Did the U.S. really grow its way out of its WWII debt?*

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Abstract

The fall in the U.S. public debt/GDP ratio from 106% in 1946 to 23% in 1974 is often attributed to high rates of economic growth. In this paper, we re-examine the roles played by primary surpluses and real interest rate distortions—through both pegged nominal interest rates before the Fed-Treasury Accord of 1951 and surprise inflation in the 1960s and 70s—in driving down the debt/GDP ratio. Under our baseline calibration, we estimate that the public debt/GDP ratio would only have declined from 106% to 73% over the same period if primary balances had always been equal to zero and there were no real interest rate distortions. Under the same assumptions, we find that the debt/GDP ratio would have persistently remained above its pre-war level and reached 91% in 2021. Put differently, the U.S. would not have grown its way out of its World War II debt without interest rate distortions and primary surpluses.

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1 Introduction

Does a high level of national debt impose a burden on future generations who must pay it off? In the last few years, economists such as Blanchard (2019) and Furman and Summers (2020) have suggested that the answer may be no, because $r < g$: the real interest rate on the debt is usually below the growth rate of the economy. In that case, the government can roll over the debt, accumulate interest without raising taxes, and the debt/GDP ratio will fall over time. Because of this possibility, a growing number of economists argue that, as Blanchard (2019) puts it, "public debt may have no fiscal cost." This idea has decreased concern about the high current level of U.S. debt.

Thinking on this issue has been influenced by a salient historical experience: the decline in the U.S. debt/GDP ratio after World War II. Paying for the war increased this ratio from 42% in 1941 to 106% in 1946, but then it started falling and reached a trough of 23% in 1974. As Elmendorf and Mankiw (1999) report, "an important factor behind the dramatic drop between 1945 and 1975 is that the growth rate of GDP exceeded the interest rate on government debt for most of that period." Krugman (2012) says that the "debt from World War II was never repaid and just became increasingly irrelevant as the U.S. economy grew." This interpretation of history lends credence to the idea that a high level of debt should not cause great concern.

Others, however, have pointed out reasons to question this interpretation. First, as discussed by authors including Hall and Sargent (2011), the U.S. actually paid off part of the World War II debt by running primary surpluses—by levying taxes in excess of current government spending—over much of the period when the debt/GDP ratio was falling. Second, as discussed by authors including Reinhart and Sbrancia (2015), interest rates were held down relative to economic growth through policies that are not likely to be feasible and/or desirable in the future. These policies included episodes of financial repression, most clearly the Fed's peg of interest rates at low levels from 1942 to 1951, which was aimed at decreasing the cost of the war. In addition, ex post real interest rates were reduced by unexpected increases in inflation in the aftermath of the war and later in the 1960s and 1970s. Because of these factors, the postwar experience does not necessarily suggest that the U.S. economy naturally grew its way out of debt.

This paper seeks to explain the path of the debt/GDP ratio since its 1946 peak of 106%. We estimate the effects on this path of the government's primary surpluses, the interest rate peg before 1951, and surprise inflation. We then derive a counterfactual path that the debt/GDP ratio would have followed in the absence of these factors. This counterfactual shows how much the ratio was reduced by growth rates in excess of undistorted real interest rates—rates that are not reduced by either a peg or surprise inflation.

We find that this counterfactual scenario differs greatly from actual history. Without primary surpluses and interest-rate distortions, the debt/GDP ratio falls only from 106% in 1946 to 73% in 1974, rather than to 23% as in reality. The natural erosion of debt from economic growth over the three decades after World War II was much smaller than is often suggested.

We also extend our counterfactual to the present, with even more negative findings about growing out of debt. The counterfactual debt/GDP ratio starts rising again in 1979, and in 2021 it is 91%, not much below its level in 1946. The rise in the path reflects the fact that since 1979 the growth rate has averaged less than the undistorted real interest rate. In our counterfactual, this pattern reverses most of the decrease in the debt/GDP ratio in the earlier postwar period.

Our methodology for estimating counterfactual debt paths builds on previous work but uses a richer set of information to make our quantitative results as accurate as possible. A key step is to measure the fractions of outstanding debt in a given year that were issued in each earlier year—the 'reverse maturity structure' of the debt—which we do using the granular data on Treasury securities produced by Hall, Payne, and Sargent (2018) before 1960 and by CRSP thereafter. We also construct a term structure of inflation expectations from surveys of short-term and long-term expectations, which allows us to estimate the effects of surprise inflation on the real returns on debt issued in different years. Finally, we estimate the effects of the pre-1952 interest rate peg by comparing the pegged interest rates on debt of various maturities to market rates during the post-peg period of 1952-1960. Our various calculations require some assumptions about unobserved variables, but our results are not greatly changed by varying these assumptions in reasonable ways.

The next section of this paper provides some historical background regarding the post-World-War-II period. We then present our methodology for constructing counterfactual paths of the debt/GDP ratio, describe our data sources, and present our results.

2 Factors Influencing the Debt/GDP Ratio

Figure 1 shows the path of the debt/GDP ratio in the United States from fiscal year 1941 through fiscal year 2021. We see that this ratio grew rapidly during World War II, rising from 42% in 1941 to 106% in 1946. It then fell steadily until it reached 23% in 1974, an experience commonly attributed to economic growth. The debt/GDP ratio has risen for most of the last 50 years and reached 110% in 2021.

This section gives some background on three factors besides economic growth that have influenced the debt/GDP ratio: primary surpluses and deficits, the Fed's interest rate peg from 1942 to 1951, and unexpected inflation. Later sections quantify the effects of these factors.

2.1 Primary Surpluses and Deficits

Figure 2 shows the primary budget surplus as a fraction of GDP from fiscal year 1947, the year after debt/GDP peaked, to the present. We can see that deviations from primary balance contributed to both the fall in the debt/GDP ratio through 1974 and the rise since then.

The sharp fall in government spending after the war produced primary surpluses of 3.6% of GDP in 1947 and 6.3% in 1948. After that, the surplus remained positive in most years, ranging between 3.4% and -1.5% of GDP through 1974. This experience reflected a strong political consensus in favor of budgetary restraint and debt reduction[1]. Over the entire period from 1947 through 1974, the primary surplus averaged 1.1% of annual GDP, helping to reduce the debt/GDP ratio.

After 1974, the pattern reversed and habitual primary deficits contributed to a rising debt/GDP ratio. The primary balance was negative at all times except in the late 1990s, and the deficit was especially high around the Great Recession of 2008 and the onset of the COVID pandemic.

2.2 Pegged Interest Rates Before the Fed-Treasury Accord

In April 1942, the Federal Reserve adopted a policy of pegging interest rates on government bonds at low levels. This policy was requested by the Treasury department and intended to contain the cost of financing the war. The Fed capped yields at levels ranging from 0.375% for Treasury bills to 2.5% for 30-year bonds, maintaining these caps by standing ready to buy any quantity of bonds. The policy continued until March 1951.

The Fed's policy presumably kept interest rates below the neutral level and made it impossible to adjust rates to control inflation. During World War II, inflation was contained

[1] See, for example, quotes from President Eisenhower in his 1959 Annual Message to the Congress on the State of the Union.

through government price controls. Price controls were eliminated in June 1946, and inflation became unstable: the annualized CPI inflation rate averaged 7.5 percent from June 1946 through February 1951, with spikes of 18.3 percent in fiscal year 1947 and 9.1 percent in 1951 (Evans 1982). Fed policymakers became increasingly unhappy with their inability to control inflation and eventually persuaded the Treasury that the peg should be abandoned, a decision announced jointly by the two agencies in their March 1951 "Accord."[2] The interest rate peg had a big effect on debt dynamics because it was in effect during the buildup and initial rolling over of the large World War II debt. In addition, a large share of the debt issued with low interest rates had maturities of ten to thirty years, so the influence on the costs of debt service was felt long after the peg ended in 1951. Both during and after the peg, periods of high inflation produced ex post real interest rates that were deeply negative for many government securities.

The pre-Accord peg is the most clear-cut case of interest rates being held down through financial repression during the postwar period. Reinhart and Sbrancia (2015) cite other types of financial repression, such as caps on banks' interest rates under Regulation Q. We ignore these other policies because we do not know how to quantify their effects on interest rates on government debt. To the extent they are important, the effects of the pre-Accord peg are a lower bound on the total effects of financial repression.

2.3 Surprise Inflation

Unexpected inflation reduces the debt/GDP ratio by pushing ex-post real interest rates below ex-ante real rates. The relevant inflation rate is the growth rate of the GDP deflator. As detailed below, the effect on the debt/GDP ratio in a given period depends on the current level of inflation relative to the level expected at various times in the past when the currently

[2]For a detailed narrative of this episode, see Hetzel and Leach (2001) and William McChesney Martin, Jr., Collection 1951.

outstanding debt was issued.

Figure 3 shows inflation surprises since 1951 (the beginning of the post-Accord period). It compares the actual level of each year's inflation to the level expected one year earlier and (starting in 1962) the level expected ten years earlier, based on several sources of data on inflation expectations (see details below). We see the well-known run-up in inflation in the 1960s and 1970s and see that inflation persistently exceed expected inflation during this period—especially the levels expected ten years before, implying a big erosion of real interest rates on long-term securities. These inflation surprises contributed to the decrease in the debt/GDP ratio through 1973 and moderated the first part of the subsequent increase in the late 70s.

Starting in the 1980s, the story was reversed: as inflation fell following the Volcker regime shift, expected inflation was usually higher than actual inflation. This pattern pushed ex post real interest rates above ex ante real rates and contributed to the rising debt/GDP ratio, although we will see that this effect was smaller than that of the earlier surprise inflation because the average maturity of the debt was shorter. The dramatic rise in inflation in 2021 means that unexpected inflation has again become a factor reducing the debt/GDP ratio.

3 Constructing Counterfactual Paths of Debt/GDP Ratios

This section describes our procedure for constructing counterfactual paths of the debt/GDP ratio with zero primary surpluses and/or without distortions in real interest rates from the pre-Accord peg and surprise inflation. The differences among these paths capture the different factors driving the actual debt/GDP path. The counterfactual without either surpluses or interest-rate distortions reveals how much the debt/GDP ratio has been reduced through economic growth in excess of undistorted interest rate. We interpret this effect as the natural tendency for the economy to grow out of debt, which is sometimes called the "negative snowball" or "melting" effect (e.g., Krugman, 2019; Aizenman and Ito, 2020).

3.1 Overview

We start with a standard equation describing the evolution of the nominal stock of debt (see, for example, Hall and Sargent 2011):

$$D_t = (1 + i_t)D_{t-1} - P_t, \tag{1}$$

where D_t is the par value of the stock of debt at time t, i_t is the average interest rate on the debt, and P_t is the primary surplus[3]. From period $t-1$ to t, the debt grows at rate i_t as it is rolled over, and primary surpluses reduce the debt (while primary deficits increase it). In our empirical work, a period is a fiscal year and debt is measured at the end of the year. The interest rate is measured as total interest payments in fiscal year t divided by D_{t-1}.

In all simulations, we start with the debt at its actual level at the end of fiscal year 1946 and derive its path after that for alternative assumptions about primary surpluses and interest rates. We assume in all cases that the path of nominal GDP is same as in actual history.

It is straightforward to construct a counterfactual with no primary surpluses: we simply set $P_t = 0$ for all t in equation (1).

Adjusting for the pre-Accord peg and inflation surprises is more complex. In our counterfactual exercise, we replace the actual nominal interest rates i_t with the rates that would

[3]Compared to Hall and Sargent (2011), we focus on the par value, not the market value of the public debt. The par value relative to GDP is the focus of most policy discussions. In any case, looking at the market value instead of the par value would complicate our analysis but not make much difference to our results.

have prevailed under two conditions. The first, which is relevant for debt issued before 1952, is that the ex ante real interest rate is the one that would have prevailed in the absence of the peg, if the Federal Reserve were operating normally (presumably setting rates to stabilize output and inflation). We estimate these undistorted interest rates from ex ante real rates observed after the peg period, as detailed below.

The second condition is that the ex post real interest rate is always equal to the ex ante real rate. We implement this assumption by adding the unexpected component of inflation (measured by comparing actual inflation to surveys of expectations) to actual nominal interest rates. This adjustment yields the nominal rates that would have prevailed given ex ante real rates if financial market participants had known the future path of inflation. We can also interpret our counterfactual interest rates as those that would have been observed if all debt were indexed to inflation[4].

Our simulations of debt/GDP ratios assume that both undistorted real interest rates and real GDP are the same in our counterfactual scenarios as in actual history. Conventional macroeconomics implies that the higher levels of debt in the counterfactuals would increase real rates and reduce real GDP by crowding out capital, and both of these effects would magnify the increases in the debt/GDP ratio relative to actual history. In light of these omitted effects, the debt/GDP paths we derive can be interpreted as lower bounds on the paths implied by our counterfactual assumptions.

3.2 Counterfactual Interest Rates and the Reverse Maturity Structure

We need to compute average interest rates on debt in our counterfactual with no real-rate distortions, which we denote by $\hat{i}_t$. In doing so, a critical nuance is that the debt outstanding

[4] Andreolli and Rey (2023) conducts a similar counterfactual exercise for Euro Area countries for the period following the introduction of the common currency.

in a given fiscal year is a mix of securities issued in different past years. We call the mix of years when the current debt was issued the "reverse maturity structure" of the debt (as opposed to the regular maturity structure, which is the mix of future years when the current debt will mature). The reverse maturity structure matters because the outstanding debt may include some securities issued during the pre-Accord peg and some issued later, and because inflation expectations differed at the various times securities were issued.

To see the role of the reverse maturity structure, we introduce some notation. The stock of debt outstanding at the end of fiscal year $t-1$ is a sum of debt issued during $t-1$ and earlier years:

$$D_{t-1} = \sum_{j=0}^{M} D_{t-1}^{j} \tag{2}$$

where D_{t-1}^{j} is debt outstanding at the end of $t-1$ that was issued during $t-1-j$ and $t-1-M$ is the earliest year when part of the outstanding debt was issued. We denote the fraction of outstanding debt at $t-1$ that was issued at $t-1-j$ by w_{t-1}^{j}:

$$w_{t-1}^{j} \equiv D_{t-1}^{j}/D_{t-1} \tag{3}$$

The weights w_{t-1}^{j} capture the reverse maturity structure of the debt. We let i_t^{j+1} equal the actual average interest rate paid at t on the part of the debt issued at $t-1-j$. The overall average rate i_t is an average of the i_t^{j+1}'s weighted by the shares of total debt to which they apply:

$$i_t = \sum_{j=0}^{M} w_{t-1}^{j} i_t^{j+1} \tag{4}$$

In any counterfactual, the overall average interest rate $\hat{i}_t$ will depend on how we adjust the weights and interest rates in equation (4). In our simulations, we hold the w_{t-1}^{j}'s in each year constant at the levels observed in actual history. That is, we assume that the increase in aggregate debt in our counterfactuals does not affect the reverse maturity structure of the debt. This is an approximation. For more precise calculations, we could make assumptions about the maturity structure of the additional securities issued in a counterfactual and then derive the reverse maturity structure of the entire debt. We leave this refinement for future work.

