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Recovery of 1933*

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Abstract

When Roosevelt abandoned the gold standard in April 1933, he converted government debt from a tax-backed claim to gold to a claim to dollars, opening the door to *unbacked fiscal expansion*. Roosevelt followed a state-contingent fiscal rule that ran nominal-debt-financed primary deficits until the price level rose and economic activity recovered. Theory suggests that government spending multipliers can be substantially larger when fiscal expansions are unbacked than when they are tax-backed. VAR estimates using data on "emergency" unbacked spending and "ordinary" backed spending confirm this prediction and find that primary deficits made quantitatively important contributions to raising both the price level and real GNP after 1933. VAR evidence does not support the conventional monetary explanation that gold revaluation and gold inflows, which raised the monetary base, drove the recovery independently of fiscal actions.

Keywords: Great Depression; monetary-fiscal interactions; monetary policy; fiscal policy; government debt
JEL Codes: E31, E52, E62, E63, N12

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1 Introduction

Anyone who doubts that history repeats itself need only to reflect on American monetary-fiscal responses to the Great Depression starting in 1933 and the Covid pandemic beginning in 2020. Monetary reactions were dramatic. In 1933 Congress placed monetary authority in the hands of the executive branch. Franklin D. Roosevelt (FDR) used that authority: abandoning the gold standard, revoking convertibility of dollars to gold, and reducing the gold content of the dollar. Two results followed. First, federal government debt, which had been a tax-backed claim to gold, transformed into a claim to dollars. Second, the monetary base was permitted to expand to accommodate economic activity, keeping nominal interest rates low and stable. In March 2020 the Federal Reserve swiftly dropped the federal funds rate to zero and expected to keep it there for the duration of the crisis. Over the next year the Fed bought $3.5 trillion in assets. In both periods, the actions taken by policymakers resulted in a stance of monetary policy that was conducive to fiscal expansion.

Fiscal policies were strikingly similar. Roosevelt distinguished between "emergency" and "ordinary" government expenditures, pledged to debt-finance emergency relief spending until recovery set in, and committed to balance the ordinary budget.[1] From the CARES Act in March 2020, which passed with an unrecorded voice vote in the House of Representatives, through the remaining pandemic spending packages, Congress suspended its usual budget procedures that required offsets for new spending. In the course of a year, spending—much of it transfers to individuals and businesses—and bond sales rose $5 trillion, about 20 percent of GDP. During both Covid and the Depression the "emergency" modifier communicated temporary, state-contingent fiscal expansion that would not ultimately be financed by tax hikes or regular spending cuts. We argue that both were *unbacked fiscal expansions*.[2]

A key difference between 21st century and Depression policies lay in their goals. Rapid economic relief was a common objective, but Roosevelt explicitly sought to reflate an economy whose consumer prices had declined 25 percent since the 1920s. Potential inflationary consequences of unbacked Covid spending received little attention in the political discourse, perhaps because stimulus spending was not associated with elevated inflation in the 2009 recovery.[3] In contrast to Covid and the Depression, the 2009 stimulus was not unbacked fiscal expansion because policymakers signaled that the spending would be repaid through the usual financing channels.

This paper analyses the recovery of 1933. We frame the policy problem—as Roosevelt posed it—as returning aggregate prices to their levels in the previous decade. This narrow framing of the problem does not preclude policies raising output and employment, but it allows us to focus on how expanding nominal government liabilities led to reflation, a novel aspect of the recovery relative to existing research. Furthermore, by pursuing rising prices Roosevelt signalled a permanent regime change and an obvious departure from the gold standard's deflationary orthodoxy in place at the time.

[1] See Bianchi, Faccini, and Melosi (2023, 2022) for excellent quantitative analyses of the separation of short-run policy interventions from long-run fiscal sustainability.

[2] Unbacked fiscal expansion stems from work on the fiscal theory of the price level, including Leeper (1991), Sims (1994), Woodford (1995), Cochrane (1999, 2023), and Leeper and Leith (2017). Bianchi and Melosi (2019) model backed and unbacked fiscal shocks. Hall and Sarent (2022) focus on how "the public paid for" increased government spending during Covid and World War I and II.

[3] See Barro and Bianchi (2023) for a cross-country study of post-Covid fiscal inflation.

Roosevelt pursued *joint* monetary and fiscal policies. His first steps were monetary: reduce the gold content of the dollar, abandon the promise to convert dollars to gold, forbid private holding of monetary gold, and abrogate the gold clause on all current, past, and future contracts. The gold standard fettered fiscal policy. Government bonds were a claim to gold, which the government bought by passively raising taxes. Deflation and its attendant increase in the real value of government debt would have required fiscal austerity to validate the deflation. Leaving gold released the fetters: Roosevelt expanded government spending on relief and works programs, financed that spending with nominal bonds, and convinced people the economic crisis required a break from fiscal norms—bonds would not be fully backed by future taxes until the economy recovered.

Once Roosevelt shucked off the gold standard's straitjacket, he could exploit the nominal nature of government debt. If dollars are convertible to gold, even dollar-denominated government liabilities are effectively *real* obligations. Credibility of the gold standard rested on government standing ready to raise real taxes to acquire the requisite gold [Bordo and Kydland (1995)]. By ending convertibility, Roosevelt enlarged his policy options. He could continue the orthodox policy that new debt begets new taxes or depart from past policies to allow prices to revalue outstanding bonds. Early in his presidency, Roosevelt chose both, backing ordinary spending with taxes while allowing inflation to finance emergency expenditures. Attempting to keep the ordinary budget balanced helped keep the US reputation for repaying debts largely intact which was vital for subsequent World War II borrowing.

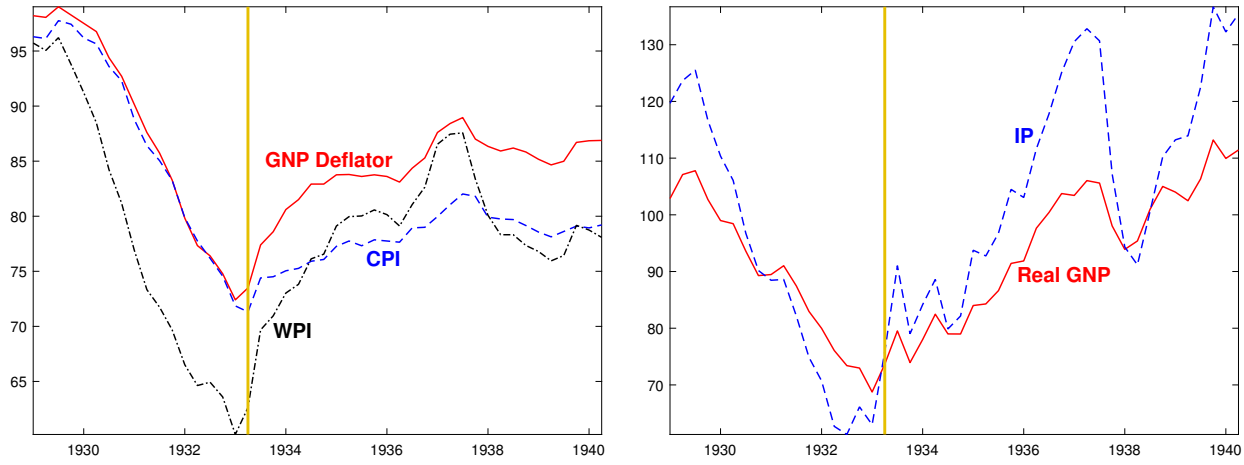
Our thesis challenges the conventional wisdom that recovery had little to do with fiscal policy. Scholars from Brown (1956) to Romer (1992) to Fishback (2010) maintain that fiscal deficits during Roosevelt's first term were too small to close the gaping gap in output.[4] That view stems from a narrow conception of the fiscal transmission mechanism: government raises real spending, directly increasing real aggregate demand; higher real demand propagates through higher real expenditures and income, eventually to raise output by a multiple of the initial fiscal expansion. We call this mechanism "Keynesian hydraulics," Coddington's (1976) evocative label.

Nominal debt doubled before the end of Roosevelt's second term. Under Keynesian hydraulics, the resulting expansion in *nominal* demand provides no additional economic stimulus. Brown (1956) and others explicitly exclude government borrowing from their analyses. Keynesian hydraulics implicitly assumes that higher taxes extinguish all wealth effects from higher nominal debt. That assumption forces debt to be fully backed, denying that the suspension of gold convertibility fundamentally altered the nature of government debt and the fiscal options available to policymakers after 1933. We broaden the perspective on fiscal transmission to include both Keynesian hydraulics and potential wealth effects from government debt growth. When nominal government debt expands without raising expected taxes, private-sector wealth and aggregate demand increase to amplify the fiscal impacts. Evidence supports the expanded view of fiscal transmission: emergency spending is more stimulative than regular spending.

Unbacked fiscal expansion worked. Jalil and Rua (2017), Binder (2016), Payne, Szőke, Hall, and Sargent (2022), and Ellison, Lee, and O'Rourke (2024) present evidence that in

[4]See also Chandler (1971), Peppers (1973), Beard and McMillin (1991), Raynold, McMillin, and Beard (1991), Eichengreen (2000), Steindl (2004), and Hausman (2016).

the second quarter of 1933 inflation expectations picked up rapidly. Vertical lines in figure 1 mark departure from gold. Price levels and output reversed their declines and rose steadily until the 1937 recession. In fact, Ellison, Lee, and O'Rourke (2024) show that the U.S. had one of the strongest rises in prices and output among 27 countries studied, which suggests that unbacked fiscal expansion played a role in the recovery complementary to devaluation after the departure from gold.[5]



(a) Price levels (b) Output

Figure 1: Panel (a): three measures of the price level. Panel (b): two measures of output. All series use 1926 base year. Vertical lines mark when the U.S. abandoned the gold standard. Sources: Balke and Gordon (1986), Federal Reserve Board, BEA and BLS from NBER Macrohistory Database.

1.1 The Policy Problem

When Roosevelt was sworn in as president in March 1933, the economy had been declining for over three years. Relative to the third quarter of 1929, real GNP was 36 percent lower while current-dollar GNP was 57 percent smaller; industrial production had fallen by half; unemployment had increased 22 percentage points; bank deposits and the money supply had contracted about 30 percent; and government debt had grown from 16 percent to over 40 percent of output. Although his first acts salvaged a banking system left reeling by three consecutive crises, Roosevelt's focus never strayed far from the macroeconomic facts.

Figure 2 encapsulates the policy problem. FDR felt that the key to economic recovery lay in returning overall prices to their 1920s levels, to achieve "... the kind of a dollar which a generation hence will have the same purchasing power and debt-paying power as the dollar we hope to attain in the near future" [Roosevelt (1933c)]. Persistent declines in overall prices in the early 1930s bankrupted the farmers and homeowners who had incurred nominal debts at elevated 1920s price levels. But the 1920s price level was 60 percent above the long-run average to which it had to revert to maintain gold convertibility at the parity that prevailed over the previous century.

[5]Hausman, Rhode, and Wieland (2019) argue that the redistribution of income to constrained farmers in the spring of 1933 links devaluation to higher agricultural incomes and aggregate demand.

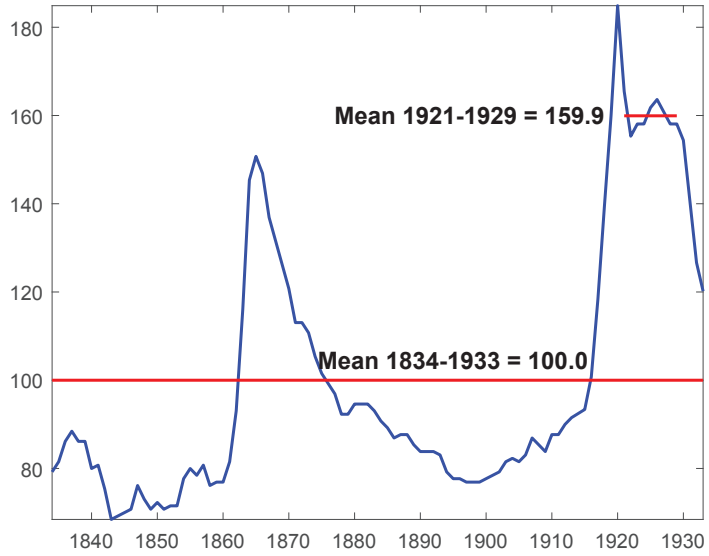


Figure 2: Consumer price index since the 1834 Coinage Act set the price of one ounce of gold at $20.67. Rescaled to make mean from 1834–1933=100. Sample includes periods when convertibility was suspended. Source: Officer and Williamson (2018) and authors' calculations.

Roosevelt's objective to return the price level permanently to that high level was inconsistent with remaining on the gold standard at the historical conversion rate. FDR pursued a triple-barreled approach to the problem. The executive branch—with Congressional approval—took control of monetary policy from a Federal Reserve that is described by Friedman and Schwartz (1963, p. 407) as "inept" since the depression started.[6] The second barrel ran "emergency" fiscal deficits financed by new issuances of nominal Treasury bonds. Emergency spending served two purposes. It provided much-needed relief through an array of relief and works programs. But the modifier "emergency" also communicated the temporary nature of a fiscal program tied directly to the country's economic emergency. At the same time, Roosevelt balanced the "ordinary" budget, underscoring that in normal times fiscal policy will revert to conventional tax-backed financing.

Roosevelt coupled his monetary and fiscal plans to a third barrel designed to persuade people the unprecedented policies were credible and essential to recovery. The administration adopted a political strategy that pitched economic recovery as the antidote for domestic unrest and foreign fascism. Roosevelt made recovery *the* priority; higher, for example, than maintaining the last century's fiscal orthodoxy. The president found innovative ways to persuade people that the stakes of recovery were unprecedentedly high. On the domestic front, he feared "agrarian revolution" and "amorphous resentment" of economic institutions [Blum (1959, p. 72), Leuchtenburg (1963)]. Internationally, Roosevelt conjured images of European fascism as the inevitable consequence of continued depression. In advisor Warren's words, Roosevelt faced "a choice between a rise in price or a rise in dictators" [quoted in Rauchway (2014, p. 4)]. The president framed economic recovery as "a war for the survival of democracy" [Roosevelt (1936a)].[7]

[6]Friedman and Schwartz (1963, p. 407) characterize their adjective "inept" for monetary policy as a "plain description of fact." Wicker (1965) and Meltzer (2003) arrive at similar assessments.

[7]Other authorities also communicated the high stakes. In February 1933, Marriner Eccles, then a private

Wicker (1971) argues that Roosevelt's fiscal programs lacked a well-articulated mechanism, though the aim to raise the price level was clear. Unbacked fiscal expansion provides that missing mechanism.

1.2 What We Do

The paper places FDR's policy actions in the political and intellectual context of the times. That context drives the narrative. We establish theoretical results that frame the issues and help to interpret the history and the data. Unbacked fiscal expansion permanently raises the price level, but is infeasible under the classical gold standard. Theory expresses the total effect of fiscal expansion as the sum of Keynesian hydraulics and wealth effects from government debt. This implies that unbacked—emergency—government expenditures have generally larger impacts than tax-backed—ordinary—fiscal expansion.

VAR evidence supports the theory: emergency expenditures have substantially larger impacts on the price level and output than do ordinary expenditures. In an expanded system of variables, higher primary deficits persistently raise prices, output, the gold stock, base money, and nominal government debt. A $1 surprise increase in the primary deficit rises real GNP between $3.5 and $4.5 after a year.

We re-examine Friedman and Schwartz's (1963) narrative that largely exogenous gold inflows and accommodating expansion of the monetary base led the recovery.[8] They point to positive comovements in monetary gold, base money, the price level, and output as evidence supporting their narrative. Identified gold supply shocks have weak predictive value for money and none for prices and output. In a search across structural VAR identifications, we find that Friedman and Schwartz's comovements are very likely to be associated with higher primary deficits, a fiscal response that is inconsistent with money-led recovery.

Informal evidence corroborates the VAR results. Ex-ante and ex-post real returns on the government bond portfolio were substantially lower after leaving the gold standard than before, even though nominal returns were comparable. Surprise real returns averaged -0.76 percent from April 1933 to June 1940 along with large and frequently negative surprise revaluations of debt. Finally, the debt-GNP ratio rose from 16.4 percent in 1929Q4 to 42.3 percent when Roosevelt took office. Although nominal debt doubled over the next seven years, the ratio averaged only 41.6 percent. Nominal economic growth stabilized debt.

The next section lays out the theoretical framework that explains why Roosevelt's desire to reflate drove him to abandon gold and turn to fiscal policy. The paper then describes the monetary-fiscal policy context of the 1930s, which the theory aims to capture. Section 4 recounts fiscal facts and reports a measure of fiscal impulse—the ratio of the primary surplus to the market value of debt—that suggests fiscal policy *was* employed aggressively. VAR evidence appears in section 5 and also reassesses Friedman and Schwartz's (1963) money-led recovery view. After the formal econometrics, the paper offers corroborating informal evidence. Section 7 embeds our narrative in the historical intellectual context and

banker, testified to the Senate Finance Committee that without federal government intervention, "we can only expect to sink deeper in our dilemma and distress, with possible revolution, with social disintegration, with the world in ruins, the network of its financial obligations in shreds, with the very basis of law and order shattered" [Eccles (1933, p. 705)].

[8]See also Romer (1992), Bernanke (2004), and Steindl (2004).

contrasts our explanation of recovery with existing literature, including Eggertsson's (2008) coordinated monetary-fiscal story of recovery. The paper ends with some lessons for today and relates our narrative to Barro and Bianchi's (2023) study of fiscal inflation in the 2020s.

2 Why Unbacked Fiscal Expansion?

Contemporary supporters and critics understood that Roosevelt's price-level objective entailed a permanent increase in prices to 60 percent above their long-run average [Fisher (1934, ch. VI)]. But a permanent revaluation of the dollar price of gold required leaving the classical gold standard. We establish this and other insights about monetary and fiscal policy under a gold standard in a simple model.[9]

A representative household maximizes

$$E_t \sum_{T=t}^{\infty} \beta^{T-t}[U\left(C_T, M_T/P_T, G_T^p\right) - V(H_T)]$$

where $U\left(C, M/P, G^p\right)$ is increasing and concave, $V(H)$ is increasing and convex, and $0 < \beta < 1$. Households derive utility from consumption purchases, C_t, real money holdings M_t/P_t that facilitate transactions, and private holdings of gold, G_t^p. They supply labor, H_t, to produce goods.

Maximization is subject to the flow budget constraint

$$M_t + P_t^g G_t^p + B_t \leq W_t + w_t H_t + P_t^g G_{t-1}^p + \Pi_t - P_t T_t - P_t C_t \tag{1}$$

where P_t is the price level, P_t^g the dollar price of gold, w_t nominal wages, Π_t dividends from equity holdings in gold firms, and T_t lump-sum taxes net of transfers. End of period liquid wealth satisfies $W_{t+1} \equiv M_t + A_{t+1}$. A_{t+1} is the nominal value of the household's bond portfolio. The price of the bond portfolio satisfies $B_t = E_t Q_{t,t+1} A_{t+1}$, where $Q_{t,t+1}$ is the stochastic discount factor pricing arbitrary financial claims in period $t+1$. Using these in (1) yields

$$P_t C_t + \frac{i_t}{1+i_t} M_t + E_t[Q_{t,t+1} W_{t+1}] \leq W_t + w_t H_t - P_t^g (G_t^p - G_{t-1}^p) + \Pi_t - P_t T_t$$

Result 1. *Under the gold standard with a fixed parity—the classical gold standard—monetary and fiscal policies cannot achieve any desired price level.*

Straightforward economic logic underlies this result. Private holdings of gold establish the goods value of gold—the aggregate price level. The Euler equations for private gold and consumption demand together imply that

$$\frac{P_t^g}{P_t} = E_t \sum_{T=t}^{\infty} \beta^{T-t} \frac{U_g(G_T^p)}{U_c(C_t)}. \tag{2}$$

When a classical gold standard fixes the dollar price of gold at $P_t^g = \bar{P}^g$, the marginal rate of substitution between gold and consumption uniquely determines the equilibrium price level.

