HOW MONETARY POLICY GOT BEHIND THE CURVE—AND HOW TO GET BACK

EDITED BY
Michael D. Bordo, John H. Cochrane, and John B. Taylor

World Wars: Fiscal-Monetary Consequences

CHAPTER TEN

Financing Big US Federal Expenditures Surges: COVID-19 and Earlier US Wars

George J. Hall and Thomas J. Sargent

Inflation is repudiation. Deflation is assumption.

—Calvin Coolidge (1922)

The first part of this chapter summarizes Hall and Sargent (2022), a pattern recognition exercise in which we described similarities and differences between how the US government financed its "war" on COVID-19 and how it financed World War I and World War II. We asked, who paid for each of these three wars? Was it taxpayers? Bondholders? Money holders? The second part of the chapter consists of additional historical evidence that helps to answer some of the probing questions we received from conference participants. To assemble our answers, we rely heavily on findings reported in Hall and Sargent (2014, 2019, 2021) and Sargent (2012). Throughout the chapter, we use a consolidated government budget constraint as our organizing principle. Data visualization and tabular summaries are our principal techniques. We organize data as though they conform to a "common stochastic trends" process of a type

We thank conference participants and our discussant Ellen McGrattan for suggestions and questions. We especially thank Michael Bordo, James Bullard, John Cochrane, and Patrick Kehoe for their probing questions.

presented by Hansen (2012) and applied to asset pricing by Hansen and Scheinkman (2009). Thus, our main tools for pre-processing the data are taking logs and their differences. As promised by Hansen (2012), these transformations uncover apparently stationary statistical behavior lurking within a suite of randomly growing time series. Thus, see our figures 10.2 and 10.9 below, which serve as virtual poster children for a Barro (1979) tax-smoothing model.

WORLD WARS I AND II AND THE WAR ON COVID-19

We start with some similar private sector patterns across World War I, World War II, and the war on COVID-19. First, the war on COVID-19, like World War I and World War II, was a worldwide adverse shock. Second, all three wars were large shocks to the civilian workforce. In World Wars I and II, the government paid, and in many cases, drafted men to leave the civilian workforce and join the military. During COVID-19, the government paid people to leave the civilian workforce and stay home to slow the spread of the virus. Third, domestic and international travel and trade were sharply curtailed during all three of these wars.

In figure 10.1, we ask what percentages of the working age population were removed from the civilian workforce during these wars? The blue line plots active duty military as a percentage of the total population, and the red line plots the share of the population receiving unemployment insurance. The figure illustrates that 3% of the population was in active duty military during World War I. This share rose to 8.5% during World War II. During COVID-19, 7% of the working-age population was receiving unemployment insurance.

Next, we discuss a few public sector patterns. Consider figure 10.2. The blue line is government expenditures, and the red line is tax revenues, both as a share of GDP. Government spending in the twentieth-century world wars had both temporary and permanent components.

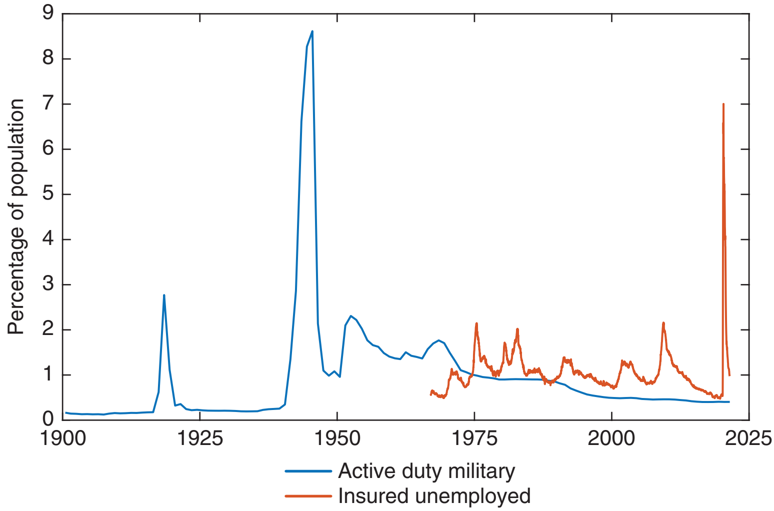

FIGURE 10.1. Active Duty Military and Unemployed Persons Receiving Insurance as Percentages of Total Population: 1900–2021

Sources: Department of Defense (active duty military); Federal Reserve Bank of St. Louis (insured unemployment), https://fred.stlouisfed.org/series/CCSA. Population is total population including armed forces overseas from the Census Bureau.

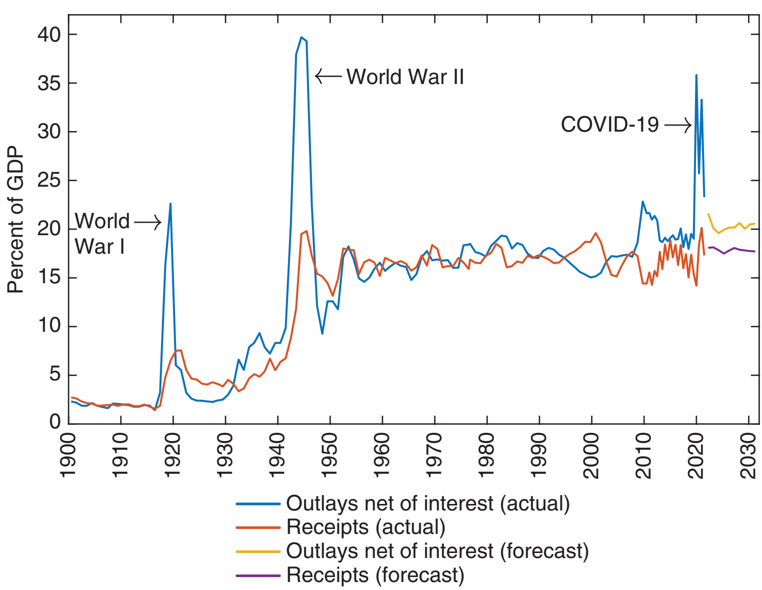

FIGURE 10.2. US Federal Government Expenditures and Receipts: 1900–2031

Sources: *Annual Report of the Secretary of the Treasury on the State of Finances*, 1940 report (1900–40); Office of Management and Budget (1940–2011); *Monthly Treasury Statement* (2011–22); *Interest Expense on the Debt Outstanding*. The forecasts of revenues and outlays for 2022–31 are computed using Congressional Budget Office forecasts, adjusted by the authors.

- Perhaps the most striking feature of this figure is the three spikes in expenditures for World War I, World War II, and COVID-19. While expenditures rose sharply during these wars, tax revenues rose by only a fraction of the total expenditures on the war. This pattern suggests that those wars were partly financed by interest-bearing debt and base money. For COVID-19, tax revenue barely budged, indicating that nearly all war costs were covered by the issuance of interest-bearing debt and base money.
- Immediately after World War I and World War II, both expenditures and tax revenue fell, but notably, after both wars, the government ran primary surpluses, implying that a portion of the wartime debt was repaid quickly. For the post–COVID-19 period, we anticipate a decade of primary deficits—not surpluses. The four major federal spending packages of 2020 and 2021 in response to COVID-19 authorized increases in spending for the next several years.[1] The gold and purple lines plot our forecasts of outlays and tax revenues for the next ten years based on Congressional Budget Office (CBO) projections. In sharp contrast to the post–World War I and World War II periods, in the post-COVID period, outlays are expected to exceed tax revenue for at least ten years.
- After World War I and World War II, expenditures fell, but they did not fall back to their prewar levels. Thus, the government grew as a share of GDP after each war. Based on CBO projections of spending and GDP growth, we anticipate the same after the war on COVID-19.
- Finally, note that the federal government's response to the Great Recession of 2008 looks similar in magnitude as a share of GDP to its response to the Great Depression in the 1930s.

As we noted in figure 10.2, each of these three world wars was financed in part by issuing interest-bearing debt. In figure 10.3, we

1. The CARES Act (signed into law on March 27, 2020); The Consolidated Appropriations Act, 2021 (signed December 27, 2020); The American Rescue Plan (signed March 11, 2021); and The Infrastructure Investment and Jobs Act (signed November 15, 2021).

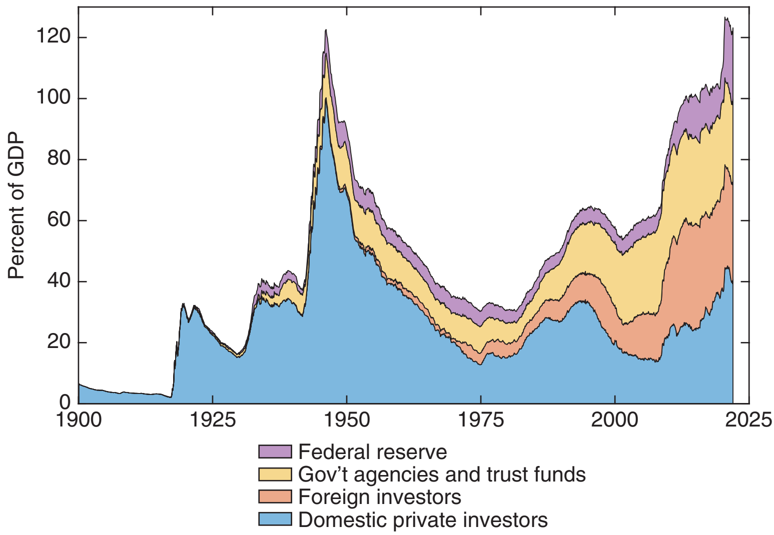

FIGURE 10.3. Par Value of US Treasury Debt by Ownership as a Percent of GDP: 1900 to 2021

Sources: US Treasury Monthly Statement of Public Debt; Federal Reserve Holdings of Treasury securities are from the Federal Reserve System Open Market Account (SOMA). Foreign holdings of US Treasury securities are from the Department of the Treasury's Treasury Bulletin (1939–99); and Treasury International Capital System (2000–21).

plot US Treasury debt as a percentage of GDP and decompose it by ownership. In all three of these wars, Treasury debt increased dramatically and quickly. But the ownership of the debt varied considerably across World War I, World War II, and COVID-19. During World War I, nearly all of the debt was held by domestic private investors (in blue). Fast-forward to 2021—as a very rough approximation—about a fifth of the debt is held by the Federal Reserve (in purple); about a fifth is held by government agencies and trust funds (in yellow); about a quarter is held by foreign investors (in brown); and about a third is held by domestic private investors. Today, a wider range of investors hold the debt than in previous wars.

Table 10.1 reports some of the numbers behind the data plotted in figure 10.3. As noted by other authors in this volume, in 2020 and

TABLE 10.1. Treasury Debt Ownership at Starts and Ends of Three Wars

	World War I		World War II		COVID-19	
	1914:5	1918:12	1939:9	1945:12	2019:12	2021:12
Federal Reserve	$0	$0.3115	$2.80	$19.41	$2,303.5	$5,580.0
	+0.312		+16.61		+3,276.5	
Gov't Agencies and Trust Funds	0	0.1070	6.55	31.88	6,030.9	6,473.5
	+0.107		+25.33		+442.6	
Foreign Investors	—	—	—	2.40	6,844.2	7,739.4
					+895.2	
Domestic Private Investors	1.1893	20.6574	31.51	224.42	8,045.2	9,824.3
	+19.468		+192.91		+1,779.1	
Total	$1.1893	$21.0759	$40.86	$278.11	$23,223.8	$29,617.2
	+19.887		+237.25		+6,393.4	

Sources: US Treasury Monthly Statement of Public Debt; Federal Reserve Holdings of Treasury securities are from the Federal Reserve System Open Market Account (SOMA). Foreign holdings of US Treasury securities are from the Department of the Treasury's Treasury Bulletin (1939–99); and Treasury International Capital System (2000–21).

Notes: The debt is measured at its par value in billions of nominal dollars. The number below and center is the change in the debt holding for each ownership class. Treasury records on holdings by foreign investors begin December 1939.

2021, the Treasury issued about $6.4 trillion in new debt. How did this debt get absorbed? The Federal Reserve increased its holding of US Treasury debt by about $3.3 trillion, or 51% of the increase in total debt outstanding. Domestic private investors increased their holdings by about $1.8 trillion, or about 28% of the total increase in US Treasury debt.

Next, we turn to the Federal Reserve System. During all three of these wars, the Federal Reserve supported the US Treasury market, and as a consequence of this support, expanded its balance sheet. In figure 10.4 we display the balance sheets of the Federal Reserve with assets on the left and liabilities on the right.