In counterfactuals with undistorted interest rates, we adjust each i_t^{j+1} to eliminate the effects of the peg and surprise inflation and denote the result by $\hat{i}_t^{j+1}$. Let x_t^j be the adjustment $\hat{i}_t^j - i_t^j$. Given the fixed weights w_t^j, the counterfactual aggregate interest rate $\hat{i}_t$ can be written as:

$$\hat{i}_t = \sum_{j=0}^{M} w_{t-1}^j \left(i_t^{j+1} + x_t^{j+1}\right) = i_t + \underbrace{\sum_{j=0}^{M} w_{t-1}^j x_t^{j+1}}_{\equiv x_t} \tag{5}$$

The path of $\hat{i}_t$, and hence counterfactual paths of debt, can be derived from the actual aggregate interest rates i_t, the weights w_{t-1}^j, and the adjustments x_t^{j+1}.

An adjustment x_t^{j+1} applies to the interest rate paid on debt issued at $t-1-j$, so it depends on whether the date $t-1-j$ is before, during, or after the peg. The expressions for x_t^{j+1} are:

$$x_t^{j+1} = \begin{cases} 0 & \text{for } t-1-j \leq 1942 \\ r_t^{\star\, j+1} - \left(i_t^{j+1} - \pi_t\right) & \text{for } 1943 \leq t-1-j \leq 1951 \\ \pi_t - \mathbb{E}_{t-1-j}[\pi_t] & \text{for } 1952 \leq t-1-j \end{cases} \tag{6}$$

where $r_t^{\star\, j+1}$ is the undistorted real interest rate on debt outstanding at t that was issued at $t-1-j$ and $\mathbb{E}_{t-1-j}[\pi_t]$ is the expectation at $t-1-j$ of the inflation rate at t.

Let us review these adjustments in reverse chronological order. For $t-1-j \geq 1952$, the adjustment x_t^{j+1} is to an interest rate paid at t that was set after the Fed-Treasury Accord. In this case, we assume the ex ante real interest rate is the undistorted rate and adjust the ex post rate to eliminate the effect of unexpected inflation. The relevant inflation surprise is the difference between actual inflation in year t and the expectation of that rate at $t-1-j$. The next section describes how we derive an estimate of this expectation from surveys.

The second line is the adjustment to interest rates in year t on debt issued during the peg period from 1943 through 1951. This adjustment is the difference between the ex post real interest rate and the undistorted rate (which no longer equals the actual ex ante rate). The ex post real rate is the average nominal interest rate on the outstanding debt that was issued at $t-j-1$ minus the inflation rate at t. The undistorted real interest rates $r_t^{\star\, j+1}$ are not observed, so we must make educated guesses about their levels. As detailed in the next section, we do so using ex ante real interest rates in the years after the peg.

Finally, the first line of equation (6) indicates that we make no adjustment to interest rates on debt issued before the start of the peg. These interest rates are relevant because part of that debt was still outstanding in 1946, when we start our simulations. In principle we should adjust interest rates set before the peg for surprise inflation, but that would require measures of long-term expectations before 1943, which do not exist. We conjecture that, if we had such measures, we would see positive inflation surprises—it is unlikely that the high inflation of the late 1940s and early 1950s was expected before 1943—so we would find an even larger role for surprise inflation in reducing the debt/GDP ratio.

3.3 Two Complications

The derivation of equation (6) ignores two details about the types of securities issued by the U.S. Treasury. Here we briefly describe these issues and how we address them. The Appendix presents a modification of equation (6) that accounts for these issues and we use that equation in our simulations.

Treasury Bills. A substantial fraction of the debt consists of Treasury bills with maturities of less than a year, most commonly 90 days. This poses a problem because equation (6) assumes that all debt outstanding at the end of year $t-1$ is eroded by surprise inflation over year t, and most of the outstanding Treasury bills will be rolled over during the year with interest rates that adjust to inflation news. To be conservative in assessing the effects of surprise inflation, we assume it has no effect on the real returns on Treasury bills and modify equation (6) accordingly[5].

Inflation Indexed Debt. Starting in 1997, part of the debt consists of Treasury Inflation-Protected Securities, whose nominal interest rates adjust to ensure that ex post real interest rates equal ex ante rates. Inflation surprises do not erode the value of these securities, so we adjust equation (6) accordingly.

4 Data and Measurement

This section describes our data sources and the measurement of the variables in our counterfactual simulations. These variables include a number of fiscal variables; inflation expectations at various horizons; and undistorted real interest rates during the peg period.

We give an overview of our approach and leave a number of details to the Appendix.

4.1 Timing

The unit of time in our analysis is a fiscal year, because much of our data are reported by fiscal year. In the early part of our sample, fiscal year t runs from July of calendar year $t-1$

[5]Note that some long-term bonds also mature within year t, so are not affected by the full inflation surprise over t. However, the resulting over-adjustment is counterbalanced by the fact that securities are issued throughout the year, so inflation surprises are understated by using expectations made at end of year. We doubt these factors are important, but future research could address them with higher-frequency data.

through the following June. Starting with fiscal year 1977, the timing shifts and fiscal years run from October of calendar year $t-1$ through the following September. This shift creates a "transitional quarter" (the third quarter of calendar year 1976) that is treated separately in the government's fiscal accounts and which requires some modifications of our procedures around that time (see Appendix).

4.2 Fiscal Variables

We use fiscal data from the OMB Historical Database, the Hall, Payne, and Sargent (2018) database on government securities, the CRSP Monthly U.S. Treasury Database, and the Treasury Bulletin.

Aggregate Debt. Our measure of D_t, the total debt in fiscal year t, is the level of debt held by the public at the end of the year, from the OMB historical database. Debt held by the public includes debt held by the private sector and the Federal Reserve but excludes intragovernmental holdings such as debt held by the Social Security Trust Fund. This variable is the most common measure of debt in the literature.

To measure debt/GDP ratios, we use the series for nominal GDP by fiscal year from the OMB database. As discussed above, our simulations hold the path of GDP constant when we consider counterfactual paths of debt.

The Reverse Maturity Structure. We construct the reverse maturity structure of the debt from the Hall et al. (2018) database for the period from 1942 through 1960, and from the CRSP Monthly U.S. Treasury Database for 1961 through 2022. For every month, these databases provide an accounting of almost every issue of a Treasury security that is currently outstanding, including its quantity and issue date. We use the data for the final month of each fiscal year to construct D_t^j, the amount of debt outstanding at the end of year t that was issued in year $t - j$. Dividing the quantities D_t^j by the total debt D_t yields the weights w_t^j that define the reverse maturity structure.

The Appendix provides details of this procedure, including approximations needed because of missing information in the Hall et al. (2018) and CRSP data sets. Perhaps the most significant issue is that the post-1960 data from CRSP do not include non-marketable debt such as savings bonds. We assume that the reverse maturity structure of non-marketable debt remains constant after 1960.

Figure 4 summarizes the evolution of the reverse maturity structure by showing the fractions of outstanding debt with maturities in various ranges. Over the first part of our sample, during the pre-Accord peg, the share of debt with reverse maturities above five years rose due to debt issued more than five years earlier to finance World War II. This longer-term debt share peaked at 48 percent in 1951 and then fell, and from 1975 through 2022 it fluctuated between 10 and 25 percent. The average reverse maturity of all outstanding debt fell from 4.4 years in 1951 to 2.2 years in 2021.

Aggregate Interest Rates. Following researchers such as Hall and Sargent (2011), we define the aggregate interest rate on debt in fiscal year t, i_t, as total interest payments during the year divided by total debt outstanding at the end of year $t - 1$. This definition is the one for which the accounting identity (1) holds. For consistency with our measure of D_t, which excludes intragovernmental holdings of Treasury debt, total interest payments excludes payments to government entities.

Our data on interest payments come from the OMB Historical Data. Starting in 1962, we derive the appropriate series by subtracting intragovernmental payments from gross interest payments. Before 1962, we lack data on intragovernmental payments. The OMB reports "net interest", but this series excludes not only intragovernmental payments but also "other interest", which should be included in our measure of interest payments. In the Appendix, we examine the relation between the net interest series and our desired series for interest payments and find that the latter is approximately ten percent higher in years when we can measure both. Therefore, before 1962 we measure total interest payments by multiplying net interest by 1.1. Other reasonable approaches yield similar results.

The Primary Balance. The primary balance is also calculated from OMB data. It is the total fiscal surplus (which is often negative) plus total interest payments, with total interest calculated as described above[6].

4.3 Inflation and Inflation Expectations

Here we describe our measurement of actual and expected inflation, which determine the inflation surprises that enter our calculations. We use data on one-year and ten-year inflation expectations to estimate the entire term structure of expectations.

The Inflation Rate. When studying the debt/GDP ratio, the relevant price index is the GDP deflator. We measure the inflation rate in fiscal year t, π_t, as the growth rate of the deflator (not seasonally adjusted) from the fourth quarter of year $t-1$ to the fourth quarter of t. (The Appendix describes complications around the Transitional Quarter in 1976.)

One-Year Expectations. We let $\mathbb{E}_t[\pi_{t+1}]$ denote the expectation at the end of year t of the inflation rate in $t+1$. We measure this expectation using two different surveys for two parts of our sample.

Starting with fiscal year $t = 1970$, we use forecasts reported in the Survey of Professional

[6] Although we compute interest payments and primary balance in a consistent way, the identity (1) does not hold exactly in our data. There is a residual due to stock-flow adjustments. In all our counterfactuals, we hold this residual constant as an extra term in the equation for the evolution of debt.

Forecasters in the last quarter of the fiscal year (either the second or third quarter of the calendar year). We use the median forecast of the growth rate of the GDP deflator over the following four quarters, that is, over fiscal year $t + 1$.

For fiscal years before 1970, we lack data on expectations of the GDP deflator, so we create a proxy. We start with expectations of the CPI from the semi-annual Livingston Survey of business economists. We use forecasts published in June—before 1970, the last month of the fiscal year—of the CPI in the following June. Then, we derive an expected CPI inflation rate over the coming fiscal year from the forecast of the CPI level.

To derive expected inflation in the GDP deflator, we assume that the expectation error $\pi_{t+1} - \mathbb{E}_t[\pi_{t+1}]$ is the same for inflation measured by the deflator and inflation measured by the CPI. This assumption is close to true during periods when we have survey expectations of both variables (see Appendix). With our assumption, we can measure the expectation error for GDP deflator inflation with actual minus expected CPI inflation, and then combine this error with actual inflation π_{t+1} for the deflator to back out expected inflation $\mathbb{E}_t[\pi_{t+1}]$ for the deflator.

Ten-Year Expectations. Our analysis also uses an expectation of the average inflation rate over the next ten years, which we denote by $\mathbb{E}_t[\pi_{t+10}]$. For fiscal years back to $t = 1968$, we measure this variable with a series for expected ten-year inflation from the Fed's data set for its FRB/US Model. (We use the observations for the last quarter of each fiscal year.) These data are expectations of inflation in the PCE deflator, but the paths of the PCE and GDP deflators are usually close (see Appendix). The Fed produces its series by combining forecasts from the Survey of Professional Forecasters and Consensus Economics with econometric estimates of expected inflation when survey measures are not available.

We have not found data on ten-year expected inflation before 1968, and our calculations require these expectations back to 1952. We construct estimates of the missing data using our series for one-year expectations $\mathbb{E}_t[\pi_{t+1}]$. Specifically, for the period from 1968 to 1997, we find that the evolution of ten-year expectations is well-explained statistically by the level and change in a smoothed version of one-year expectations. We use this estimated relation to construct fitted values for long-term expectations before 1968. See the Appendix for details.

Figure 5 shows our final series for one-year inflation expectations $\mathbb{E}_t[\pi_{t+1}]$ and ten-year expectations $\mathbb{E}_t[\pi_{t+10}]$. (Note that these forward-looking expectations differ from the series shown above in Figure 3, which are expectations of current inflation in past years.)

The Term Structure of Inflation Expectations. To adjust interest rates in our counterfactuals, we need expectations of inflation at all horizons. We derive estimates of these expectations by making assumptions about the shape of the term structure of expected inflation. Specifically, we assume that the term structure $\mathbb{E}_t[\pi_{t+1}]$, $\mathbb{E}_t[\pi_{t+2}]$, ... is linear from $t+1$ through $t+5$ and then perfectly flat. Along with our series for $\mathbb{E}_t[\pi_{t+1}]$ and $\mathbb{E}_t[\pi_{t+10}]$ (which is the average of $\mathbb{E}_t[\pi_{t+x}]$ from $x = 1$ to $x = 10$), our shape assumptions determine the entire term structure. Once again, the Appendix discusses the details of our procedure, its rationale, and robustness to other reasonable assumptions.

Figure 6 shows the term structure of expected inflation for each year in our sample. In some years the entire term structure is flat, but long-term expectations lag behind short-term expectations when the latter are trending up or down (which occurs when actual inflation trends up or down).

4.4 The Peg Period

For debt issued during the peg period before 1952, our interest-rate adjustments require series for i_t^{j+1}, the actual nominal interest rates on the debt, and for $r_t^{\star\, j+1}$, the undistorted real interest rates. We derive these variables as follows.

Actual Interest Rates Under the Peg. For each issue of a Treasury security, the Hall et al. (2018) database reports the issue date, quantity, and maturity and usually the coupon rate, which is the relevant interest rate. When the coupon rate is missing, we use the interest rates by maturity reported by Friedman and Schwartz (1963).

We construct i_t^{j+1}, the average interest rate on securities outstanding at t that were issued at $t-j-1$, by averaging across the interest rates on the individual securities.

Counterfactual Real Rates. We do not have direct evidence on the ex ante real interest rates that would have prevailed on securities issued during the pre-Accord period if the Fed had not pegged rates. As a baseline measure, we simply assume that the rate for any security of a given maturity would have been equal to the average of the ex ante real rates of securities of the same maturity issued over the decade after the peg ended, from 1951 through 1960. The counterfactual real rate $r_t^{\star\, j+1}$ is an average of the assumed rates on securities of different maturities weighted by the term structure of securities issued at $t-1-j$. The Appendix examines the implications of assuming higher or lower rates in our counterfactuals.

To calculate the ex ante real rates by maturity for 1951-1960, we use data on nominal interest rates on debt issued for various maturities during this period from the Global Financial Database. We then obtain ex ante real rates using the term structure of inflation expectations, derived as described above. We average the ex ante real rates at each maturity over all securities issued over 1951-1960.

The resulting term structure of real rates includes 1.4% at the one-year horizon, 2.1% at five years, 2.5% at ten years, and 2.65% at thirty years.

5 Results

Here we present our central results, which are simulations of the path of the debt/GDP ratio. All simulations start in 1946 with the ratio at its actual level of 106%. We compare the actual path of debt/GDP after 1946 to three counterfactual scenarios. In one, the "primary balance scenario," we set the primary surplus to zero in all years (but leave interest rates unchanged at their historical levels). In another, the "adjusted interest rate scenario," we apply the adjustments x_t^{j+1} to eliminate the effects of both surprise inflation and the pre-Accord peg (but leave primary surpluses at their historical levels). Finally, in a "combined scenario" we assume primary balance and adjust interest rates. The debt/GDP path in the combined scenario is determined by $r^\star - g$, the difference between the undistorted real interest rate and the growth rate of output.

Figure 7 presents the alternative paths of debt/GDP. In interpreting these results, we divide the period since 1946 into two parts: 1946-1974, the period when the actual debt/GDP ratio declined to is trough of 23%; and 1975-2021, when the ratio rose to 110%. We examine these two periods in turn.