[9] We build on Barro (1979) and Goodfriend (1988). Appendix A provides the complete model, calculations, and proofs for all the theoretical results in the paper.

Monetary policy must passively adjust to accommodate the price level consistent with the pegged price of gold, according to Keynes's "rules of the gold standard game" [McKinnon (1993)]. Fiscal policy must passively adjust primary surpluses to provide gold backing for outstanding government debt at that price level [Bordo and Kydland (1995)]. This establishes that monetary actions—leaving the classical gold standard and abandoning convertibility—were necessary to achieve Roosevelt's price-level objective.

Definition 1. *Unbacked fiscal expansion increases government expenditures on purchases or transfers, issues nominal bonds to cover the deficit, and persuades people that surpluses will not rise to finance the bonds.*

Our theory makes this definition precise and illustrates the price-level consequences of unbacked fiscal expansion. The transversality condition for optimal asset holdings and the flow budget constraint deliver the household's intertemporal constraint

$$W_t = E_t \sum_{T=t}^{\infty} Q_{t,T} \left[P_T C_T + P_T T_T + \frac{i_T}{1+i_T} M_T^s + P_T^g (G_T^p - G_{T-1}^p) - w_T H_T - \Pi_T \right] \quad (3)$$

where $Q_{t,T}$ comes from recursively applying the consumption Euler equation. The real value of asset holdings is the expected discounted value of spending less income.

We close the model with the following assumptions. Under a gold standard the government fixes the dollar price of gold at $P_t^g = \bar{P}^g$. The government's holdings of gold, G_t^m, back the money supply according to $\bar{P}^g G_t^m = \alpha M_t$ where the policy parameter satisfies $0 < \alpha < 1$. The central bank pegs the nominal interest rate, $i_t = \bar{i}$, to approximate Federal Reserve behavior after 1933. Government purchases are zero, so taxes less transfers equal the primary surplus, which obeys $S_t = \bar{S} + \varepsilon_t$, where $E_t \varepsilon_{t+j} = 0$ for $j > 0$. Absent shocks to technology, output is constant at $\bar{Y}$. Gold supply is exogenous and profits from the gold sector are $\Pi_t = \bar{P}^g (G_t - G_{t-1})$.

A rational expectations equilibrium is a set of state-contingent paths for endogenous variables that satisfy the conditions for household and firm optimality together with market-clearing conditions

$$\bar{Y} = C_t \quad (4)$$
$$M_t = M_t^s \quad (5)$$
$$A_{t+1} = A_{t+1}^s \quad (6)$$
$$G_t = G_t^m + G_t^p \quad (7)$$

at all dates and states, where M_t^s and A_t^s denote the supplies of government liabilities.

Substituting (4) and (5) into the first-order conditions for real money demand and private gold holdings and imposing policy behavior gives

$$\frac{U_m(M_t^s/P_t)}{U_c(\bar{Y})} = \frac{\bar{i}}{1+\bar{i}}$$
$$\frac{U_g(G_t - \alpha M_t^s/\bar{P}^g)}{U_c(\bar{Y})} = \frac{\bar{P}^g}{P_t} \frac{\bar{i}}{1+\bar{i}}$$

Real money balances and the relative price of gold emerge as

$$\frac{M_t^s}{P_t} = L^m(\bar{Y}, \bar{i}) \tag{8}$$

$$\frac{\bar{P}^g}{P_t} = L^g(\bar{Y}, \bar{i}, G_t) \tag{9}$$

where the functions L^m—the liquidity preference schedule—and L^g have obvious properties. We note that equation (2) is the more general version of equation (9).

Applying policy rules, imposing goods- and bond-market clearing on (3), and evaluating expectations yields the equilibrium condition

$$\frac{M_{t-1} + (1+\bar{i})B_{t-1}}{P_t} = S_t + \frac{\beta}{1-\beta}\bar{S} + L^m(\bar{Y}, \bar{i}) \tag{10}$$

where $A_t = (1+\bar{i})B_{t-1}$ in the case of one-period risk-free debt. The real value of government liabilities equals the expected present value of seigniorage revenues plus primary surpluses. Lower S_t financed by newly issued B_t without the expectation of higher future S_{t+j} is an unbacked fiscal expansion. Higher transfers with no offsetting future taxes shifts resources from the government to households. This positive wealth effect induces households to attempt to raise their consumption paths. Higher demand for goods raises their price, P_t, which reduces the real value of the household's initial nominal assets, W_t/P_t. This negative wealth effect must be large enough to eliminate the excess demand for goods at time t, and make households happy to consume their endowments.

Corollary 1. *Unbacked fiscal expansion is infeasible under a classical gold standard.*

Unbacked fiscal expansion requires that the government does not use future surpluses to stabilize debt which is an active fiscal behavior. Condition (10) uniquely determines the price level as a function of the expected present value of primary surpluses including seigniorage revenues—the right side—and outstanding nominal government liabilities. The optimality condition for gold holdings, (9), determines the price level as a function of the gold price, $\bar{P}^g$, and prevailing conditions in the gold market. These two price levels will generally be different unless gold supply and surpluses are perfectly correlated.

When the price level consistent with $\bar{P}^g$ is too low to satisfy (10), the real value of debt exceeds its real backing. Agents would over-accumulate government bonds, violating their optimality conditions. When the price level under the gold standard is too high, agents would refuse to buy bonds, and the government would violate its budget constraint. In either case, no equilibrium exists with valued government bonds.

The fiscal requirements of the gold standard highlight a practical difficulty Roosevelt faced. Deflation sharply increased the real value of government debt. To maintain convertibility, primary surpluses would have to increase accordingly. At a time when deflation created out-sized real returns to creditors on private loans, fiscal policy would have to transfer wealth from taxpayers to bond holders. For a politician who campaigned on helping the "forgotten man," the classical gold standard was politically untenable.

Result 2. *Unbacked fiscal expansion permanently raises the price level.*

A one-time unbacked fiscal expansion, $\varepsilon_t < 0$, raises P_t in equilibrium condition (10). To see that this increase is permanent, examine how nominal government liabilities at time t change. Both real money balances, $M_t/P_t = L^m(\bar{Y}, \bar{i})$, and real debt, $B_t/P_t = \frac{\beta}{1-\beta}\bar{S}$, remain unchanged because they do not depend on S_t and monetary policy pegs the interest rate. With the change in price level, ΔP_t, given by (10), both M_t and B_t expand in proportion to ΔP_t. In the absence of any further disturbances, nominal liabilities remain at those permanently higher levels, as does the price level.[10]

These theoretical points establish that an appropriately scaled unbacked fiscal expansion could, in principle, achieve Roosevelt's price-level objective and that ending convertibility of dollars for gold was a necessary first step. Roosevelt's double budget consisting of tax-backed ordinary expenditures and inflation-financed emergency expenditures will be developed in more detail in section 4.2. Because Roosevelt only intended emergency expenditures to last until prices recovered to his price-level objective, successive unbacked fiscal expansions, and hence time-inconsistency, would be unlikely given the well-communicated state-contingent objective. Taking a step back, we first ask why did Roosevelt turn to fiscal policy in the form of unbacked fiscal expansion, rather than rely on further monetary solutions?

3 Policies in 1933

The state of monetary and fiscal policies in 1933 framed the policy options that Roosevelt could, and did, choose.

3.1 Monetary Policy

In the wake of the Federal Reserve's "inactivity" in the worst years of the depression, Congress feared that any recovery would be stymied by continued Fed inaction [Meltzer (2003, p. 459)]. The Thomas Amendment of May 1933 granted the executive unprecedented monetary powers, which included fixing the gold value of the dollar, issuing greenbacks, and ordering the Fed to buy Treasury securities. This action ensured the Fed could not thwart the stimulative impacts of fiscal expansion.

Enter Klüh and Stella (2018) who argue that the Gold Reserve Act of 1934 undermined the Fed's ability to reverse the stimulus through open-market operations. The Act gave to the Treasury legal title to all monetary gold. The Treasury bought gold by issuing gold certificates, which could be held only by the Fed and were redeemable *in dollars* only at the Treasury's discretion. Treasury gold purchases raised the Fed's monetary liabilities—Treasury deposits at the Fed—without commensurate increases in liquid assets.[11] Klüh and Stella (2018, p. 4) observe that Fed officials "understood they could not win a war of attrition with the Treasury." The Treasury could undertake gold purchases to expand reserves without

[10]Because the expansion in M_t depends on $L^m(\bar{Y}, \bar{i})$, rather than directly on the size of the deficit, this is not conventional money financing of deficits, as in Sargent and Wallace (1981). Instead, the money supply expands passively to clear the money market at the pegged nominal interest rate $\bar{i}$, with no change in seigniorage revenues.

[11]By the end of 1936, the Fed's total monetary liabilities were $10.89 billion, but only $2.43 billion of assets were liquid: over 80 percent of the Fed's assets were irredeemable gold certificates [Board of Governors of the Federal Reserve System (1937)]. Total monetary liabilities are Federal Reserve and Federal Reserve Bank notes outstanding plus bank reserves; total liquid assets are gold reserves plus U.S. Treasuries.

limit, secure in the knowledge that it was infeasible for the Fed to sterilize them, i.e. prevent them from expanding the monetary base, as sterilization was the Treasury's decision.

Operational factors combined with institutional features of the Federal Reserve System in the early 1930s to reduce the Fed to "impotence," according to Eccles (1951). At the time, there was no single Federal Reserve policy: there were 13 policies—one for each regional Reserve Bank and the Board of Governors. Eccles emphasizes that Reserve Banks were beholden to their directors, who acted in the private interests of bankers. Before accepting the nomination to chair the Federal Reserve Board, Eccles insisted on institutional reforms that consolidated decision-making power in Washington, D.C.[12]

While the Fed could not sterilize the Treasury's gold purchases, monetary policy also did little to advance Roosevelt's economic agenda. After only minor actions in 1933, the Fed conducted no continuous open-market operations from November 1933 to mid-1940 [Friedman and Schwartz (1963, p. 512)]. This inactivity occurred against a backdrop of current and former Fed officials publicly expressing concerns about the loss of Fed authority and the possibility of run-away inflation. After leaving his position as Fed Chairman on May 10, 1933, Eugene Meyer (1934) wrote that "...the mere fact that the Administration has assumed responsibility for defining our monetary policies and fixing our price goal, indicates a subordinate role for the Federal Reserve System." Adolph Miller, one of the original governors of the Federal Reserve System, who served until 1936, vociferously called for a return to gold, fearing the discretion that underlies a "managed currency," which he labeled "human nature money" [Miller (1936, p. 4)].

Banks were worried about the Federal Reserve's failure to fulfill its lender-of-last-resort function and opted to behave conservatively by expanding holdings of government bonds, rather than loans to the private sector. From March 1933 to June 1940, annual growth rates of narrow money far outstripped those of broad money: reserves (23.1 percent), base (12.8 percent), M1 (7.7 percent), and M2 (5.2 percent). This was a very different pattern from the 1920s when M2 averaged 3.2 percent annual growth and reserves averaged 2.8 percent.

A confluence of operational, institutional, credibility, and even personnel issues conspired to render the Fed in 1933 and 1934 incapable of delivering a monetary policy to combat depression. Additionally, effective monetary policy faced the obstacles of interest rates at their effective lower bound and the economy reeling from a banking panic.

3.2 Fiscal Policy

Fiscal policy was a different matter because Roosevelt could use it to achieve both political and economic objectives. Given his strong support in Congress, particularly from "inflationists" like Senators Thomas and Connally, fiscal policy was largely under the president's direct control.

Fiscal policy in the form of stimulus spending served political objectives. By providing immediate relief to the unemployed, farmers, and homeowners, federal expenditures tamped down domestic unrest. Direct relief was a visible indicator that the federal government had

[12]Eccles (1951, p. 170) described the Fed's decision process before the Banking Act of 1935: "...before a uniform decision could be reached...there had to be a complete meeting of the minds between the governors of the 12 Reserve banks and the 108 directors of those banks, plus the FRB in Washington. A more effective way of diffusing responsibility and encouraging inertia and indecision could not very well have been devised."

the common man's interests at heart, helping to re-establish confidence in policy institutions. Finally, economists and politicians alike understood that deflation had redistributed wealth from debtors to creditors. Reflation, and the fiscal actions underlying it, were deliberate efforts to reverse that redistribution. Roosevelt's attitudes toward redistribution shone through in a letter to Secretary of the Treasury Woodin: "I wish our banking and economist friends would realize the seriousness of the situation from the point of view of the debtor classes—i.e., 90 percent of the human beings in this country—and think less from the point of view of the 10 percent who constitute creditor classes" [Roosevelt (1933a)].

After taking the necessary monetary steps himself, Roosevelt leaned entirely on fiscal policy to achieve economic objectives, the topic of this paper. Roosevelt walked a fine line on fiscal policy, maintaining seemingly contradictory positions. During the 1932 campaign for president, he harshly criticized Hoover's deficits and took a "Pittsburgh pledge" to balance the budget by reducing expenditures [Roosevelt (1932a)]. Just six months earlier he delivered his famous speech about "the forgotten man at the bottom of the economic pyramid" [Roosevelt (1932b)]. That speech characterized the depression as a "more grave emergency" than World War I and called on government to restore the purchasing power of farmers and rural communities and assistance to homeowners and farmers facing foreclosure.

Six days after taking office, Roosevelt sent to Congress a proposal to cut federal spending by nearly 14 percent of total expenditures. Cuts eliminated government agencies, reduced federal worker pay, and shrank veterans' benefits by half. When the Economy Act of 1933 was finally signed into law, spending cuts amounted to a little under seven percent of expenditures, but Roosevelt could point to the legislation to establish his bona fides as a "sound finance" man.

Just 20 days into his administration, Roosevelt created fresh fiscal nomenclature in a press conference. Asked when it might be possible to balance the budget, the president replied, "... it depends entirely on how you define the term, 'balance the budget' " [Roosevelt (1933b, p. 13)]. His reply spawned the distinction between "regular" and "emergency" expenditures, which became institutionalized in Treasury Reports. The reply continued:

> What we are trying to do is to have the expenditures of the Government reduced, or, in other words, to have the normal regular Government operations balanced and not only balanced, but to have some left over to start paying the debt. On the other hand, is it fair to put into that part of the budget expenditures that relate to keeping human beings from starving in this emergency? I should say probably not... You cannot let people starve, but this starvation crisis is not an annually recurring charge. I think that is the easiest way of illustrating what we are trying to do in regard to balancing the budget. I think we will balance the budget as far as the ordinary running expenses of the Government go" [Roosevelt (1933b, pp. 13–14)].

FDR was more comfortable with deficits by 1936. In the face of precipitous declines in tax receipts, he argued, "To balance our budget in 1933 or 1934 or 1935 would have been a crime against the American people" [Roosevelt (1936b)]. And in response to budget director Lewis W. Douglas's advice that the only way to project a balanced budget in 1936 was to cut spending, Roosevelt replied, "No, I do not want to taper off [spending programs] until

the emergency is passed" [Rosen (2005, p. 85)]. On the other hand, he supported tax hikes in 1935 and 1937.

Why did FDR waffle so on fiscal policy? It is possible, as Stein (1996) suggests, that Roosevelt was tentative and uncertain about fiscal stimulus. But the waffling may have been deliberate. His distinction between "ordinary" and "emergency" government expenditures was central to communicating that unbacked fiscal expansion was state-contingent. Linking the state-contingent emergency expenditures tightly to the economic emergency—through both their timing and their labels—Roosevelt drove home their temporary nature and guarded against successive unbacked fiscal expansions. At the same time, by demonstrating fiscal responsibility with the ordinary budget, he could reassure his critics, particularly bankers, that once the crisis passes, he would balance the budget. That reassurance maintained the safe and secure reputation of treasuries, enabling the government in later years to borrow at favorable rates which was especially important for financing World War II. Roosevelt's January 1936 budgetary address made this point explicit when he said, "...it is the deficit of today which is making possible the surplus of tomorrow" [Roosevelt (1936c)].

4 Empirical Facts and Theoretical Interpretations

This section contrasts fiscal variables during the gold standard (January 1920 to March 1933) to their behavior during the unbacked fiscal expansion (April 1933 to June 1940) and reports a measure of fiscal impulses that indicates fiscal actions were more aggressive than commonly believed. The section then employs the theoretical model to compare fiscal multipliers under Keynesian hydraulics and unbacked fiscal expansion.

4.1 Fiscal Indicators

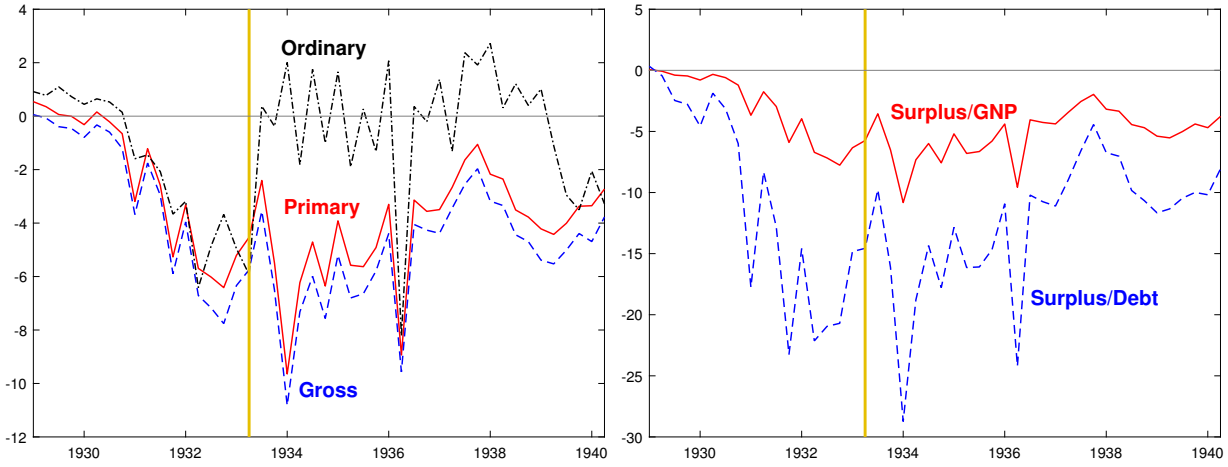
4.1.1 Emergency Expenditures

Figure 3a plots three measures of the federal budget surplus: gross, primary, and ordinary, defined as total receipts less "ordinary" expenditures. The difference between ordinary and primary surpluses is the emergency surplus. All three measures deteriorated sharply as economic activity contracted in the early 1930s. Falling surpluses stemmed from declining revenues due to lower corporate and income tax receipts and rising expenditures due to increased relief spending. Table 1 shows that deficits remained sizable through 1936, despite growing receipts from 1934 onward. With the exception of 1936, when large veterans' bonuses were paid out, Roosevelt could claim that he balanced the regular budget.

From 1934 to 1937, emergency expenditures ranged from one-third to over one-half of total federal expenditures as shown in table 1. Emergency expenditures, which consisted of relief and other spending due to the depression plus public works.

4.1.2 Measuring Fiscal Impulses

Unbacked fiscal expansion changes the relevant measure of fiscal impulse from the surplus-output ratio common to Keynesian hydraulics to the surplus-debt ratio. In expression (10), the ultimate impact on aggregate demand and the price level depends on total real backing—right side—relative to outstanding nominal liabilities—left side. A negative innovation in the ratio of the surplus to the market value of debt indicates that backing is currently low relative to outstanding debt: either future



(a) Surpluses as a percent of GNP (b) Fiscal impulses

Figure 3: Panel (a): surpluses defined as total receipts less expenditures, ordinary or total; primary surplus is gross surplus less net interest payments. Panel (b): fiscal impulses defined as primary surplus as a percentage of GNP and primary surplus as a percentage of the market value of gross debt. Vertical line marks when the U. S. abandoned the gold standard. Sources: Federal Reserve Board (1943) from NBER Macrohistory Database, and Balke and Gordon (1986). See Appendix B for details on the data.

surpluses must rise or current debt is overvalued. In the latter case individuals shed debt in favor of goods and services, raising aggregate demand.