Panels 4a and 4b report the Fed balance sheet during the period around World War I. The first thing to note is that the balance sheet expanded dramatically during the war. The Federal Reserve did purchase Treasury securities outright, chiefly the Liberty Loans. In

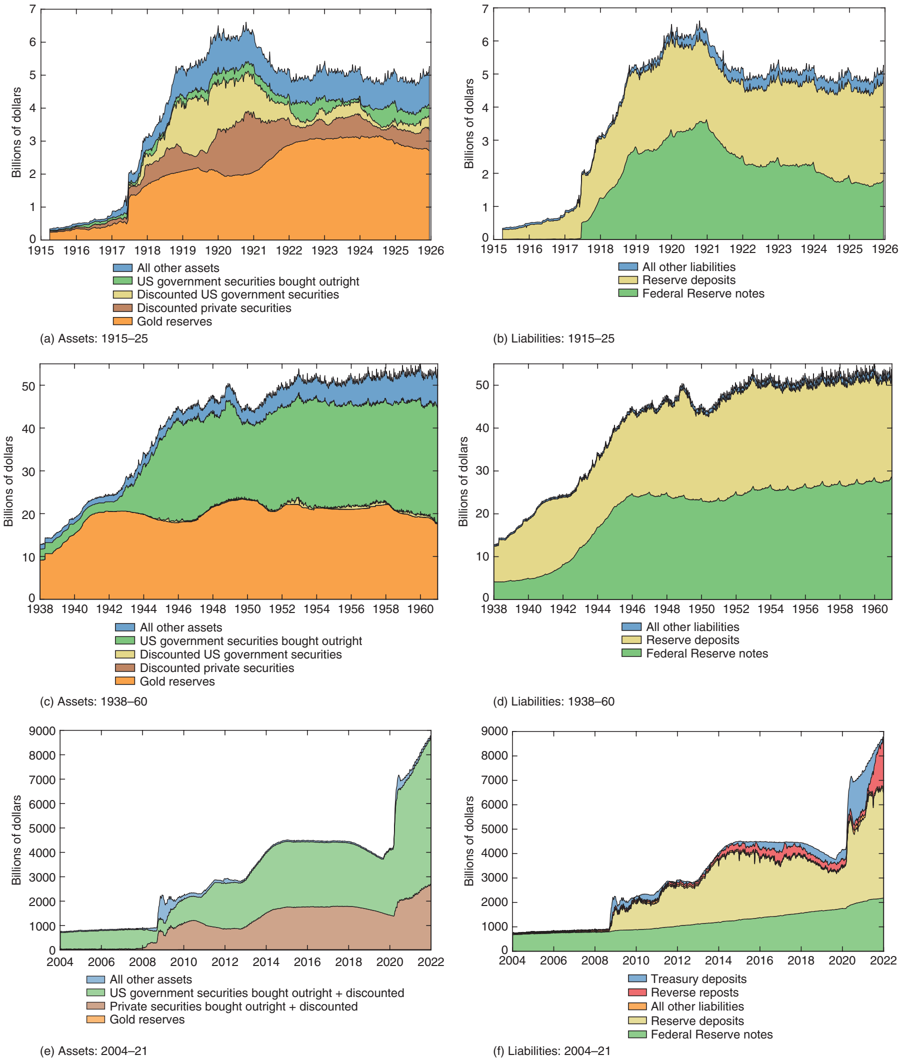

FIGURE 10.4. Federal Reserve Balance Sheets during Three Wars

Source: Tables of assets and liabilities of the twelve Federal Reserve Banks reported in each issue of the *Federal Reserve Bulletin* and the Federal Reserve's H.4.1 statistical release, "Factors Affecting Reserve Balances of Depository Institutions and Condition Statement of Federal Reserve Banks."

the asset graph, these purchases are denoted by the green area, but note this green area is quite small. The primary way that the Federal Reserve supported the US Treasury market was by making loans to banks at preferred interest rates. If those loans were used to purchase Liberty Loans, the Fed would hold those Liberty Loans as collateral on its balance sheet. The yellow area in the asset panel denotes these bonds held as collateral.

How did the Federal Reserve raise the funds to make these loans? On the liability side of its balance sheet, we see that currency outstanding (in green) rose, as did bank reserves at the Federal Reserve (in yellow). Of course, currency plus reserves is the monetary base. So the answer is: by expanding the monetary base.

During World War II, the Federal Reserve purchased US Treasury securities outright on a large scale. These purchases are depicted by the green area of the panel 4c. As a consequence of the Treasury's wartime policy of a fixed upward-sloping yield curve during World War II, private investors perceived little or no interest rate risk. Hence, private investors largely concentrated their purchases in longer-term notes and bonds. This left the Federal Reserve to concentrate most of its holdings in short-term treasury bills and certificates of indebtedness.

Again how did the Fed pay for its support of the Treasury market? As before in World War I, looking at the liability side of the balance sheet in panel 4d we see increases in both currency outstanding (in green) and bank reserves at the Federal Reserve (in yellow).

As others at this conference have noted and as we have discussed above, the Federal Reserve in 2020 and 2021 purchased $3.3 trillion in US Treasury securities (in green) and purchased over $1 trillion in private assets, primarily mortgage-backed securities (in brown), as shown in panel 4e. How did the Fed pay for these purchases? Once again, by increasing currency (in green) and by increasing bank reserves at the Federal Reserve (in yellow) as denoted in the panel 4f. But unlike the two world wars, the Fed also issued reverse repurchase agreements (in red) partly to increase liquidity in key markets, particularly the money market mutual fund market.

There are two other differences between the COVID-19 and World War II periods. First, during the current COVID-19 period, much of the Fed's holdings were weighted toward the longer-term notes and bonds. In contrast, during World War II, the Fed's holdings were concentrated mainly in shorter-term securities. Second, since 2008, the Federal Reserve has paid interest on bank reserves and the reverse repurchase agreements (reverse repos). So we ask whether we should include these bank reserves and reverse repos as part of the money supply or whether they belong as part of the interest-bearing debt of the federal government?

The analytical core of our paper is a decomposition of revenues for the three world wars. Before doing this decomposition, we make adjustments to the Treasury data to bring it in line with economic theory. The first adjustment is to net out debt held by the Federal Reserve and government agencies. That is, we want to record just the debt owned by private investors, both domestic and private. The second adjustment is to measure the debt at its market value instead of its par value. In figure 10.5 we plot the market value of the Treasury debt held by private investors as a share of GDP (in blue) and the corresponding par value (in red). These two series track each other quite closely, but they deviate at times of fiscal stress.

We note again that since 2008, the Fed has paid interest on bank reserves and reverse repos. If we add those two private sector claims on the Fed to our stock of interest-bearing debt, we get the green line. Interestingly, this summation brings the debt to GDP ratio to nearly 100%. Of course, the Fed used some of these bank reserves to purchase private assets; subtracting these asset purchases from the total debt yields the series plotted in light blue.

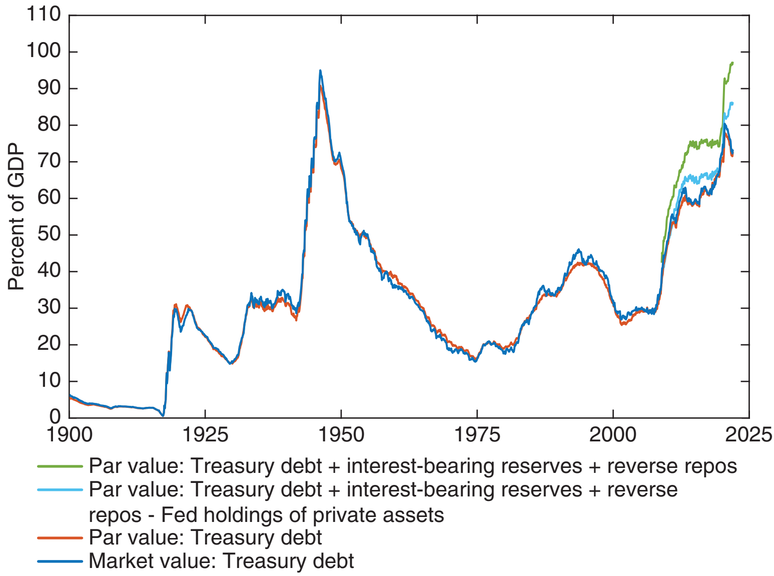

FIGURE 10.5. Par and Market Values of US Federal Debt Held by Domestic Private Investors and Foreign Investors as Percentages of GDP: 1900 to 2021

Sources: (1900–60) Hall et al. 2018; (1960–2021) CRSP US Treasury Database and the US Treasury Monthly Statement of Public Debt. We measure reserves balances and reserve repo agreements using the balances reported in the Federal Reserve's H.4.1 statistical release, "Factors Affecting Reserve Balances of Depository Institutions and Condition Statement of Federal Reserve Banks."

Notes: From October 2008 to December 2021, the green line plots the sum of the par value of privately held Treasury debt and interest-bearing reserves and reverse repos at the Federal Reserve. The light blue line subtracts the Federal Reserve's holdings of private assets from the sum reported in the green line.

Our third adjustment is to interest payments. Instead of using the accounting measure reported by the federal government, we measure interest payments by the ex post holding period returns earned by bondholders to take into account the capital gains and losses that John Cochrane discussed earlier this morning (in his conference presentation).

Our revenue decomposition is based on the period-by-period consolidated government budget constraint stated in equation 1.

On the left side of this equation are expenditures; on the right side are revenues.

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

where

G_t = Government outlays (net of official interest payments)

B_{t-1} = Nominal market value of interest-bearing government debt held by private investors at the end of $t-1$

$r^B_{t-1,t}$ = Nominal value-weighted holding period return on government debt between $t-1$ and t

A_t = Private assets purchased by the Federal Reserve

$r^A_{t-1,t}$ = Nominal holding period return on Fed-held private assets between $t-1$ and t

T_t = Tax receipts

M_t = Federal Reserve credit

OM_t = Funding by other means

Funding by other means includes dollar deposits with and letters of credit to the IMF, changes in special drawing rights certificates issued to Federal Reserve Banks, and net activity of various loan financing activities.

We divide each term in equation 1 by nominal GDP and rearrange the term. Doing so yields equation 2:

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

where $g_{t-1,t}$ denotes the net growth rate of real GDP and $\pi_{t-1,t}$ denotes the net inflation rate. As before, expenditures are to the left of the equal sign and revenues are to the right.

For each term in equation 2, we compute the average of the five years of observations before the war and use this value as a counterfactual; that is, it is our estimate of what the series would have been had the war not occurred. We call this the "peacetime baseline." We then sum up the differences between the observed series and the peacetime baseline. We do this term by term for every term in equation 2.

Table 10.2 reports the results of this decomposition. Consider World War I. The decomposition finds that for the two years that the United States was involved in World War I, it spent 36.93% of a single year's GDP on the war. It paid its bondholders 3/10 of 1% of a year's worth of GDP. The US also purchased private assets of 16/100 of one percent of a year's worth of GDP, bringing the total cost of the war to 37.39% of a year's worth of GDP. How did the US government pay for this? We decompose revenue raised into tax revenue, debt growth, money growth, GDP growth, inflation, and everything else. The terms in columns (5) through (10) add up to 37.39.

It may be more intuitive to look at the second row for each war, which reports the revenue sources as percentages of the total. How did the US finance its spending on World War I? The answer is 20.8% through raising taxes; 74.3% through issuing interest-bearing debt; and 6.9% through increases in the monetary base, with a residual of –2.0% explained by the remaining terms.

For the war on COVID-19, the US government spent 21.37% of a year's worth of GDP to fight the virus in 2020 and 2021.[2] The government paid its bondholders 2/10 of 1% of a year's worth of GDP, and the Federal Reserve purchased the assets of 5.85% of a

2. This represents actual spending—not just the authorizations.

TABLE 10.2. Decomposition of Wartime Revenues from Equation (2)

War		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Start	End	Government spending	Payouts on net debt	Asset purchases	(1) + (2) + (3)	Tax revenue	Debt growth	Money growth	GDP growth	Inflation	Other
World War I											
1917:4	1918:11	36.93	0.30	0.16	37.39	7.76	27.79	2.59	0.03	0.68	−1.46
						20.8	74.3	6.9	0.1	1.8	−3.9
World War II											
1941:12	1945:8	116.48	2.00	—	118.48	35.80	54.53	11.96	8.99	6.05	1.14
						30.2	46.0	10.1	7.6	5.1	1.0
COVID-19											
2020:1	2021:12	21.37	0.22	5.85	27.45	0.95	−0.59	25.16	1.02	3.03	−2.12
reserves $\subset M$						3.5	−2.2	91.7	3.7	11.0	−7.7
2020:1	2021:12	21.37	0.17	5.85	27.40	0.95	18.36	5.07	1.48	3.99	−2.45
reserves $\subset B$						3.5	67.0	18.5	5.4	14.6	−8.9

Sources: See figures 10.2, 10.3, 10.4, and 10.5 for the World War I and World War II periods. Federal Reserve credit is the sum of bills discounted, bills bought, United States government securities bought outright and discounted, deposits in foreign banks, industrial and commercial loans, municipal warrants, and Federal Reserve bank float. For the COVID period, Federal Reserve credit is the sum of Bills Discounted and US Treasury Securities held by the Fed. For a more complete discussion of this measure, see Section 2 of the Data Appendix in Hall and Sargent (2022). The Federal Reserve policy rates are from https://www.federalreserve.gov/monetarypolicy/reserve-balances.htm.

Notes: For each war, the elements in the first row are in percent of GDP. Columns 5–10 sum to column 4. The numbers in the second row are percentages of the sum of war-related spending, net debt payments, and purchases of private assets (column 4) accounted for by each term on the right side of equation (2). Column 10 is the sum of other means, the cross product, and a residual. See the appendix for the definition of M.

year's worth of GDP. Summing these terms brings the total cost of the war to 27% of a year's worth of GDP.

How did the government pay for this spending? Increased tax revenue made up a mere 3.5% of the war payments. Debt growth is negative. Why is this? In the five years prior to COVID-19, the federal government ran large deficits, issuing debt that was primarily purchased by private investors rather than the Federal Reserve. The decomposition expects that this trend would have continued had COVID-19 not occurred. Thus, the decomposition implies that nearly all of the cost of COVID—91.7%—was financed by money growth.