5.1 The Postwar Erosion of Debt, 1946-1974

The actual debt/GDP ratio declined steeply over the 1946-1974 period. Our counterfactual ratios also decline, but more slowly, reflecting the adjustments for primary surpluses and interest-rate distortions. While the actual debt/GDP ratio reached 23% in 1974, the counterfactual ratios in 1974 are substantially higher: 40% in the primary-balance scenario, 51% in the adjusted-rate scenario, and 73% in the combined scenario.

To appreciate these results, recall that the actual debt/GDP ratio fell by 83 percentage points from 1946 to 1974 (from 106 percent to 23 percent). In the combined scenario, it falls by only 33 points (from 106 to 73). Therefore, of the 83 point actual fall, 50 points are explained by the combination of primary surpluses and interest rate distortions. By comparing the different counterfactuals, we can divide this 50 points into 17 points explained by primary surpluses alone, 27 points explained by interest rate distortions alone, and 6 points from the interaction of the two factors. The interaction arises because a lower primary balance leads to a higher debt/GDP ratio, which in turns leads to a greater effect of interest rate distortions on the ratio.

The interest-rate adjustment eliminates distortions from both surprise inflation and the suppression of ex ante real rates under the peg. It would be interesting to separate the effects of these two distortions, but that would be difficult because it requires measures of expected inflation during the peg period from 1942 to 1951. There are no data on long-term inflation expectations before 1951 or even short-term expectations before 1947 (the start of the Livingston survey) and it is difficult even to make educated guesses. (What was long-term expected inflation in the middle of World War II and its price controls?)

In Figure 8, we examine more closely how interest-rate distortions helped to erode the debt/GDP ratio. For the period 1947-1974, the Figure shows the series for x_t, the adjustment of the aggregate interest rate in our counterfactuals. We see large adjustments at the start of the period—13 percentage points in 1947 and 7.5 points 1951—reflecting deeply negative real interest rates arising from surges in inflation with pegged nominal rates. Because of these episodes, the actual debt/GDP ratio in 1951 had already diverged by more than 20 percentage points from its level in our rate-adjusted scenario. After that, the x_t adjustment is mostly small until the late 1960s, when unexpected inflation starts pushing it up. The adjustment reaches 3 percentage points in 1974. (It then stays high through the rest of the 1970s, somewhat dampening the rise in the debt/GDP ratio that we discuss next.)

5.2 The Debt Buildup, 1975-2022

As shown in Figure 7, the actual debt/GDP ratio started rising in 1975 and continued rising except for a dip in the late 1990s. In 2021, it stood at 110%, slightly higher than its level in 1946. The biggest factor was a shift from primary surpluses to primary deficits. Persistent deficits emerged as a result of tax cuts at several points, most notably the Reagan tax cuts of the early 1980s, and the deficit ballooned in the wake of the 2008 financial crisis and the 2020 pandemic.

For our purposes, the most important part of Figure 7 is the combined counterfactual with primary balance and undistorted real interest rates. In this case the debt/GDP ratio falls from its 1974 level of 73% to 69% in 1979, but then starts rising. In 2021, debt/GDP is 91%, not far from the 1946 level of 106%. Recall that the evolution of debt/GDP in the combined counterfactual depends on the difference between the growth rate g and the undistorted real interest rate $r^\star$. The rise in debt/GDP from 1979 to 2021 indicates that on average $r^\star > g$ during this period.

These findings cast doubt on the common narrative that the US "grew its way" out of its World War II debt. Over the 76 years from 1946 to 2021, the difference between g and $r^\star$ reduced the debt/GDP ratio by only 15 percentage points (from 106% to 91%), with a moderate negative effect of $r^\star < g$ before 1980 largely offset by $r^\star > g$ since then. If we seek to learn from this experience, the lesson is that we should not count on much of a contribution from economic growth to resolving the problem of a high debt level.

A nuance of our results is that the post-1979 rise in the debt/GDP ratio in the primary balance counterfactual—which maintains real interest rates at their actual ex post levels—is even larger than the rise in the combined counterfactual (27 percentage points, from 33% to 60%, compared to 23 percentage points). This result reflects the fact that inflation surprises since 1979 have on average been negative, so they have increased the debt/GDP ratio. The rise in debt/GDP in the primary-balance counterfactual indicates that the actual real interest rate r has been higher than the growth rate g since 1979.

This finding might appear inconsistent with the analysis in Blanchard (2019) Presidential Address. Blanchard reports that r has been less than g over almost all of the post-World-War-II period, including the period since 1979. Figure 9 shows the differences between Blanchard's findings and ours. The different paths for the debt/GDP ratio reflect two differences in the measurement of interest rates. First, we use the government's interest payments on outstanding debt whereas Blanchard (2019) uses market yields on debt, which have been lower since 1979 because interest rates have trended downward. Second, we use pre-tax interest rates and Blanchard (2019) uses after-tax rates. The Appendix details these differences and explains why we believe our measurement of interest rates is appropriate for our purposes.

6 Conclusions

This paper investigates the factors behind the behavior of the U.S. debt/GDP ratio since 1946, both the large decline in the ratio from 1946 to 1974 and the large increase since then. We seek to decompose the movements of debt/GDP into the effects of primary surpluses and deficits; distortions of real interest rates from surprise inflation and from pegged nominal rates before the 1951 Fed-Treasury Accord; and the difference between the undistorted real interest rate and the growth rate of output ($r^\star - g$).

For the period up to 1974, we find that primary surpluses and interest-rate distortions explain most of the fall in the debt-GDP ratio. Absent those factors, with the ratio determined only by the $r^\star - g$ effect, the ratio of 106% in 1946 would have fallen only to 73% in 1974 rather than the actual level of 23%.

The debt increase since 1974 is explained primarily by large primary deficits. Another factor, however, is that the $r^\star - g$ effect changes sign: on average the growth rate was lower than undistorted real interest rate. With primary balance and no interest-rate distortions, we estimate that the debt/GDP ratio would have risen to 91% in 2021, not far from its 1946 level. Therefore the entire period since 1946 suggests only a small tendency for the economy to grow out of debt in the absence of primary surplus or interest-rate distortions.

As of the end of fiscal year 2021, the actual debt/GDP ratio stands at 110%, a bit higher than its previous peak of 106% in 1946. It does not seem likely that the ratio will be pushed down by the same factors as it was after 1946. Presumably U.S. policymakers are not considering the kind of interest rate peg, with price controls containing the inflationary effects, that was imposed during World War II. Despite the surge in inflation since 2021, the Federal Reserve appears committed to returning inflation to a low level and keeping it there, which would preclude debt erosion through surprise inflation. In addition, any surprise inflation that occurs would have smaller effects than in the past because the average maturity of the debt is shorter (Hilscher et al. 2021). Finally, debt will be not be reduced through primary surpluses unless there is a radical shift in fiscal policy. Under current policy, the Congressional Budget Office predicts large primary deficits for the next three decades, which are likely to push the debt/GDP ratio even higher than it is today and to cast doubt on the valuation of the debt (Jiang et al. 2022).

It is possible that the economy can grow its way out its current debt—and even the higher debt projected by the CBO—because growth rates exceed undistorted real interest rates. However this source of debt reduction was weak on average from 1946 through 2022. History should not make us optimistic about the prospects for growing out of debt.

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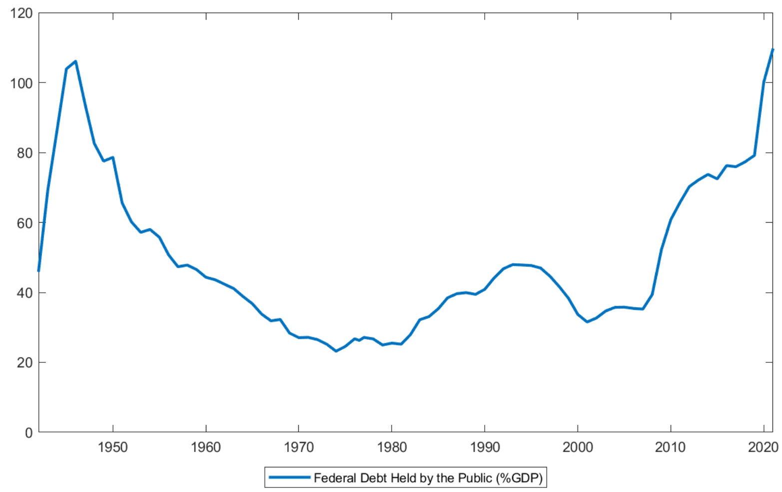
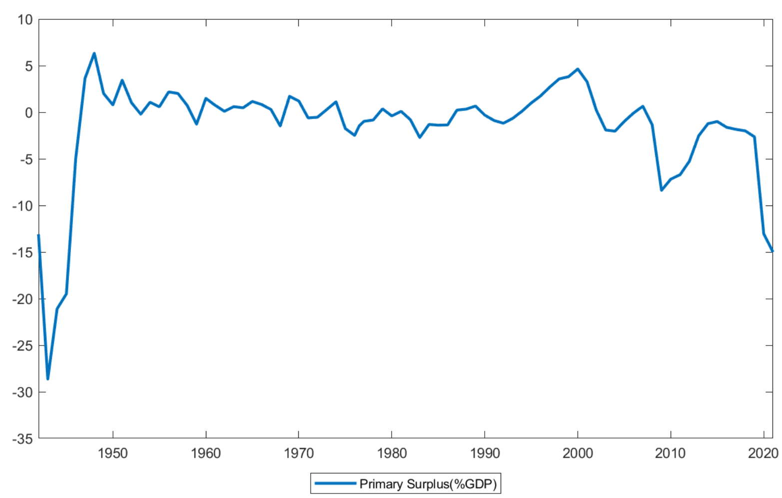
A Appendix - Charts

Figure 1 FEDERAL DEBT HELD BY THE PUBLIC AS A PERCENT OF GDP: D_t



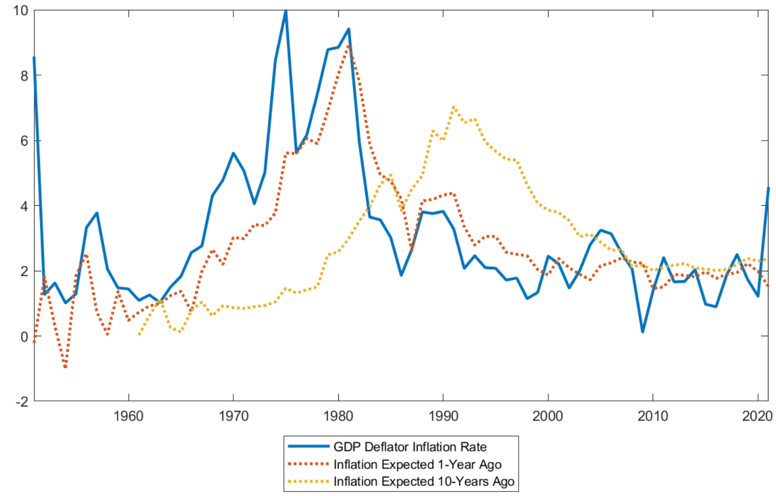
NOTE. The line represents the ratio of the par value of outstanding Treasury securities held by the public to GDP. Source: OMB.

Figure 2 PRIMARY BALANCE AS A PERCENT OF GDP: P_t



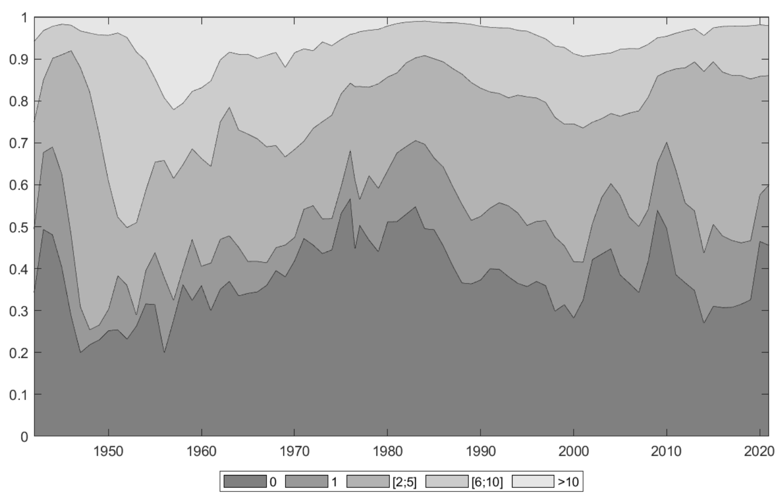
NOTE. The line represents the ratio of the primary balance to GDP. It is computed as the ratio of the sum of the total fiscal balance plus interest payment to GDP. Source: OMB, authors' calculations.

Figure 3 Inflation π_t and Expected Inflation $\mathbb{E}_{t-1}[\pi_t]$, $\mathbb{E}_{t-10}[\pi_t]$



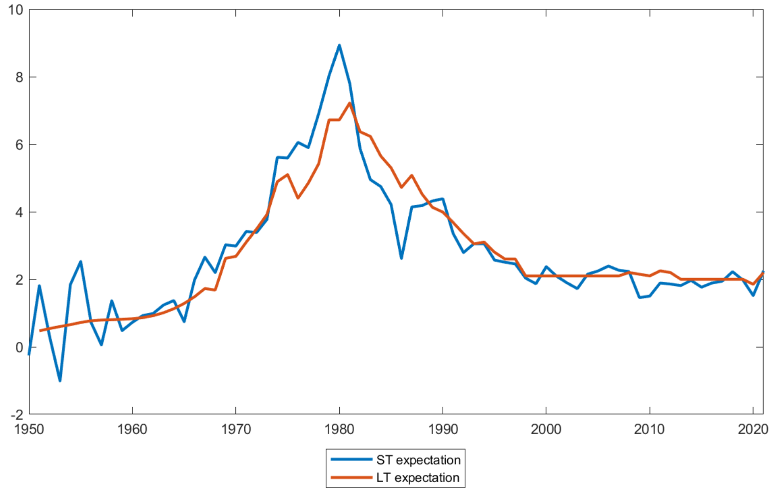
Note. The lines represent the GDP deflator inflation rate, and its forecast values made 1 year and 10 years ago. Source: Authors' calculations.

Figure 4 Reverse Maturity Structure of All Public Debt: w_{t-1}^{j}



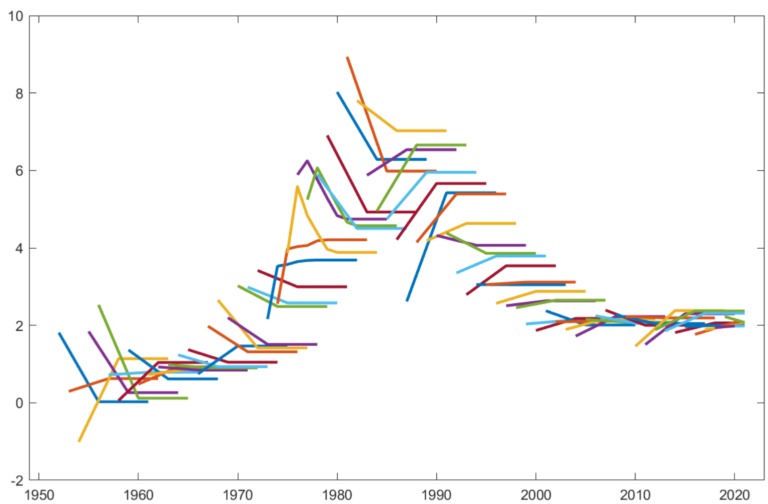
Note. This chart represents the reverse maturity structure of total outstanding debt held by the public. The different shades represent the share of the outstanding debt held by the public at the end of fiscal year t which was issued in the same year, last year, 2 to 5 years ago, 6 to 10 years ago, and more than 10 years ago. Lighter shades are associated with longer reverse maturity. Source: Authors' calculations.