Keynesian hydraulics focuses narrowly on the size of deficits relative to the economy, leading to Brown's (1956, p. 863–866) oft-cited conclusion: "Fiscal policy, then, seems to have been an unsuccessful recovery device in the thirties—not because it did not work, but because it was not tried."

Figure 3b contrasts the two measures of fiscal impulse. Data to the right of the vertical line shows that once government debt expansion *could* be unbacked, deficits were very large relative to debt. Between April 1933 and June 1940, primary deficits averaged 5.2 percent of GNP, but 12.5 percent of debt, almost two-and-a-half times larger. By this alternative measure of fiscal impulse, fiscal policy *was* tried aggressively.

4.2 Keynesian Hydraulics vs. Unbacked Fiscal Expansion

In drawing a distinction between emergency and ordinary expenditures, Roosevelt not only introduced a politically beneficial accounting convention, he also made fiscal policy more powerful. We develop a simple analytical model to show the mechanisms through which unbacked fiscal expansions generally have larger spending and tax multipliers than those that arise under Keynesian hydraulics.[13] Bianchi, Faccini, and Melosi's (2023; 2022) quantitative frameworks of the Post-War U.S. economy with partially unfunded debt and emergency budgets complement our analytical framework. Section 5 shows how our predictions of a permanently higher price level and larger multipliers are borne out in the data.

[13]To make the exposition transparent, we log-linearize the model around its deterministic steady state and focus on a cashless equilibrium. Appendix A provides details. Extensions to models with long-duration debt and nominal rigidities in price setting yield similar results.

	1929	1930	1931	1932	1933	1934	1935	1936	1937
Total Receipts	4033	4178	3317	2121	2080	3116	3801	4116	5294
Total Expenditures (excluding debt retirements)	3299	3440	3780	4594	4681	6745	6802	8477	8001
Regular	3299	3440	3780	4594	4681	2741	3148	5186	5155
Emergency	0	0	0	0	0	4004	3655	3301	2847
Regular Deficit	−734	−738	463	2473	2601	−375	−653	1070	−139
Deficit	−734	−738	463	2473	2601	3629	3001	4361	2707

Table 1: Millions of current dollars. "Emergency" expenditures are variously labeled as "emergency organization expenditures," "major expenditures due to or affected by the depression," "recovery and relief," or "public works." Designations of types of spending as "regular" or "emergency" changed over time. A negative deficit is a surplus. Source: Department of the Treasury (various). Details about emergency expenditures appear in appendix B.1.

Consider a simple model that approximates Roosevelt's budgetary arrangements. The budget identity is

$$b_{t-1} = \beta b_t + (T_t^o + T_t^e - F_t^o - F_t^e) - \beta\delta i_t + \delta\pi_t$$

where T_t^o and F_t^o are ordinary lump-sum taxes and spending, and T_t^e and F_t^e their emergency counterparts. π_t is inflation, b_t is real debt and $\delta \equiv b/y$ is the steady state debt-GDP ratio. Fiscal variables are in deviations from steady state relative to steady state output, while inflation and interest rates are log deviations from steady state. The ordinary budget is balanced each period, so that $T_t^o = F_t^o$. Emergency fiscal variables, (T_t^e, F_t^e), are assumed to be exogenous and taken to be *i.i.d.* This reduces the budget identity to

$$b_{t-1} = \beta b_t + (T_t^e - F_t^e) - \beta\delta i_t + \delta\pi_t \tag{11}$$

Only the emergency primary surplus appears in the budget identity.

With flexible prices, a log-linear approximation to the consumption Euler equation yields the Fisher equation

$$i_t = r_t^n + E_t\pi_{t+1} \tag{12}$$

where

$$\begin{aligned} r_t^n \equiv& \sigma^{-1} E_t[(F_t - F_{t+1}) - (\hat{Y}_t^n - \hat{Y}_{t+1}^n)] \\ =& \frac{1}{\sigma + \omega^{-1}} F_t \\ =& \frac{1}{\sigma + \omega^{-1}} (F_t^o + F_t^e) \end{aligned} \tag{13}$$

is the exogenously given natural real rate of interest. The expression $\hat{Y}_t^n$ stems from the real marginal cost function $\hat{mc}_t$ along with the *i.i.d.* shocks and no technology shocks assumptions.

$$0 = \hat{mc}_t = \omega\hat{Y}_t^n + \sigma^{-1}(\hat{Y}_t^n - F_t) \tag{14}$$

Parameters $\sigma > 0$ and $\omega^{-1} > 0$ denote the intertemporal elasticity of substitution and Frisch elasticity of labor supply. Higher government purchases always raise the natural real rate

of interest. Ordinary and emergency purchases have identical impacts on r^n. The model is closed with an interest rate rule in log-linear form

$$i_t = \phi \pi_t \tag{15}$$

where the parameter satisfies $0 \leq \phi < 1$, making monetary policy passive and consistent with the historical narrative.

Result 3. *Government spending and transfer impacts from unbacked fiscal expansions typically exceed those from Keynesian hydraulics alone.*

Use (13) and (15) in (11) and (12) and solve for equilibrium inflation

$$\pi_t = \underbrace{\frac{\beta}{\sigma + \omega^{-1}}(F_t^o + F_t^e)}_{\text{Keynesian hydraulics}} + \underbrace{\frac{\beta}{\delta}(F_t^e - T_t^e) + \frac{1}{\delta} b_{t-1}}_{\text{wealth effects}} \tag{16}$$

Inflation depends on all fiscal variables, with the exception of ordinary taxes. We call the first term Keynesian hydraulics to emphasize the fact that government expenditures are claims on the real resources of the economy. Rising public claims require higher real interest rates to deliver equilibrium crowding out of private spending. The second and third terms are the wealth effects from an unbacked fiscal expansion. The second term is the impact effect of a rise in spending and transfers; and the third term the wealth effects from nominal debt issuance which does not herald future tax increases.[14] Consistent with the earlier discussion on fiscal impulses, these wealth effects are scaled by the inverse of the steady-state debt to GDP ratio.[15] At low debt levels, the inflationary impact of a given deficit can be large.

Using the policy rule and the solution for inflation in (11) yields debt dynamics

$$b_t = \underbrace{-\frac{\delta(1-\beta\phi)}{\sigma + \omega^{-1}}(F_t^o + F_t^e)}_{\text{Keynesian hydraulics}} + \underbrace{\beta\phi(F_t^e - T_t^e) + \phi b_{t-1}}_{\text{wealth effects}} \tag{17}$$

once again decomposed into Keynesian hydraulics and wealth effects. The smaller the debt-GDP ratio the smaller are Keynesian hydraulics—movements in real interest rates matter less when the quantity of outstanding debt is small. Monetary policy's response to inflation has multiple effects. Monetary policy determines the persistence of real debt, which is stationary under passive monetary policy, and more aggressive responses to inflation amplify the impacts of deficits on real debt and future inflation.

From these expressions we compute impulse response functions to evaluate the relative magnitudes of Keynesian hydraulics and wealth effects from nominal debt. Start with the response of inflation to a one percent of GDP reduction in taxes

$$-\frac{\partial \pi_{t+j}}{\partial T_t^e} = \frac{\beta}{\delta}\phi^j \geq 0$$

[14] When monetary policy is active, $\phi > 1$ and fiscal policy is passive equilibrium inflation is $\pi_t = r_t^n/\phi$. Inflation is independent of taxes and transfers, and depends on government spending only through the effect on the real interest rate. A passive fiscal policy would adjust taxes in response to debt, $T_t = \gamma b_{t-1}$, with $\gamma > 1 - \beta$ ensuring stable debt. Then debt evolves as $b_t = \beta^{-1}(1-\gamma)b_{t-1} + \beta^{-1}\left[(\sigma + \omega^{-1}) + \delta\left(\frac{\beta\phi - 1}{\phi}\right)\right] r_t^n$. Higher spending raises r_t^n, but real debt converges to steady state with no impacts on future inflation.

[15] If the approximation instead scaled debt by steady state surpluses, δ would be the surplus-debt ratio.

for $j \geq 0$. This is a pure wealth effect, with no impact on real interest rates. Households receive a transfer or reduction in taxes financed by an increase in nominal debt. The price level rises, consistent with **Result 4**. How much prices rise depends on preferences, policy, and the steady-state level of debt. Low average levels of debt can deliver large changes in the price level. For a given increase in the deficit, lower levels of outstanding debt require a larger revaluation effect: inflation rises more in 1933 when debt was 40 percent of output than in 2020 when gross debt was 128 percent.[16]

The dynamic effects of emergency and ordinary government spending on inflation satisfy

$$\frac{\partial \pi_{t+j}}{\partial F_t^e} - \frac{\partial \pi_{t+j}}{\partial F_t^o} \;=\; -\frac{\partial \pi_{t+j}}{\partial T_t^e} \geq 0$$

for all $j \geq 0$. Total effects of emergency spending are the sum of the effect from ordinary spending—Keynesian hydraulics—and an effect equivalent to a reduction in taxes—a pure wealth effect. Because wealth effects are always non-negative, emergency spending generally has larger impacts on the price level than ordinary spending.

Result 4. *An increase in emergency transfers always increases the long-run price level. By contrast, an increase in ordinary government spending always decreases the long-run price level. Finally, an increase in emergency government spending will increase the long-run price level if*

$$\delta < \frac{\beta}{1-\beta}\left(\sigma + \omega^{-1}\right).$$

If this condition is satisfied, the magnitude of the price level rise is decreasing in δ.

This restriction will be satisfied for any plausible values of preference parameters. Emergency government spending and transfers both serve reflation. Figure 4 displays a numerical example, allowing for persistent emergency spending and transfers shocks and long-term debt. The inclusion of long-term debt spreads the inflationary consequences over time. The figure decomposes the effects of shocks into Keynesian hydraulics and wealth effects. For both spending and transfers, wealth effects explain the entire increase in the long-run price level. In the short run, the Keynesian hydraulics of emergency expenditures have a hump-shaped profile for the price level, ultimately reducing the price level below its initial value. For transfers, Keynesian hydraulics are absent because they have no effects on real interest rates, only a pure wealth effect that generates a growing price level that eventually plateaus.

5 Structural VAR Analysis

This section conducts formal econometric analysis of fiscal and monetary impacts over the period of unbacked fiscal expansions to address two questions:

1. What, if any, evidence supports the view that unbacked fiscal expansion contributed to economic recovery?

[16] Consider a 1 percent of GDP debt-financed fiscal expansion that is unbacked. When the debt-output ratio is 40 percent, nominal GDP must ultimately rise by 2.5 percent, but when debt is at 128 percent nominal spending rises only 0.8 percent (holding real discount rates fixed).

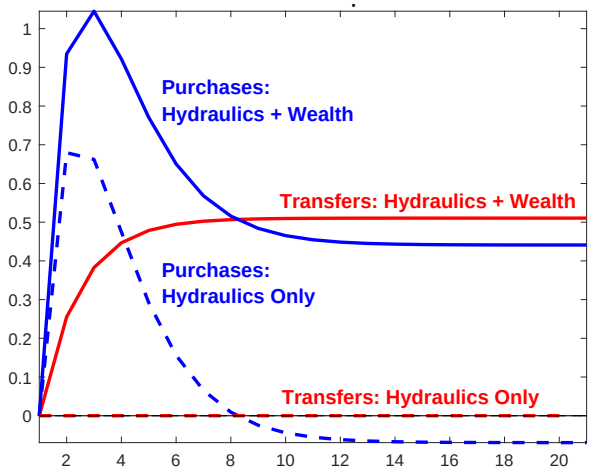


Figure 4: Keynesian hydraulics and wealth effects. Impulse responses of the price level to persistent spending and transfer shocks with an autoregressive coefficient of 0.5, long-term debt averaging a duration of 6 years, δ is 40 percent of annual output, and monetary policy responsiveness, $\phi = 0.5$.

2. Do data lend support to the monetary view of recovery: unsterilized gold inflows raised the monetary base, the price level, and real GNP? Originally due to Friedman and Schwartz (1963), money-led recovery is now the conventional view [Romer (1992), Bernanke (2004), Steindl (2004)].

5.1 VAR Methods[17]

If y_t is a $k \times 1$ vector of time series, the economic structure is

$$A_0 y_t = A_+(L) y_{t-1} + \varepsilon_t \tag{18}$$

where $E\varepsilon_t\varepsilon_t' = I$ and ε_t is uncorrelated with y_s for $s < t$. The ε_t's are economically interpretable exogenous disturbances. The reduced-form is

$$y_t = B(L) y_{t-1} + u_t$$

where, assuming that A_0 is invertible, $B(L) = A_0^{-1}A_+(L)$, $u_t = A_0^{-1}\varepsilon_t$, and $Eu_tu_t' = A_0^{-1}(A_0^{-1})' = \Sigma$. Identification comes down to imposing sufficient restrictions on the VAR coefficients to uniquely determine A_0.

5.2 Data and Identification

All VARs use monthly data from April 1933 to June 1940 and some combination of the following variables: the commercial paper rate, i, (NSA), the monetary base, M, (NSA), federal primary surplus, S, (SA), ordinary federal expenditures, F^o, (SA), emergency federal expenditures, F^e, (SA), federal tax receipts, T, (SA), the market value of nominal gross

[17]See Leeper, Sims, and Zha (1996), Christiano, Eichenbaum, and Evans (1999), Canova (2007), or Kilian and Lütkepohl (2017) for detailed surveys.

federal government debt, B, (NSA), the monetary gold stock, G^m, (NSA), monthly interpolated GNP deflator, P, (SA, 100 = 1926), monthly interpolated real GNP, Y, (SA), and the nominal monthly holding period return on the government's bond portfolio, i^B, (NSA).[18]

VAR estimates employ the Sims and Zha (1998) prior, which allows for unit roots and cointegration, and probability bands are computed as in Sims and Zha (1999). All variables except the primary surplus and interest rates are logged; interest rates are divided by 100 to put them in percentage units. We include six lags and a constant.[19]

5.3 Ordinary vs. Emergency Spending

Theory in section 4.2 predicts that higher emergency spending, whose debt issuance is not backed by taxes, is more expansionary that ordinary tax-backed spending. A five-variable VAR with ordinary and emergency expenditures, tax receipts, the price level, and real GNP addresses that prediction. The fiscal variables are scaled by the market value of federal debt which implicitly includes debt in the VAR to avoid misspecification as described by Cochrane (2023, section 4.3). A recursive ordering with expenditures first follows Blanchard and Perotti (2002).

Figure 5 reports impacts of the two types of federal spending—ordinary in the left column and emergency in the right column—on the price level and real GNP. Shocks are normalized to have the same initial size. Higher ordinary spending raises the price level somewhat, with the 68 percent probability bands only slightly positive for about six months after the shock. Real GNP hardly moves.

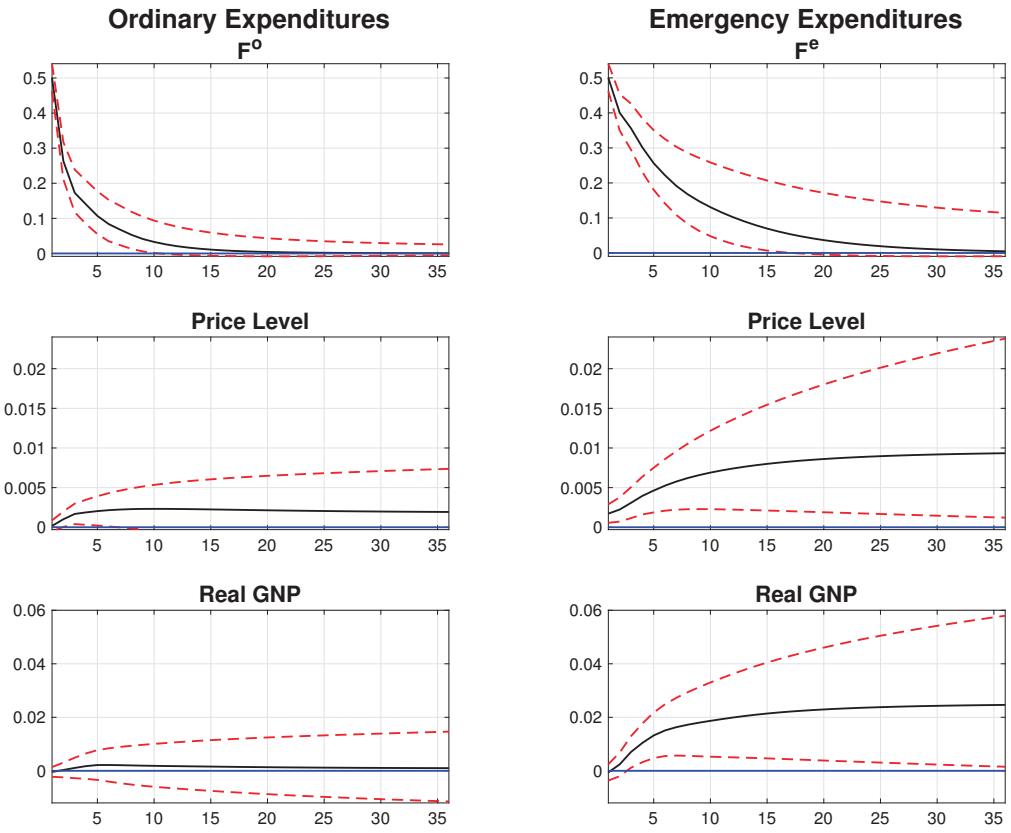
Emergency spending has significantly larger effects. Prices are higher over the three-year horizon the figure reports, with over 68 percent probability that the response is positive at three years. The modal response to emergency spending is five times larger than to ordinary spending. These differences extend to real GNP, which with high probability remains positive over the horizon. Modal output responses are many times larger for emergency spending.

The importance of emergency spending relative to ordinary shows up in variance decompositions at 36 months, which table 2 reports. Emergency spending accounts for nearly 30 percent of forecast error variance in prices and output; ordinary spending accounts for little.

The evidence that emergency government expenditures have larger macroeconomic effects than ordinary expenditures is consistent with the predictions of theory. In the theory, the

[18]Primary surpluses, expenditures, and receipts were seasonally adjusted using the X-11 procedure in RATS. The deflator and real GNP were interpolated from Balke and Gordon's (1986) quarterly series using the Chow and Lin (1971) algorithm. Monthly series used to interpolate the deflator included M2, the consumer price index, the wholesale price index, the long-term yield on Treasury bonds (NBER Macrohistory Database, m13033a), and index composite wages (NBER Macrohistory Database, m08061c); series used to interpolate real GNP included industrial production, composite index of six roughly coincident series (NBER Macrohistory Database, m16003a); index of factory employment, total durable goods (NBER Macrohistory Database, m08146a), and production worker employment, manufacturing (NBER Macrohistory Database, m08010b). Appendices B.2 and B.3 describe fiscal data in detail and compare our series to three widely used sources—NBER Macrohistory Database, Firestone (1960), and Romer (1992). The holding period return is based on Hall, Payne, Sargent, and Szőke (2021) and provided by George Hall.

[19]In Sims and Zha's (1998) notation, the hyperparameters for the prior are set as $\mu_1 = 0.6, \mu_2 = 0.3, \mu_3 = 1.0, \mu_4 = 1.75, \mu_5 = 2.0, \mu_6 = 2.0$. The prior was chosen based on the model's marginal data density. See figure C.1 in Appendix C for the model's unconditional forecasts under this prior.