As we noted earlier, some of the components of this newly created "money" paid interest, so we repeat the decomposition counting bank reserves at the Federal Reserve and the reverse repos as part of the stock of interest-bearing debt. If we do so, we shift about 70% of the revenues from the money growth category to interest-bearing debt. Thus, the cost of this most recent war was split: 3.5% by tax revenue, 67% by interest-bearing debt, and 18.5% by money growth.

Comparing the revenue decomposition across all three wars, we see that increases in tax revenues covered 20.8% of the cost of World War I, 30.2% of the cost of World War II, and only 3.5% of the war on COVID-19. Money growth covered 6.9% of the cost of World War I, 10.1% of the cost of World War II, and 18.5% of the cost of the war on COVID-19.

What impact did this money growth have on prices? In figure 10.6 we plot the log of the consumer price index (CPI) normalized to be 0 at the start of each war. Looking at the red line, we see that six years after the start of World War I, the CPI was 70% higher than it was in 1914. Then the US experienced two years of deflation. But by eight years after the war, the price level was still 55–60% higher than it was at the start of the war.

For World War II, we see a similar pattern. Prices rose early in the war, but price and wage controls dampened rates of increase in

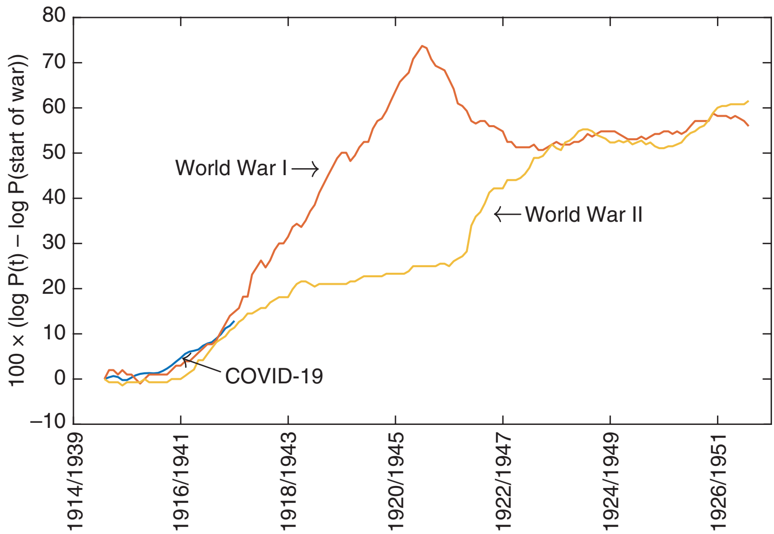

FIGURE 10.6. Natural Log of the Price Level during and After World War I, World War II, and the War on COVID-19

Source: BLS, Consumer Price Index for All Urban Consumers, Not Seasonally Adjusted, from FRED.

Notes: This figure displays 100 × ($logP_t - logP$ start of war), where P_t is the CPI for All Urban Consumers. Ticks on the x-axis correspond to January for the 1914 to 1926 period and March for the 1939 to 1951 period. For the COVID-19 war, the series begins January 2020 and ends May 2022.

the CPI. When the federal government lifted these controls in 1946, prices jumped. As was the case after World War I, eight years after the war, the price level was 55–60% higher than before the war. Today, we have only two years and five months of price data for the war on COVID-19 period. But prices during this period, plotted in blue, track the price increases from two previous wars.

How did bondholders do after each war? Not well. In figure 10.7 we plot the real (inflation-adjusted) value of $100 invested in a representative value-weighted portfolio of US Treasury securities in which the coupon and principal payments are continually reinvested. The red and gold lines represent the values of this representative portfolio during and after World War I and World War II, respectively.

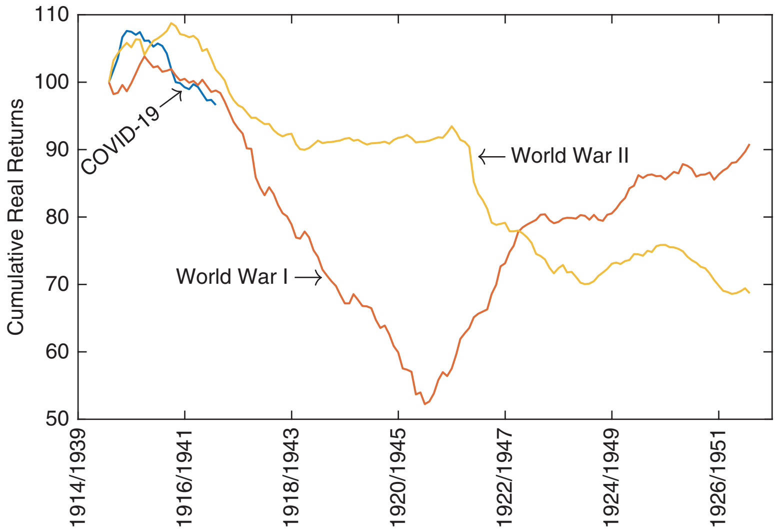

FIGURE 10.7. Real Values of $100 Portfolio of Treasury Securities Invested at the Start of World War I, World War II, and the War on COVID-19

Sources: See figures 10.5 and 10.6.

Notes: This figure reports the cumulative real values coming from continually reinvesting in a value-weighted re-balanced portfolio of all outstanding US Treasury securities of an initial investment of $100 at the start of each war. Ticks on the x-axis correspond to January for the 1914 to 1926 period and March for the 1939 to 1951 period. For the COVID-19 period, the series begins January 2020 and ends December 2021.

Both lines are near mirror images of the normalized price levels plotted in figure 10.6. Six years after the start of World War I, the value of that portfolio was 50% of what it was at the beginning of the war.[3] During and after World War II, once again, bondholders did poorly. Price controls mitigated these losses, but bondholders received a large capital loss once price controls were released. As John Cochrane pointed out at the conference, these losses were transfers from the bondholders to the taxpayer. The blue line represents the value

3. One of those bondholders was Army Captain Harry Truman. He never forgot these losses. One of the reasons why the Korean War was tax financed was that President Harry Truman argued that wartime inflation was due to "our failure to tax enough." (Truman 1951).

of the representative portfolio during the war on COVID-19. In the two years since this war began, the portfolio's value tracked the values during the previous two world wars.

MORE HISTORY

In the remainder of this chapter, we describe historical precedents that shaped how twentieth-century policy makers framed decisions. Responses to the enormous disruptions associated with World War I did not start from a blank slate. Decision makers remembered how governments had coped during earlier wars, for example, in the United Kingdom during and after the wars from 1792 to 1815 against France, and in the United States during and after the Civil War. Those experiences had shaped a conventional wisdom about how to finance wars and how to manipulate returns on government debts through price level adjustments that could be engineered by temporarily suspending convertibility of government notes into gold but eventually resuming convertibility at prewar rates of exchange. Thus, an issue that confronted many countries after World War I was how to reconstruct a prewar gold standard. That same problem had also been faced in the nineteenth century. UK monetary-fiscal authorities after 1815 had awarded high real returns to government creditors by presiding over a fall in the price level sufficient to allow the Bank of England in 1821 to make its notes convertible into gold once again at the same rate that had been maintained before convertibility was suspended in 1797. US monetary-fiscal authorities did something similar after the US Civil War ended in 1865. Greenback dollars issued by the Union during the dark days of the Civil War at big discounts relative to gold dollars were ultimately made convertible into gold one-for-one starting in January 1879. Authors of these policies wanted wartime suspensions of convertibility to be temporary because they wanted markets to infer that future suspensions would also be temporary. Subsequent monetary and fiscal decision makers praised those episodes for fostering expectations among creditors that public debts would be honored, thus enhancing the marketability of public debts and providing future government officials opportunities to borrow at the low interest rates brought about by low default probabilities.

Digging deeper reveals that post–US Civil War debt repayment and currency policies emerged only after bitterly contested political struggles that had pitted the interests of government creditors against the interests of both taxpayers and the private borrowers who had issued bonds dominated in paper units of account. Those disputes probably taught post–World War I policy makers that the foundations of the conventional wisdom were fragile and subject to substantial political risks.

Various conference participants raised questions about how a monetary authority, or consolidated fiscal-monetary authority, acquires credibility. The idea that a government earns a reputation as a trustworthy creditor by honoring promises to award high returns to government creditors has been treated well by modern theories of how sovereign debts are valued and optimally managed. Theories of sovereign and domestic government debts are driven by assumptions about consequences of paying and defaulting, consequences that are affected by feedback on how government deficits are chosen. Outcomes hinge on assumptions regarding consequences of defaults and about incentives to repay.

DISTINGUISHING BETWEEN MONEY AND BONDS

Since the beginning of the Republic, US policy makers have thought hard about how to design evidences of federal debt. Attitudes about “bonds versus money” evolved during the first century under the Constitution of 1789, as conflicting interests and theories interacted with a string of experiences. These formed the background

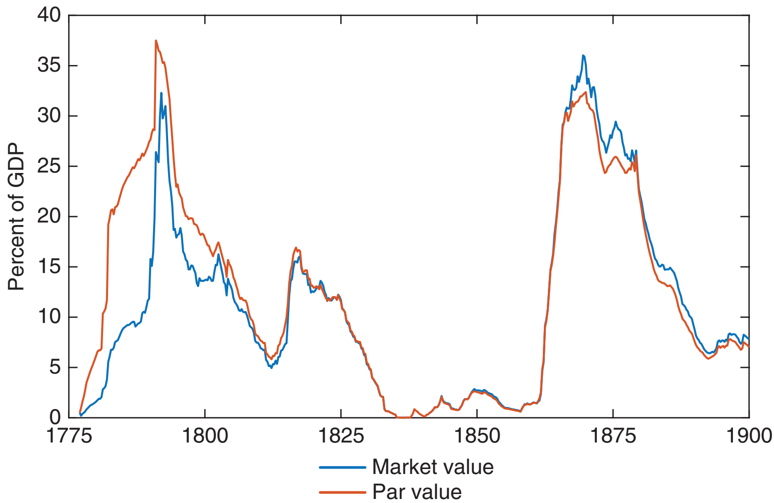

FIGURE 10.8. Par and Market Values of Treasury Debt Held by Private Investors
Source: Hall et al. 2018.
Note: Excludes bonds issued to Pacific Railway Companies.

for policy debates that were precursors to contemporary discussions of whether and how to pay interest on reserves. A fascinating drama unfolded entailing actions designed at first to poison, then to restore, and ultimately to sustain expectations that the US federal government's paper IOUs were as good as gold.[4]

As a preview of the outcomes, notice the large gaps between the market and par values of US government debt plotted in figure 10.8. Starting in 1775 with the issuance of the Continental Government's Loan Office Certificates until the end of James Madison's administration in 1817, US government debt traded at a deep discount relative to its par value. Further, note that beginning in the late 1860s, the market value of the debt *exceeded* the par value. Now contrast the large deviations between the market and

4. At the conference, Patrick Kehoe and Elena Pastorini wanted evidence about the social process that allows a monetary-fiscal authority to acquire and sustain a reputation.

par values observed in the eighteenth and nineteenth centuries with the relatively minor deviations observed in the twentieth century plotted in figure 10.5.

In 1790, the framers of the US federal government debated whether and how to discriminate the rates of return given to US creditors. James Madison wanted to allocate payoffs among current and former bondholders in ways that would withhold capital gains from more recent purchasers and compensate former holders who had experienced capital losses from selling their bonds. Alexander Hamilton (1790) opposed Madison's discrimination scheme because of its adverse effects on the expectations of prospective government creditors. Hamilton criticized Madison's proposal, first, because it would defeat Hamilton's goal of fostering a liquid market in US government bonds, and, second, because it would inappropriately reward former holders of government bonds who, by selling, had bet against the credit of the US; it would also unfairly punish current holders who, by buying, had expressed their confidence in US credit.

Hamilton won that argument, and Congress did not implement Madison's particular version of a discrimination scheme. But it did discriminate. In particular, in following Hamilton's recommendations about how to restructure US and state debts in 1790, Congress discriminated among creditor classes in ways that were designed to intentionally poison the US government's reputation for servicing some types of debt (the despised paper money known then as "bills of credit") while simultaneously enhancing its reputation for servicing other types of debt (interest-bearing medium- and long-term obligations, especially to foreign creditors).

US fiscal authorities' propensity to discriminate was destined gradually to diminish over time, a pattern revealed in how the United States financed its expenditures during the Revolutionary War, the War of 1812, and the Civil War. During all three wars, the federal government and the states issued debts that differed in their maturities, denominations, and units of account. A theoretical contribution of

Bryant and Wallace (1984) explains why federal and state governments might have wanted to award different rates of return to different classes of government creditors. Bryant and Wallace showed how such price discrimination can improve fiscal efficiency.

The units of account in which government debts can be expressed and enforced are central to a price-discrimination analysis of monetary and fiscal policy. Bryant and Wallace, in effect, assumed that a government can issue some securities that are expressed in a foreign government's unit of account or otherwise indexed against domestic inflation, and that it can issue other securities that are not.

Whether units of account should be arranged in this way is an issue that underlies a fascinating story, namely the evolution of US government officials' opinions about whether they should, or even legally could, issue small denomination zero-interest notes (paper money) and whether they should declare those notes legal tender for public and private debts. James Madison thought that making paper money a leading tender was reprehensible, while Ulysses S. Grant thought that it was useful. But making US paper money a legal tender meant something different to James Madison in 1787 or 1813 than it did to Ulysses S. Grant in 1869. In 1787 and 1790, issuing paper money portended depreciation and repudiation. In 1869 and 1870, when the Congress and the president took actions to make US-issued paper money as good as gold, paper money meant appreciation and resumption.