Figure 5 SHORT-TERM AND LONG-TERM INFLATION EXPECTATIONS TIME SERIES: $\pi_t^{GDP,eS}$ AND $\pi_t^{GDP,eL}$



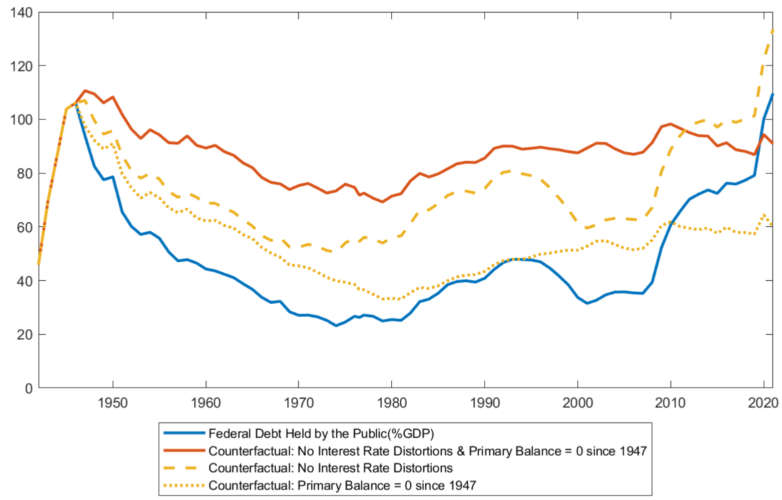
NOTE. Sources: Livingston Survey, Survey of Professional Forecasters, Federal Reserve Bank of New York FRB/US Model, authors' calculations.

Figure 6 TERM STRUCTURE OF INFLATION EXPECTATIONS: $\mathbb{E}_{t-1-j}[\pi_t]$



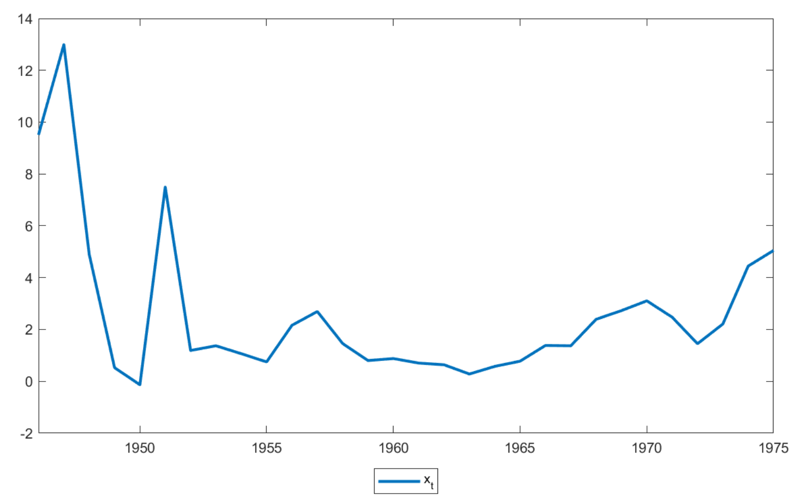
NOTE. Each line indicates inflation expectations made at the year previous to the beginning of the line. For example, the line beginning at 1952 indicates inflation expectations formed at 1951. Sources: Livingston Survey, Survey of Professional Forecasters, Federal Reserve Bank of New York FRB/US Model, authors' calculations.

Figure 7 Debt Dynamics - Counterfactual Scenarios



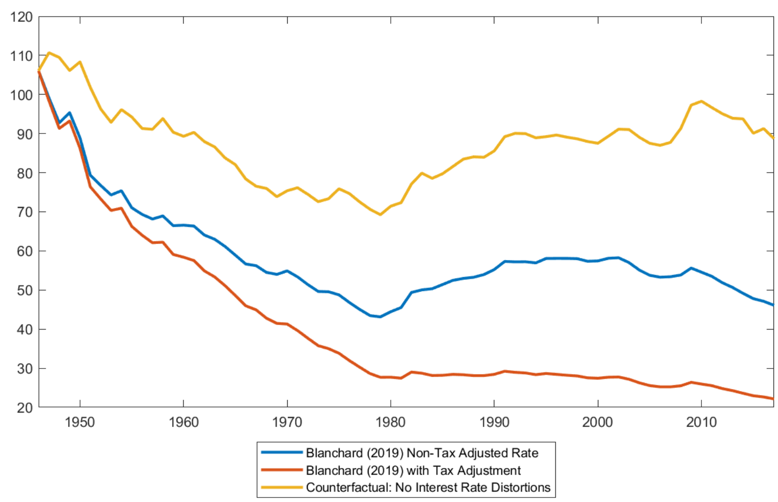
Note. The lines represent the actual debt dynamics and our different counterfactual scenarios.Source: Authors' calculations.

Figure 8 Effective Interest Rate Differential (1951-1975)



Note. The line represents the difference between the counterfactual and the average effective interest rate on debt held by the public. Source: Authors' calculations.

Figure 9 Debt Dynamics, with Zero Primary Balance, starting in 1947



Note. The lines represent our counterfactual debt dynamics versus a replication of the debt dynamics in Figures 5 and 6 from Blanchard (2019) Source: Authors' calculations.

B Appendix - Methodology

B.1 Counterfactual Debt Dynamics

This section describes the procedure used to compute our counterfactual debt dynamics. In this paper, $X_T^{s,J,t}$ will refer to the value of a variable X at time T regarding a public debt security s of type t which was first issued during year $T-J$.

Our objective is to compare actual debt dynamics to a counterfactual with non-distorted real interest rates (i.e. no inflation surprises and no nominal interest rate peg), and different primary surpluses. The actual debt dynamics is given by:

$$D_t = (1+i_t)D_{t-1} - P_t + \epsilon_t \tag{B.1}$$

where D_t is the debt held by the public at the end of t, i_t is the average effective interest rate on the debt held by the public, P_t is the primary balance in t, and ϵ_t represents a residual which makes the equation hold exactly[7]. Our counterfactual debt dynamics is given by:

$$\hat{D}_t = (1+\hat{i}_t)\hat{D}_{t-1} - \hat{P}_t + \hat{\epsilon}_t \tag{B.2}$$

where we use the notation $\hat{}$ to denote the value of a variable in the counterfactual scenario. We assume that $\hat{\epsilon}_t = \epsilon_t \ \forall t$. In the counterfactual analysis section, we will assume different paths for the primary balance. We define the average effective interest rate adjustment as:

$$x_t \equiv \hat{i}_t - i_t \tag{B.3}$$

The outstanding debt at the end of year t can be written as the sum of the outstanding debt at the end of year t which was first issued during the year $t-j$:

$$D_t = \sum_{j=0}^{M} D_t^j \tag{B.4}$$

where M is the maximum reverse maturity of the outstanding debt securities and D_t^j is the amount of debt securities outstanding at the end of year t which were first issued in year $t-j$.

Outstanding debt can further be decomposed between marketable and non-marketable debt:

$$D_t = D_t^m + D_t^{nm} = \sum_{j=0}^{M} D_t^{j,m} + \sum_{j=0}^{M} D_t^{j,nm} \tag{B.5}$$

where D_t^m is the total marketable debt outstanding at time t, D_t^{nm} is the total non-

[7] This residual includes other means of financing the deficits such as Treasury cash management operations.

marketable debt outstanding at time t, $D_t^{j,m}$ is the amount of marketable debt securities outstanding at the end of year t which were first issued in year $t-j$, and $D_t^{j,nm}$ is the amount of non-marketable debt securities outstanding at the end of year t which were first issued in year $t-j$.

Following the same logic, the total interest payment at time t, which is the product of the average interest rate at time t and the outstanding stock of debt at time $t-1$, can be written as:

$$i_t D_{t-1} = \sum_{j=0}^{M} i_t^{j+1} D_{t-1}^{j} = i_t \left(D_{t-1}^{m} + D_{t-1}^{nm} \right) = \sum_{j=0}^{M} i_t^{j+1} \left(D_{t-1}^{j,m} + D_{t-1}^{j,nm} \right) \tag{B.6}$$

where M is the maximum reverse maturity of the outstanding debt securities, D_{t-1}^{j} is the amount of debt securities outstanding at the end of year $t-1$ which were first issued in year $t-1-j$, and i_t^{j+1} is the average effective interest rate paid at time t on debt securities which were first issued in year $t-1-j$. We can define the average effective interest rate adjustment by year of first issuance:

$$x_t^{j+1} \equiv \hat{i}_t^{j+1} - i_t^{j+1} \tag{B.7}$$

For our purposes, it will be useful to introduce the concept of reverse maturity structure. The reverse maturity structure of the debt indicates the share of outstanding debt at time t which was first issued at time $t-j$ for different values of j. Define the share of outstanding debt at the end of year $t-1$ which was first issued at $t-1-j$ as:

$$w_{t-1}^{j} \equiv D_{t-1}^{j} / D_{t-1} \tag{B.8}$$

The reserve maturity structure of total outstanding debt held by the public at any time t is given by the vector of $w_t^j \; \forall j \in [0, M]$. Similarly, define the share of outstanding marketable and non-marketable debt at the end of year $t-1$ which was first issued at $t-1-j$:

$$w_{t-1}^{j,m} \equiv D_{t-1}^{j,m} / D_{t-1}^{m} \tag{B.9}$$

$$w_{t-1}^{j,nm} \equiv D_{t-1}^{j,nm} / D_{t-1}^{nm} \tag{B.10}$$

The reverse maturity structures of marketable and non-marketable outstanding debt held by the public at any time t are given, respectively, by the vector of $w_t^{j,m}$ and $w_t^{j,nm} \; \forall j \in [0, M]$. Define the share of marketable debt within total outstanding debt at the end of year $t-1$ as:

$$m_{t-1} \equiv D_{t-1}^{m} / D_{t-1} \tag{B.11}$$

Using equations (B.8)-(B.11), the reverse maturity structure of the debt can be rewritten as[8]:

$$w_{t-1}^{j} = w_{t-1}^{j,m} m_{t-1} + w_{t-1}^{j,nm}(1 - m_{t-1}) \tag{B.12}$$

Using equations (B.6), (B.9), (B.10) and (B.11), we obtain:

$$i_t = \frac{\sum_{j=0}^{M} i_t^{j+1}\left(D_{t-1}^{j,m} + D_{t-1}^{j,nm}\right)}{D_{t-1}} = \sum_{j=0}^{M} \frac{i_t^{j+1}\left(w_{t-1}^{j,m} D_{t-1}^{m} + w_{t-1}^{j,nm} D_{t-1}^{nm}\right)}{D_{t-1}} = \sum_{j=0}^{M} i_t^{j+1}\left(w_{t-1}^{j,m} m_{t-1} + w_{t-1}^{j,nm}(1 - m_{t-1})\right) \tag{B.13}$$

Using the same logic, we obtain the non-distorted average effective interest rate:

$$\hat{i}_t = \sum_{j=0}^{M} \hat{i}_t^{j+1}\left(\hat{w}_{t-1}^{j,m} \hat{m}_{t-1} + \hat{w}_{t-1}^{j,nm}(1 - \hat{m}_{t-1})\right) = \sum_{j=0}^{M} \left(i_t^{j+1} + x_t^{j+1}\right)\left(\hat{w}_{t-1}^{j,m} \hat{m}_{t-1} + \hat{w}_{t-1}^{j,nm}(1 - \hat{m}_{t-1})\right) \tag{B.14}$$

B.2 Assumptions and Interest Rate Adjustment

Assumption 1: We assume that the reverse maturity structure of marketable and non-marketable debt are the same in the counterfactual as in actual history[9], i.e. that $\hat{w}_{t-1}^{j,m} = w_{t-1}^{j,m}$ and $\hat{w}_{t-1}^{j,nm} = w_{t-1}^{j,nm}$ $\forall t$ and $\forall j \geq 0$. We also assume that the share of marketable debt within total outstanding debt is the same in the counterfactual as in actual history, i.e. $\hat{m}_t = m_t$ $\forall t$. This gives us:

$$\hat{i}_t = i_t + \sum_{j=0}^{M} x_t^{j+1}\left(w_{t-1}^{j,m} m_{t-1} + w_{t-1}^{j,nm}(1 - m_{t-1})\right) = i_t + \underbrace{\sum_{j=0}^{M} x_t^{j+1} w_{t-1}^{j}}_{=x_t} \tag{B.15}$$

Assumption 2: As we only have detailed data at the security level for non-marketable debt up to 1960, in our computations we will assume:

$$w_{t-1}^{j,nm} = w_{1960}^{j,nm} \ \forall t > 1961 \text{ and } \forall j \geq 0.$$

Assumption 3: Given the lack of information regarding expected inflation, and the fact that nominal rates were not determined by the market during that period, we assume that the ex-ante interest rate on debt securities issued during the peg period (1942-1951) before the Fed-Treasury Accord of March 1951[10] was equal to the average ex-ante real rate

[8] Proof:

$$w_{t-1}^{j} \equiv \frac{D_{t-1}^{j}}{D_{t-1}} = \frac{D_{t-1}^{j,m} + D_{t-1}^{j,nm}}{D_{t-1}} = \frac{D_{t-1}^{j,m}}{D_{t-1}^{m}}\frac{D_{t-1}^{m}}{D_{t-1}} + \frac{D_{t-1}^{j,nm}}{D_{t-1}^{nm}}\frac{D_{t-1}^{nm}}{D_{t-1}} = w_{t-1}^{j,m}\frac{D_{t-1}^{m}}{D_{t-1}} + w_{t-1}^{j,nm}\frac{D_{t-1}^{nm}}{D_{t-1}} = w_{t-1}^{j,m} m_{t-1} + w_{t-1}^{j,nm}(1 - m_{t-1})$$

[9] We could instead assume the maturity structure of newly issued debt at time t is the same in our counterfactual as in actual history.

[10] In April 1942 the United States Treasury and the Federal Reserve agreed to control nominal interest

for debt securities with similar maturity issued between 1951 and 1960. We provide different calibrations as robustness checks by assuming that the ex ante real rate on all securities was either 1% or 2% (Reinhart and Sbrancia (2015)). This does not affect our main results.

Assumption 4: We assume that debt securities issued during year $t-j$ are all issued[11] at the end of year $t-j$. We also assume that debt securities maturing during year t all mature at the end of year t, except for Treasury bills which are constantly rolled over during the year.

Assumption 5: We assume that the counterfactual history of debt first diverges from the actual history after $t = 1946$, which corresponds to the year during which the debt-to-GDP ratio reached its peak:

$$\hat{D}_{1946} = D_{1946} \tag{B.16}$$

Assumption 6: We assume that the nominal GDP and the inflation rate remain unchanged in our different counterfactual scenarios, independently of our adjusted interest rate or primary balance.

