (2022) discussion of "forward guidance" is about his struggle to understand episodes in which bond markets acted as if they did not believe the Fed's guidance.

[31] See Silber, William L., "Why Last Week's Higher Inflation Left Bond Yields Unchanged." Linkedin Post, July 18, 2021, available at `https://www.linkedin.com/in/william-silber-0a854b158/detail/recent-activity/shares`

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