We can summarize the main features of this story as follows. The US Constitution prohibits states from issuing bills of credit; during the 1790s, federal issues of bills of credit, though not explicitly prohibited, were widely regarded as bad. There was also a broad sentiment against making anything other than specie a legal tender. Madison thought that denying legal tender status to government-issued paper money was a good way to limit its capacity to damage credit markets. Alexander Hamilton's restructuring of federal and state government's debt harshly discriminated against continental bills of credit. That saved federal tax revenues. And by impairing their reputation, it also had the salutary effect of discouraging future issues of federal bills of credit.

Despite that history, on February 25, 1862, the Union made greenbacks a legal tender for all private debts and some public obligations, an act hotly disputed at the time.[5] In 1869 the Supreme Court declared the act that made greenbacks a legal tender unconstitutional. Soon thereafter, President Grant appointed two new justices who concurred in the court's quick reversal of that earlier decision, thereby affirming that the federal government was empowered to make a paper fiduciary currency a legal tender. Instead of unleashing an era of high inflation fueled by government printing of paper money, President Grant and the Congress presided over an appreciation of the greenback that awarded people who held them higher returns than those who, when Union Armies had suffered setbacks, had speculated against the greenback. In 1790, people deplored federal paper money as "not worth a continental"; after 1879, people trusted greenbacks to be small-denomination warehouse certificates for gold. Reputational considerations were very much on the minds of public officials in both periods.

Tax Smoothing

We received questions about how our analysis relates to leading "tax smoothing" models. Our figure 10.2 prompted such questions because it reminded some conference participants of a computer simulation of a Barro (1979) tax smoothing model. Figure 10.9 confirms that nineteenth-century US observations look like that too. This pattern reflects that Secretary of the Treasury Albert Gallatin (1837) can be credited as an early co-author of the Barro model, and that subsequent administrations and Congresses adhered to Gallatin's advice.

5. See Lowenstein (2022).

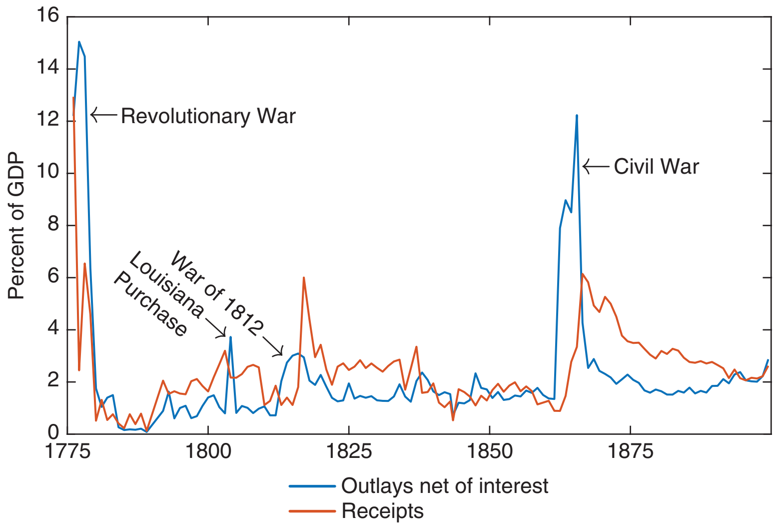

FIGURE 10.9. US Federal Government Expenditures and Receipts: 1775–1900
Source: *Annual Report of the Secretary of the Treasury on the State of the Finances*, 1940.
Notes: Outlays are net of official interest payments. During the Civil War, GDP includes the Confederacy.

Hamilton (1790) and the Congress rescheduled Continental and state obligations in ways that they hoped would give the federal government sustained access to domestic and international credit markets. That would expand the Federal government's subsequent options for financing temporary surges in government expenditures by borrowing, thereby allowing it to moderate the contemporary tax increases needed to finance those surges. This part of Federalist policy was embraced and extended by the Jefferson administration when it took office in 1801. In his 1807 report to Congress, Secretary of the Treasury Albert Gallatin (1837) used a line of reasoning that contains all of the components of a normative model of fiscal policy later formalized in models of Barro (1979) and Aiyagari et al. (2002). Gallatin's report recommended that tax rates should be set to "provide a revenue at least equal to the annual expenses on a peace establishment, the interest on the existing debt, and the interest on the loans which may be raised . . . losses and privations caused by war should not be aggravated by taxes beyond what is strictly necessary." (Gallatin 1837). Thus, Gallatin proposed that the best way to pay for a surge in government expenditures would be temporarily to borrow during the surge, to increase taxes permanently by enough to service the resulting debt, and after the expenditure surge had ended, to run a net of interest surplus sufficiently large to roll over the debt. Like Hamilton, Gallatin's presumption was that the debt would surely be serviced as promised, and that a good fiscal policy would adjust net of interest surpluses required to service the debt to smooth tax distortions over time.

US fiscal authorities embraced Gallatin's model throughout the nineteenth century. Gallatin and his successors presumed, and wanted markets to presume, that US government debts would always be paid in a timely manner; they promoted expectations that no circumstances would be offered as excuses for failures to pay. Essentially, they proposed to use risk-free government debt to smooth tax distortions across time, and they sought to sustain a reputation that their debt would be risk-free. They would smooth tax distortions across contingencies only to the extent that risk-free debt allowed them effectively to "self-insure" fluctuating government expenditures.

TO BUY INSURANCE AGAINST EXPENDITURE RISK OR SELF-INSURE?

Some conference participants asked us about the applicability of the Lucas and Stokey (1983) model. In the representative agent Ramsey models of Lucas and Stokey (1983) and Chari, Christiano, and Kehoe (1994), a government optimally finances a stochastic stream of exogenous government expenditures by trading state-contingent claims with the private sector. The government thereby enters into a complete risk-sharing scheme with the private sector that allows it to smooth tax distortions across time and across random histories of government expenditures. Lucas and Stokey (1983) and Chari, Christiano, and Kehoe (1994) show that if the government does not have access to complete insurance markets, but can issue only risk-free nominal bonds, then it can achieve the same equilibrium outcomes by using history-contingent inflation and deflation to award real capital losses and gains to holders of government bonds. Here, denominating risk-free bonds in a nominal unit of account, then making nominal values respond appropriately to random shocks to government expenditures, are parts of an optimal fiscal and monetary policy. Sims (2001) used this logic to argue against "dollarization" schemes because they prevent sovereign governments from reaping the benefits that flow from using inflation to award history-contingent returns to government creditors.

Early American policy makers did not see it Sims's (2001) way. Influenced by the repudiation of the Continentals, they saw inflation as a deplorable way of abrogating contracts, not implementing a well-understood risk-sharing scheme between the government and the private sector. For more than eighty years after 1790, most American statesmen denied that there were benefits to be reaped by denominating government debt contracts, and forcing citizens to denominate theirs, in a nominal unit of account other than specie. This drove their hostility to making a federal paper money a legal tender.

THE CIVIL WAR

Union expenditures during the Civil War were unprecedented, generating four years of budget deficits over 8% of GDP. See figures 10.9 and 10.10 and compare the magnitudes of the Civil War deficits to the 2% of GDP deficits during the War of 1812. In response to the sudden increase in needed funds, Secretary of the Treasury Salmon P. Chase initially relied heavily on short-term borrowing.

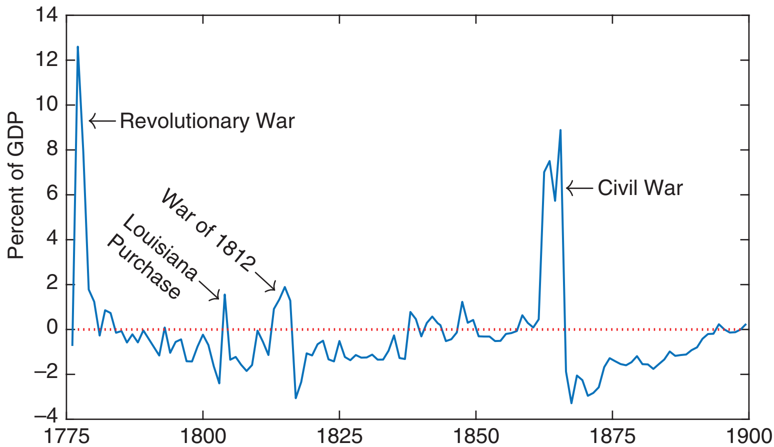

FIGURE 10.10. Primary Deficit: 1775–1900
Source: *Annual Report of the Secretary of the Treasury on the State of the Finances*, 1940.
Note: During the Civil War, GDP includes the Confederacy.

Much of this short-term debt was in the form of three-year "7-30s," Treasury notes paying an interest rate of 7.3%.[6]

In table 10.3 we repeat our revenue decomposition for the War of 1812 and the Civil War. During the Civil War, while the Treasury imposed a host of new internal taxes, including the first federal income tax, taxes only accounted for 6.8% of total expenditures. Increases in interest-bearing debt and money accounted for 59.6% and 19.6%, respectively. These proportions are remarkably similar

6. Remnants of hard money Jackson Democrats had long regarded the Whig Party as soft on paper money. Remnants of the Whig Party formed the backbone of the Republican party. Did this history bequeath a credibility problem to the new Lincoln administration in March 1861? Maybe. But, anticipating an idea of Rogoff (1985) that you can resist a temptation to inflate by strategically delegating monetary policy to an inflation hawk, Lincoln appointed as his secretary of the Treasury Salmon P. Chase, governor of Ohio, formerly a Jackson hard money Democrat and a future chief justice of the US Supreme Court. A decade later Chase would write the Supreme Court decision that declared unconstitutional Congress's 1862 action that awarded legal tender status to the paper money called greenbacks that he, as secretary of the Treasury, had issued to help pay for the war. The Congress had made them legal tender for all debts public and private, except payment of customs duties, the lion's share of federal revenues. The legal tender clause created many winners (debtors who owed dollars) and losers (creditors in dollars). See Lowenstein (2022) for much more about these events.

TABLE 10.3. Decomposition of Wartime Revenue: War of 1812 and the Civil War

War		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Start	End	Government spending	Return on debt	Total spending	Tax revenue	Debt growth	Money growth	GDP growth	Inflation	Other
War of 1812										
1812:6	1815:2	7.34	–0.20	7.14	2.35	10.60	0.00	–0.16	0.06	–1.01
					–32.9	148.5	0.0	–2.2	0.8	–14.2
Civil War (Union)										
1861:4	1865:4	31.04	2.10	33.14	2.26	19.74	6.49	1.08	3.95	–0.37
					6.8	59.6	19.6	3.2	11.9	–1.1

Sources: See figures 10.8 and 10.9.

Notes: For each war, the elements in the first row are percentages of GDP. Columns 4–9 sum to column 3. The numbers in the second row are percentages of the sum of war-related government spending and returns to bondholders (column 3) accounted for by each term in 4–9. Peacetime baseline is the average value five years prior to the war.

to proportions for the financing of the war on COVID-19 reported in table 10.2.

To refinance these 7-30s into longer maturity securities, beginning in February 1862, the Congress authorized the Treasury to sell 5-20s, a bond redeemable in twenty years, but callable at par at the government's discretion in five years. (In effect, the Union government simultaneously borrowed and purchased a call option.) The 5-20s promised to pay interest in gold, but, in a masterpiece of ambiguity, were silent about whether the principle would be payable in greenbacks or in gold.[7] Uncertainty about the currency in which the principal of the 5-20s would be repaid was resolved only after a heated political debate after the war. It mattered whether they would be paid in gold or in greenbacks because prices denominated in greenbacks doubled during the Civil War. They receded enough from 1865 to 1879, that by 1879 the US could resume specie payments, de facto making the greenbacks warehouse certificates for a set quantity of gold. However, before the election of President Grant in November 1868, there was widespread doubt and debate about whether the principal owed to owners of 5-20s was due in paper or in gold. In June 1868, the 5-20s comprised 70.5% of the interest-bearing debt, and gold was trading at a 40% premium. The creation of the legal tender notes also created two types of debts: those promising to pay "lawful money" (i.e., greenbacks) and those promising to pay "coin" (i.e., gold). At its peak in September 1865, debt promising to pay in "lawful money" comprised over 54% of outstanding debt. During the War of Independence, the unit of account had been specie (Spanish dollars) and the paper money (the Continental currency) traded at a discount. However, from 1862 to 1879 prices for both goods and bonds (including those that promised to pay in coin) were quoted in "lawful money" (i.e., greenbacks) and gold dollars sold at a premium.

7. Lowenstein (2022) presents a fascinating account of the log-rolling process that designed the 5-20s. It sheds light on the political coalitions supporting many features of the 5-20s, but not the ambiguity about units of account for repayment of principal.

Rationalizing the 5-20s

We interpret the government's decision to issue 5-20s in the first place as indicating policy makers' wish to implement policies that would promote lower future interest rates on government debt. The 5-20s had a par value of 100, promised 6% coupons each year, matured after twenty years, and were callable at par at the government's discretion after five years. Wanting to raise large amounts, why would the Union sell a bond that involved simultaneously purchasing a call option? To understand the government's decision to issue 5-20s, it helps to posit heterogenous beliefs about future interest rates. If Union fiscal authorities imputed to most market participants different views about the likely future path of interest rates than theirs, then the call options associated with the 5-20s would have been a good buy for the Union government. Also, by buying a call option, the Union fiscal authorities could indicate to the market their intention to pursue continuation policies that would drive future interest rates lower than those forecast by the market, thereby rendering the call option more valuable than the market might otherwise have thought.