Interest Rate Adjustment. For our purposes, it will be useful to define the amount of outstanding Treasury bill[12] securities as the share of outstanding debt at the end of year $t-1$ which was issued in year $t-1$:

$$s_{t-1} \equiv \frac{D^{0,bills}_{t-1}}{D^{0}_{t-1}} = \frac{D^{0,bills}_{t-1}}{w^{0}_{t-1} D_{t-1}} \tag{B.17}$$

Define the share of TIPS[13] securities within outstanding debt at the end of year $t-1$ as:

$$z_{t-1} \equiv D^{tips}_{t-1} / D_{t-1} \tag{B.18}$$

Define the share of outstanding TIPS at the end of year $t-1$ which was first issued at $t-1-j$:

$$w^{j,tips}_{t-1} \equiv D^{j,tips}_{t-1} / D^{tips}_{t-1} \tag{B.19}$$

The reserve maturity structure of TIPS securities held by the public at any time t is given by the vector of $w^{j,tips}_{t}$ $\forall j \in [0, M]$. Finally, define the share of TIPS securities among

rates on short-term and long-term government securities. The interest-rate peg became effective in July 1942. With respect to short-term securities, the Fed announced that it would buy at a rate of 3/8 percent all 3-month Treasury bills presented by the public. With respect to longer-term securities, the Fed agreed to support 25-year government bond prices at a level consistent with a 2.5 percent interest rate ceiling. Whereas the Treasury and Fed ended the bill rate peg by mutual consent in July 1947, the ceiling on 25-year government bond rates lasted until the Accord of March 1951.

[11]Because we consider that all debt issued in a year is issued at the end of this fiscal year, we assume that debt issued in FY 1951 is issued under the peg regime while debt issued in FY 1942 is not.

[12]Source for outstanding Treasury Bills: https://fraser.stlouisfed.org/title/treasury-bulletin.

[13]Source for outstanding TIPS: https://fraser.stlouisfed.org/title/treasury-bulletin.

total outstanding debt at the end of year $t-1$ which was first issued at $t-1-j$:

$$z_{t-1}^{j} \equiv \frac{D_{t-1}^{j,tips}}{D_{t-1}^{j}} = \frac{D_{t-1}^{j,tips}}{D_{t-1}^{tips}} \frac{D_{t-1}^{tips}}{D_{t-1}} \frac{D_{t-1}}{D_{t-1}^{j}} = \frac{w_{t-1}^{j,tips} z_{t-1}}{w_{t-1}^{j}} \tag{B.20}$$

The average effective interest rate adjustment x_t^{j+1}, which is adjustment on the average interest rate paid at time t on debt securities which were first issued in fiscal year[14] $t-1-j$ is given by:

$$x_t^{j+1} = \begin{cases} 0 & \text{for } t-1-j \leq 1942 \text{ and } j \geq 0 \\ \pi_t + \tilde{r}_t^{j+1} - i_t^{j+1} & \text{for } 1943 \leq t-1-j < 1951 \text{ and } j \geq 0 \\ \pi_t + \tilde{r}_t^{j+1} - i_t^{j+1} & \text{for } t-1-j = 1951 \text{ and } j > 0 \\ (1-s_{t-1})(\pi_t + \tilde{r}_t^{j+1} - i_t^{*,j+1}) & \text{for } t-1-j = 1951 \text{ and } j = 0 \\ \pi_t - \mathbb{E}_{t-1-j}[\pi_t] & \text{for } 1952 \leq t-1-j < 1997 \text{ and } j > 0 \\ (1-s_{t-1})\left(\pi_t - \mathbb{E}_{t-1-j}[\pi_t]\right) & \text{for } 1952 \leq t-1-j < 1997 \text{ and } j = 0 \\ \left(1-z_{t-1}^{j}\right)\left(\pi_t - \mathbb{E}_{t-1-j}[\pi_t]\right) & \text{for } 1997 \leq t-1-j \text{ and } j > 0 \\ \left(1-s_{t-1}-z_{t-1}^{j}\right)\left(\pi_t - \mathbb{E}_{t-1-j}[\pi_t]\right) & \text{for } 1997 \leq t-1-j \text{ and } j = 0 \end{cases} \tag{B.21}$$

where $\tilde{r}_t^{j+1}$ is the average ex ante real interest rate on debt securities outstanding at $t-1$ and which were first issued in year $t-1-j$, π_t is the GDP deflator at time t, $\mathbb{E}_{t-1-j}[\pi_t]$ is the expectation of the GDP deflator at time t made at time $t-1-j$, and $i_t^{*,j+1}$ is the average interest rate paid at time t on non-bills debt securities which were first issued in year $t-1-j$.

Finally, we compute our counterfactual history of $\hat{D}_t$ from 1947 up to 2021 by using equation (B.2). The key variable is the counterfactual non-distorted average effective interest rate $\hat{i}_t$, defined in equation (B.15) under Assumption 1. To compute it, we need to compute the actual average effective interest rate i_t, the interest rate adjustment x_t^{j+1} defined in equation (B.21), and the reverse maturity structure of debt held by the public w_{t-1}^{j} defined in equation (B.12).

[14] From January 1842 until 1977, the fiscal year began in July. From July 1977 onwards, the fiscal year has started in October. For example, FY 2021 started on October 1st 2020 and ended on September 30th 2021.

C Appendix - Data

For replication purposes, this section describes the source of our data and any treatment applied to the original data in order to perform our analysis.

C.1 Public Debt Database

Pre-1960

For the pre-1960 period, our source is Hall, Payne, and Sargent (2018). In particular, we use their BondQuant and BondList databases[15] which provide, respectively, quantities and descriptions of all securities issued by the U.S. Treasury between 1776 and 1960[16]. More specifically, we use the following procedure to construct our dataset:

1. Use the BondQuant database and filter the "Series" data (column B) to keep "Public Holdings" rows only as we are interested in publicly-held debt.

2. Reshape wide to long and keep one month only (June, i.e. the end of FY) for every year.

3. Use the L1 ID numerical ID, which uniquely identifies debt securities, to match public holdings data to the security's characteristics (notably its first issue date, its payable date, and its coupon rate) contained in the BondList database.

4. For each security and Year, use the information contained in the variables FirstIssueDate and PayableDate to compute the variables InitialMaturity[17] and CurrentMaturity[18]. (Perform some checks to compare the FirstIssueDate and PayableDate to the first and last occurrence of the security in the database. Replace missing values for FirstIssueDate and PayableDate with, respectively, the first and last occurrence of the security in the database.)[19]

Post-1960

For the post-1960 period, our source is the CRSP Monthly US Treasury Database which provides quantities and descriptions of marketable securities held by the public, excluding Treasury bills, issued by the U.S. Treasury between 1925 and 2021. In particular, we use the TFZ_MTH, TFZ_ISS, and TFZ_MAST data-sets[20]. The CRSP database reports quantities of publicly held marketable bonds and notes back to 1960. The CRSP database does not

[15] Data are available at https://github.com/jepayne/US-Federal-Debt-Public. Screenshots below.

[16] Both the CRSP and Hall et al. (2018) databases provide a monthly snapshot of the outstanding public debt by using information originally contained in the Monthly Statement of the Public Debt (MSPD).

[17] Defined as PayableDate - FirstIssueDate

[18] Defined as PayableDate - Year

[19] Code available upon request.

[20] More information can be found in the CRSP US Treasury Database Guide.

contain data for non-marketable debt and Treasury bills. More specifically, we use the following procedure to construct our dataset:

1. Merge the TFZ_MTH, TFZ_ISS, and TFZ_MAST data-sets (which contain, for each security, information regarding the coupon rate, and the first and last monthly observation) using the variable CRSPID which is the issue identification number.

2. Keep one month only (June before 1976, October after 1977) for every year.

3. For each security and Year, use the information contained in the variables TMFSTDAT, TCALDT and TMATDT, respectively the date of the first monthly observation, the calendar date, and the maturity date, to compute the variables InitialMaturity and CurrentMaturity[21].

Other Fiscal Data

OMB: The nominal GDP data, the outstanding aggregate debt held by the public, the gross interest paid on Treasury debt securities, the interest received by trust funds, net interest payments data, and the total fiscal balance.
Hall: The aggregate outstanding marketable and non-marketable debt held by the public.
Treasury Bulletin: The aggregate amounts of Treasury bills and TIPS securities.
Global Financial Database: Data on nominal yields by maturity.

C.2 Inflation Database

GDP deflator - NIPA. For the GDP deflator inflation rate, we use Line 1 of NIPA Table 1.1.9 ("Implicit Price Deflator for Gross Domestic Product"), which is the quarterly time series for the GDP price index. The quarterly time series begins from the 1st quarter of 1947. We take these quarterly GDP deflator index values $P_{t,q}^{GDP}$ for year t and quarter q. This time series data is also listed in the FRED database, listed below as GDP-BEA.

GNP/GDP/PCE deflator - NBER/NIPA. The sources are the following:
1942-1947: GNP-NBER.
1947-2021: GNP-BEA, GDP-BEA, PCE-BEA.

CPI inflation - BLS. For the CPI inflation rate, we use the time series for "All items in U.S. city average, all urban consumers, not seasonally adjusted" (CUUR0000SA0), from the U.S. Bureau of Labor Statistics. This time series beginning on January 1913 is on a monthly basis, so we take quarterly average values for each quarter to get quarterly CPI values $P_{t,q}^{CPI}$ for Fiscal year t and quarter q. This time series data is also listed in the FRED database under the time series CPIAUCNS.

[21] Code available upon request.

Short-term expectations - Livingston survey. For short-term inflation expectations for Fiscal Years 1951 to 1969, we use median growth rate forecasts of CPI inflation from the semiannual Livingston Survey. Specifically, we use the Excel file for "Growth of Median Forecast for the Levels of Survey Variables" at the Livingston Survey website at the Federal Reserve Bank of Philadelphia.

1. Look under the "CPI" sheet of the Excel file for "Median Forecast Data for Levels".
2. Take the variable $G\_BP\_To\_12M$ values for observations beginning with "6" from 1948 to 1969, i.e. "648", "649", and so on. For example, the June 1951 survey observation is listed under 651, and corresponds to 1-year CPI inflation expectations at Fiscal Year 1951 of Fiscal Year 1952, or $\pi^{eS}_{1951} = \mathbb{E}_{1951}[\pi_{1952}]$.

Short-term expectations - SPF. For short-term inflation expectations for Fiscal Years 1970 to 1976, we use median level forecasts of the GNP/GDP price index (i.e. forecasts of the GNP/GDP deflator inflation rate) from the Survey of Professional Forecasters[22]. In the Survey of Professional Forecasters, the current quarter value for the GDP price index in the quarter in which the survey is taken is under the variable $PGDP2$. The 4-quarter ahead median forecast for the GDP price index is under the variable $PGDP6$, and the 1-quarter ahead median forecast under variable $PGDP3$.

1. Look under the "PGDP" sheet of the Excel file for "Median Forecast Data for Levels".
2. For Fiscal Years 1970 to 1976:
   (a) Take the observations from the 2nd quarter of calendar years 1970[23] to 1976.
   (b) Compute the percentage change between the $PGDP6$ values and the $PGDP2$ values. This is done by dividing the $PGDP6$ value with the $PGDP2$ value (then subtracting by 1 and multiplying by 100 to get the expected inflation rate in percentage points).
3. For the Transition Quarter:
   (a) Take the observations from the 2nd quarter at calendar year-quarter 1976:Q3.
   (b) Divide the $PGDP3$ value with the $PGDP2$ value, then subtract by 1 and multiply by 100 to get the expected inflation rate in percentage points during the Transition Quarter.
4. For Fiscal Years 1977 to 2021:
   (a) Take the observations from the 3rd quarter of calendar years 1977 to 2021.

[22] Data are available at the Survey of Professional Forecasters at the Federal Reserve Bank of Philadelphia.

[23] While the Survey of Professional Forecasters began in the 4th quarter of calendar year 1968, the first 2nd quarter forecasts of 1-year inflation rates is in 1970.

(b) Compute the percentage change between the $PGDP6$ values and the $PGDP2$ values, as done in Fiscal Years 1970-1976.

Long-term expectations - FRB/US[24]. For long-term inflation expectations for Fiscal Years 1968 to 2021, we use the FRB/US 10-year PCE inflation forecasts starting from the 1st quarter of calendar year 1968, available at the Federal Reserve's FRB/US Model website. This quarterly time series begins from the 1st quarter of calendar year 1968. As in short-term inflation expectations, we use the 2nd calendar quarter values for fiscal years 1968 to 1976, the 3rd quarter value of calendar year 1976 divided by 4 for the Transition Quarter, and then the 3rd calendar quarter values for fiscal years 1977 to 2021.

In order to extend the long-term inflation expectations series back to 1951, we regress the difference between the long-term and the HP filtered short-term GDP deflator expectations, denoted respectively by $\pi_t^{GDP,eL}$ and $\tilde{\pi}_t^{GDP,eS}$, on the change in the HP filtered short-term GDP deflator expectation $\Delta\tilde{\pi}_t^{GDP,eS}$ for period between 1968 and 1997, and obtain the fitted values for long-term GDP deflator expectation for the period from 1951 to 1967. We apply the HP filter on short-term expectations for the entire sample from 1950 to 2021. The smoothing parameter λ is set to 100.

Table 1 Long-term and HP Filtered Short-term Expectations

VARIABLES	$\pi_t^{GDP,eL} - \tilde{\pi}_t^{GDP,eS}$
$\Delta\tilde{\pi}_t^{GDP,eS}$	-1.549***
	[0.217]
Observations	30
R-squared	0.637

Standard errors in brackets
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

[24] Historical values of PTR come from several sources. Since 1991Q4, the source is the Survey of Professional Forecasters (SPF), first for expected CPI inflation and then, when it becomes available in 2007, for expected PCE price inflation. PTR data from 1981Q1 to 1991Q3 is primarily from a survey conducted by Richard Hoey. The Hoey and SPF CPI observations are reduced by 40 basis to account for the average difference between CPI and PCE inflation. Values of PTR before 1981 are constructed in a manner similar to the one described in Kozicki and Tinsley (2001, section 3.3), "Term Structure Views of Monetary Policy under Alternative Models of Agent Expectations," Journal of Economic Dynamics and Control, 25: 149-184.

C.3 Inflation and Inflation Expectations

This subsection describes our procedure to obtain inflation expectations for different horizons, using both the 1-year or short-term inflation forecasts π_t^{eS} and 10-year annual average or long-term inflation forecasts π_t^{eL} as defined in the main text. To obtain our estimates, we make two assumptions; we first assume that inflation expectations adjust linearly for the first 5 years, then stay constant for all years $j > 5$.

Given a linear increment k_t for adjusting inflation expectations for years $2 \leq j5$:

$$\mathbb{E}_t[\pi_{t+j}] = \mathbb{E}_t[\pi_{t+1}] + (j-1)k_t \text{ for } 2 \leq j \leq 5 \tag{C.1}$$

$$\mathbb{E}_t[\pi_{t+j}] = \mathbb{E}_t[\pi_{t+5}] \text{ for } j > 5 \tag{C.2}$$

We also assume that the annual average of expected inflation rates for the first 10 years equals long-term inflation expectations:

$$\pi_t^{eL} = \frac{1}{10}\sum_{i=1}^{10} \mathbb{E}_t[\pi_{t+i}] \tag{C.3}$$

Given these assumptions, we solve for k_t:

$$\begin{aligned}
\pi_t^{eL} &= \frac{1}{10}\sum_{i=1}^{10} \mathbb{E}_t[\pi_{t+i}] \\
&= \frac{1}{10}\sum_{i=1}^{10} [10\mathbb{E}_t[\pi_{t+1}] + (1+2+3+4)k_t + (4+4+4+4+4)k_t] \\
10\pi_t^{eL} &= 10\pi_t^{eS} + 30k_t
\end{aligned}$$

We obtain:

$$k_t = \frac{\pi_t^{eL} - \pi_t^{eS}}{3} \tag{C.4}$$

Thus, we can use those measures of expectations to calculate inflation forecast errors at different time horizons. This procedure works well for forecasts made during fiscal years 1951 to 1971, and fiscal years 1977 to 2021.