(a) Responses to ordinary expenditures (b) Responses to emergency expenditures

Figure 5: Responses to unanticipated increases in expenditures. VAR is recursive in the order $(F^o/B, F^e/B, T/B, P, Y)$, where the three fiscal variables are scaled by the market value of debt. Solid lines are modes and dashed lines are 68 percentile probability bands based on 500,000 draws from the posterior distribution of all the VAR parameters. Appendix C reports the full set of impulse response functions [figure C.2].

	% of P	% of Y
$\boldsymbol{F^o}$	5.5	0.4
$\boldsymbol{F^e}$	27.7	29.1

Table 2: Percentage of forecast errors in the price level, P, and real GNP, Y, at 36 months accounted for by ordinary spending, $\boldsymbol{F^o}$, and emergency spending, $\boldsymbol{F^e}$. Appendix C reports the full set of variance decompositions [table C.1]

distinction between the two spending types lies in their financing: ordinary spending is tax-financed, while emergency spending is unbacked by tax changes.

5.4 Larger Systems

Results that contrast the impacts of ordinary and emergency spending are suggestive, but obtained from a small system in which we cannot examine the joint behavior of monetary, gold, and fiscal policies. We extend the analysis to a seven-variable VAR that includes the monetary base, a short-term nominal interest rate, the primary surplus, the monetary gold

stock, the nominal market value of debt, the price level, and real GNP.

We use this system to estimate the impacts of shocks to the primary surplus and gold supply. The latter sheds some initial light on the monetary explanation for recovery.

5.4.1 Identification The identification aims to be consistent with actual policy behavior in the post-gold standard period of the 1930s. We impose zero restrictions only on A_0, the contemporaneous interactions among innovations in variables, leaving lags unrestricted.

Money Supply: The supply of monetary base, M^s, depends on the short-term nominal interest rate, i, and the monetary gold stock, G^m. The decision about whether or not to sterilize gold inflows lay with the Treasury during this period, but in the case when inflows were not sterilized, there was a direct impact of G^m on M^s.[20] We also allow the Federal Reserve to adjust supply to influence interest rates to yield the money supply rule

$$a_1 M_t^s = a_2 i_t + a_3 G_t^m + \varepsilon_t^{MP}$$

Money Demand: The demand for base money is a derived demand. Demand for nominal money balances, M^d, depends on the short-term nominal interest rate, the price level, P, and real income, Y

$$a_4 M_t^d = a_5 P_t + a_6 i_t + a_7 Y_t + \varepsilon_t^{MD}$$

Fiscal Policy: Fiscal policy chooses the real primary surplus, S. Revenues are procyclical and an unindexed tax code makes revenues depend on the price level. Surpluses react to the price level and real economic activity. We also permit a contemporaneous response of surpluses to the nominal market value of debt, B. This leads to the fiscal rule

$$a_8 S_t = a_9 B_t + a_{10} P_t + a_{11} Y_t + \varepsilon_t^{FP}$$

Government Debt: Government debt is the nominal market value of gross federal debt. Because bond prices react immediately to all shocks in the economy, B is an "information variable," in Leeper, Sims, and Zha's (1996) terminology. The debt equation is

$$a_{12} B_t = a_{13} i_t + a_{14} M_t + a_{15} S_t + a_{16} G_t^m + a_{17} P_t + a_{18} Y_t + \varepsilon_t^B$$

Gold: With the passage of the Gold Reserve Act in January 1934, the Treasury bought all gold supplied at the price chosen by the Treasury and the President, which was $34.00 an ounce. This made the demand for gold perfectly elastic at that price. The supply of gold to the U.S. was driven by both exogenous political conditions in Europe and endogenous factors within the United States. We model the supply of monetary gold as a function of the nominal interest rate and goods-market conditions:

$$a_{19} G_t^m = a_{20} i_t + a_{21} P_t + a_{22} Y_t + \varepsilon_t^{GS}$$

With perfectly elastic demand, ε_t^{GS} is a gold supply shock and G_t^m is the equilibrium monetary gold stock.

[20] See Appendix D for the details of sterilization under either the Federal Reserve or the Treasury.

Goods Market: The remaining variables—P and Y—are treated as inertial variables that are predetermined and obey a recursive ordering. We do not distinguish between the two "goods market shocks"

$$a_{23}P_t = a_{24}Y_t + \varepsilon_t^P \tag{19}$$
$$a_{25}Y_t = \varepsilon_t^Y \tag{20}$$

Predeterminedness of goods market variables is a restriction: it says that the price level and output do not respond to non-goods-market shocks within the month, an assumption that Romer (1992) employs with annual data. We relax this assumption in section 5.5.

With 28 distinct moments in the covariance matrix of innovations and 25 freely estimated parameters, the system is overidentified. If data strongly reject the overidentifying restrictions, the estimated exogenous disturbances may not be mutually uncorrelated, muddling the economic interpretations of the shocks.[21]

5.4.2 Primary Surplus Impacts Figure 6 reports the dynamic impacts of a surprise decrease in the real primary surplus during the unbacked fiscal expansion period. The one standard deviation initial shock raises the primary deficit by \$0.21 billion, which is about half of the average annualized monthly deficit in the sample. Because the deficit decays rapidly, the total increase over the three-year forecast horizon is only \$0.51 billion. This is a relatively small and transitory fiscal impulse. Higher deficits do not bring forth higher future surpluses, lending support to the interpretation that fiscal expansion is unbacked.

Deficits produce expansionary impacts. Prices and output, which the identification prevents from rising contemporaneously, steadily increase and significantly so. Monetary policy makes no effort to offset the inflationary consequences of the fiscal expansion, suggesting the Fed behaves passively. Nominal interest rates fall slightly in the short run. The lower nominal rates, together with higher expected inflation, drive *ex-ante* real rates lower. Lower real rates induce households and firms to shift demand for goods into the present.

New nominal bonds finance the higher deficits. Debt jumps on impact and remains elevated. Economic recovery encourages gold to flow into the United States. By choosing not to sterilize gold inflows, the Treasury allows the monetary base to expand to accommodate rising demand for money from increased economic activity. Figure 7 shows that despite the rise in nominal debt, fiscal expansion raises nominal GNP sufficiently to reduce the debt-GNP ratio, consistent with beliefs that higher surpluses will not follow the initial deficits.

Looking down the panels in figure 6 reveals the positive comovements among gold, the monetary base, the price level, and real GNP that underlie the conventional monetary narrative of the recovery. But the responses create a problem for this narrative. How does one reconcile monetary-induced economic recovery with the sharp short-run declines in primary surpluses and the persistent increase in nominal government debt? Existing literature does not address this question, primarily because the fiscal dimensions have not been integrated into the monetary interpretations. We return to this topic in section 5.5.

[21] Appendix C reports the estimated coefficients [table C.2] and that the exogenous shocks in this model are mutually uncorrelated [table C.3].

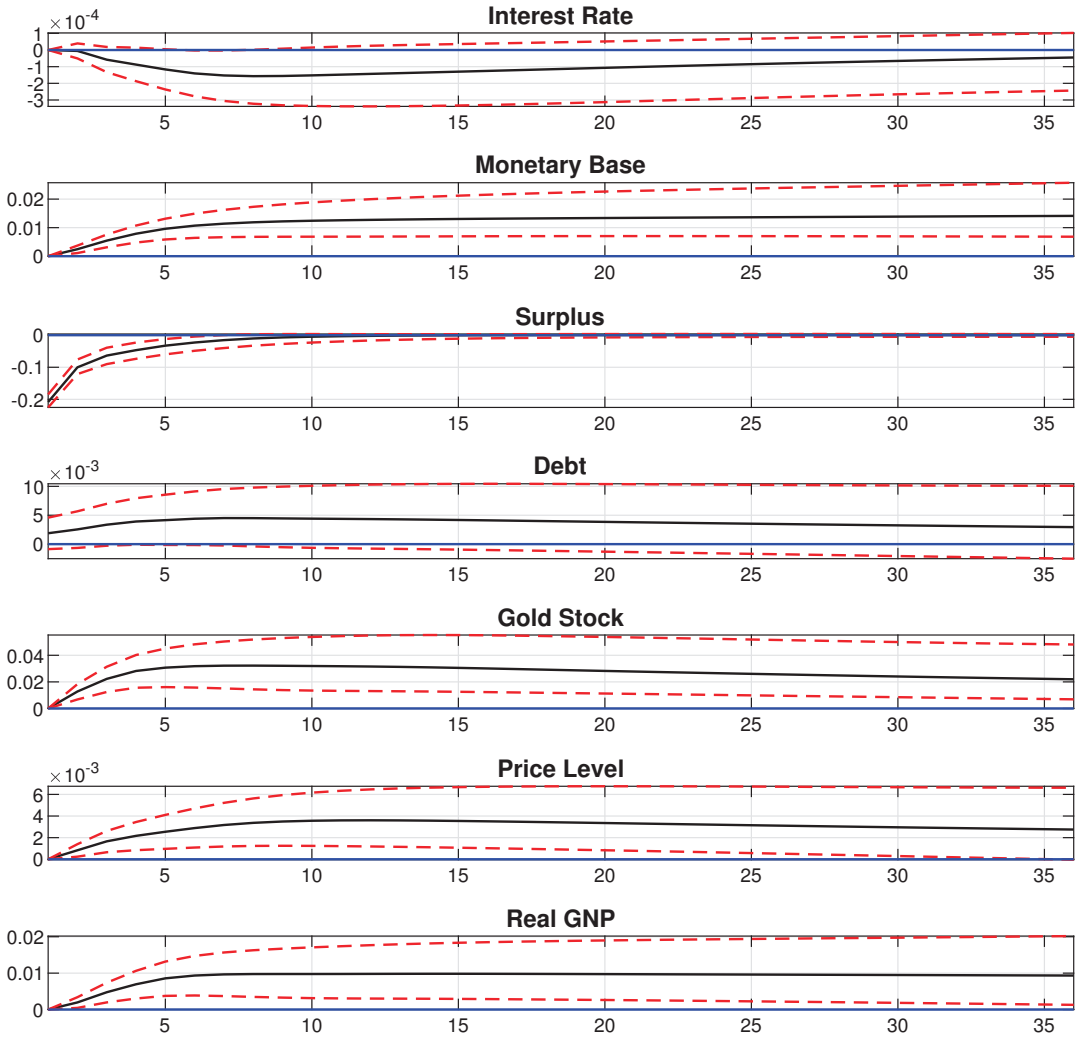


Figure 6: Responses to an unanticipated decrease in the primary surplus in the unbacked fiscal expansion period (April 1933 to June 1940). Solid lines are modes and dashed lines are 68 percentile probability bands based on 500,000 draws from the posterior distribution of all the VAR parameters. Appendix C reports the full set of impulse response functions [figure C.3].

5.4.3 Output Multipliers VAR estimates imply sizable output multipliers from increases in primary deficits. Figure 8 reports multipliers k periods after an increase in the deficit at time t, calculated as $\Delta Y_{t+k}/\Delta S_t$, as in Blanchard and Perotti (2002), from the system that underlies figure 6. In the VAR, real GNP is in logs, while the surplus is in real dollars, so we scale the impulse response by the mean of real GNP. Because GNP grew over the sample period, we compute the multipliers using two different measures of the mean—the full sample period and the first year of the sample.

Output multipliers are large and persistent. Taking the average of output over the full sample—top panel—the multiplier peaks at 4.5 after a year and remains close to that level. Credible sets expand over the forecast horizon, but remain above zero over the three-year horizon in the figure. The peak multiplier falls to 3.6 when the mean of real GNP is based on the first year of the sample. Multipliers are not appreciably different under the recursive

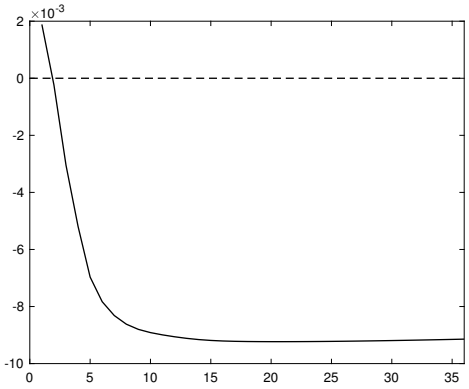


Figure 7: Modal response of debt-GNP ratio to an unanticipated decrease in the primary surplus in the unbacked fiscal expansion period (April 1933 to June 1940), computed from figure 6.

orderings (dashed lines).[22] Finally, estimates of multipliers should not be too sensitive to the presence of infrastructure spending as it was only about 20 percent of emergency spending in the unbacked fiscal expansion period [table B.1].

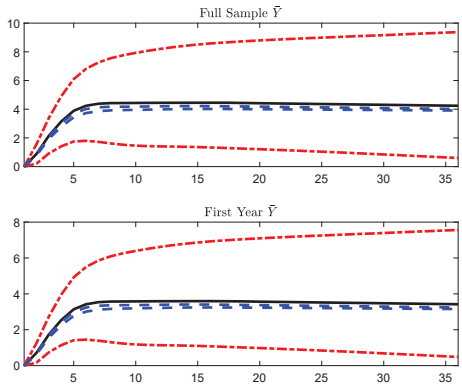


Figure 8: Output multipliers from a \$1 increase in the primary deficit, calculated as $\Delta Y_{t+k}/\Delta S_t$ at horizon k. Solid line is posterior mode from the identified model underlying figure 6, dotted-dashed lines are 68 percent credible sets for that model, and dashed lines are posterior modes from alternative recursive orderings. Top panel uses the mean of real GNP over the full sample, April 1933 to June 1940; bottom panel uses the mean over the first year of the sample.

5.5 Reassessing the Money-Led Recovery Evidence

Analysis of recovery is neither complete nor persuasive without a thorough examination of the conventional view of recovery that Friedman and Schwartz (1963), Romer (1992), Bernanke (2004), and Steindl (2004) describe.[23] The initial revaluation of gold, together

[22] Appendix C reports results for a recursively ordered eight-variable VAR that splits the primary surplus into expenditures net of interest payments and tax receipts [figure C.4]. Spending multipliers are comparable to those in figure 8, though less precisely estimated; tax multipliers are highly uncertain [figures C.5 & C.6].

[23] Friedman and Schwartz (1963, p. 499) give this narrative a different twist than Romer by writing that "... the rise in the money stock [from 1933 to 1937] was produced not by the monetary authorities but by gold

	% of M	% of i	% of G^m	% of S
MP	18.9	79.9	2.5	0.5
MD	29.8	7.2	0.4	1.1
FP	39.1	5.2	26.9	92.1
GS	2.4	1.0	59.3	0.4
Rest	9.8	6.7	10.9	5.9

Table 3: Percentage of forecast errors in the monetary base, M, nominal interest rate, i, monetary gold stock, G^m, and real primary surplus, S at 36 months accounted for by shocks to monetary policy, **MP**, money demand, **MD**, fiscal policy, **FP**, gold supply, **GS**, and the three remaining shocks, **Rest**.

with the steady inflows of gold largely due to political uncertainty in Europe, were permitted by the Treasury to steadily increase the monetary base. Expansion in both high-powered and broad money measures stimulated real activity and raised prices. At the same time, enhanced confidence in banks after the early 1930s crises reduced cash hoarding and raised the income velocity of money to reinforce the expansionary effects of the growth in the base. Steindl (2004, p. 9) concludes that existing literature offers "incontrovertible" evidence that "strongly supports the view that the recovery was principally due to the growing money stock. . . ."

Steindl (2004, pp. 40-41) provides an explicit description. He writes that Friedman and Schwartz's reasoning that base money rose because of gold inflows

> "...isolates a historical state in which the behavior of the money stock was effectively exogenous, providing a type of natural experiment. The movements of the money stock could not be attributed to the Federal Reserve increasing bank reserves by accommodating increased demand for loans owing to an improving economy; the observed increases in the quantity of money were 'in no way a consequence of the contemporaneous business expansion' [Friedman and Schwartz (1963, p. 544)]. Rather they were due to the expansion of the base owing to the increasing stock of gold."

5.5.1 Importance of Identified Shocks Evidence from the identified VAR in section 5.4 is not sympathetic to Steindl's "natural experiment." Table 3 reports percentages of 36-month forecast error variances in the monetary base, the nominal interest rate, the gold stock, and the primary surplus due to the four identified shocks—monetary policy (MP), money demand (MD), fiscal policy (FP), and gold supply (GS), along with the remaining three shocks (Rest).

Gold supply shocks account for only 2.4 percent of fluctuations in base money, sharply at odds with Steindl's contention. Fiscal policy disturbances are by far the most important source of base movements, followed by shocks to money demand. This pattern is the obverse of the money-led view; it is consistent with the monetary base being supplied elastically to

inflow. Though accidental gold inflows served the same economic function as compliant monetary authorities would have, it occurred despite rather than because of the actions of unions, business organizations, and government in pushing up prices." Romer attributes much of the growth in base money to the Treasury's choice not to sterilize the inflows.

target a short-term nominal interest rate, 80 percent of whose fluctuations are attributable to monetary policy behavior [table C.4].

Turning to gold stock variation, supply disturbances do explain 60 percent. But fiscal policy shocks account for 27 percent. No other shock matters. While gold flows contain a sizable "exogenous" component as the monetary view maintains, the gold stock also responds endogenously to fiscal policy, as figure 6 shows. Among those endogenous factors were the relative strength of the recovery, American willingness to buy unlimited quantities of gold at a high price, increased sale of American merchandise abroad as the dollar depreciated, the inflow of capital to the United States, and foreign-owned capital sent to the United States to build up dollar balances or to purchase American securities [Paris (1938)].

The only policy variable that appears largely exogenous is primary surpluses. Although we assume endogenous primary surpluses, they turn out to be largely exogenous in the estimates. Fiscal shocks explain 92 percent of surplus error variance. Because the identification permits surpluses to respond both contemporaneously and with lags to all the disturbances, this finding supports ascribing to fiscal policy a causal role.

5.5.2 Gold Supply Shocks Variance decompositions find that 60 percent of gold stock fluctuations are driven by gold supply shocks. Do those shocks—which are the genesis of Friedman and Schwartz's monetary narrative—generate the comovements that underlie the money-led recovery view?

From early 1933 until December 1936, the Treasury opted not to sterilize gold inflows, which permitted the monetary base to expand along with the gold stock. We use figure 9 to ask if gold supply shocks move base money strongly and persistently. They are an important source of gold-stock fluctuations, but little else. Positive innovations in gold supply are followed by a higher monetary base, although not significantly higher; if anything, higher monetary gold leads to lower prices and real GNP. The prime candidate for the monetary narrative shock in this VAR does not deliver the required comovements in macro variables.

Only disturbances to the primary surplus generate the full set of comovements in assets, the price level, and real GNP that align with existing monetary explanations of the recovery. Figure 6's responses to a shock that raises the primary deficit are fully consistent with what the theory predicts for the consequences of an unbacked fiscal expansion.

5.5.3 Sign Restrictions Figure 9 suggests that a positive shock to the supply of gold does not generate expansionary paths for the price level and real GNP. But that finding and the variance decompositions in section 5.5.1 are conditional on the particular identification of exogenous gold supply shocks. A skeptic may argue this is not compelling evidence against a gold-induced recovery. To address skeptics, we reframe the empirical question to be

> What implications do shocks that generate persistent positive comovements among gold, base money, the price level, and real GNP carry for the paths of primary surpluses?

To answer this question, we adopt sign restrictions on impulse response functions to identify the set of structural shocks that produce the positive comovements that Friedman and Schwartz associate with economic recovery.[24] We impose that G^m, M, P, and Y must

[24]See Faust (1998), Canova and De Nicolo (2002), Uhlig (2005).