A persistent theme in US policy circles has been how to reduce interest paid on US government debt. Both sides of the late 1860s debate about whether to repay the principal on the 5-20s in paper or in gold could claim to advocate policies in the tradition of our first secretary of the Treasury. Hamilton (1790) had asserted that by restructuring the US debt as he had recommended, prospective interest rates on new issues of government debt would fall because default premiums would fall. But, by discriminating among government creditors, Hamilton had lowered interest rates in another sense, namely, by paying out substantially less to various classes of US creditors than had originally been promised. The magic that Hamilton's restructuring plan promised was that it would save money for US taxpayers by partially defaulting on some debts, while simultaneously promoting the prospect of lower default premiums on new and future issues of US government debt. That Hamilton managed that balancing act left room for advocates of very different debt management policies to claim that they were his true followers.

Thus, the Democrats and President Andrew Johnson meant one thing when they advocated reducing interest payments on the government debt, while the Republicans and Ulysses S. Grant meant something else. The Democrats wanted to reduce interest payments ex post by paying government creditors with a depreciated currency. By paying in gold, Republicans wanted to reduce risk premia on prospective issues of Federal debt, thereby reducing interest payments ex ante.

Deciding to repay the 5-20s in gold resulted in large real returns to bondholders. From 1869 to 1879 the real holding period returns to federal government creditors averaged 7.2% per year. Owners of the 5-20s received an average real annual return of 8.2% over this period. However, in contrast to Hamilton's refinancing in 1790, the high returns delivered to federal bondholders did not come at the expense of holders of paper money. Holders of non-interest-bearing "lawful money" legal tender notes and fractional currency saw the specie value of their assets appreciate through deflation. In June 1868, it took 140 greenbacks to buy 100 gold dollars. Five years later in 1873, the price had fallen to 116.5. In December 1878, greenbacks traded at par. In this way, the federal government "assumed" all of its promised obligations to holders of the greenbacks (see the above words of Calvin Coolidge). Contrast this "closing the gap" between market and par values to the persistent gap between the market and par values of the debt after Hamilton's 1790 rescheduling, summarized in figure 10.8 above.

Payne et al. (2022) argue that Hamilton's and Grant's strategy for reducing the cost of financing US Treasury debt succeeded. Over the nineteenth century, yields on US Treasury securities steadily declined, with the zero-coupon 10-year yield falling from 8% in 1800 to 2% in 1900. Further, prior to and during the Civil War, US

Treasury debt traded at a premium relative to UK debt, the “safe asset” of the era, but by the 1880s this risk premium had evaporated.

HISTORICAL FRAGMENT ABOUT PAYING INTEREST ON RESERVES

The Fed’s policy since 2008 of paying interest on reserves, and now also on reverse repos, arose several times at the conference. Proposals to pay interest on reserves are interesting when viewed from perspectives supplied by nineteenth-century US proposals. As noted above, the framers of the US Constitution disapproved of any government’s issuance of “bills of credit” that resembled money, either federal or state. So for them, proposals to pay interest on paper money were moot. An originalist and strict constructionists President Andrew Jackson and his successors Presidents Martin Van Buren and James K. Polk took steps to implement a 100% reserve regime: bank reserves were to be full-bodied gold and silver coins.[8] Paying nominal interest on those reserves was not on the table in that perfect commodity standard. But in the nineteenth century, whenever federal or state governments did issue paper money backed by fractional reserves, the issues about paying interest on money really lay close to the surface. This situation provoked the shifting opinions about exploiting gains from price discrimination among classes of government creditors that we have described above, and in more detail in Hall and Sargent (2014).

LEARNING FROM EXPERIENCE

Wartime surges in government expenditures have always provoked debates about how to pay for them. Those debates inspired classic theoretical contributions about the optimal mix of debt and taxes

8. See Rothbard (2002).

and whether the mix matters at all. The origin of theories of optimal tax-borrowing policies in those debates is an element of our defense against a charge of inappropriate presentism (interpreting the past from a perspective and with information not available to those who acted in history). Statesmen who made the tax and borrowing decisions studied here had purposes and theories in mind, intellectual forces that will be important parts of our story. Therefore, we are naturally ambivalent about whether the theories that guide our pattern recognitions are to be viewed as normative (how things should be) or positive (how things are). We use the theories both ways because key historical actors sometimes used them as rationalizations of their proposals. A poster child for this point of view is the coincidence of recommendations of the Barro (1979) model with Secretary of the Treasury Albert Gallatin's 1807 Report as well as subsequent actions of Gallatin and his successors.

For over two centuries, policy makers confronted their predicaments by combining their recollections of histories with their theories. They repeatedly struggled against the same forces. These include rollover risks associated with unanticipated changes in market conditions and interest rates that bedevil decisions about the maturity structure of debt being sold; issues about units of account in which to denominate coupon and principal payments; interactions between banking and fiscal policies; temptations to default; and issues forced on them by prospective government creditors, along with incentives to delay supplying credit in anticipation of better terms later.

We appreciate Gary Becker's (1962) view that constraints alone go a long way in explaining patterns in outcomes, regardless of decision makers' purposes or their rationality. When we spot differences across patterns of wartime financings, our theories naturally direct us to ask how much of these are to be explained by the decision makers' *purposes* or their *constraints* or their *theories*. Our research in Hall and Sargent (2021) described decision makers' evolving understandings. Thus, memories of how the Continental currency that had financed the War of Independence from Great Britain had eventually depreciated to one penny on the dollar convinced War of 1812 decision makers to take steps to avoid that outcome. Non-callable federal bonds issued to pay for the Mexican-American War appreciated in value after the war when interest rates fell, creating ex post regrets that the bonds had not been bundled with call options, something that the Union would do early in the Civil War. As we noted in figure 10.7, rising prices and thus rising nominal interest rates after World War I delivered nominal capital losses to owners of the Liberty Bonds that had been used to finance the war, teaching Captain Harry Truman a lesson that he would remember when, as president, he insisted the Treasury and Federal Reserve manage interest rates after World War II to prevent that from happening again. In Hall and Sargent (2021) we described many other instances of later statesmen learning from what came to be recognized as mistakes during past wars. Prevailing understandings evolved about how government securities should be designed and marketed; about types of taxes to be imposed; and about the roles of the legal restrictions such as price controls and portfolio restrictions recommended by Keynes (1940) and formalized by a theory of Bryant and Wallace (1984).[9]

In most wars, we see evidence of Gallatin-Barro tax smoothing (i.e., taxes responding much less than one-for-one with spending), but only during the Civil War and the war on COVID-19 do we actually see a close approximation to the split between taxes and debt that the model recommends for a purely temporary expenditure surge. We also see negative wartime bond returns followed by positive postwar returns in the War of 1812, the Civil War, and World War I as prescribed by the Lucas-Stokey model (see

9. Statisticians tell us that the only things we can learn about are parameters of a necessarily restricted model, so perhaps it is excusable that we see successive government authorities processing information about past government expenditure surges in order to modify and refine their theories.

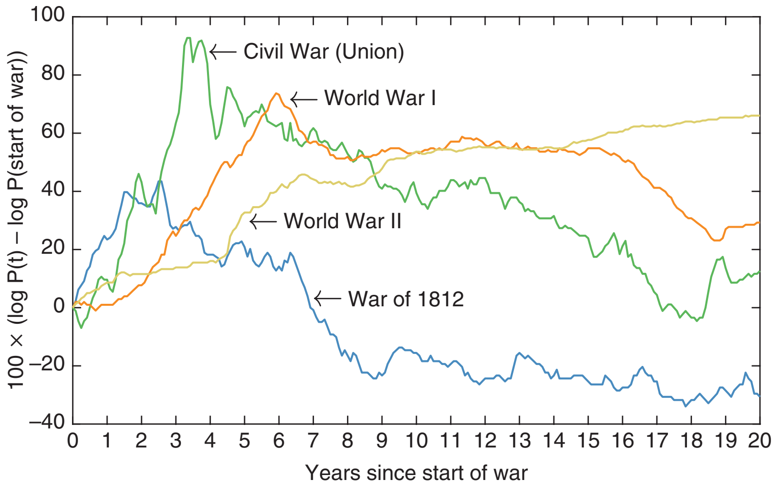

FIGURE 10.11. Natural Log of the Price Level during and after the War of 1812, the US Civil War, World War I, and World War II

Sources: Warren-Pearson Index, US Census Bureau (War of 1812 and Civil War); BLS, Consumer Price Index for All Urban Consumers, Not Seasonally Adjusted, from FRED (World Wars I and II).

figures 10.11 and 10.12). But as John Cochrane noted at the conference, this model directs that bondholders should receive an immediate capital loss at the outbreak of a war. To implement that Lucas-Stokey recommendation, there had to be a sufficiently large outstanding stock of debt at the time of the wartime surge in government spending. As shown in figures 10.5 and 10.8, the US had little debt at the start of the Civil War and World War I. Thus for these wars, the Lucas-Stokey action would not help the government's financial situation. In various episodes, Hall and Sargent (2021) discusses how Congress and Treasury secretaries experimented and innovated with various debt designs and management policies to induce potential investors to purchase bonds early in wars despite fears of wartime capital losses.

From observations before the war on COVID-19, we think that we detected some notable patterns. As table 10.4 reports, from the

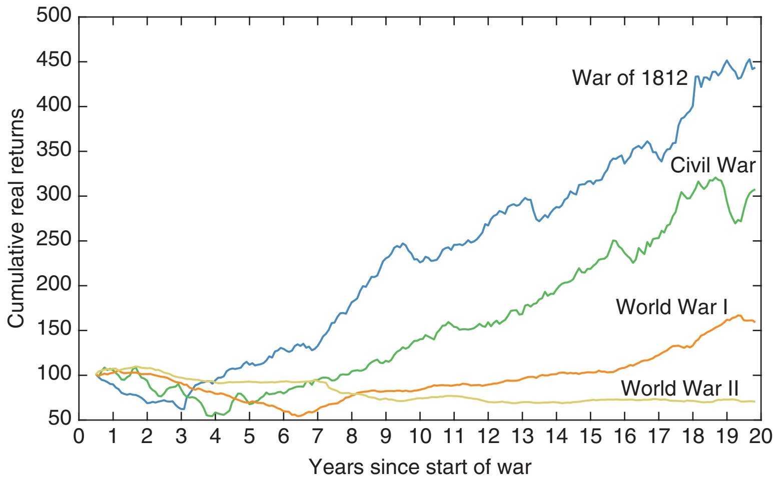

FIGURE 10.12. Real Values of $100 Portfolio of Treasury Securities Invested at the Start of the War of 1812, the US Civil War, World War I, and World War II
Sources: See figures 10.8 and 10.11.

TABLE 10.4. How US Paid for Five Wars as Percentages of Total Revenues

	Taxes	Bonds	Money
War of 1812	–32.9	148.5	0
Civil War	6.8	59.6	19.6
World War I	20.8	74.6	7.0
World War II	30.2	46.0	10.1
COVID-19	3.5	67.0	18.5

Source: Data repeated from tables 10.2 and 10.3.

War of 1812 to World War II, the US financed larger shares of wartime spending with taxes and smaller shares with debt. This trend did not continue for COVID-19. Seigniorage contributed a significant share of revenue in the Civil War, World War I, World War II, and the war on COVID-19. Over time, postwar real returns paid to bondholders have declined. After four major wars, the War of 1812, the Civil War, World War I, and World War II, average annual returns to bondholders were 12.0%, 8.5%, 5.5%, and –1.4%, respectively.

A BROADWAY MUSICAL?

Thomas Jefferson (standing next to James Madison):
But Hamilton forgets
His plan would have the government assume state's debts
Now, place your bets as to who that benefits
The very seat of government where Hamilton sits
. . .
Alexander Hamilton: If we assume the debts,
the Union gets new line of credit, a financial diuretic. How do you not get it?
If we're aggressive and competitive, the Union gets a boost.
You'd rather give it a sedative?

—Lyrics from "Cabinet Battle #1,"
Hamilton: An American Musical[10]

At the conference, Michael Bordo stressed that it mattered that the US was on a limping gold-exchange standard during World Wars I and II, while during COVID-19, links of the US dollar to gold had been completely severed. An important aspect of our account of pre-1900 US fiscal-monetary policies was a struggle about how firmly to link various types and denominations of federal government debts to gold. Perhaps parts of our story could inspire a Broadway musical "Madison" that rewrites a conventional wisdom encoded in the Broadway hit *Hamilton* in a way that presents a less confused Madison and a subtler Hamilton.

Thus, Hall and Sargent (2014) offers a provocative revisionist interpretation of the first 100 years of US government finance.

10. CABINET BATTLE #1 (from *Hamilton*). Words and Music by LIN-MANUEL MIRANDA, CLIFTON CHASE, EDWARD FLETCHER, MELVIN GLOVER and SYLVIA ROBINSON.

A conventional wisdom sees Alexander Hamilton as a paragon of financial responsibility who in 1790 promoted US credit by executing an honorable and credit-enhancing rescheduling of debts incurred during the American Revolution. In doing that, Hamilton received little help from a less economically knowledgeable James Madison, who had advocated a misdirected discrimination scheme for tampering with payouts to US creditors, a scheme that would have permanently damaged US credit. But if we judge Hamilton and Madison by the actions over which they presided, a different picture emerges.