However, computing the path of inflation expectations is more tedious when the Transition Quarter lies within five years after the quarter during which the inflation expectations are made. This is because starting from the 3rd quarter of 1976, the fiscal year shifts by one quarter. Thus, to obtain the inflation expectation for a fiscal year after TQ which was made before TQ, we have to adjust all forecasts by one quarter. For example, a 1-year ahead forecast, which would normally corresponds to the average forecast over the next 4 quarters, will in this case correspond to the average forecast over the 2nd to 5th quarters ahead. Similarly, a 2-year ahead forecast, which would normally corresponds to the average forecast over the 5th to 8th quarters ahead, will in this case correspond to the average forecast over the 6th to 9th quarters ahead. In practice, this issue arises for the expectations made in fiscal years 1972 to 1976. We describe our procedure to obtain expectations made during those fiscal years in the next section, and find that it provides estimates which are similar to the ones obtained from the above procedure.

C.4 Inflation and Inflation Expectations: Quarterly Procedure

In this section, we compute inflation expectations for different horizons made in the last quarter of each fiscal year from 1972 to 1976. We denote by $\mathbb{E}_t[\pi_{t,q}]$ the q-quarter ahead expected inflation rate made in the last quarter of fiscal year t, with $1 \leq q$. For example, $\mathbb{E}_{1976}[\pi_{1976,5}]$ denotes the 5-quarter ahead expected inflation rate made in the last quarter of 1976.

The Survey of Professional Forecasters provides data for the 1-quarter to 4-quarter ahead inflation expectations for the fiscal years from 1972 to 1976. Put differently, the Survey of Professional Forecasters already provides the data for $\mathbb{E}_t[\pi_{t,q}]$ for $1972 \leq t \leq 1976$ and $1 \leq q \leq 4$. We will also use the 10-year annual average of long-term inflation forecasts π_t^{eL} as defined in the main text.

To obtain our estimates, we make the assumption that inflation expectations adjust linearly from the 4th to 20th quarters, and then stay constant for all quarters $q > 20$. Given a linear increment k_t for adjusting inflation expectations for quarters $4 \leq q 20$:

$$\mathbb{E}_t[\pi_{t,q}] = \mathbb{E}_t[\pi_{t,4}] + (q-4)k_t \text{ for } 4 \leq q \leq 20 \quad \text{(C.5)}$$

$$\mathbb{E}_t[\pi_{t,q}] = \mathbb{E}_t[\pi_{t,20}] \text{ for } q > 20 \quad \text{(C.6)}$$

This linear adjustment is set such that annual average inflation expectation for the first 40 quarters equals long-term inflation expectation:

$$\pi_t^{eL} = \frac{1}{40}\sum_{q=1}^{40} \mathbb{E}_t[\pi_{t,q}] \quad \text{(C.7)}$$

Given these assumptions, we solve for k_t:

$$40\pi_t^{eL} = \sum_{q=1}^{3} \mathbb{E}_t[\pi_{t,q}] + 37\mathbb{E}_t[\pi_{t,4}] + 456k_t \quad \text{(C.8)}$$

We obtain:

$$k_t = \frac{1}{456}\left[40\pi_t^{eL} - \sum_{q=1}^{3} \mathbb{E}_t[\pi_{t,q}] - 37\mathbb{E}_t[\pi_{t,4}]\right] \quad \text{(C.9)}$$

Finally, we combine quarterly expected inflation rates over each fiscal year to obtain a measure of inflation expectations by fiscal year:

$$\mathbb{E}_t[\pi_{t+j}] = \left[\prod_{q=4j+1}^{4(j+1)} (1 + \mathbb{E}_t[\pi_{t,q}])\right]^{1/4} - 1 \tag{C.10}$$

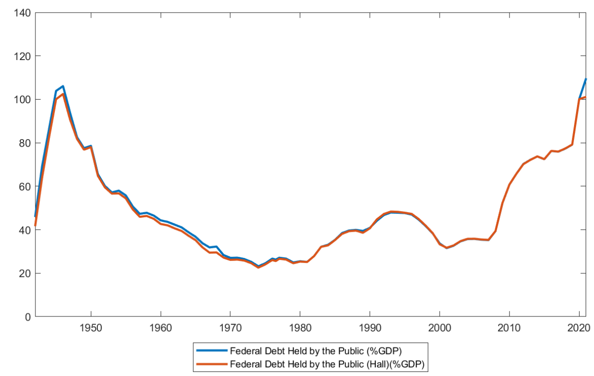
where, as in the main text, $\mathbb{E}_t[\pi_{t+j}]$ is the expectation of the GDP deflator in fiscal year $t + j$ made in the last quarter of fiscal year t.

We use this procedure to obtain the term structure of inflation expectation for fiscal years t from 1972 to 1976, and use the procedure described in the previous subsection for expectations made in all fiscal years before 1972 or after 1976.

D Additional Charts - Not for Publication

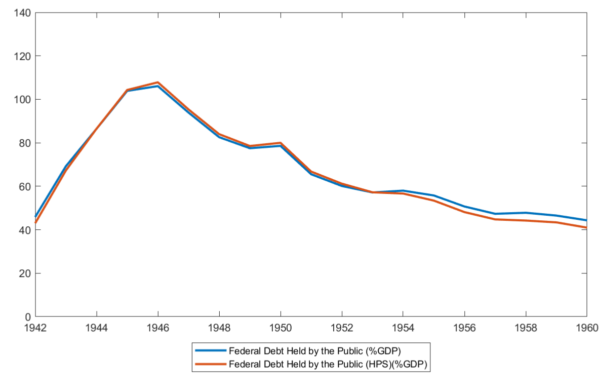
D.1 Debt Held by the Public

Figure 10 Federal Debt
Held by the Public as a Percent of GDP



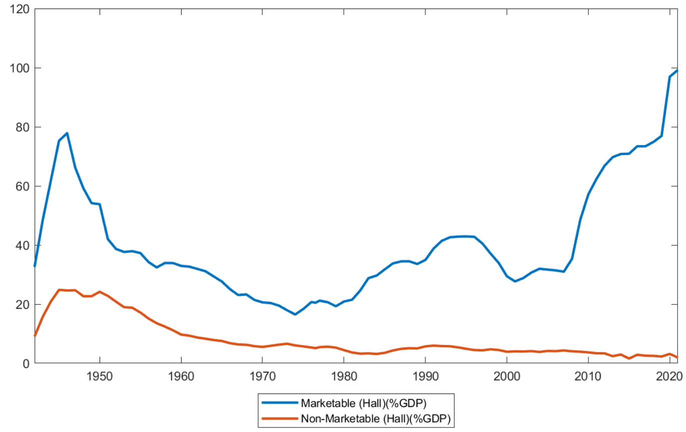
Note. The lines represent the ratio of the par value of outstanding Treasury securities held by the public to GDP. Source: OMB for GDP, OMB and Hall for Federal Debt held by the public.

Figure 11 Pre-1960 Federal Debt
Held by the Public as a Percent of GDP



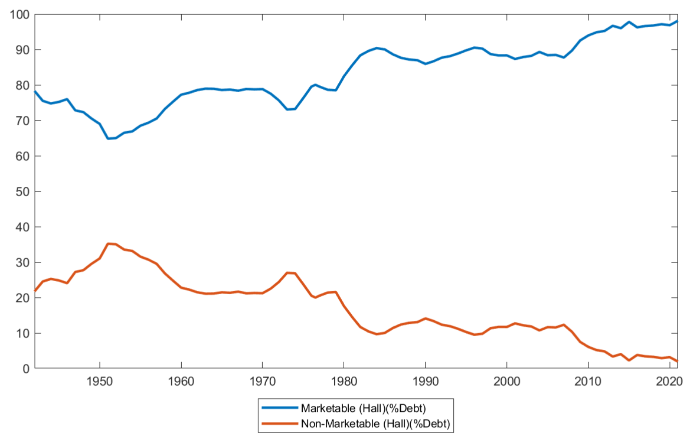
Note. The lines represent the ratio of the par value of outstanding Treasury securities held by the public to GDP. Source: OMB for GDP, OMB and Hall, Payne, and Sargent (2018) for Federal Debt held by the public.

Figure 12 Marketable and Non-Marketable Federal Debt Held by the Public as a Percent of GDP



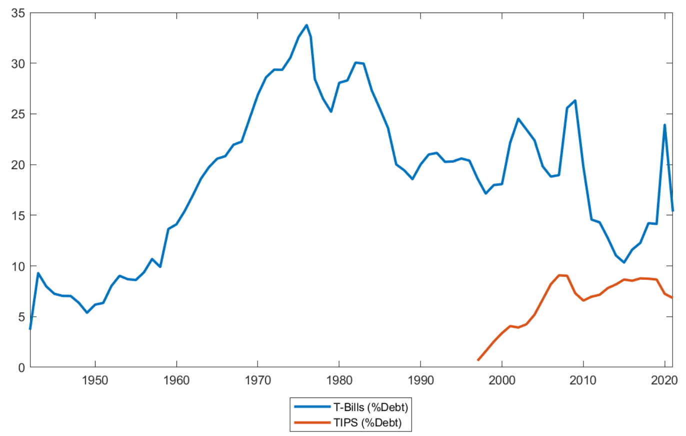
Note. The lines represent the ratio of the par value of marketable and non-marketable outstanding Treasury securities held by the public to GDP. Source: OMB, Hall.

Figure 13 Marketable and Non-Marketable Federal Debt Held by the Public as a Percent of Federal Debt



Note. The lines represent the ratio of the par value of marketable and non-marketable outstanding Treasury securities held by the public to Federal Debt. Source: Hall.

Figure 14 Share of Treasury Bills and TIPS in Outstanding Public Debt



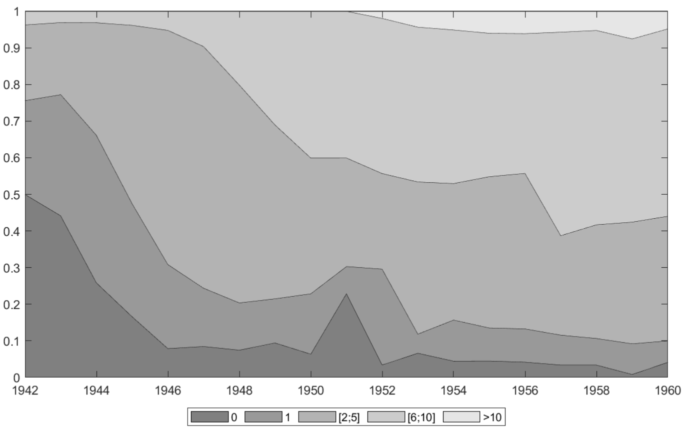
Note. This chart represents the share of Treasury bills and TIPS in total outstanding debt held by the public. Source: Treasury Bulletin.

D.2 Reverse Maturity Structure

Figure 15 Reversed Maturity Structure of Marketable Public Debt Pre-1960

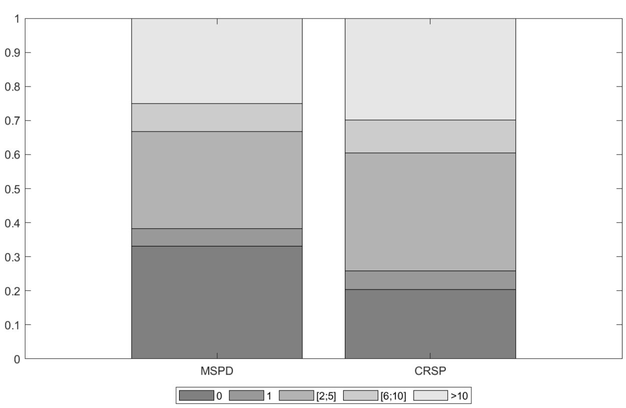
Note. This chart represents the reverse maturity structure of the total debt held by the public between 1942 and 1960, computed using equation (B.9). The different shades represent the share of the outstanding debt held by the public at the end of fiscal year t which was issued in the same year, last year, 2 to 5 years ago, 6 to 10 years ago, and more than 10 years ago. Lighter shades are associated with longer reverse maturity. Source: Authors' calculations.

Figure 16 Reversed Maturity Structure of Non-Marketable Public Debt



Note. This chart represents the reverse maturity structure of the non-marketable debt held by the public between 1942 and 1960, computed using equation (B.10). The different shades represent the share of the outstanding debt held by the public at the end of fiscal year t which was issued in the same year, last year, 2 to 5 years ago, 6 to 10 years ago, and more than 10 years ago. Lighter shades are associated with longer reverse maturity. Source: Authors' calculations.

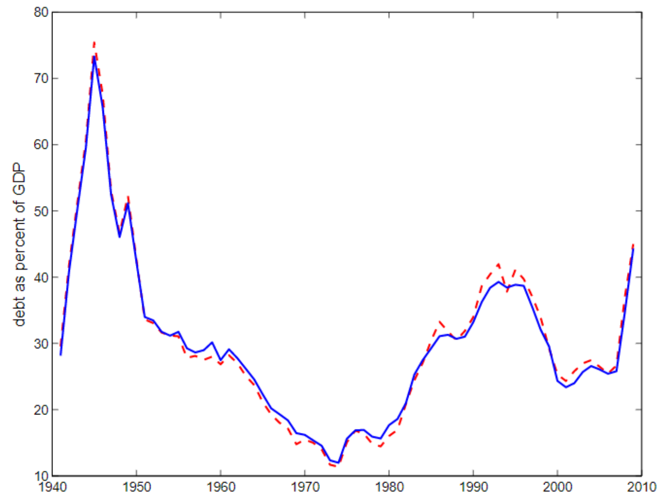
Figure 17 Reverse Maturity Structure of Marketable Non-Bills in 1960: MSPD and CRSP



Note. This chart represents the reverse maturity structure of the marketable non-bills debt held by the public in 1960, both according to MSPD (left bar) and CRSP (right bar) datasets. The different shades represent the share of the outstanding debt held by the public at the end of fiscal year t which was issued in the same year, last year, 2 to 5 years ago, 6 to 10 years ago, and more than 10 years ago. Lighter shades are associated with longer reverse maturity. Source: Authors' calculations.