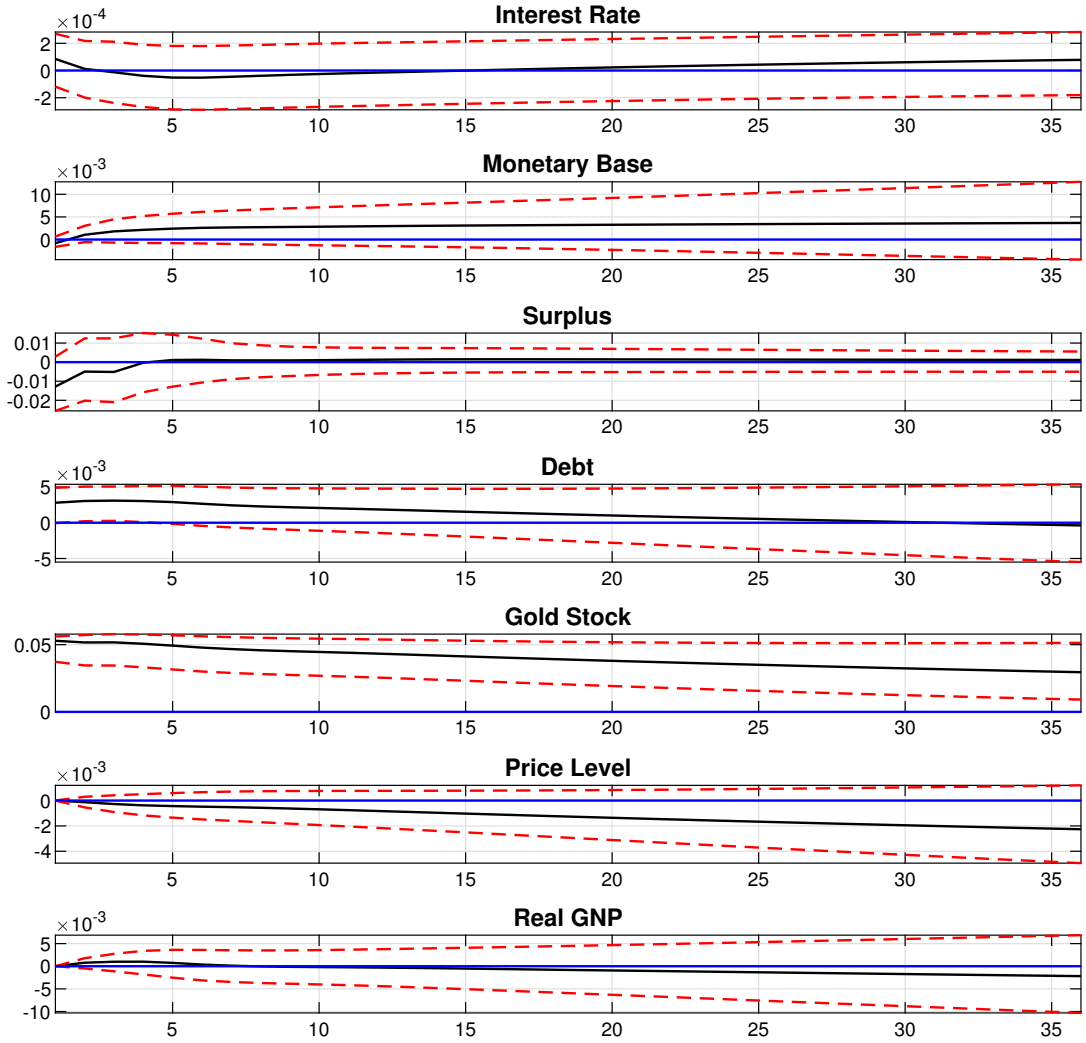


Figure 9: Responses to an unanticipated increase in the supply of gold in the unbacked fiscal expansion period (April 1933 to June 1940). Solid lines are modes and dashed lines are 68 percentile probability bands based on 500,000 draws from the posterior distribution of all the VAR parameters.

rise or fall in unison over the three-year horizon for which response functions are computed. We add smoothness criteria. Let $R_{i,j}$ be the response of variable i in period j. Smoothness takes the form $|R_{i,3}| > |R_{i,2}| > |R_{i,1}|$ for variables $i = G^m, M, P, Y$ to rule out shocks that generate erratic responses over the first quarter.

Another way to word the question we address with sign restrictions is: are there shocks that generate Friedman and Schwartz's comovements but *are not* associated with a lower path for primary surpluses? An affirmative answer leads to believing that both fiscal expansion and gold inflows played important roles in the recovery.

Denote the moving average representation of the structural model by

$$y_t = C(L)\varepsilon_t$$

Because the structural errors, the ε_t's, are orthogonal, the impulse responses to a given shock in any identification is the $(k \times 1)$ vector of lag polynomials, $C(L)\alpha$, for some α that satisfies $\alpha'\alpha = 1$. Each candidate α implies a different version of A_0 in the structure (18). We seek the set of α's that satisfy the positive comovement and smoothness restrictions. We take each α_i in that set to represent an identification that is consistent with the comovements that underlie the monetary recovery explanation.

After fixing the coefficients $(A_0, A_+(L))$ at their estimated posterior modes, we adopt Rubio-Ramírez, Waggoner and Zha's (2010) algorithm to our problem:

1. Take many draws of the elements of the vector α_i from $\alpha_i \sim N(0,1)$ for $\alpha_i'\alpha_i = 1$.

2. Compute the impulse responses from

$$y_t^{(i)} = [C(L)\alpha_i][\alpha_i'\varepsilon_t]$$

3. If the four variables (G^m, M, P, Y) in $y_t^{(i)}$ satisfy the restrictions, retain the full set of impulse response functions.

4. Discard any α_i draw that fails to satisfy the restrictions.

Figure 10 plots the impulse responses to the shocks that generate positive comovements among (G^m, M, P, Y). The system replaces the commercial paper rate, i, with the monthly holding period return on the bond portfolio, i^B. Responses of the remaining variables, (i^B, S, B), are unrestricted. Solid lines are medians of the marginal distributions at each impulse response horizon; dashed lines are 68 percentile bands and dashed-dotted lines are 90 percentile bands, reflecting the dispersion of those marginal distributions. The lines—connected across horizons—do not reflect a particular α_i draw, any more than the previous impulse response lines reflect a particular draw from the posterior distribution of the VAR parameters.[25]

Interpretation of figure 10 is different. Earlier figures hold fixed the identification—the ε_t's—while figure 10 summarizes uncertainty *about* the identification—the $\alpha_i'\varepsilon_t$'s. Among the three unrestricted variables, primary surpluses exhibit the clearest pattern across identifications. Ninety-five percent of the identifications produce declining surpluses that are sharp and short-lived. Over longer horizons, about 80 percent of the identifications generate higher nominal government debt.

An alternative summary of the surplus responses, which conforms closely with theory, is the present value of primary surpluses, which we compute as

$$PV(s_0) = \sum_{j=0}^{T} (i_j^B - \pi_j + s_j)$$

where date 0 is the date of the shock, T is 35 months. The impulse responses are i_j^B, the monthly holding period return j months after the shock, $\pi_j = p_j - p_{j-1}$, monthly inflation in logs, and s_j, the primary surplus. $i_j^B - \pi_j$ is the ex-post real return on the bond portfolio in period j, which we take to be the rate at which surpluses are discounted.

[25] Uhlig (2017) makes this point in a comment on Fry and Pagan's (2011) critique of sign restrictions.

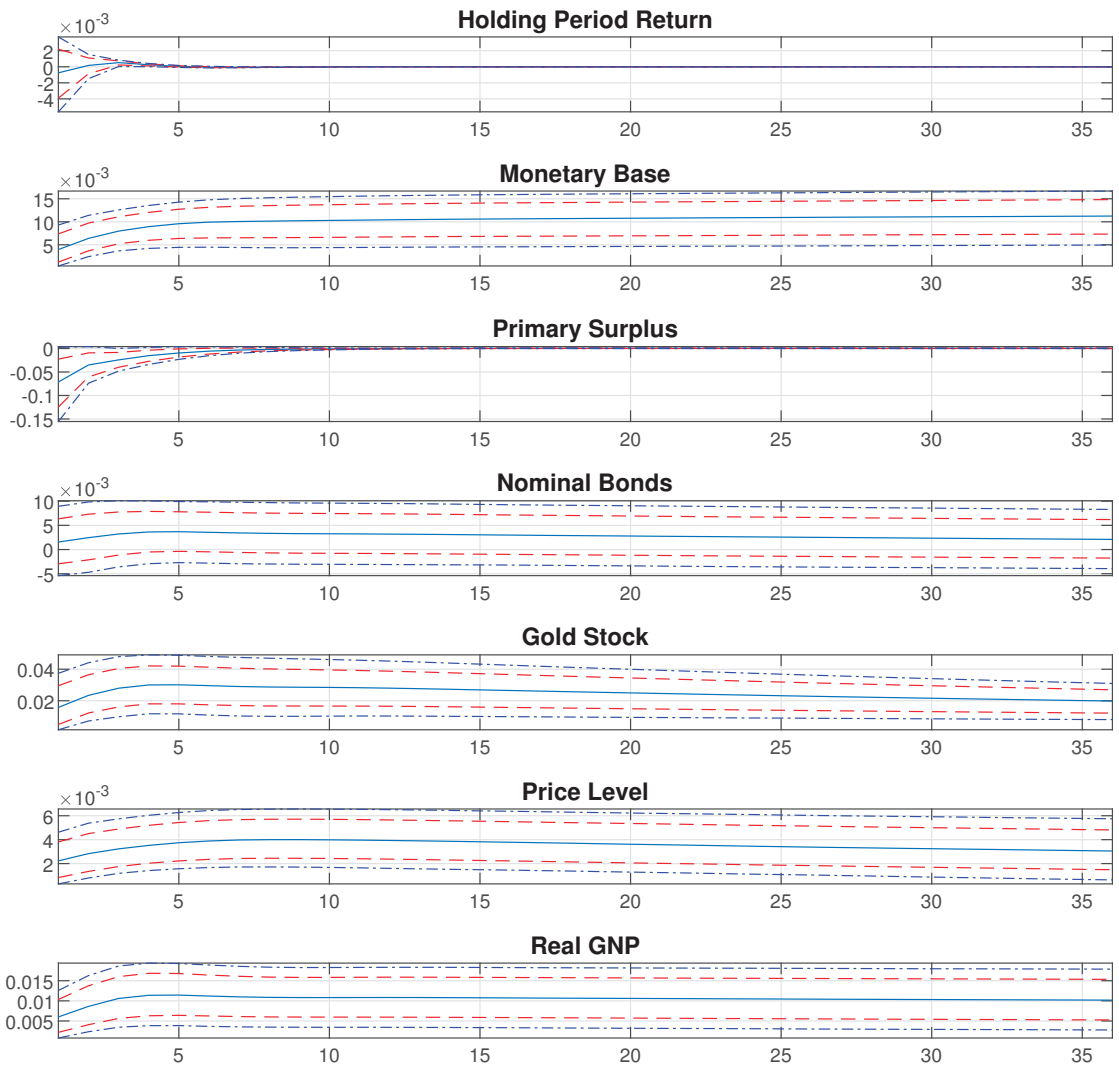


Figure 10: Marginal distributions of responses to the shocks that satisfy Friedman and Schwartz's recovery comovements. Median (solid), 68 percentile (dashed), 90 percentile (dashed-dotted), based on 10,000 draws.

Figure 11 plots the distribution of present values of primary surpluses associated with α_i draws that deliver positive comovements in gold, base money, the price level, and output. Only 10 percent of the draws yield positive present values of surpluses, which is implausibly low for the monetary explanation of recovery. If exogenous increases in the gold stock and subsequent increases in the monetary base underlay expansions in the price level and real economic activity, one would expect surpluses to rise: an unindexed tax code together with rising incomes would raise revenues; even with no reduction in spending, primary surpluses should rise through the recovery. Instead, figure 11 reports the preponderance of draws produce negative present values of surpluses, with the distribution heavily skewed toward deficits. The mean and median of the present values are -0.16, higher in absolute value than the maximum positive value of 0.13. Based on this evidence, it seems unlikely that gold, base money, the price level, and real GNP covary positively when primary surpluses rise.

Taken together, the sign-restrictions analyses lend little support to the money-led view.

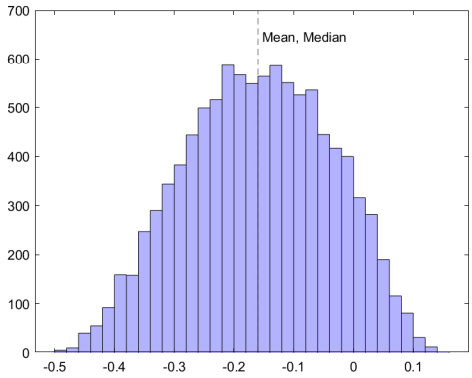


Figure 11: Distribution of the present value of primary surpluses associated with shocks that satisfy Friedman and Schwartz's recovery comovements. Based on 10,000 draws of α_i.

The fiscal responses are difficult to reconcile with a recovery triggered by gold inflows and monetary expansion. Such a recovery would tend, as table 1 reports, to raise revenues with higher nominal income, increasing surpluses.

5.6 Summary of VAR Evidence

VAR evidence leads to the following conclusions:

1. Emergency government expenditures have larger and more significant dynamic impacts on the price level and real GNP than ordinary expenditures, as theory predicts.

2. Lower primary surpluses persistently raise prices, output, the monetary gold stock, base money, and government debt, while they reduce the debt-GNP ratio, consistent with unbacked fiscal expansion.

3. A $1 increase in the primary deficit raises real GNP between $3.50 and $4.50 after a year.

4. Multivariate analysis finds little support for the conventional monetary explanation that gold inflows raised the monetary base, prices, and output. Gold supply shocks have weak predictive value for the base and none for prices and output.

5. A search across structural identifications that generate positive comovements in gold, money, prices, and output finds that with high probability those comovements are associated with sharply lower surpluses; if fiscal variables were responding passively to economic recovery, surpluses should have increased.

These results do not deny that expansion in the gold stock and money played roles in the recovery. But the roles were decidedly supporting, rather than leading.

6 Economic Outturns and Corroborating Evidence

This section presents a variety of facts about the state of the U.S. economy in the 1930s. It also offers some evidence that corroborates the interpretation that unbacked fiscal expansion spurred recovery. Data are quarterly.

6.1 Interest Rates and Prices

Figure 12 plots the level of the GNP deflator along with two interest rates—the commercial paper rate and the New York Fed's discount rate. Although during the gold standard interest rates generally followed the decline in the price level, there are also several distinct deviations when rates rose sharply despite a flat or declining price level. In October 1931, for example, concerns about gold outflows induced most Federal Reserve banks to raise their discount rates after Britain left the gold standard, even though overall prices were in free fall.

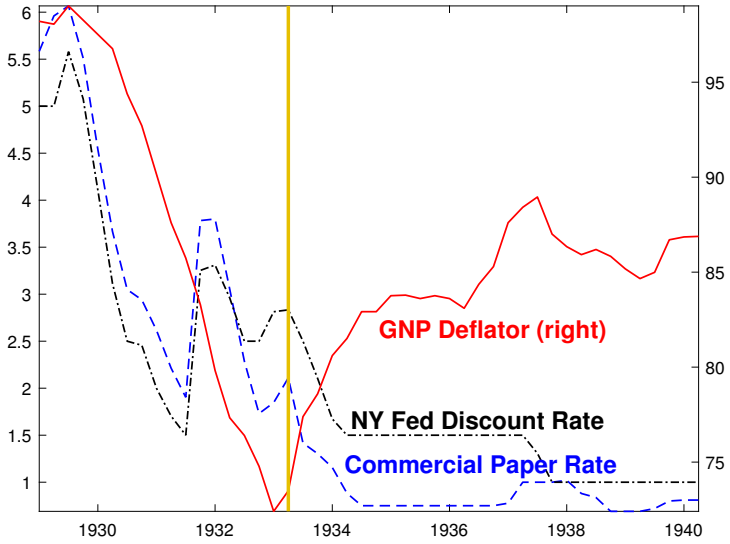


Figure 12: Price level and interest rates. The GNP deflator (1926 = 100) is the solid line (right scale), the commercial paper rate is the dashed line, and the New York Fed discount rate is the dotted-dashed line. The vertical line marks when the U.S. abandoned the gold standard. Sources: Federal Reserve Board (1943).

After the abandonment of the gold standard in April 1933, the Federal Reserve pegged the discount rate, changing it infrequently. Meltzer (2003, p. 413) notes that the Federal Reserve made few changes to its market portfolio and discount rates from 1933 to 1941. If anything, rates moved against the price level: the Fed was not adjusting policy to combat higher prices; instead, it permitted price-level rises to devalue outstanding government bonds.[26]

6.2 Government Debt

If FDR had intended to engineer an unbacked fiscal expansion, growth in government liabilities suggests he was successful. Nominal gross debt doubled during his first seven years in

[26] Appendix E reports additional macroeconomic variables.

office. By comparison, seven fiscal years after the financial crisis in 2008, U.S. gross federal debt had increased only by a factor of 1.8.

Figure 13 makes a key point about unbacked fiscal expansion. From April 1933 to June 1940 the value of nominal debt doubled (dashed line). The debt-GNP ratio, measured at market value, rose sharply from 15 percent in 1930 to 42 percent at the time gold was abandoned (solid line). Then it hovered around 40 percent for the next six years, until the recession and Roosevelt's abandonment of unbacked fiscal expansion policy raised the debt-GNP ratio. Before leaving the gold standard, bond holders expected debt would be fully backed, so its value rose. Once debt became only a claim to dollars, expectations shifted to the view that on the margin new debt issuances would not bring forth higher primary surpluses. Despite the rise in nominal debt, the value of debt remained stable during unbacked fiscal expansions.

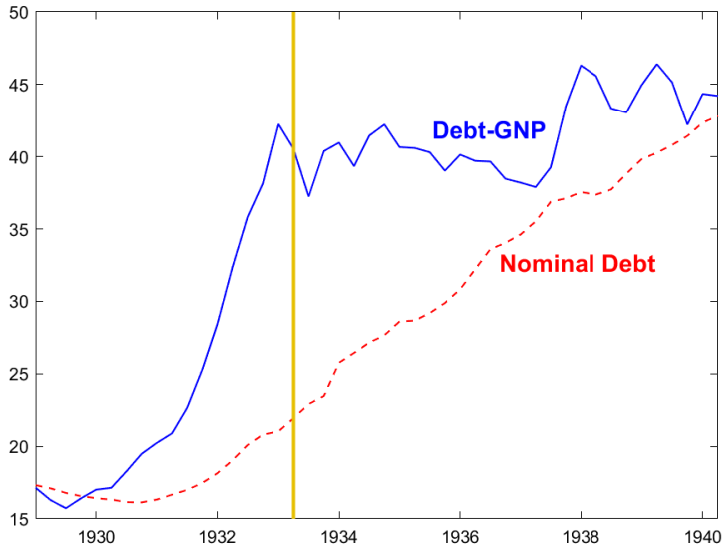


Figure 13: Market value of gross debt as percentage of nominal GNP (solid line) and par value of gross debt in billions of dollars (dashed line); vertical axis measures both percentage and billions of dollars. Vertical line marks when the U.S. abandoned the gold standard. Sources: Authors' calculations, Balke and Gordon (1986).