It was Hamilton who presided over widespread discriminations and repudiations, though perhaps he repudiated less than had been expected during the 1780s, undoubtedly earning him substantial gratitude from 1780s speculators in some US and state debts, but not in others (purchasers of those forlorn Continentals). It was James Madison who during the War of 1812 presided over an administration that declined to make short-term US debt a legal tender and, at the end of the war, awarded positive returns to holders of short-term US debt. Despite considerable difficulty in selling interest-bearing debt, in financing the War of 1812 the US government refrained from using that mainstay of government finance during the American Revolution, the inflation tax. That established precedents that influenced how Ulysses S. Grant and the Republican party chose to complete Union policy for financing the Civil War. Andrew Johnson and other late 1860s advocates of ex post *lowering* interest payments to Union creditors could have appealed to Alexander Hamilton's discriminatory haircuts as antecedents; but they wanted to repudiate the precedent set by the high returns paid out by the Madison administration and its immediate successors.

Of course, our revisionist history omits as much as it includes. The Madison administration faced different constraints and opportunities than did the Washington-Hamilton administration in 1790. The US was bigger and wealthier in 1812. And as a result of how markets interpreted what Washington and Hamilton had done, the US in 1812 faced reputations vis-à-vis its prospective creditors that differed from those that had confronted the Washington administration in 1790.

More generally, from the observations that we have surveyed here we can gather five enduring lessons:[11]

1. The ability of a government to borrow today depends on expectations about future tax revenues.
2. Free-rider problems exist for subordinate governments vis-à-vis a central government.
3. Good reputations can be costly to acquire.
4. Sometimes, it can help to sustain distinct reputations with different parties.
5. Confused monetary-fiscal coordination creates costly uncertainties.

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11. Versions of these lessons were also stated in Sargent (2012, 3–4).

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DISCUSSANT REMARKS

Ellen R. McGrattan

An important question in public finance is how best to finance unanticipated emergency government spending needs. The prime example is war financing, but recent experience has highlighted the fact that there are other kinds of emergencies that also necessitate large temporary increases in government spending. Hall and Sargent do not answer the question of how to do this optimally, but they do lay out a strong case that the COVID-19 experience shares many features with the two world wars of the twentieth century.

In my discussion, I revisit two questions that are central to their paper. First, is a pandemic akin to battling a world war? I argue that there are some important differences that Hall and Sargent do not discuss that lead me to conclude that it is not like a world war. Second, who will pay? Like Hall and Sargent, I cannot answer this, because only time will tell us. But I will dig a little deeper into the "who": namely, which taxpayers and bondholders have been bearing the burden of US public financing.

IS COVID-19 LIKE A WORLD WAR?

For many analyzing budgets of the US government, figure 10.13 provides smoking-gun evidence that the pandemic was a world war–like event. The figure shows the federal primary deficit—that is, the gap between federal spending and revenues, excluding interest payments—as a percentage of gross domestic product (GDP). In figure 10.13, two lines are plotted: one for the annual data, in dark blue, and one for quarterly data, in light blue. These lines are hard to distinguish until the end, when quarterly spending increased midyear 2020 and decreased midyear 2021 at the same time that GDP fell.

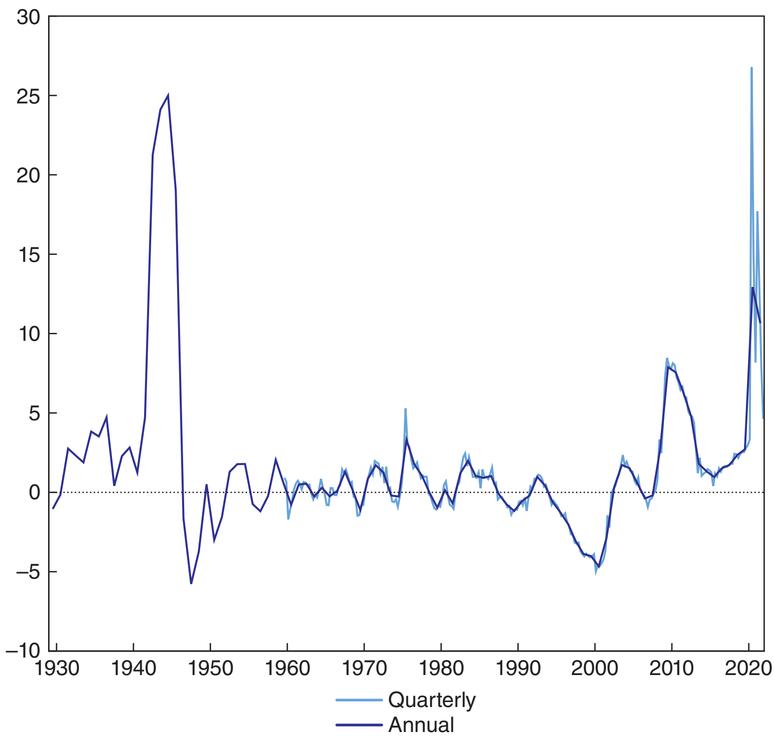

FIGURE 10.13. Primary Deficit as Percentage of GDP
Source: National Income and Product Accounts (NIPA), Bureau of Economic Analysis, US Department of Commerce. Included in NIPA are detailed government expenditures and receipts—both federal and state and local—compiled consistently back to 1929.

There is no argument that government spending greatly exceeded receipts during the pandemic. After all, figure 10.13 is simply a summary of NIPA data. However, in my view, this figure masks important differences between wars and pandemics. To address this, I will depart from Hall and Sargent in two ways. First, I will put greater focus on the spending needs during the periods of the world wars and the more recent pandemic period (2020–21). Second, I will avoid dividing government budget items by US GDP, given there are large expansions during world wars and large contractions during pandemics. I will instead analyze the

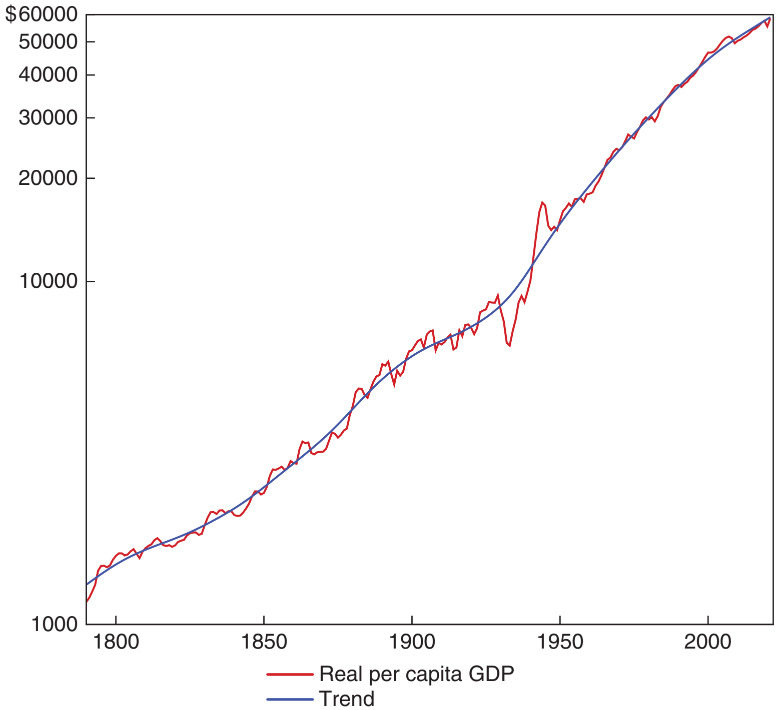

FIGURE 10.14. Historical Real Per Capita GDP (2012$)
Source: NIPA.

budget constraint after dividing by the trend in US GDP, displayed in figure 10.14.

Figure 10.14 shows the historical real per capita GDP series over the period 1790–2021 that Hall and Sargent use in their analysis. I plot this on a log scale so that the fluctuations are visible. The second line in the graph is the time trend that I will use for detrending all historical time series. This trend is constructed by applying a very low-frequency filter.[1] Figure 10.15 shows the ratio of the two lines and gives a graphical sense of output fluctuations over much of the history of the United States. Not surprisingly, the prominent

1. I should note that the issues I raise below are not overturned by using alternative low-frequency filters.

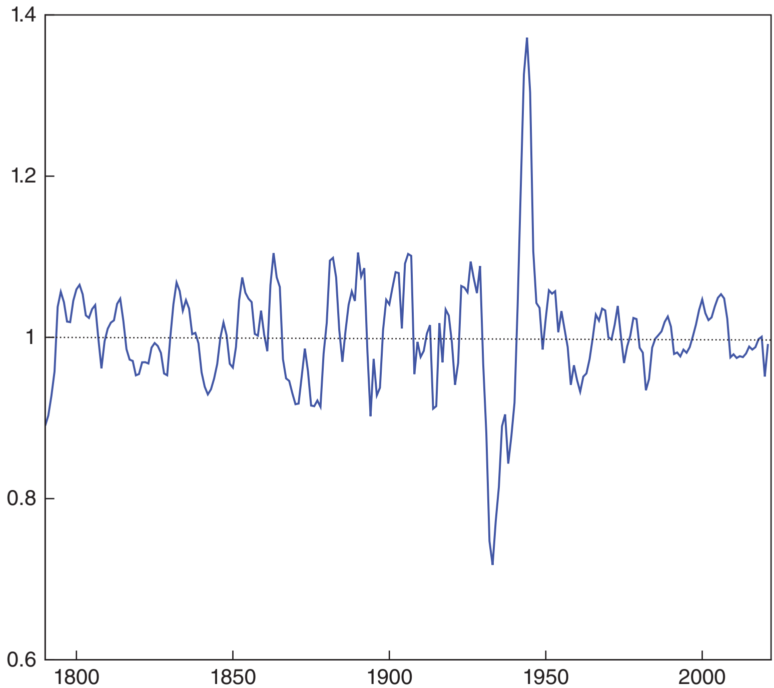

FIGURE 10.15. Detrended Real Per Capita GDP (2012$)
Source: NIPA.

episodes are the Great Depression of the 1930s and World War II in the first half of the 1940s. Less prominent are World War I and the pandemic, which are of shorter duration.

In figure 10.16, I plot the detrended real per capita GDP series from figure 10.15, along with two measures of government spending over the period 1929–2021.[2] To construct the detrended real, per capita spending measures, I first divide the relevant nominal spending series by the GDP deflator to get a measure of real spending. I then divide by the population (available in NIPA, table 2.1). Finally, I divide the spending measures by the trend in figure 10.13. The nominal

2. Since the BEA data are revised regularly back to 1929, I compare only World War II with the COVID-19 "war." Better measures of spending are needed to do the relevant comparison with World War I.

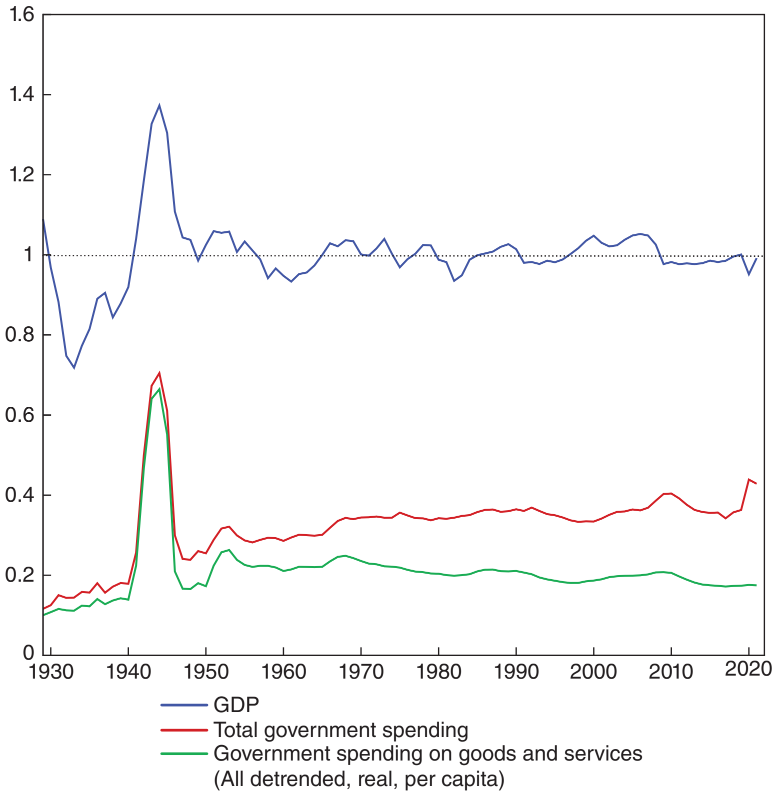

FIGURE 10.16. Detrended GDP and Spending (2012$)
Source: NIPA.

series underlying government spending on goods and services is the purchase of goods and services at the federal, state, and local levels. The nominal series underlying total government spending is the total purchase of goods and services at all levels of government plus interest payments, current and capital transfers, and subsidies.