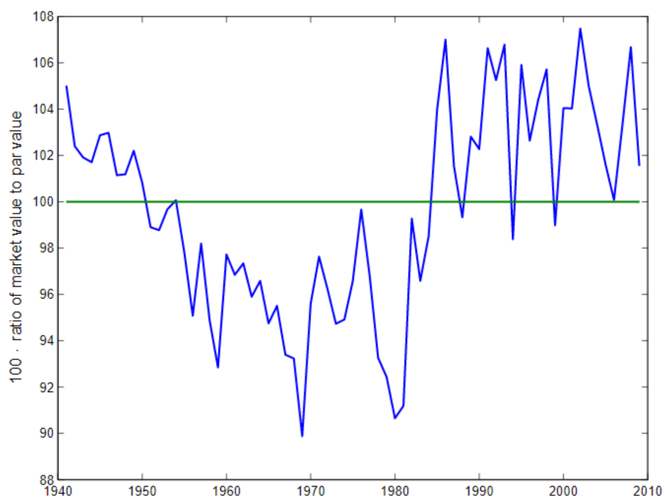
D.3 Par Versus Market Value

Figure 18 Par Value and Market Value of Marketable Debt Held by the Public as a Percent of GDP



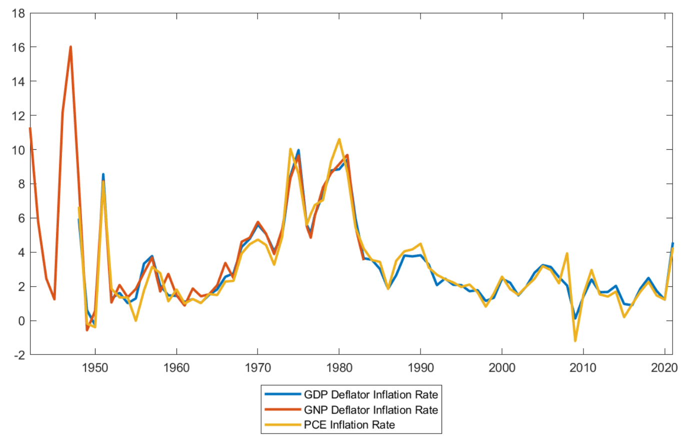
Note. The solid blue line is the ratio of the par value of marketable Treasury securities held by the public to GDP. The dashed red line is ratio of the market value of marketable Treasury securities held by the public to GDP. Source: Borrowed from Hall and Sargent (2011).

Figure 19 Ratio of the Market Value of Marketable Debt Held by the Public to its Par Value



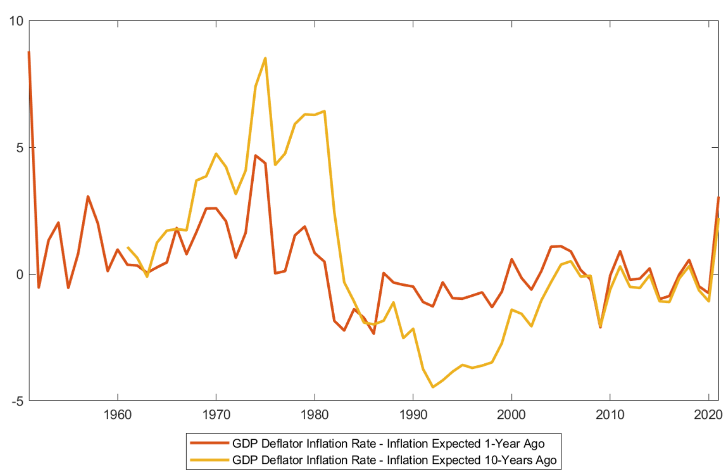
D.4 Inflation and Inflation Expectations

Figure 20 GDP Deflator (1948-2021) and GNP Inflation (1942-1983): π_t^{GDP}



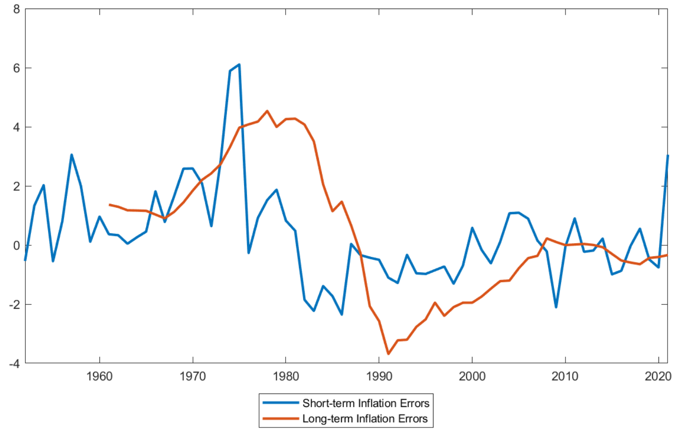
Note. The blue, orange, and yellow lines represent, respectively, the GDP deflator inflation rate, the GNP deflator inflation rate, and the PCE inflation rate. Sources: Bureau of Economic Analysis, NBER "The American Business Cycle" Database.

Figure 21 Inflation Surprises



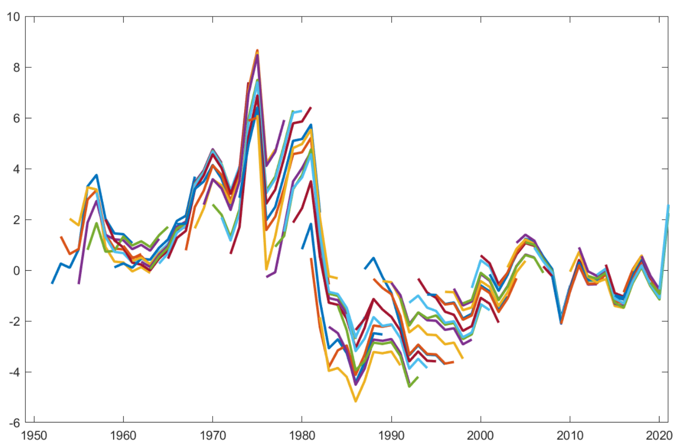
Note. The lines represent the differences between the GDP deflator inflation rate and its forecast values made 1 year and 10 years ago. Source: Authors' calculations.

Figure 22 Short-Term and Long-Term Inflation Expectations Errors



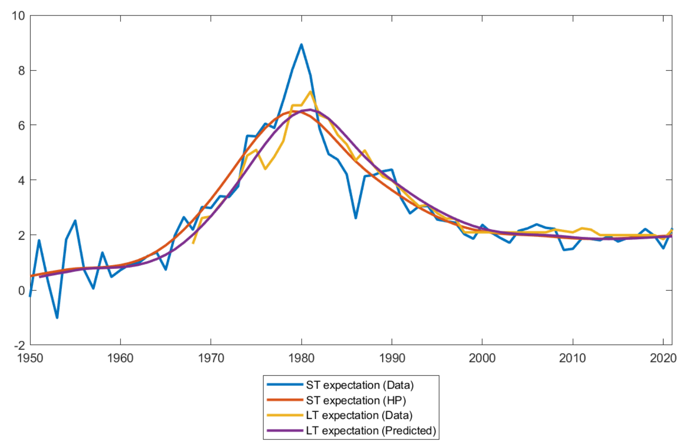
Note. Sources: Livingston Survey, Survey of Professional Forecasters, Federal Reserve Bank of New York FRB/US Model, authors' calculations. The short-term expectations errors are computed as: $\pi_t^{GDP} - \pi_{t-1}^{GDP,eS}$. The long-term expectations errors are computed as: $\frac{1}{10}\sum_{j=0}^{9} \pi_{t-j}^{GDP} - \pi_{t-10}^{GDP,eL}$. Variables are defined in the Data section.

Figure 23 Inflation Surprises: $\pi_t - \mathbb{E}_{t-1-j}[\pi_t]$



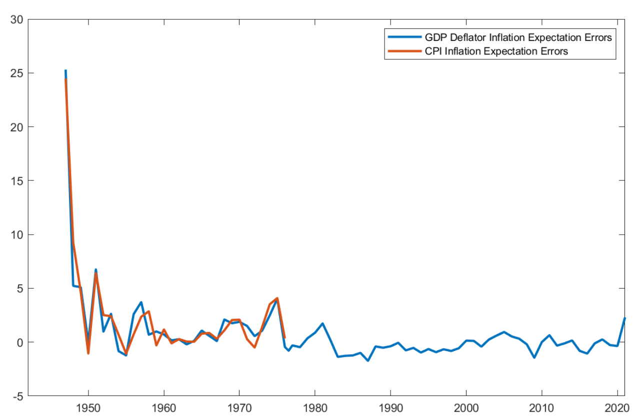
Note. Each line indicates the inflation expectation errors from expectations made at the year previous to the beginning of the line. Sources: Livingston Survey, Survey of Professional Forecasters, Federal Reserve Bank of New York FRB/US Model, authors' calculations.

Figure 24 Short-term and Long-term Inflation Expectations Time Series



Note. Sources: Livingston Survey, Survey of Professional Forecasters, Federal Reserve Bank of New York FRB/US Model, authors' calculations.

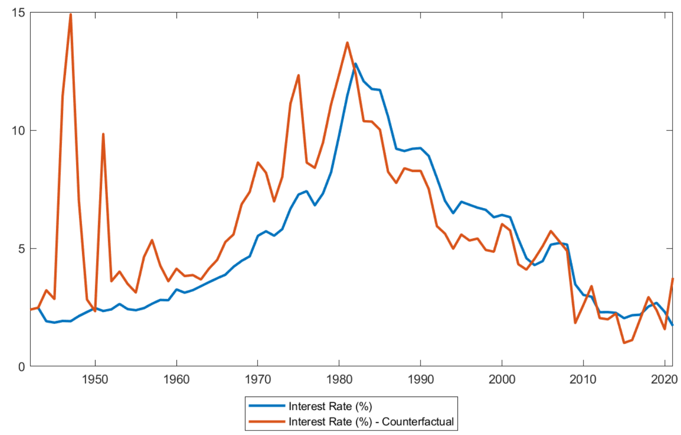
Figure 25 GNP Deflator and CPI Inflation Expectations Errors



Note. The line for CPI inflation expectation errors is computed as the actual CPI inflation rate (FRED) minus the expected CPI inflation rate (Livingston Survey), from FY 1947 to FY 1976. The line for the GDP inflation expectation errors is computed as the GDP deflator inflation rate (FRED) minus the expected GDP deflator inflation rate (Survey of Professional Forecasters). The GDP deflator inflation rate time series, as used in this graph, is composed of the GNP deflator inflation rate (NBER American Business Cycle dataset) from FY 1942 to FY 1947, then the GDP deflator inflation rate (FRED) from FY 1948 to FY 2021. The GDP deflator inflation expectations time series is composed of GNP deflator inflation expectations from FY 1970 to FY 1991 (Survey of Professional Forecasters), then the GDP deflator inflation expectations from FY 1992 to FY 2021 (Survey of Professional Forecasters). Sources: FRED, NBER Ameriacan Business Cycle dataset, Livingston Survey, Survey of Professional Forecasters, Federal Reserve Bank of New York FRB/US Model, authors' calculations.

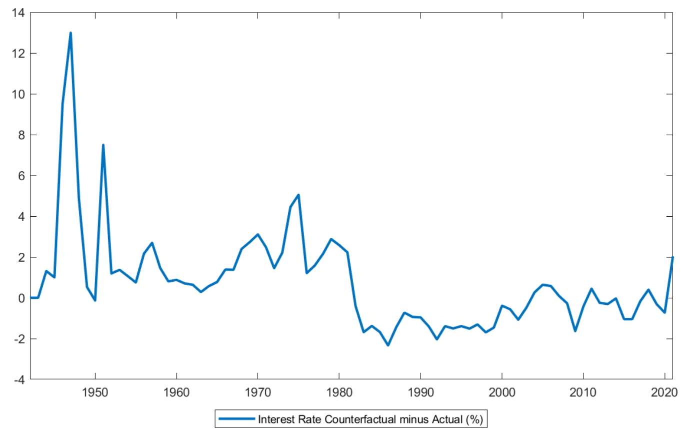
D.5 Interest Rate Adjustment

Figure 26 Effective Average Interest Rates



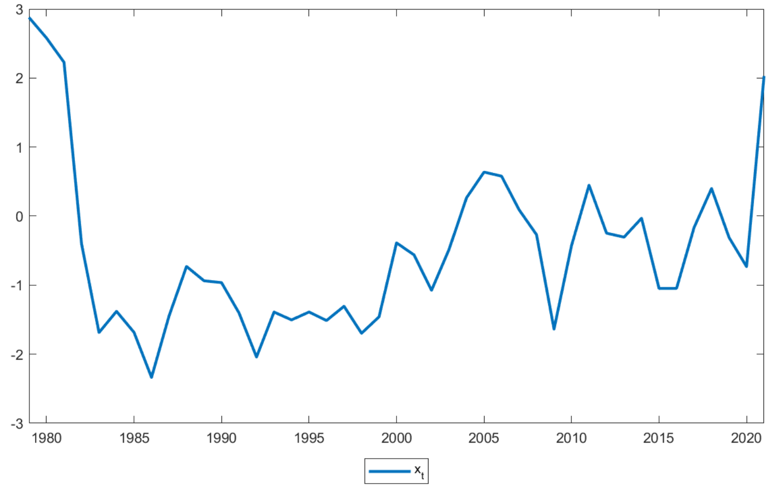
Note. The lines represent the average effective interest rate on debt held by the public and its counterfactual. Source: Authors' calculations.

Figure 27 Effective Interest Rate Differential



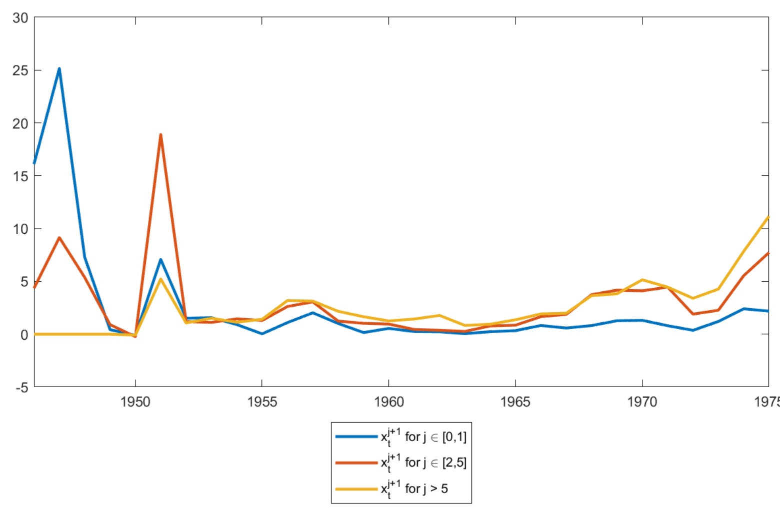
Note. The line represents the difference between the counterfactual and the average effective interest rate on debt held by the public. Source: Authors' calculations.

Figure 28 Effective Interest Rate Differential (1978-1921)



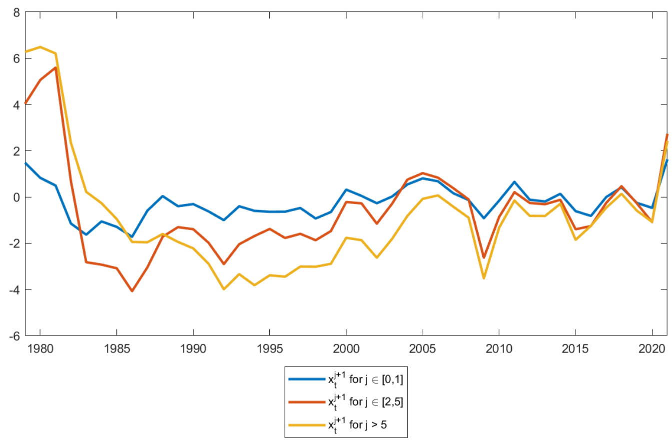
Note. The line represents the difference between the counterfactual and the average effective interest rate on debt held by the public. Source: Authors' calculations.