6.2.1 Returns on Treasury Bond Portfolio Revaluation effects on the government's bond portfolio are a central feature of unbacked fiscal expansion. This section reports nominal and real—ex-post and surprise—returns on the bond portfolio, contrasting returns under the gold standard to those after leaving gold.[27] Several patterns emerge from returns data in table 4. First, nominal returns are comparable across the gold standard and unbacked fiscal expansion period. Second, ex-post real returns are substantially higher in the gold standard period than in the later period (average annual real returns of 7.86 percent versus 1.20 percent). Finally, on average, surprises in real returns are strongly positive in the early period (4.81 percent), but negative during the unbacked fiscal expansions (−0.76

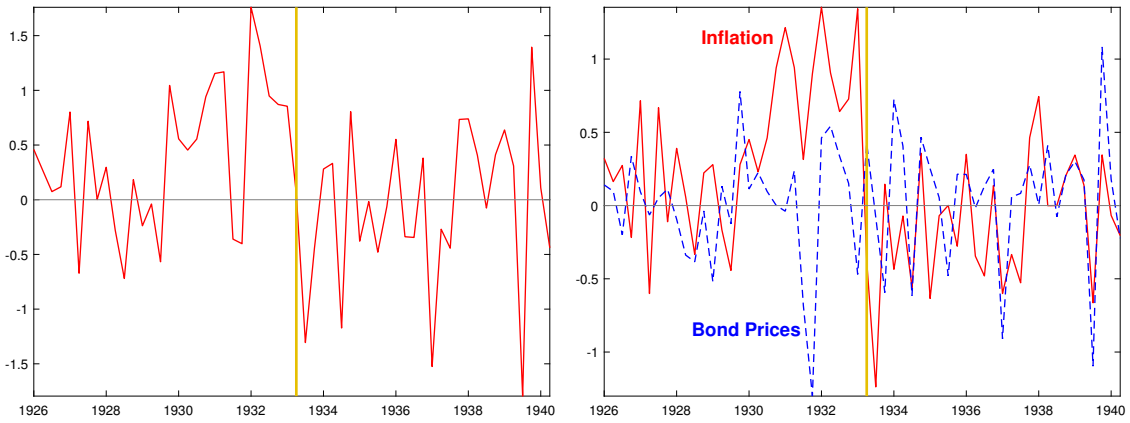
[27]Data availability limits the gold standard period to run from January 1926 to March 1933. Appendix F describes the underlying calculations.

percent). These patterns are fully consistent with surprise inflation devaluing government debt during Roosevelt's administration.

	Gold Standard		**Unbacked Fiscal Expansion**	
	Monthly	*Annual*	*Monthly*	*Annual*
Nominal	0.24	2.91	0.23	2.72
Ex-Post Real	0.66	7.86	0.10	1.20
Surprise Real	0.40	4.81	−0.06	−0.76

Table 4: Average returns on government bond portfolio at monthly and annual rates. Return data start in 1926, so "gold standard" is Jan. 1926 to Mar. 1933 and unbacked fiscal expansion is Apr. 1933 to Dec. 1940.

Surprise real returns on government debt are quantitatively important. After leaving the gold standard, surprise revaluations are both large and frequently negative, as figure 14a shows. With debt at 40 percent of GNP, the revaluations are several percentage points of output, a substantial fraction of primary deficits.[28]



(a) Surprises in real returns (b) Decomposition of surprises

Figure 14: Panel (a): surprises in real returns on bond portfolio as percentage of market value of outstanding debt. Panel (b): decomposition of surprises in real returns on bond portfolio into components due to unanticipated inflation (solid line) and unanticipated bond prices (dashed line). See appendix F for details. Vertical line marks when the United States abandoned the gold standard. Source: Hall, Payne, Sargent, and Szőke (2021), CRSP, and authors' calculations.

The decomposition of surprise real returns, graphed in figure 14b, confirms that before leaving the gold standard, high realized real returns were driven by low inflation (solid line). The negative spike due to bond prices in 1931Q4 was created by the Fed's efforts to defend the gold parity by sharply raising discount rates (dashed line). In the period of unbacked fiscal expansions, again with the exception of the jump in early 1938, surprise devaluations of debt from inflation dominate the surprise real returns.

The last informal piece of empirical evidence about the unbacked fiscal expansion appears in figure 15, which plots the relative price of the bond portfolio. This relative price

[28]Sims (2013) computes surprise capital gains and losses on U.S. government bonds since World War II to find revaluation effects are the same order of magnitude as annual fluctuations in primary surpluses.

is computed as the real market value of debt over the nominal par value of debt to yield the goods-price of government bonds. Bonds became increasingly costly in terms of goods throughout the gold standard period, reaching a peak in 1933Q1. With the departure from gold came a steady devaluation of the bond portfolio, bottoming out in the middle of 1937 when the recession began. This cheapening of bonds is consistent with bondholders substituting out of debt and into buying goods and services: an increase in aggregate demand triggered by unbacked fiscal expansion.

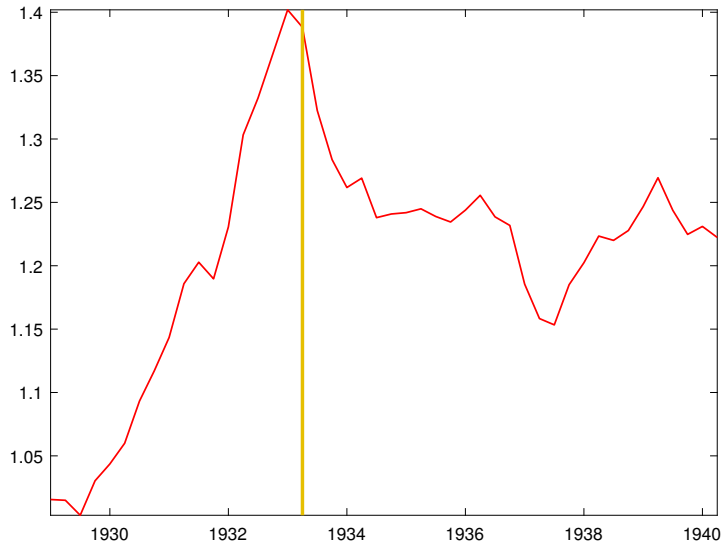


Figure 15: Relative price of the bond portfolio is the ratio of the real market value to the nominal par value of debt. Vertical line marks when the U.S. abandoned the gold standard. Source: Authors' calculations.

7 Political and Intellectual Context

Roosevelt's decision to leave the gold standard and reflate arose against a backdrop of growing political and intellectual consensus that higher retail and wholesale prices were critical to recovery of wages, employment, investment, and consumption. The banking crisis of February–March 1933 heightened expectations of a dollar devaluation as political pressure mounted against maintaining gold convertibility at the existing parity.[29] Gold reserves came close to their statutory minimums, particularly at the New York Fed. To avoid further strain on the financial sector, Senator Elmer Thomas advocated issuing unbacked currency to raise the price level and Senator Tom Connally proposed reducing the gold content of the dollar by one-third. Financial and political forces were aligning against the gold standard.

Keynes (1924) was foundational to Roosevelt's desire to raise and stabilize the price level. He explained that large swings in the price level can produce capricious distributional effects and destroy wealth, leading him to advocate targeting and smoothing the price level [p. 38]. Keynes also distinguished seigniorage as a source of revenues from revaluations of nominal government liabilities as a means of reducing debt burden. The latter played a central role in the reflation.

[29] See Eichengreen (1992), especially chapter 11.

Opposition to the gold standard came from a camp of economists who agitated for reflation. Irving Fisher's (1932; 1933b) debt-deflation theory argued that when the private sector is over-indebted, a falling price level triggers a sequence of events that drives the economy into depression. Viewing nominal income through the equation of exchange, Fisher advocated government policies designed to raise the money supply and velocity. Fisher carried on extensive correspondence with the president and met with him several times to discuss his economic proposals. In an April 30, 1933 letter to Roosevelt, Fisher (1933a) expressed joy over "...the reflation legislation," referring to the Agricultural Adjustment Act, which included the Thomas Amendment giving the president unprecedented powers to reflate.

Keynes (1933) wrote an open letter to Roosevelt, published in the *New York Times*, calling for the U.S. government "...to create additional current incomes through the expenditures of borrowed or printed money." Keynes emphasizes "governmental loan expenditure" as "the only sure means of obtaining quickly a rising output at rising prices," echoing his 1924 *Tract*. Keynes prescribed unbacked fiscal expansion: nominal-liability-financed deficits with a promise not to raise taxes to pay off the debt.

While the consensus favoring reflation was strong, Roosevelt received diverse advice on how to achieve it. There were false starts, such as the National Industrial Recovery Act of 1933, which in addition to being ruled to contain unconstitutional features, likely slowed recovery [Cole and Ohanian (2004)]. But his "try anything" macroeconomic approach contained the essential ingredients for an unbacked fiscal expansion: suspension of the gold standard, a commitment to run debt-financed emergency deficits until specified parts of the state of the economy improved, and a policy decision not offset gold inflows via sterilization, which permitted the monetary base to grow without further increases in government indebtedness for monetary reasons.

Our argument that the *joint* monetary-fiscal mix underlies recovery contrasts with existing explanations, which frequently attribute diminished roles to both monetary and fiscal policy. Some studies argue that the combination of dollar devaluation, the departure from the gold standard, regime change, expansion of the monetary base, and rising inflation expectations account for the recovery. Our unbacked fiscal expansion interpretation broadly agrees with many of these arguments, but also links them to the monetary and fiscal policies of the 1930s.

Another distinction concerns the view that monetary policy made no substantive contribution to the recovery. Friedman and Schwartz (1963), for example, conclude the immediate recovery "owed nothing to monetary expansion" [p. 433]. Wicker (1965) attributes Fed inaction to a leadership vacuum and the Fed's incomplete understanding of how monetary policy affects the economy and the price level. Meltzer (2003, p. 273) flatly declares that "...in the middle and late thirties, just as in the early thirties, the Federal Reserve did next to nothing to foster recovery."

By ensuring short-term interest rates did not rise with inflation through the 1930s, the Fed permitted unbacked fiscal expansion to reflate the economy. If interest rates are pegged, monetary policy prevents the nominal debt expansion from raising debt service enough to put debt on an explosive path. In this manner, Federal Reserve policy fulfilled a critical role: by permitting higher price levels to bring the real market value of debt in line with the expected present value of the primary surpluses, the Fed stabilized debt. Monetary and fiscal policy are partners in successful unbacked fiscal expansion.

The economic consequences of the unbacked fiscal expansion that began in 1933 rationalize why concerns that expanding federal debt would threaten the U.S. government's creditworthiness were not realized. Studenski and Krooss (1952, p.428) summarize a key feature of unbacked fiscal expansion: "...the New Deal administration itself believed that the public credit could not sustain continuous budgetary deficits and increases in the public debt. But in practice this also proved incorrect." Unbacked expansions raise prices and output to ensure that higher nominal debt does not transform into a higher debt-output ratio, as figure 13 shows.

The initial impetus for recovery came from dollar devaluation and departure from the gold standard, which signaled a change in policy regime that raised inflation expectations, according to the consensus view. We agree that these elements all contributed to the recovery, particularly in commodity prices, but argue they cannot account for the rapid pick up in the price level and output in isolation. Temin and Wigmore (1990) offer evidence that dollar devaluation in 1933 signaled that Roosevelt had abandoned the deflation associated with adherence to the gold standard and that the lower dollar directly increased aggregate demand and indirectly raised prices and production throughout the economy. Romer (1992), however, makes a forceful case that the dollar depreciation after April 1933 cannot account for the sustained increases in subsequent price levels. Empirical evidence from Ellison, Lee, and O'Rourke (2024) shows that the strength of the U.S. recovery was an outlier among countries that left gold. We agree with Romer and point out—as do Jalil and Rua (2017)—that both Britain and France experienced similar depreciations in their currencies after leaving gold, yet prices and output did not rise as they did in the United States. Our work complements Jalil and Rua's narrative evidence on the role of rising inflation expectations in the recovery of 1933. We ground those expectations in the prevailing monetary-fiscal policy mix.

Our narrative shares some elements with Eggertsson (2008), but the economic mechanisms differ in important ways. Eggertsson relies on new Keynesian mechanisms for escaping from the lower bound on the nominal interest rate, with expectations anchored on an eventual return to the conventional active monetary/passive fiscal policy mix. Eggertsson's story rests on coordinated monetary and fiscal policies that maximize household utility, allowing the time-consistent policy to generate the same mechanisms that Eggertsson and Woodford's (2003) optimal commitment policy delivers.

This interpretation faces difficulties. First, it requires substantial policy coordination. Eccles (1951) describes a highly decentralized Federal Reserve, both in its operations and in its objectives [see section 3.1 and Wicker (1966), Wheelock (1991), and Meltzer (2003)]. Federal Reserve officials frequently voiced concerns about the prospect of inflation, even during the deflationary years in the early 1930s [Meltzer (2003, p. 280)].[30] Second, Eggertsson's mechanism leans heavily on rational expectations at a time when the entire monetary system had no precedent. Unbacked fiscal expansion does not require rational expectations, as Eusepi and Preston (2012) and Sims (2016) show. In this important sense, our mechanism is less demanding than is Eggertsson's. Finally, Eggertsson's explanation does not trigger reflation—though it arrests deflation—and his model predicts a rising debt-output ratio, two

[30]Some academic economists backed those voices. Eleanor Lansing Dulles (1933, p. V) wrote that the United States faced "serious dangers" from inflation: "Inflation takes many forms, Government debt is the most insidious...." Oliver Sprague, a Harvard professor, opposed leaving gold, warning that America was "in great danger of a great inflation such as Germany had" [Pearson, Meyers, and Gans (1957, p. 5616)].

predictions at odds with data.

Our perspective elaborates Eichengreen's (2000) conclusion that "...the fundamental change in policy making in the 1930s was not the Keynesian revolution, but the 'nominal revolution'—the abandonment of the gold standard for managed money." To reach our perspective, broaden "money" to "nominal government liabilities." Nothing compels policymakers to back expansions in nominal liabilities—base money or bonds—with higher taxes. When they don't, debt-financed fiscal expansion becomes a potent policy tool.

8 Lessons for Today

By and large, American fiscal policy has followed the Hamilton (1790) norm: government debt expansions are backed by real primary surpluses. Explicit departures from that norm occurred during the Covid pandemic and Roosevelt's efforts to pull the economy out of the Great Depression.

This paper combines historical facts with simple theory and both formal and informal empirical evidence to weave a fresh narrative about the recovery launched in 1933. Recovery was a joint monetary-fiscal phenomenon. The monetary step of abandoning the gold standard and revoking convertibility was necessary for Roosevelt to run debt-financed emergency deficits until recovery set in.

Roosevelt understood his policies were unprecedented and took pains to communicate to the public why unprecedented actions were essential not only to recovery, but to "survival of democracy." Those efforts helped to make unbacked emergency fiscal expansion believable.

In Roosevelt's case, his economic and political objectives aligned. The relief provided to farmers, homeowners, and unemployed workers, which unbacked government debt financed, also reflated the economy, as Roosevelt desired. Covid spending had similar effects, though higher inflation was not a stated goal of policy. That unbacked fiscal expansion is inflationary comes as no surprise to those familiar with the fiscal theory of the price level. In 2022 it seems to have caught many off guard.

Roosevelt's successful, if incomplete, reflation carries lessons for policymakers today. First, fiscal expansions can have two effects: Keynesian hydraulics and wealth effects from government debt. Wealth effects may be large, depending on expectations of future fiscal actions. Analyses that neglect these may underpredict the stimulative impacts and misguide policy responses to the resulting inflation. In fact, Barro and Bianchi's (2023) cross-country study of 37 OECD countries shows that increases in government expenditures from 2020 to 2022 have explanatory power for post-Covid inflation surges.

A second lesson from the Roosevelt policies is that fiscal stimulus and fiscal sustainability need not be in conflict. After all, Barro and Bianchi (2023) estimate that only about half of the required financing for government expenditures from 2020 to 2022 can be attributed to raising future revenue or cutting future spending. When the aim is to raise inflation and economic growth, higher nominal government debt—if people are convinced it does not portend higher future taxes—can achieve both the macroeconomic objectives and the goal of stabilizing debt. To engineer an unbacked fiscal expansion, rapid growth in *nominal* debt need not threaten fiscal sustainability, just as it didn't in 1930s America. However, to maintain the value of government debt, policymakers in the context of our model must assure—as with Roosevelt's balanced ordinary budget—that unbacked fiscal expansion is a

temporary measure to address an immediate need.

Finally, policymakers can speak as clearly about fiscal intentions as Roosevelt.[31] But clarity is the exception in fiscal policy. On the other hand, central bankers clearly emphasize the importance of anchoring monetary expectations. Because fiscal expectations are equally important, fiscal actions could be more effective if coupled with communication about how those actions will be financed.

[31]Two examples. On February 23, 2009, six days after passage of his stimulus package, Barack Obama pledged "to cut the deficit... in half by the end of my first term in office." On March 15, 2022, following about $5 trillion in Covid relief spending, White House Press Secretary Jen Psaki urged lawmakers to approve additional support "provided on an emergency basis, not something where it would require offsets." Furthermore, Treasury Secretary Janet Yellen stated in a 2021 Congressional testimony that "...right now, with interest rates at historic lows, the smartest thing we can do is act big," (https://www.finance.senate.gov/imo/media/doc/JLY%20opening%20testimony%20%20(1).pdf). While Obama sought to follow Hamilton's norm; policymakers during Covid did not.

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Appendices for Recovery of 1933*

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Appendices

A Model Details, Derivations and Results

This section provides additional model details and states the results of the main text more generally. Most results can easily be extended to include nominal rigidities and long-term government debt.

A.1 A model of the gold standard

Necessary and sufficient conditions for optimality are that the first-order conditions

$$\frac{U_m(m_t)}{U_c(C_t)} = \frac{i_t}{1+i_t} \tag{A.1}$$

$$\frac{U_g(G_t^m)}{U_c(C_t)} = \frac{P_t^g}{P_t}\left(1 - Q_{t,t+1}\frac{P_{t+1}^g}{P_t^g}\right) \tag{A.2}$$

$$\frac{U_c(C_t)}{U_c(C_{t+1})} = \frac{\beta}{Q_{t,t+1}}\frac{P_t}{P_{t+1}} \tag{A.3}$$

$$\frac{V_h(H_t)}{U_c(C_t)} = \frac{w_t}{P_t} \tag{A.4}$$

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must hold at all times and states, along with the transversality condition

$$\lim_{T\to\infty} E_t[Q_{t,T}W_T] = 0.$$

The above conditions assume that utility from gold is additively separable to that obtained from consumption and real money balances. The period interest rate must satisfy

$$\frac{1}{1+i_t} = \beta E_t\left[\frac{U_c(C_{t+1})}{U_c(C_t)}\frac{P_t}{P_{t+1}}\right]. \tag{A.5}$$

For simplicity, we assume that the supply of gold, G_t, is exogenously given. Household and government holdings of gold satisfy

$$G_t = G_t^m + G_t^p.$$

The government's holdings of gold back the money supply according to $P_t^g G_t^m = \alpha M_t$ where the policy parameter satisfies $0 < \alpha < 1$. Under a gold standard the government fixes the dollar price of gold at $P_t^g = \bar{P}^g$. Given exogeneity of the gold supply, gold sector profits are

$$\Pi_t = P_t^g(G_t - G_{t-1}).$$

A rational expectations equilibrium is then a set of state-contingent paths for endogenous variables that satisfy the conditions for household optimality together with market-clearing conditions

$$Y_t = C_t + F_t \tag{A.6}$$

$$M_t = M_t^s \tag{A.7}$$

$$A_{t+1} = A_{t+1}^s \tag{A.8}$$

at all dates and states, with F_t government purchases which are exogenously determined.

Combining (A.2) and (A.3), taking expectations and solving forward gives

$$\frac{P_t^g}{P_t} = E_t\sum_{T=t}^{\infty}\beta^{T-t}\frac{U_g(G_T^g)}{U_c(C_t)}$$

as reported in the main text. Substituting (A.6) – (A.7) into (A.1) and (A.2) gives

$$\frac{U_m(M_t^s/P_t)}{U_c(Y_t - F_t)} = \frac{i_t}{1+i_t} \tag{A.9}$$

$$\frac{U_g(G_t - \alpha M_t^s/\bar{P}^g)}{U_c(Y_t - F_t)} = \frac{\bar{P}^g}{P_t}\frac{i_t}{1+i_t} \tag{A.10}$$

where (A.10) makes use of the constant dollar price of gold under the gold standard. Under standard assumptions on preferences we can solve for real money balances and the relative

price of gold as

$$\frac{M_t^s}{P_t} = L^m(Y_t - F_t, i_t) \tag{A.11}$$

$$\frac{\bar{P}^g}{P_t} = L^g(Y_t - F_t, i_t, G_t) \tag{A.12}$$

where the liquidity preference function L^m is increasing in the first argument and decreasing in the second argument. The function L^g is increase in the first and final argument, decreasing in the second and third.