In table 10.5, I reproduce the nominal BEA series from the NIPA tables that underlie the spending series during World War II and break out items relevant to the war. The spending is shown in billions of US dollars but can be easily converted to the deflated, per capita estimates used in figure 10.16 (and later). For example,

TABLE 10.5. Government Receipts and Expenditures, 1940–46 (Billions$)

	1940	1941	1941	1943	1944	1945	1946
Total Expenditures	20.5	32.4	70.5	103.6	115.9	107.6	62.4
Consumption expenditures	11.1	17.0	36.5	58.1	70.5	71.1	38.3
Of which:							
National defense	2.0	8.0	27.1	48.7	60.5	60.8	25.3
Current transfer payments	2.4	2.3	2.4	2.0	2.7	5.5	12.4
Of which:							
Veterans' benefits	0.5	0.5	0.5	0.5	0.9	2.8	5.3
Interest payments	1.7	1.8	2.1	2.9	3.6	4.5	5.6
Subsidies	0.7	0.5	0.5	0.6	1.0	1.1	1.4
Capital transfer payments	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gross government investment	4.4	10.8	29.0	39.9	38.2	25.3	4.7
Of which:	0.8	7.4	26.4	38.1	36.8	24.0	2.7
Defense structures	0.6	3.6	10.3	5.8	2.5	1.7	0.3
Defense equipment	0.2	3.6	15.7	31.5	33.0	21.0	1.2
Defense IPP	0.0	0.2	0.4	0.7	1.3	1.3	1.2
Total Receipts	17.1	24.3	31.8	48.2	50.1	52.2	51.3
Current tax receipts	14.3	21.0	27.8	43.2	44.3	45.2	43.1
Contributions, social insurance	1.9	2.3	2.9	3.8	4.3	5.3	6.6
Income receipts on assets	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Current enterprise surplus	—	—	—	—	—	—	—
Current transfer receipts	0.3	0.3	0.4	0.5	0.6	0.7	0.5
Capital transfer receipts	0.5	0.5	0.6	0.6	0.7	0.8	0.9

Source: NIPA.

Notes: Total expenditures include consumption of fixed assets and exclude net purchases of nonproduced assets. Veterans' benefits include pension, disability, and life insurance. Subsidies and current surplus of government enterprises not shown separately prior to 1960.

given the GDP deflator is equal to 9.5% at the peak of the war, we can convert the estimates into 2012 dollars by first dividing by the deflator and then dividing by the population of roughly 138 million to get an estimate for the per capita real spending. In other words, the $116 billion nominal total expenditures in 1944 is roughly equal to per capita spending of $8,800 in 2012 dollars, and the $50 billion nominal total receipts is equal to per capita revenues to the government of $3,800 in 2012 dollars. There are several noteworthy features of these spending measures. First, at the peak of the war, 86% of consumption expenditures and 96% of government investment expenditures were made on behalf of national defense. Current transfer payments are a minor category of spending that start to grow steadily only after the war. Half of the 1946 estimate is transfers to veterans. Also growing throughout the war are net interest payments.

Figure 10.17 shows the major categories of spending—all detrended, real, and per capita. This figure gives a good sense of the history of government spending since 1929. Wars—including World War II, the Korean War, and the Vietnam War—are times of elevated spending on goods and services. The pandemic is not. In table 10.6, I reproduce the nominal BEA series from the NIPA tables that underlie expenditure measures during the recent pandemic. As before, I report expenditures and receipts in billions of US dollars and break out categories relevant to the emergency spending. The last available data are from first quarter of 2022. In the case of the COVID-19 pandemic, there are twenty-two subcategories of spending listed that relate to different programs.

Programs that directly affect the accounting of government expenditures are included in four spending categories, namely, consumption expenditures, current transfer payments, subsidies, and capital transfer payments. One of the largest payouts of the Coronavirus Aid, Relief, and Economic Security (CARES) Act was

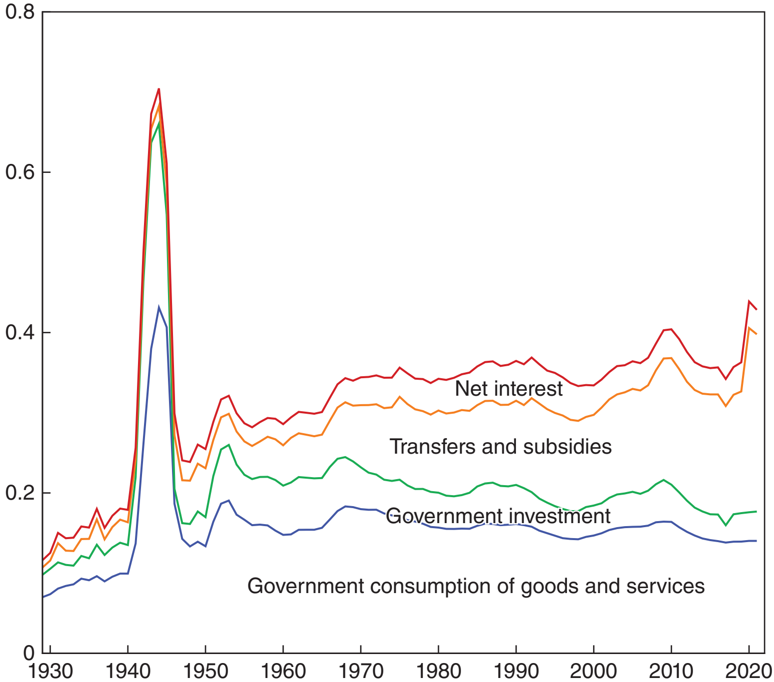

FIGURE 10.17. Detrended Spending and Components (2012$)
Source: NIPA.

the Paycheck Protection Program (PPP), which provided forgivable loans for small businesses and nonprofit institutions to help cover their payroll and other expenses during the pandemic. These payments show up as transfers to nonprofits and subsidies to businesses. PPP payments were also made to lenders to administer the loans and show up as government consumption of financial services. According to BEA estimates, the total funding for PPP was $726 billion over two years.

Another large spending initiative under the CARES Act was the Economic Impact Payments, which provided direct payments to eligible individuals. These transfers totaled $848 billion over two years.

TABLE 10.6. Government Receipts and Expenditures (Billions$)

	2019	2020	2021	2022 Q1
Total Expenditures	7,874	9,746	10,051	8,827
Consumption expenditures	2,974	3,078	3,250	3,375
Of which:				
Paycheck Protection lender fees	—	18	17	0
Current transfer payments	3,157	4,266	4,620	3,919
Of which:				
Paycheck Protection, NPISH	—	41	13	0
Economic Impact Payments	—	276	572	0
Provider Relief Fund	—	89	60	114
Coronavirus Relief Fund	—	150	246	1
Education Stabilization Fund	—	15	66	72
Lost Wages Supplement	—	36	1	0
Expansion of UI programs	—	395	293	3
Child Tax Credit	—	—	128	106
Increase in Medicare rates		10	14	15
Interest payments	890	829	807	845
Subsidies	73	761	493	150
Of which:				
Paycheck Protection, business loans	—	411	226	0
Provider Relief Fund for business	—	38	26	32
Coronavirus Food Assistance Program	—	20	6	1
Economic Injury Disaster Loans	—	20	7	2
Employees Retention Tax Credit	—	55	63	0
Tax credits to fund paid sick leave	—	105	8	0
Grants to air carriers	—	20	22	0
Restaurant Revitalization Fund	—	—	29	0
Support for public transit	—	15	14	20
Capital transfer payments	26	16	70	17
Of which:				
Emergency rental and homeowners	—	—	51	0
Gross government investment	740	782	802	825
Net purchases of nonproduced assets	14	14	9	–305
Total Receipts	5,919	5,926	6,691	7,424
Current tax receipts	4,055	4,021	4,623	5,217
Of which:				
Aviation Tax Holiday	—	–13	0	0
Contributions for social insurance	1,427	1,464	1,597	1,705
Income receipts on assets	207	216	236	269
Of which:				
Student Loan Forbearance	—	–30	–38	–38
Current surplus of government enterprises	–13	–17	–13	–14
Current transfer receipts	223	216	215	214
Capital transfer receipts	22	26	32	33

Source: NIPA.

Note: Total expenditures include consumption of fixed assets.

The Provider Relief Fund (PRF) has been supporting transfers and business subsidies—to date totaling $359 billion—to hospitals and health care workers treating uninsured individuals. The Education Stabilization and Coronavirus Relief Funds have provided $397 billion and $153 billion, respectively, in grants-in-aid to states and local governments for schools and other local needs during the pandemic.

A supplement of $37 billion drawn from the Disaster Relief Fund was paid by the Federal Emergency Management Agency (FEMA) for wages deemed "lost" in the pandemic. In addition to the new transfer programs, existing ones were expanded. There was an expansion of unemployment benefits and child tax credits, which increased current transfer payments. During 2021 and 2022:Q1, child tax credits were increased to $3,600 per child for children under age six and $3,000 per child between ages six and seventeen, which led to increases in current transfer payments. Reimbursement rates for Medicare service providers was also increased, which resulted in additional transfers of $39 billion over the period reported.

In addition to PPP and PRF subsidies, other subsidies to businesses were granted during the pandemic. The Coronavirus Food Assistance Program provided $27 billion in subsidies to farmers and ranchers impacted by supply chain disruptions. The Economic Injury Disaster Program provided $29 billion in loans to small businesses and nonprofit organizations experiencing a temporary loss of revenue. Tax credits totaling $231 billion were offered for employee retention and to fund sick leave.

There were also targeted subsidies in some sectors. Air carriers received grants totaling $42 billion. The Restaurant Revitalization Fund provided $29 billion in subsidies to owners of food and beverage–related industries including bars, restaurants, and their suppliers. The CARES Act provided $25 billion to state and local transit agencies.

Pandemic-related programs also affected capital transfers in which payments are made for liabilities incurred for services in earlier periods. In this category, the BEA includes the Emergency

Rental Assistance Program and the Homeowner Assistance Fund, both of which provided assistance for rental arrears and delinquent mortgage payments. To date, the government has spent $51 billion on this program.

Given the remarkable number of programs initiated during 2020–22, one can get lost in the weeds, and thus it helps to recap the clear message that the facts convey. The main spending of World War II was purchases of goods and services by the military. The spending was temporary—lasting four years. The main spending of the pandemic is in the form of new transfers and subsidies—to lots of different recipients—and expansions of some existing programs. Importantly, some of this spending will be hard to discontinue. Estimates in table 10.6 will be updated as new data are compiled by the BEA.

The more important data that has yet to be compiled is the eventual funding sources. I turn to this next.

WHO WILL PAY?

In figure 10.18, I plot total spending and total receipts. With total spending, I include net interest payments and gross government investment.[3] (See tables 10.5 and 10.6 for the underlying BEA data during World War II and the recent pandemic.) As is clear from the figure and tables, there is a significant and persistent funding gap. The only emergency provisions are noted in table 10.6, namely, the Aviation Tax Holiday, which lowered revenues by $13 billion in 2020, and the Student Loan Forbearance, which suspended interest payments on certain federally held student loans until August 2022. According to BEA estimates, the latter program costs roughly $38 billion annually in lost revenue.

3. If I were to include *net* government investment instead, then consumption of government fixed assets must be subtracted.

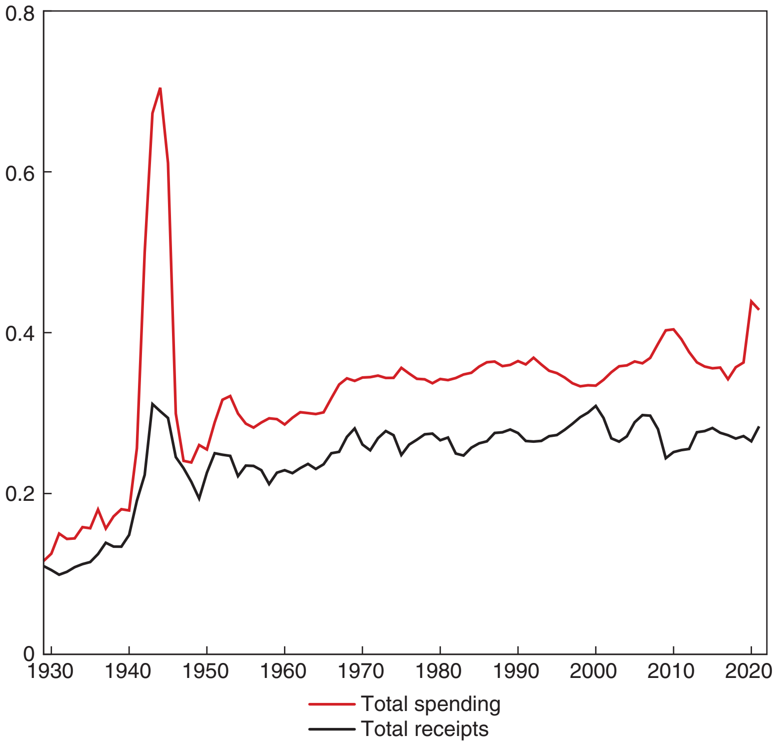

FIGURE 10.18. Detrended Spending and Receipts (2012$)
Source: NIPA.

Figure 10.19 shows the history of total receipts, by funding source. The figure shows that individual income and corporate taxes rose considerably during World War II, but as figure 10.18 makes clear, these tax receipts do not come close to funding the war. Sales and property taxes change little and, if anything, property taxes fall relative to trend during the 1940s and remain at that lower level after that. Over time, with corporations able to relocate production abroad and with a rise in pass-through business activity, the corporate income tax funding has diminished while individual income taxes have risen as a share of receipts. But, here again, the receipts are still far too low to cover the spending.