Figure 29 Effective Interest Rate Differential by Reverse Maturity (1951-1975)



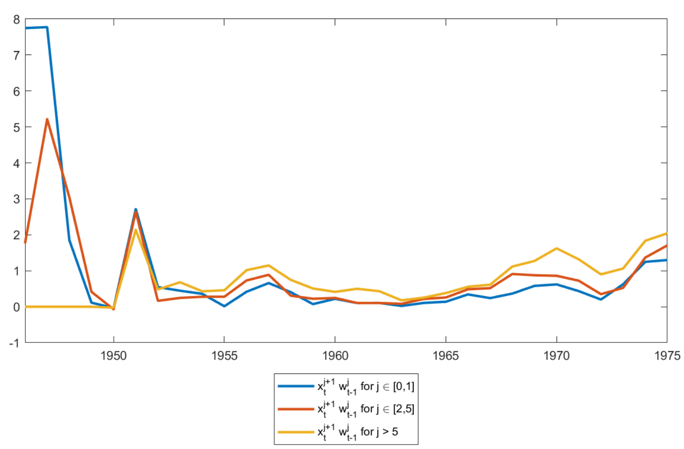
Note. The line represents the difference between the counterfactual and the average effective interest rate on debt held by the by reverse Maturity. Source: Authors' calculations.

Figure 30 Effective Interest Rate Differential by Reverse Maturity (1978-1921)



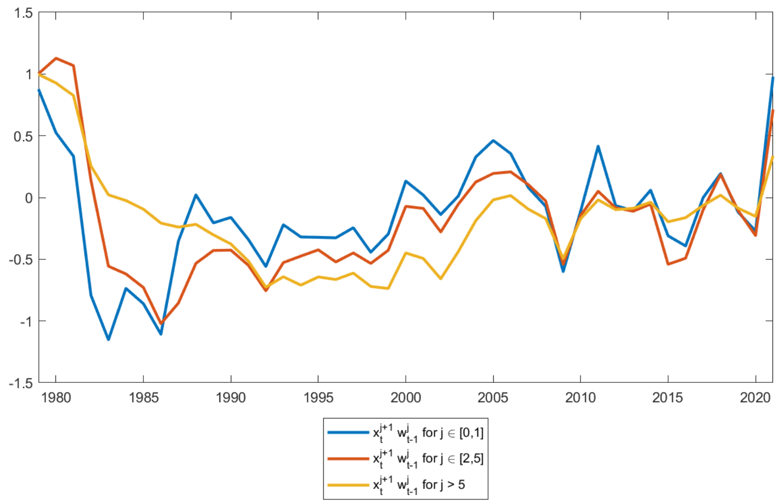
Note. The line represents the difference between the counterfactual and the average effective interest rate on debt held by the by reverse Maturity. Source: Authors' calculations.

Figure 31 Effective Interest Rate Differential by Weighted Reverse Maturity (1951-1975)



Note. The line represents the difference between the counterfactual and the average effective interest rate on debt held by the by weighted reverse Maturity. Source: Authors' calculations.

Figure 32 Effective Interest Rate Differential by Weighted Reverse Maturity (1978-1921)



Note. The line represents the difference between the counterfactual and the average effective interest rate on debt held by the by weighted reverse Maturity. Source: Authors' calculations.

Table 2 Decomposition of the Average Effective Interest Rate Adjustment x_t
Selected Years post WWII

Variable	j	1946	1947	1948	1951	1957	1969	1970	1974	1975
$\mathbf{x_t}$		9.51	12.99	4.90	7.50	2.69	2.73	3.11	4.45	5.05
$x_t^{j+1} w_{t-1}^j$	0	4.99	4.63	1.20	2.27	0.33	0.45	0.35	0.84	0.85
	1	2.76	3.15	0.66	0.44	0.33	0.13	0.27	0.41	0.45
	[2:5]	1.76	5.22	3.05	2.64	0.89	0.88	0.86	1.37	1.71
	> 5	0.00	0.00	0.00	2.14	1.15	1.27	1.62	1.83	2.04
w_{t-1}^j	0	0.29	0.20	0.22	0.25	0.28	0.38	0.42	0.45	0.53
	1	0.19	0.11	0.04	0.13	0.05	0.08	0.06	0.07	0.06
	[2:5]	0.44	0.57	0.57	0.14	0.29	0.21	0.21	0.25	0.22
	> 5	0.08	0.12	0.18	0.48	0.38	0.33	0.32	0.23	0.18
x_t^{j+1}	0	17.34	23.09	5.47	8.92	1.16	1.17	0.83	1.89	1.60
	1	14.25	28.96	18.40	3.43	7.25	1.75	4.88	5.47	6.96
	[2:5]	4.01	9.15	5.37	18.91	3.05	4.16	4.10	5.53	7.73
	> 5	0.00	0.00	0.00	4.49	2.99	3.82	5.15	7.84	11.18

NOTE. The table provides a decomposition of the average effective interest rate adjustment x_t for selected years. The years shows corresponds to the ones for which the adjustment x_t was above the average adjustment x_t over the period 1946-1975. Source: Authors' calculations.

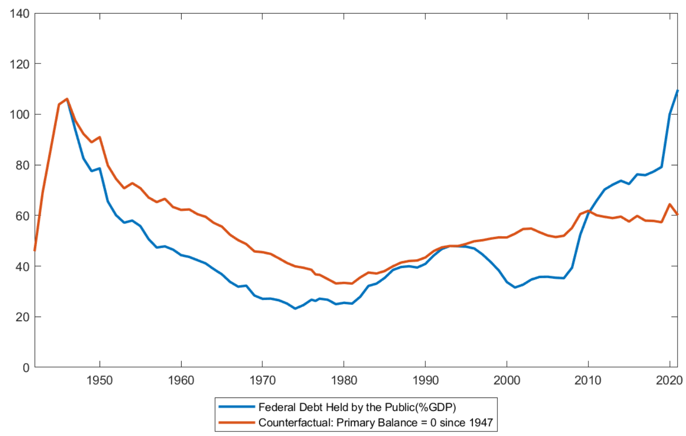
Table 3 Decomposition of the Average Effective Interest Rate Adjustment x_t
Selected Years post 1975

Variable	j	1979	1980	1981	1983	1984	1985	1986	1987	2021
$\mathbf{x_t}$		2.88	2.58	2.23	-1.69	-1.38	-1.68	-2.34	-1.45	2.03
$x_t^{j+1} w_{t-1}^j$	0	0.38	0.16	0.11	-0.51	-0.34	-0.38	-0.56	0.01	0.69
	1	0.50	0.37	0.22	-0.64	-0.39	-0.48	-0.55	-0.36	0.29
	[2:5]	1.00	1.13	1.07	-0.56	-0.62	-0.73	-1.02	-0.85	0.71
	> 5	1.00	0.93	0.83	0.02	-0.02	-0.09	-0.21	-0.24	0.34
w_{t-1}^j	0	0.44	0.51	0.51	0.55	0.50	0.49	0.45	0.41	0.46
	1	0.15	0.12	0.16	0.16	0.20	0.17	0.19	0.19	0.14
	[2:5]	0.25	0.22	0.19	0.20	0.21	0.24	0.25	0.28	0.26
	> 5	0.16	0.14	0.13	0.10	0.09	0.10	0.11	0.12	0.14
x_t^{j+1}	0	0.87	0.30	0.22	-0.93	-0.70	-0.78	-1.23	0.02	1.52
	1	3.28	3.02	1.36	-4.06	-1.94	-2.78	-2.90	-1.91	1.99
	[2:5]	4.03	5.06	5.60	-2.82	-2.93	-3.08	-4.08	-3.04	2.74
	> 5	6.27	6.49	6.21	0.22	-0.27	-0.96	-1.94	-1.96	2.43

Note. The table provides a decomposition of the average effective interest rate adjustment x_t for selected years. Source: Authors' calculations.

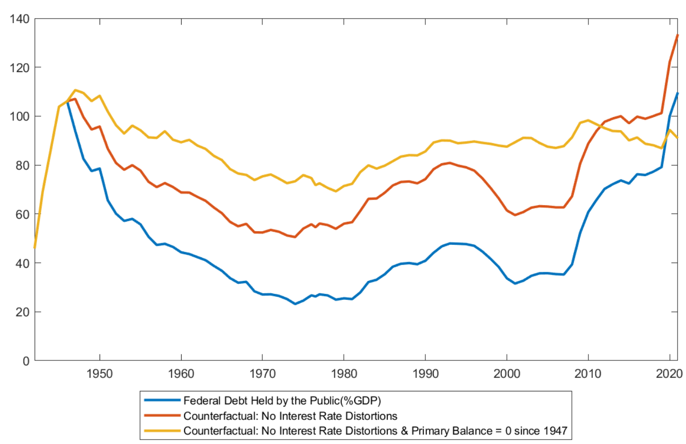
D.6 Counterfactuals

Figure 33 ACTUAL D_t AND COUNTERFACTUAL $\hat{D}_t$ DEBT DYNAMICS: PRIMARY BALANCE ADJUSTMENT



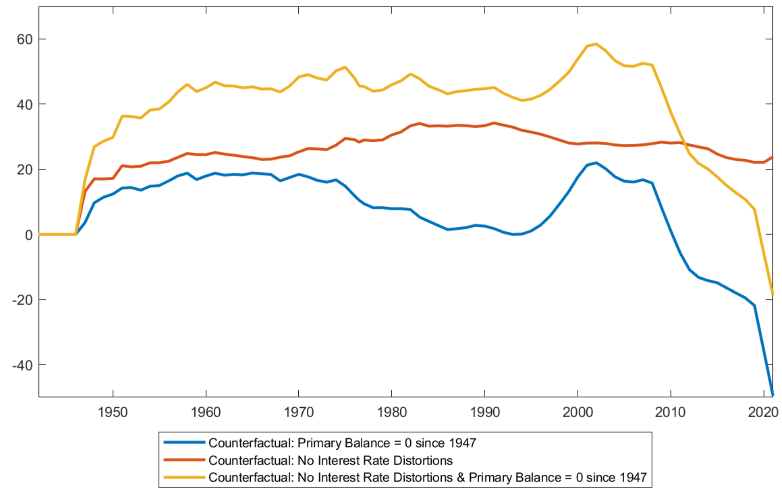
NOTE. The lines represent the the ratio of the par value of outstanding Treasury securities held by the public to GDP and its counterfactual assuming a primary balance equal to zero for every fiscal year starting from 1947. Source: Authors' calculations.

Figure 34 ACTUAL D_t AND COUNTERFACTUAL $\hat{D}_t$ DEBT DYNAMICS: REAL RATES AND PRIMARY BALANCE ADJUSTMENTS



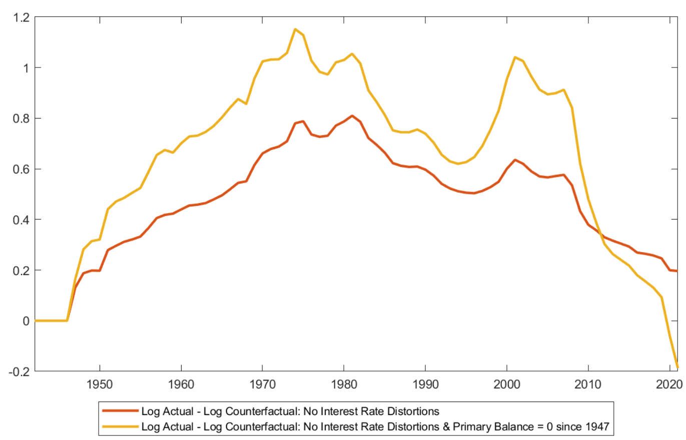
NOTE. The lines represent the the ratio of the par value of outstanding Treasury securities held by the public to GDP and its counterfactual assuming no interest rate distortions alone, and both no interest rate distortions and a primary balance equal to zero for every fiscal year starting from 1947. Source: Authors' calculations.

Figure 35 Difference in Debt Dynamics



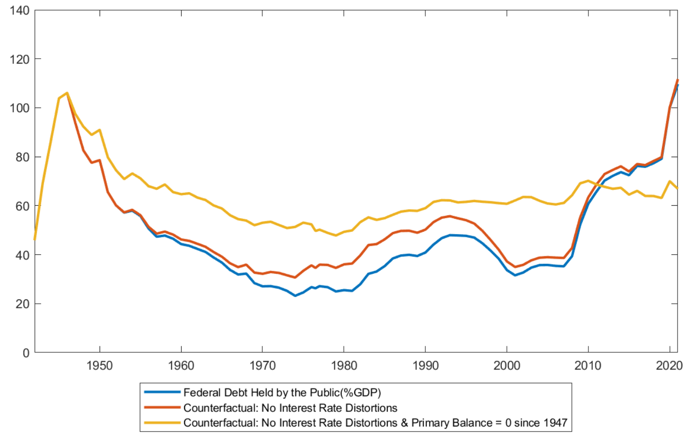
Note. The lines represent the differences in percentage points between our counterfactual estimates and the actual debt to GDP ratio. Source: Authors' calculations.

Figure 36 Log Differences in Debt Dynamics: Real Rates Adjustments



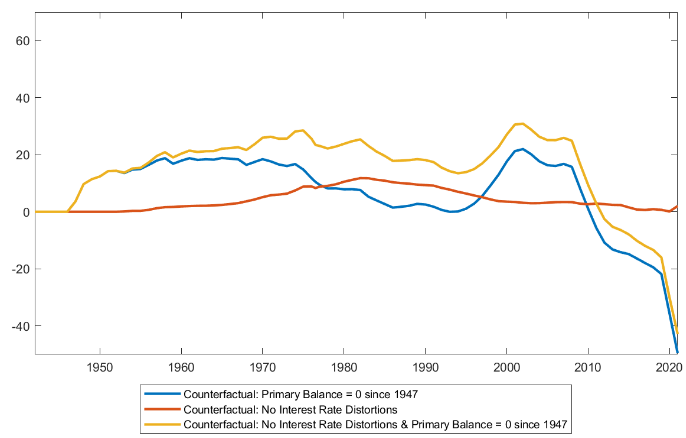
Note. The lines represent the differences between the log of our counterfactual estimates and the log of the actual debt to GDP ratio, assuming no interest rate distortions for debt issued after the Fed-Treasury Accord. Source: Authors' calculations.

Figure 37 ACTUAL D_t AND COUNTERFACTUAL $\hat{D}_t$ DEBT DYNAMICS: PRIMARY BALANCE AND POST ACCORD REAL RATES ADJUSTMENTS



NOTE. The lines represent the the ratio of the par value of outstanding Treasury securities held by the public to GDP and its counterfactual assuming no interest rate distortions for debt issued after the Fed-Treasury Accord, and both no interest rate distortions for debt issued after the Fed-Treasury Accord and a primary balance equal to zero for every fiscal year starting from 1947. Source: Authors' calculations.

Figure 38 DIFFERENCE IN DEBT DYNAMICS: PRIMARY BALANCE AND POST ACCORD REAL RATES ADJUSTMENTS



NOTE. The lines represent the differences in percentage points between our counterfactual estimates and the actual debt to GDP ratio, assuming no interest rate distortions for debt issued after the Fed-Treasury Accord. Source: Authors' calculations.