The transversality condition and flow budget constraint provide the restriction

$$\begin{aligned}
\frac{W_t^s}{P_t} &= E_t \sum_{T=t}^{\infty} \beta^{T-t} \frac{U_c(Y_T - F_T)}{U_c(Y_t - F_t)} \left[S_T + \frac{i_T}{1+i_T} \frac{M_T^s}{P_T} + \frac{\bar{P}^g}{P_T}(G_t^p - G_{t-1}^p) - \Pi_T^g \right] \\
&= E_t \sum_{T=t}^{\infty} \beta^{T-t} \frac{U_c(Y_T - F_T)}{U_c(Y_t - F_t)} \left[S_T + \frac{i_T}{1+i_T} \frac{M_T^s}{P_T} - \frac{\bar{P}^g}{P_T}(G_t^m - G_{t-1}^m) \right] \\
&= E_t \sum_{T=t}^{\infty} \beta^{T-t} \frac{U_c(Y_T - F_T)}{U_c(Y_t - F_t)} \left[S_T + \frac{i_T}{1+i_T} \frac{M_T^s}{P_T} - \alpha(\frac{M_T^s}{P_T} - \frac{M_{T-1}^s}{P_{T-1}}) \right]
\end{aligned}$$

and

$$W_t^s = M_{t-1}^s + (1 + i_{t-1}) B_{t-1}^s$$

in the special case of risk free debt and where the surplus is defined as $S_t = T_t - F_t$.

Now consider the implications of a purely exogenous, possibly time-varying, interest rate peg, $i_t = \bar{i}_t$ and an exogenous surplus rule, $S_t = \bar{S}_t$ for all t. Using (A.11) and (A.12) gives

$$m_t = L^m(Y_t - F_t, \bar{i}_t)$$

which is determined by the exogenous processes for output and government spending. This permits solving for the price level as

$$P_t = \bar{P}^g / L^g(Y_t - F_t, \bar{i}_t, G_t). \tag{A.13}$$

The price level is a stationary random variable determined by the exogenous processes for income, government spending, and gold supply. Using liquidity preference function, goods market clearing and the gold backing policy

$$\frac{M_{t-1}^s + (1 + i_{t-1}) B_{t-1}^s}{P_t} = E_t \sum_{T=t}^{\infty} \beta^{T-t} \frac{U_c(Y_T - F_T)}{U_c(Y_t - F_t)} \left[\bar{S}_T + (\Delta_T - \alpha) \frac{M_T^s}{P_T} + \alpha \frac{M_{T-1}^s}{P_{T-1}} \right] \tag{A.14}$$

where

$$\Delta_T = \frac{\bar{i}_T}{1 + \bar{i}_T}$$

so that the right hand side is uniquely determined and exogenous. For the intertemporal budget constraint to be satisfied requires variations in P_t with variations in structural surpluses, S, to ensure appropriate revaluation of government liabilities. But the resulting price

level will not satisfy (A.13), being independent of the structural surplus. An unbacked fiscal expansion is not feasible under a gold standard.

When the dollar price of gold is allowed to vary the household's intertemporal budget constraint uniquely determines the price level. Then (A.13) determines the equilibrium relative price of gold. Permanent changes in the price level result in permanent changes in the dollar price of gold. Unbacked fiscal expansion requires leaving the gold standard. In this case, the liabilities of the government satisfy

$$\begin{aligned} W^s_{t+1} &= M^s_t + (1+\bar{i}_t)B^s_t \\ &= M^s_t + (1+\bar{i}_t)[W^s_t + P_t\bar{S}_t - M^s_t - P^g(G^m_t - G^m_{t-1})] \\ &= (1+i_t)[W^s_t + P_t\bar{S}_t - \Delta_t M^s_t - P^g(G^m_t - G^m_{t-1})] \end{aligned} \tag{A.15}$$

Finally, we can verify that (A.5) is satisfied under an unbacked fiscal expansion

$$\begin{aligned} \beta E_t[U_c(C_{t+1})P^{-1}_{t+1}] &= \frac{1}{W^s_{t+1}} E_t \sum_{T=t+1}^{\infty} \beta^{T-t} U_c(C_T)[P_T\bar{S}_T + \Delta M^s_T - P^g_T(G^m_T - G^m_{T-1})] \\ &= \frac{U_c(C_t)}{(1+\bar{i}_t)P_t}\left[\frac{(1+\bar{i}_t)W^s_t}{W^s_{t+1}} - \frac{(1+\bar{i}_t)P_t}{W^s_{t+1}}[P_t\bar{S}_t + \Delta M^s_t - P^g_t(G^m_t - G^m_{t-1})]\right] \\ &= \frac{U_c(C_t)}{(1+\bar{i}_t)P_t} \end{aligned}$$

where the final equality follows from (A.15).

A.2 Firm Decisions

We assume a simple theory of production to give microfoundations to movements in the natural rate of interest. This matters for later results on the effects of government spending. A continuum of competitive firms solve a standard profit maximization problem. Each firm j produces according to the production function

$$Y_t(j) = A_t f(H_t(j))$$

where $A_t > 0$ is an exogenous technology factor and f increasing and concave with labor the only input to production. Nominal variable cost of supplying $Y_t(j)$ is

$$w_t H_t(j) = w_t f^{-1}(Y_t(j)/A_t).$$

Real marginal costs are given by

$$mc_t(j) = \frac{MC_t(j)}{P_t} = \frac{v_h(f^{-1}(Y_t/A_t))}{u_c(Y_t - F_t)A_t}\Psi(Y_t(j)/A_t) = mc(Y_t(j), Y_t; A_t, F_t).$$

Firms maximize profits

$$\Pi^f_t(j) = p_t(j)Y_t(j) - w_t H_t(j)$$

subject to the production technology giving the first order condition

$$1 = mc(Y_t(j), Y_t; A_t, F_t) \tag{A.16}$$

for all j. In equilibrium there is a unique solution in which all firms supply the identical amount $Y_t(j) = Y_t = Y^n(A_t, F_t)$

A.3 Log-linear Approximation

Because the empirical analysis emphasizes the evolution of debt in response to variations in the structural surplus, we rewrite the evolution of government liabilities as

$$\begin{aligned} B_t^s &= (1+i_{t-1})B_{t-1}^s - M_t^s + M_{t-1}^s + P_t^g G_t^m - P_t^g G_{t-1}^m - P_t T_t + P_t F_t \\ &= (1+i_{t-1})B_{t-1}^s - \left(M_t^s - M_{t-1}^s - P_t^g G_t^m + P_t^g G_{t-1}^m + P_t T_t\right) + P_t F_t \\ &= (1+i_{t-1})B_{t-1}^s - P_t \bar{T}_t + P_t F_t \end{aligned}$$

where

$$P_t \bar{T}_t = P_t T_t + M_t^s - M_{t-1}^s - P_t^g G_t^m + P_t^g G_{t-1}^m$$

so that $\bar{T}_t$, in addition to representing taxes net of transfers to effects the required adjustments in money balances and the purchase and sale of gold for monetary purposes. This expression satisfies

$$b_t^s = (1+i_{t-1})\frac{P_{t-1}}{P_t} b_{t-1}^s - S_t$$

where we redefine the primary surplus as

$$S_t = \bar{T}_t - F_t.$$

Finally, redefine the state variable for debt such that $B_t = (1+i_t)B_t^s$ gives

$$\frac{b_t}{1+i_t} = \frac{P_{t-1}}{P_t} b_{t-1} - S_t$$

where $b_t = B_t/P_t$.

We look for an approximation in the neighborhood of steady state in which the relative prices P_t/P_{t-1} and $\bar{P}_t^g/P_t$ are in the neighborhood of unity, $1+i = \beta^{-1}$, and real variables are constant. Defining

$$\tilde{b}_t = \frac{b_t - b}{Y}; \quad \tilde{T}_t = \frac{\bar{T}_t - \bar{T}}{Y}; \text{ and } \quad \tilde{F}_t = \frac{F_t - F}{Y}$$

and

$$\pi_t = \ln\left(\frac{P_t}{P_{t-1}}\right) \text{ and } \quad \hat{i}_t = \ln\left(\frac{1+i_t}{1+i}\right).$$

For all other variables Z_t, we have

$$\hat{z}_t = \log\left(\frac{Z_t}{Z}\right)$$

for steady state value Z.

This permits the first-order approximation

$$\tilde{b}_t = \beta^{-1}\tilde{b}_{t-1} + \beta^{-1}\delta(\hat{i}_t - \pi_t) - (\tilde{T}_t - \tilde{F}_t). \tag{A.17}$$

The real marginal cost function satisfies

$$\begin{aligned} \hat{mc}_t &= (\omega_p + \omega_w)(\hat{Y}_t^n - \hat{A}_t) - \hat{A}_t + \sigma_c^{-1}\hat{C}_t \\ &= \omega\hat{Y}_t^n - (1+\omega)\hat{A}_t + \sigma^{-1}(\hat{Y}_t^n - \tilde{F}_t) \\ &= 0 \end{aligned}$$

where $\sigma = s_c\sigma_c$, $s_c = \frac{C}{Y}$ and

$$\begin{aligned} \sigma_c &= \frac{U_c}{U_{cc}C} \\ \omega_p &= -\frac{f''f}{(f')^2} \\ \omega_w &= \frac{V_{hh}H}{V_h}\frac{f}{f'H}. \end{aligned}$$

It follows that

$$\hat{Y}_t^n = \frac{(1+\omega)\hat{A}_t + \sigma^{-1}\tilde{F}_t}{\omega + \sigma^{-1}}.$$

The log-linear approximation to the Euler equation provides

$$\hat{Y}_t^n = E_t\hat{Y}_{t+1}^n - \sigma(\hat{i}_t - \pi_{t+1}) + E_t(\tilde{F}_t - \tilde{F}_{t+1}) \tag{A.18}$$

which can be re-written as

$$\hat{i}_t = E_t\pi_{t+1} + r_t^n$$

where

$$r_t^n = \sigma^{-1}E_t[(\tilde{F}_t - \tilde{F}_{t+1}) - (\hat{Y}_t^n - \hat{Y}_{t+1}^n)].$$

In the absence of technology shocks and other shocks being *i.i.d.* we have

$$r_t^n = \frac{1}{\sigma + \omega^{-1}}\tilde{F}_t.$$

The model is then closed with assumptions on monetary and fiscal policy.

A log-linear approximation to the Euler equations for money and gold holdings provide

$$\beta E_t\pi_{t+1} + \varphi(1-\beta)\hat{m}_t = \sigma^{-1}\left(\hat{Y}_t^n - \tilde{F}_t\right) - \sigma^{-1}\beta E_t\left(\hat{Y}_{t+1}^n - \tilde{F}_{t+1}\right) \tag{A.19}$$

$$\hat{p}_t^g + \nu(1-\beta)\hat{G}_t^p = \beta E_t\hat{p}_{t+1}^g + \sigma^{-1}E_t\left(\left(\hat{Y}_t^n - \tilde{F}_t\right) - \beta\left(\hat{Y}_{t+1}^n - \tilde{F}_{t+1}\right)\right) \tag{A.20}$$

where

$$\hat{p}_t^g = \log\left(\frac{\bar{P}^g}{P_t}\right)$$

and

$$\varphi \equiv -\frac{U_{mm}}{U_m}m > 0 \text{ and } \nu \equiv -\frac{U_{gg}}{U_g}\bar{G}_m > 0$$

give the curvature of the utility function with respect to real money balances and gold holdings. A log-linear approximation to the market clearing condition for gold, the gold backing policy and the definition of inflation (given the fixed dollar price of gold) is

$$\hat{G}_t^p = (1+\theta_m)\,\hat{G}_t - \theta_m \hat{G}_t^m \tag{A.21}$$

$$\hat{p}_t^g + \hat{G}_t^m = \hat{m}_t \tag{A.22}$$

$$\pi_t = -\hat{p}_t^g + \hat{p}_{t-1}^g \tag{A.23}$$

where $\theta_m = G^m/G^p$, the steady state ratio of monetary to private gold. To close the model, an assumption must be made about tax policy, discussed further below.

The model of the gold standard is therefore given by equations (A.17)-(A.23) and the tax rule. These eight equations describe the evolution of

$$\left\{\pi_t, \hat{i}_t, \hat{m}_t, \hat{p}_t^g, \hat{G}_t^p, \hat{G}_t^m, \tilde{b}_t, \tilde{T}_t\right\}$$

as a function of exogenous disturbances

$$\left\{\hat{Y}_t^n, \tilde{F}_t, \hat{G}_t\right\}.$$

A.4 Proof of Result 1

Solving the model provides insight into the mechanics of monetary and fiscal policy under a gold standard. We show that both monetary and fiscal policy must be passive, accommodating required equilibrium adjustments in money balances and government debt.

For simplicity assume that government spending and gold supply are constant. Combining (A.21) and (A.22) gives

$$\hat{G}_t^p = -\theta_m(\hat{m}_t - \hat{p}_t^g).$$

Using this expression with (A.19) and (A.20) provides

$$(1+\nu\theta_m)\,\hat{p}_t^g = (\nu\theta_m + \varphi)\,\hat{m}_t$$

or

$$\hat{m}_t = \frac{(1+\nu\theta_m)}{(\varphi+\nu\theta_m)}\hat{p}_t^g. \tag{A.24}$$

Substituting this expression to eliminate money balances in (A.19) gives

$$\sigma\beta E_t\hat{Y}_{t+1}^n - \beta E_t\hat{p}_{t+1}^g = \sigma\hat{Y}_t^n - \beta\hat{p}_t^g - \varphi\,(1-\beta)\,\frac{(1+\nu\theta_m)}{(\varphi+\nu\theta_m)}\hat{p}_t^g. \tag{A.25}$$

a linear rational expectations model of $\hat{p}_t^g$. This equation can be solved using standard methods. Given a solution for $\hat{p}_t^g$, the variables $\left\{\pi_t, \hat{m}_t, \hat{G}_t^p, \hat{G}^m, \hat{i}_t, \tilde{b}_t\right\}$ follow directly.

Solving the difference equation forward, assuming the natural rate of output is an *i.i.d.* process, we have

$$\beta E_t \hat{p}^g_{t+1} + \sigma \hat{Y}^n_t = \left(\beta + \varphi\,(1-\beta)\,\frac{(1+\nu\theta_m)}{(\varphi+\nu\theta_m)}\right)\hat{p}^g_t$$

or

$$\hat{p}^g_t = \left(\beta + \varphi\,(1-\beta)\,\frac{(1+\nu\theta_m)}{(\varphi+\nu\theta_m)}\right)^{-1}\left(\beta E_t \hat{p}^g_{t+1} + \sigma \hat{Y}^n_t\right).$$

Because the eigenvalue must be less than unity we have a unique bounded rational expectations equilibrium of the form

$$\hat{p}^g_t = \sigma\left(\beta + \varphi\,(1-\beta)\,\frac{(1+\nu\theta_m)}{(\varphi+\nu\theta_m)}\right)^{-1}\hat{Y}^n_t.$$

Which means that $\log P_t$ is stationary with mean $\log \bar{P}^g$. This condition holds for all maintained parameter values.

The remaining variables can be solved immediately. Note that together the consumption and money Euler equations, (A.18) and (A.19), connect the evolution of interest rates to money balances. Interest rate policy must passively adjust to ensure the correct level of nominal and real money holdings. Finally note that for a bounded solution for government debt, we must restrict the evolution of taxes. In particular, for a tax rule

$$\tilde{T}_t = \gamma \tilde{b}_{t-1}$$

debt evolves according to

$$\tilde{b}_t = \left(\beta^{-1} - \gamma\right)\tilde{b}_{t-1} + \beta^{-1}\delta(\hat{i}_t - \pi_t).$$

For stability we must have the eigenvalue $\beta^{-1} - \gamma$ inside the unit circle. That is, taxes must be adjusted passively to stabilize the public debt. This result extends directly to a model with endogenous supply of output, nominal rigidities and long-term debt. Monetary and fiscal policy cannot achieve any desired price level under a gold standard. If taxes do not stabilize the public debt, there is no equilibrium. Debt grows without bound violating the household's transversality condition.

A.5 Impulse Response Functions

To approximate FDR's budgetary arrangements, let

$$\begin{aligned}\tilde{T}_t &= \tilde{T}^o_t + \tilde{T}^e_t \\ \tilde{F}_t &= \tilde{F}^o_t + \tilde{F}^e_t\end{aligned}$$

for ordinary and emergency taxes and spending. The flow budget constraint of the government is then

$$\tilde{b}_{t-1} = \beta \tilde{b}_t + (\tilde{T}^o_t + \tilde{T}^e_t - \tilde{F}^o_t - \tilde{F}^e_t) - \beta\delta\hat{i}_t + \delta\pi_t. \tag{A.26}$$

We assume that the "ordinary budget" is balanced each period, so that $T^o_t = F^o_t$ in both levels and deviations from steady state. This permits the budget identity to be expressed as

$$\tilde{b}_{t-1} = \beta \tilde{b}_t + (\tilde{T}^e_t - \tilde{F}^e_t) - \beta\delta\hat{i}_t + \delta\pi_t. \tag{A.27}$$

only the emergency primary surplus appears in the budget identity.

We posit an interest rate rule in log-linear form

$$\hat{i}_t = \phi \pi_t \tag{A.28}$$

Emergency fiscal variables, (T_t^e, F_t^e), are exogenous and taken to be *i.i.d.* for these derivations.

The model includes a Fisher equation

$$\hat{i}_t = r_t^n + E_t \pi_{t+1} \tag{A.29}$$

where

$$r_t^n \equiv \frac{1}{\sigma + \omega^{-1}} \tilde{F}_t = \frac{1}{\sigma + \omega^{-1}} (\tilde{F}_t^o + \tilde{F}_t^e) \tag{A.30}$$

is the exogenously given natural real rate of interest. Given the restrictions on preference parameters, higher government purchases always raise the natural rate of interest. Ordinary and emergency purchases have identical impacts on r^n.

With emergency taxes and spending exogenous, identity (A.27) is a stable difference equation in real debt when solved forward. Use (A.28) to replace the nominal interest rate, iterate forward, and impose the transversality condition to yield

$$\tilde{b}_{t-1} = \sum_{j=0}^{\infty} \beta^j E_t \left[\tilde{T}_{t+j}^e - \tilde{F}_{t+j}^e + \delta(1 - \beta\phi) \pi_{t+j} \right] \tag{A.31}$$

i.i.d. emergency fiscal variables reduce the expected present value of primary surpluses to only the current surplus, $T_t^e - F_t^e$. To solve for expected inflation rates, combine (A.28) with (A.29) to yield an expression for the one-step-ahead inflation rate

$$E_t \pi_{t+1} = \phi \pi_t - r_t^n$$

which generalizes to

$$E_t \pi_{t+j} = \phi^j \pi_t - \phi^{j-1} r_t^n$$

We now can express

$$\delta(1 - \beta\phi) \sum_{j=0}^{\infty} \beta^j E_t \pi_{t+j} = \delta(\pi_t - \beta r_t^n) \tag{A.32}$$

Use this solution in (A.31) to solve for equilibrium inflation

$$\begin{aligned} \pi_t &= \frac{1}{\delta} \tilde{b}_{t-1} - \frac{1}{\delta} (\tilde{T}_t^e - \tilde{F}_t^e) + \frac{\beta}{\sigma + \omega^{-1}} (\tilde{F}_t^o + \tilde{F}_t^e) \\ &= \underbrace{\frac{\beta}{\sigma + \omega^{-1}} (\tilde{F}_t^o + \tilde{F}_t^e)}_{\text{Keynesian hydraulics}} + \underbrace{\frac{\beta}{\delta} (\tilde{F}_t^e - \tilde{T}_t^e) + \frac{1}{\delta} \tilde{b}_{t-1}}_{\text{wealth effects}} \end{aligned} \tag{A.33}$$

where we used (A.30) to replace the natural rate of interest with the sum of ordinary and emergency purchases.