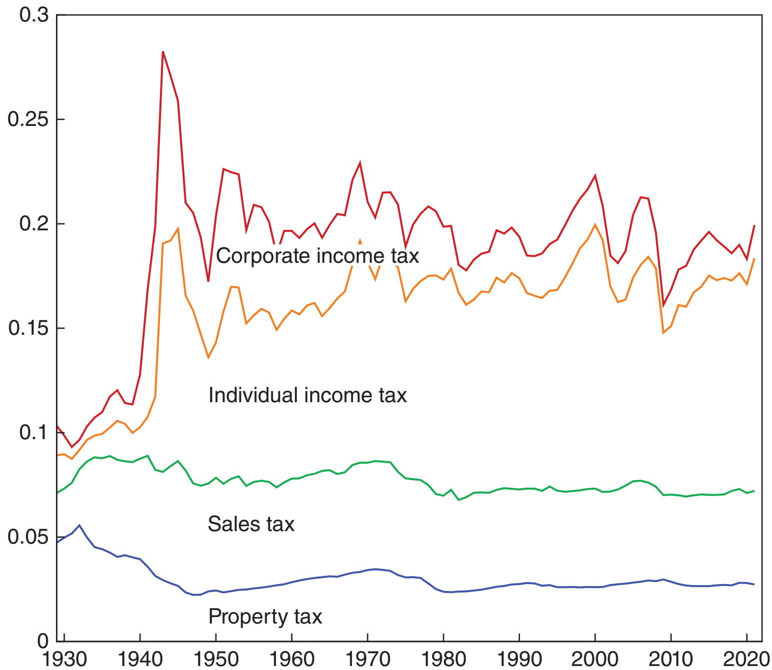

FIGURE 10.19. Detrended Receipts and Components (2012$)
Source: NIPA.

As a result, federal debt levels have soared. In figure 10.20, I plot total debt, debt held by private investors—both foreign and domestic—and debt held by foreigners. All series are in real, per capita terms and have been divided by the GDP trend level shown in figures 10.13 and 10.14. A value of 1 here means a real, per capita level of debt that is equal to real, per capita GDP. The figure makes clear that while foreign holdings of US debt have been rising over time, there is significant debt held domestically. Figure 10.21 provides a breakdown of these holdings. In this case, the data are reported in trillions of dollars (without any detrending) over the period 2011–21. The foreign holdings rise from a little under $5 trillion to $7.5 trillion. The net largest holder are mutual funds, which held little in 2011 but grew their positions

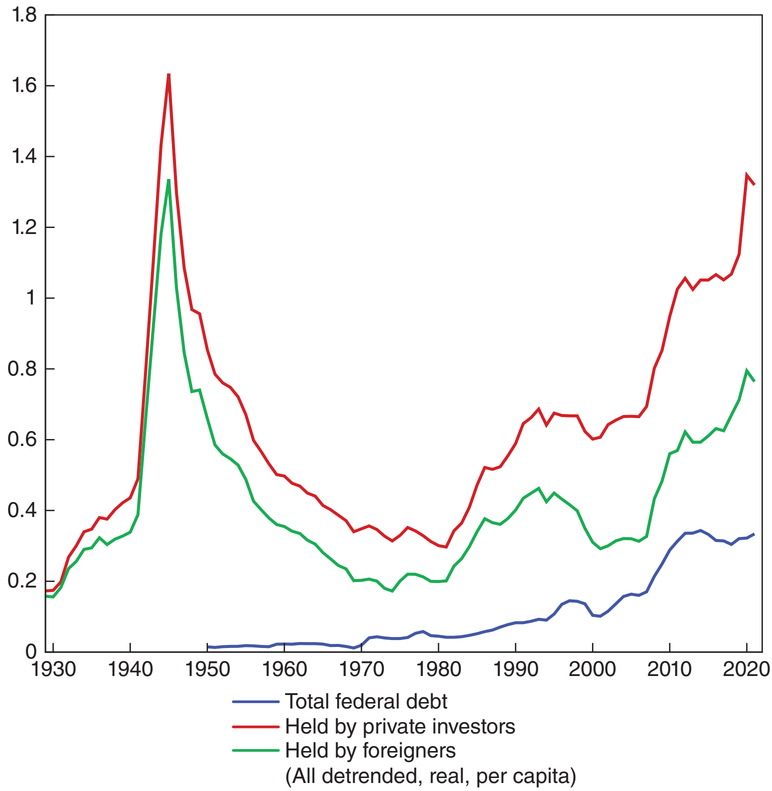

FIGURE 10.20. Detrended Federal Debt and Components (2012$)
Source: *US Treasury Bulletin*.

to $3.5 trillion. Adding banks, governments, pension funds, and insurance companies to this sum, we have another $4.5 trillion in 2021.

Financing the pandemic spending through an effective default on the federal debt—say, because inflation is now on the rise—will be difficult since so much debt is held domestically. Financing the pandemic with higher current taxes will be difficult given the "no new taxes" climate that has persisted for decades. That leaves the usual plan of action: ever-increasing debt levels and higher taxation on future generations.

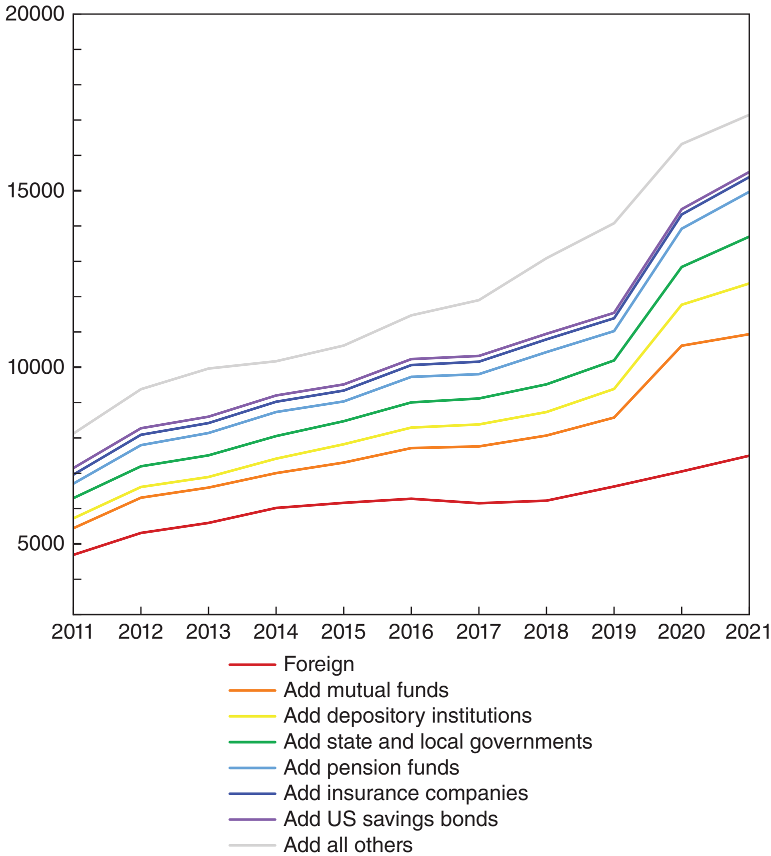

FIGURE 10.21. Cumulative Holdings of Federal Debt (Current$)
Source: *US Treasury Bulletin*.

NEXT STEPS

An interesting next step of the Hall Sargent research program is to work out optimal tax policy responses in the case of a war and in the case of a pandemic. Given the different spending requirements, I would be interested to know if the policy prescription is the same, regardless of the type of crisis.

GENERAL DISCUSSION

JOHN LIPSKY (INTRODUCTION): Something we do frequently is to think back to past occurrences and try to derive lessons that help illuminate our choices today. Of course, this is what historians do as a career. And, all of us, presumably, are guided in such endeavors by Mark Twain's notion that history doesn't repeat itself but that it often rhymes. And today, we are fortunate to be joined by two very distinguished poets of economics, who are going to examine aspects of the two world wars of the twentieth century to see if it is possible to derive some useful comparisons applicable to the COVID-19 pandemic. And that explains the title of the presentation we're about to hear: "World Wars: Fiscal-Monetary Consequences."

The presenters are—first—Professor George Hall from Brandeis. He is a professor of economics and also in the International Business School, and whose work focuses on fiscal policy and debt management, firm inventory investment and dynamic pricing, and business cycle dynamics. His coauthor is Professor Tom Sargent, the W. R. Berkley Professor of Economics and Business at NYU and a senior fellow here at Hoover. I presume that Professor Sargent is well known to this audience. After all, he was awarded a Nobel Prize in 2011. Moreover, his Wikipedia entry states that he is the twenty-ninth-most-cited economist in the world. George Hall is going to present the paper. Following the presentation will be comments by Professor Ellen McGrattan, who is a professor of economics at the University of Minnesota and also the director of the Heller-Hurwicz Economics Institute. Professor McGrattan's research is concerned with the aggregate effects of monetary and fiscal policy on GDP, investment, equity markets, and international capital flows.

* * *

JAMES BULLARD: I just have a question for the authors. The Barro literature would say that when you have a big expenditure that you have to make, maybe you should borrow and smooth the taxes. It looks like in these graphs that the US government did not impose a lot of taxes at the time. Is your gut instinct that this looks like optimal tax smoothing in which the inflation tax could be part of that optimal tax smoothing? Or is there some sense where there's faulty policy going on here?

KRISHNA GUHA: Thank you. I'm Krishna Guha with Evercore Partners. So I just wanted to ask the authors what relationship, if any, they established between the ways in which the wars were paid for and these big price level shifts that you observe at least in the historic episodes? Then relatedly, when we look at the current episode, and you're sort of looking at whether to classify the interest-bearing federal liabilities as part of consolidated government debt in effect, or as part of money, what are you left with? Are you assigning some special inflationary quality to what you're left with and calling money being the non-interest-bearing liabilities? Are you viewing it in a different way?

MICHAEL BORDO: World War I and less so World War II were fought in an environment where the gold standard prevailed. Under the gold standard the price level was anchored by the commitment mechanism of the fixed gold peg. Bordo and Kydland (1996) viewed the gold standard as a contingent rule which allowed temporary departures from gold parity to finance wars. Tax smoothing, as followed by the UK and the US, was complimentary to the gold standard. In the COVID-19 episode, the world was not on the gold standard, but the price level was supposedly anchored by credible central banks committed to low inflation. However with the current surge in inflation, the nominal anchor under the present regime may not be as credible or durable as under the gold standard. Would not this influence the debt dynamics?

WILLIAM NELSON: Thank you, Bill Nelson, Bank Policy Institute. George, just a factual question. So I've always thought of currency as being determined by demand and largely independent of anything that the Fed does or the rest of its balance sheet. And you see, in fact, the growth in currency undisturbed through the COVID event. But in both of the world wars, currency rises sharply. So, could you explain how that comes about?

ROBERT HALL: One of the jobs of the Fed is to keep currency and reserves on par with each other. So there's no independent control of their quantities. The Fed buys and sells currency in order to maintain exact parity. So, we shouldn't be talking about any buying or selling the Fed does separately. The Fed cannot determine either one of the components but only the sum. The price remains exactly the same. And changes in demand, therefore, show up as changes in quantities and not in price.

JOHN COCHRANE: Thanks, this was great. I want to bring us back a little bit to the topic of the conference and inflation. The big question is, of course, to what extent did this inflation look like the last one? There's a story that you finance wars with a Lucas-Stokey state-contingent default via inflation. That story is going around about COVID: "Don't worry about this inflation. It comes out of the pockets of the bondholders, and it's the right thing to do to finance a once-in-a-lifetime emergency with a once-in-a-lifetime state-contingent default via inflation." But there's a big puzzle here: That's supposed to happen at the *beginning* of the war, not at the *end* of the war, because if people see it coming, they don't take the bonds in the first place. So it's quite a puzzle that our pattern seems to be: sell bonds to unsuspecting people and then whack them three years afterwards with big inflation. Why don't people see it coming and refuse to buy the bonds?

Now on to Ellen's big question, which is the larger fiscal question facing us: Who's going to pay? You both pointed to the ongoing structural deficits due to entitlements. How does that work out? I'm not so sanguine as Ellen. First of all, how much high-income taxpayers could possibly bear it is an interesting question. The all-in marginal tax rate on the top end in California is over 70%. There is a Laffer curve out there somewhere; I don't know how much you can raise that. So middle-class taxpayers will bear the brunt, as they do in Europe, if that's the route it's going to go. Inflation is attractive, default on the debt through inflation. But as you're both pointing out, the problem is not so much the past debt, the problem is the ongoing and future surpluses. And default does nothing to solve that. Indeed it makes the problem worse. Default, or inflate. Now, where are we going to borrow that trillion bucks a year that we need to keep borrowing? There is also one option you didn't mention: spending. It has to be either taxes, default, inflation, or cutting spending. It's not so obvious to me that individual income taxes will just float up to solve the difference.

PATRICK KEHOE: I would like to follow up on what John Cochrane said. We heard a lot about the implications of the Barro tax-smoothing result. The Lucas-Stokey tax-smoothing paper also has implications for what John said. It would be useful to use that model as the baseline and see how much the historical events you study differ from the basic Lucas and Stokey prescriptions. That is, we could ask, Did the United States do a poor job on how we levied taxes in these periods? Or did we follow the Lucas-Stokey prescription of how a government should pay less to bondholders during the war and then pay more after the war? That is the interesting twist. It's not just did we tax-smooth as in the Barro prescription, it's did we find a way to pay less on debt during the war and more after the war ended? That'd be an interesting paper for you to follow up with: Take the simple Lucas-Stokey idea on how it is optimal to have contingent payments on the bonds—low during the war and high after the war—and see if actual policies essentially mimicked that pattern. We touched on it, but it'd be interesting if you could keep going with that idea.