Turning to debt dynamics, use (A.28) in (A.27) to obtain this form of the budget identity

$$\tilde{b}_t = \beta^{-1} \tilde{b}_{t-1} - \beta^{-1} (\tilde{T}_t^e - \tilde{F}_t^e) - \delta(\beta^{-1} - \phi) \pi_t$$

and substitute for equilibrium inflation from (A.33) to yield

$$\begin{aligned}\tilde{b}_t &= \phi\tilde{b}_{t-1} - \phi(\tilde{T}_t^e - \tilde{F}_t^e) - \left(\frac{1-\beta\phi}{\delta(\sigma+\omega^{-1})}\right)(\tilde{F}_t^o + \tilde{F}_t^e) \\ &= \underbrace{-\frac{\delta(1-\beta\phi)}{\sigma+\omega^{-1}}(\tilde{F}_t^o + \tilde{F}_t^e)}_{\text{Keynesian hydraulics}} + \underbrace{\beta\phi(\tilde{F}_t^e - \tilde{T}_t^e) + \phi\tilde{b}_{t-1}}_{\text{wealth effects}} \end{aligned} \tag{A.34}$$

establishing Result 5. The multiplier effects for different fiscal variables follow immediately.

To establish Result 6 note that

$$\begin{aligned}\frac{\partial\pi_t}{\partial F_t^o} &= \frac{\beta}{\sigma+\omega^{-1}} \\ \frac{\partial\pi_{t+j}}{\partial F_t^o} &= -\frac{1-\beta\phi}{\sigma+\omega^{-1}}\phi^{j-1}\end{aligned}$$

where the second condition holds for $j > 0$. The price effect of emergency spending is then given by summing the inflation changes

$$\begin{aligned}\sum_{j=0}^{\infty}\frac{\partial\pi_{t+j}}{\partial F_t^e} &= \sum_{j=0}^{\infty}\left(\frac{\partial\pi_{t+j}}{\partial F_t^o} - \frac{\partial\pi_{t+j}}{\partial T_t^e}\right) \\ &= \frac{\beta}{\sigma+\omega^{-1}} - \frac{1-\beta\phi}{\sigma+\omega^{-1}}\sum_{j=1}^{\infty}\phi^{j-1} + \frac{\beta}{\delta}\sum_{j=0}^{\infty}\phi^j \\ &= \frac{\beta}{\sigma+\omega^{-1}} - \frac{1-\beta\phi}{\sigma+\omega^{-1}}\frac{1}{1-\phi} + \frac{\beta}{\delta}\frac{1}{1-\phi}.\end{aligned}$$

It is straightforward to show that for the final expression to be positive requires satisfaction of the stated condition in Result 6.

B Data Details

B.1 Emergency Expenditures

Table B.1 shows the three main categories of emergency expenditures: public works, relief, and other spending.

The first category, public works, doubled under Roosevelt from record highs under Hoover. These expenditures consisted of public highways, Hoover dam, reclamation projects, improvements of rivers and harbors, flood control, and the Tennessee Valley Authority.

Relief spending—the second category of emergency expenditures—comprised the largest category in most years and was a mixture of direct relief and works projects. The Federal Emergency Relief Administration (FERA) was established in May 1933 and totaled $3.1 billion from 1934 to 1936, replacing many of the relief efforts of Hoover's January 1932

Reconstruction Finance Corporation (RFC).[1,2,3,4]

"Other emergency spending"—the third category—includes grants to the Agricultural Adjustment Administration for farm subsidies aimed at raising agricultural prices, RFC loans, and other farm and housing assistance including the Home Owners' Loan Corporation created in June 1933 to assume mortgage debt of distressed homeowners amounting to $3.1 billion [Studenski and Krooss (1952, p. 417)].

Finally, table B.1 shows that regular operating expenditures were lower under Roosevelt than Hoover in all years except 1936 when the veterans' bonus was paid out [Hausman (2016)]. Although there were cuts to regular operating expenditures, the shifting of existing RFC and public works expenditures to the emergency category starting in 1934 largely account for the lower level [Annual Report of the Secretary of the Treasury (1934, p. 5)].[5]

	Hoover				Roosevelt			
	1930	**1931**	**1932**	**1933**	**1934**	**1935**	**1936**	**1937**
Regular Operating	2927.5	3028.4	3231.3	2879.4	2348.7	2676.9	4743.2	3746.0
Social Security	0	0	0	0	0	0	28.4	447.7
Total Emergency	414.4	642.5	1509.7	1801.9	4396.5	4125.4	3704.6	3802
Public Works	256.5	404.1	478.7	458.7	613.1	762.7	912.5	1079.4
Relief	0	0	0	359.5	1852.8	2360.9	2342.4	2466.8
Other	157.9	238.4	1031.0	983.7	1930.6	1001.8	449.7	255.8
Total Expenditures	3341.9	3670.9	4741.0	4681.3	6745.2	6802.3	8476.3	7995.7

Table B.1: Federal expenditures by category for fiscal years, millions of dollars. Total expenditures exclude debt and railroad retirements. Emergency expenditures in this table contain some regular expenditures resulting in totals that are 10 to 30 percent higher than the official emergency expenditures listed in table 1. The "other emergency expenditures" category includes net loans, subscriptions to stock and surplus, and the agricultural adjustment program. Source: Annual Report of the Secretary of the Treasury (p. 354, 1937). A fiscal year starts July 1 of the preceding year and ends June 30 of the stated year. For example, the 1933 fiscal year is July 1, 1932 to June 30, 1933

[1]While the RFC lent primarily to states, public entities, and distressed financial institutions, the FERA made direct grants to states who used the proceeds for relief programs including sanitation improvements, repair or construction of public buildings, national park improvements, and financial assistance to troubled farmers [Studenski and Krooss (1952, pp. 374, 411) and Fishback, Kantor, and Wallis (2003)].

[2]In contrast to FERA, the Civil Works Administration (CWA) operated directly under the federal government and focused on works projects such as sewer pipes, roads, schools, playgrounds, and airports as well providing work to teachers, writers, and artists [https://slate.com]. From 1934 to 1935, the CWA had $1 billion in federal relief expenditures and employed 4 million workers.

[3]The Works Progress Administration (WPA) also focused on work relief by spending $8.1 billion between 1936 and 1940 and employing 2.2 million workers per year on average for projects that included highways, reforestation, and rural rehabilitation [Studenski and Krooss (1952, p. 412)].

[4]The Civilian Conservation Corps (CCC) spent $2.5 billion to employ 3 million from 1933 to 1942 on natural resources conservation [Annual Report of the Secretary of the Treasury (1940, p. 27)].

[5]Even though the Economy Act of 1933 cut $243 million of regular operating expenditures by reducing the pay of federal workers by 15 percent and decreasing veterans' benefits by 10 percent, Congress eventually restored most of the pay cuts which unwound the budgetary savings [Studenski and Krooss (1952, p. 404)].

B.2 Net Interest

B.2.1 Interest Receipts This section details our sources and calculation of monthly net interest. Interest receipts are only available on a yearly basis in the *Annual Report of the Secretary of the Treasury on the State of the Finances*. From 1928 to 1940, we use the total of series called "Interest, exchange, and dividends on capital stock" or "Total interest, exchange, dividends" computed from the unrevised daily Treasury statements.[6] Disaggregated components of this series are available in tables based on warrants issued or revised daily Treasury statements.[7]

In 1927, interest receipts are only available based on warrants issued. Although the aggregate total of "Interest, premium, and discount" is no longer provided, the disaggregated elements of this total are included. We continue to include dividends, premiums, discounts, and exchanges to be consistent with the years when only the aggregate series is available.

[6] From 1928 to 1933, we use total interest receipts which is the sum of general and special funds categories.

[7] On Page 389 of the 1928 Annual Report, daily Treasury statements (unrevised) are defined as figures compiled "from the latest daily reports received by the Treasurer of the United States, from Treasury officers, and public depositaries holding Government funds. The daily Treasury statement, therefore, is a current report compiled from latest available information, and, by reason of the promptness with which the information is obtained and made public, it has come into general use as reflecting the financial operations of the Government covering a given period, and gives an accurate idea of the actual condition of the Treasury as far as it is ascertainable from day to day. This is known as 'current cash basis,' according to daily Treasury statements (unrevised)." Revised Treasury statements reflect actual transactions during the period under review. Page 373 of the 1929 annual report explains that receipts and expenditures are revised "on account of the distance of some of the Treasury offices and depositaries from the Treasury, it is obvious that the report from all officers covering a particular day's transactions cannot be received and assembled in the Treasury at one time without delaying for several days the publication of the Treasury statement." Warrants issued (receipts) are defined based on Section 305 of the Revised Statues as, "receipts for all moneys received by the Treasurer of the United States shall be indorsed upon warrants signed by the Secretary of the Treasury, without which warrants, so signed, no acknowledgment for money received into the Public Treasury shall be valid. The issuance of warrants by the Secretary of the Treasury, as provided by law, represents the formal covering of receipts into the Treasury." Warrants issued (expenditures) are defined by the fact that, "The Constitution of the United States provides that no money shall be drawn from the Treasury but in consequence of appropriations made by law. Section 305 of the Revised Statutes requires that the Treasurer of the United States shall disburse the moneys of the United States upon warrants drawn by the Secretary of the Treasury. As the warrants are issued by the Secretary they are charged against the appropriate appropriations provided by law. Some of these warrants do not represent actual payments to claimants, but are merely advances of funds to be placed to the credit of disbursing officers of the Government with the Treasurer of the United States for the payment of Government obligations. The disbursing officer then issues his check on the Treasurer in payment of such obligations. As far as the appropriation accounts are concerned, the warrants issued and charged thereto constitute expenditures, but it will be observed that such expenditures necessarily include unexpended balances to the credit of the disbursing officers. Under normal conditions these balances over a period of several years fluctuate very little in the aggregate, and the difference between the total expenditures on a warrant basis and a cash basis (revised) is immaterial.

TABLE 1.—*Receipts and expenditures for the fiscal year 1929, classified according to funds*

[On basis of daily Treasury statements (revised), see p. 373]

	General funds	Special funds (various acts)[1]	Trust funds (various acts)[1]	District of Columbia (act June 29, 1922)[1]	Total
ORDINARY RECEIPTS					
Revenue receipts:					
Customs	$602,813,939.84	$6,216.58			$602,820,156.42
Internal revenue	2,939,629,903.78	414,582.31			2,940,044,486.09
Miscellaneous taxes	6,217,857.20	2,842,745.01			9,060,602.21
Interest, exchange, and dividends on capital stock	32,783,750.49	137,786,535.06			170,570,285.55

(a) 1929, page 374

TABLE 1.—*Receipts and expenditures for the fiscal year 1928, classified according to funds*

[On basis of daily Treasury statements (revised), see p. 389]

	General funds	Special funds (various acts)[1]	Trust funds (various acts)[1]	District of Columbia (act June 29, 1922)[2]	Total
Ordinary receipts:					
Revenue receipts—					
Customs	$568,154,301.86	$2,291.06			$568,156,592.92
Internal revenue	2,791,799,268.52	393,843.15			2,792,193,111.67
Interest, premium, and discount	[3] 43,706,736.12	136,388,871.69			[3] 180,095,607.81

[1] Exclusive of District of Columbia special and trust funds.
[2] Includes District of Columbia special and trust funds.
[3] Includes $11,212,165.68 receipts credited direct to appropriations.

(b) 1928, page 391

Figure B.1: Annual Reports

TABLE 4.—*Comparison of detailed receipts for the fiscal years 1927 and 1926*

[On basis of warrants issued, see p. 421]

	1927	1926	Increase, 1927	Decrease, 1927
Ordinary receipts:				
Customs—				
Duties	$603,426,552.67	$577,891,561.18	$25,534,991.49	
Tonnage tax	2,245,912.51	1,825,049.44	420,863.07	
	605,672,465.18	579,716,610.62	25,955,854.56	
Internal revenue—				
Income tax	2,219,952,443.72	1,974,104,141.33	245,848,302.39	
Miscellaneous internal revenue taxes	648,230,548.89	862,252,303.79		$214,021,754.90
Collections under enforcement of national prohibition act	[1] 501,891.11	[2] 415,336.63	86,554.48	
	2,868,684,883.72	2,836,771,781.75	245,934,856.87	214,021,754.90
Public lands (included in public domain receipts below).				
Miscellaneous—				
Interest, premium, and discount—				
Interest on bonds of foreign governments under funding agreements	139,826,159.14	139,804,662.99	21,496.15	
Interest on unfunded obligations of foreign governments	20,563,440.76	19,556,925.99	1,006,514.77	
Interest on miscellaneous obligations	1,092,143.04	989,520.80	102,622.24	
Interest on overpayments under section 209, transportation act, 1920, as amended	5,244.48	17,811.46		12,566.98
Interest on farm loan bonds	670,060.92	3,648,139.22		2,978,078.30
Interest on public deposits	4,707,706.25	4,530,081.48	177,624.77	
Interest on advance payments to contractors	44,551.39	194,161.69		149,610.30
Dividends on capital stock of the Panama Railroad owned by the United States	350,000.00	350,000.00		
Final dividend of the U. S. Sugar Equalization Board	[3]			
Gain by exchange	1,707,203.70	24,418.98	1,682,784.72	

[3] On July 15, 1926, the unexpended balance to the credit of the checking account of the United States Sugar Equalization Board on the books of the Treasurer of the United States amounting to $11,370,621.39 was transferred to the warrant account, $5,000,000 of which was covered into the Treasury to the credit of the appropriation as a repayment of capital stock originally advanced therefrom; the remainder, $6,370,621.39, was covered into the Treasury as "Miscellaneous Receipts—final dividends of United States Sugar Equalization Board." Since this transfer of funds from one account to another is merely an adjustment between accounts in this fiscal year of cash transactions occurring in prior fiscal years, the items have not been included in the receipts or expenditures as they did not affect the cash in the Treasury during the current fiscal year.

Figure B.2: 1927 Annual Report, page 431

Starting in 1922, interest receipts, premiums, discounts, and exchanges are no longer given as separate categories. The components of federal receipts are listed alphabetically.[8]

Comparison of receipts, fiscal years 1922 and 1921, on the basis of warrants issued (net).

	1922	1921	Increase, 1922.	Decrease, 1922.
Customs	$357,544,712.40	$308,025,102.17	$49,519,610.23	
Internal revenue:				
Income and profits taxes	2,086,918,464.85	3,228,137,673.75		$1,141,219,208.90
Miscellaneous	1,121,239,843.45	1,351,835,935.31		230,596,091.86
Sales of public lands	895,391.22	1,530,439.42		635,048.20
Alaska fund	136,053.10	174,329.90		38,276.80
Assessments on Federal reserve banks for salaries, etc.	3,067,169.36	4,819,339.72		1,752,170.36
Assessments on national banks for expenses of examiners	2,012,600.00	1,583,037.11	429,562.89	
Consular fees	6,707,058.72	5,676,850.61	1,030,208.11	
Customs fees, fines, penalties, services of officers, etc.	1,032,589.34	1,173,285.63		140,696.29
Commerce collections	239,432.57	305,904.84		66,472.27
Donation of royalty on machine guns		520,266.12		520,266.12
Depredations on public lands	60,149.90	68,646.25		8,496.35
Deposits for surveying public lands	68,461.03	62,324.51	6,136.52	
District of Columbia general receipts	14,777,218.19	14,439,983.93	337,232.26	
District of Columbia sources	457,798.25	561,106.29		103,308.04
Discount on bonds, notes, and certificates purchased	3,436,145.91	10,675,194.55		7,239,048.64
Earnings on radio service	369,735.67	666,371.84		296,636.17
Federal land banks, liquidation of capital stock	1,057,830.00	954,535.00	102,995.00	
Food Administration		37,078,988.55		37,078,988.55
Forest Service, cooperative fund	1,394,826.71	1,946,041.18		551,214.47
Fees on letters patent	2,875,013.15	2,606,502.46	175,510.69	
Forest reserve fund	5,125,668.20	2,591,297.93	2,534,370.27	
Franchise tax (surplus earnings of Federal reserve banks)	59,974,465.64	60,724,742.27		750,276.63
Funds contributed for river and harbor improvements	2,930,051.68	3,774,947.68		844,896.00
Gain by exchange	7,245,624.49	19,008.08	7,226,616.41	
Grain Corporation, decrease of capital stock	25,000,000.00	100,000,000.00		75,000,000.00
Housing Corporation, operations and disposal of properties	4,523,207.53	4,240,055.17	283,152.36	
Farm loan bonds:				
Principal	44,400,000.00		44,400,000.00	
Interest	8,611,170.08	8,306,075.00	305,095.08	
Foreign loans:				
Principal	49,114,107.46	83,678,223.38		34,564,115.92
Interest	6,607,723.54	18,327,306.91		11,719,583.37
Interest on foreign obligations, sale of surplus property, War Department	21,107,317.25	12,701,508.93	8,405,808.32	
Interest on public deposits	7,388,278.07	5,668,852.42	1,719,425.65	
Interest on loans to railroad companies	[1] 3,000.00	[2] 84,000.00		81,000.00
Interest on advance payments to contractors	14,300.29	667,383.05		653,082.76
Immigrant fund	2,517,823.19	5,767,893.69		3,250,070.50
Judicial fees, fines, penalties, etc.	5,132,937.71	4,382,676.51	750,261.20	
Land fees	1,139,880.25	1,753,759.83		613,879.58

[1] Exclusive of $12,906,960.89 interest received on account of loans to railroads under section 210 of the transportation act of 1920, and $27,324,181.14 interest collected under the provisions of the Federal control act of Mar. 21, 1918, which amounts were credited, respectively, to the revolving funds, "Loans to railroads" and "Federal control of transportation systems."

[2] Exclusive of $4,369,607.49 interest received on account of loans to railroads under sec. 210 of the transportation act of 1920, and $26,415,163.88 interest collected under the provisions of the Federal control act of Mar. 21, 1918, which amounts were credited, respectively, to the revolving funds, "Loans to railroads" and "Federal control of transportation systems."

Figure B.3: 1922 Annual Report, page 107

Interest receipts on foreign obligations—a subset of total interest receipts—are available on an unrevised cash basis. This data is also available at a monthly frequency for fiscal years 1929 to 1931 and 1936 to 1940. The location of these data is included in Table B.2.

[8]Net warrants issued includes unexpended balances to the credit of disbursing officers at the end of the year, but not expenditures under such unexpended balances at the beginning of the year.

Table name	Year	Basis	Page no.
Comparison of receipts, fiscal years 1920 and 1919	1920	warrant	262/263
Comparison of receipts, fiscal years 1921 and 1920	1921	warrant	140
Receipts and exp. for fiscal years 1920 and 1921 (int. on foreign obl.)		unrevised	152
Comparison of receipts, fiscal years 1922 and 1921	1922	warrant	107
Receipts and exp. for fiscal years 1921 and 1922 (int. on foreign obl.)		unrevised	100
Comparison of receipts, fiscal years 1923 and 1922	1923	warrant	114
Receipts and exp. for fiscal years 1922 and 1923 (int. on foreign obl.)		unrevised	107
Comparison of receipts, fiscal years 1924 and 1923	1924	warrant	131
Receipts and exp. for fiscal years 1923 and 1924 (int. on foreign obl.)		unrevised	123
Comparison of receipts, fiscal years 1925 and 1924	1925	warrant	150
Receipts and exp. for fiscal years 1924 and 1925 (int. on foreign obl.)		unrevised	141
Comparison of receipts, fiscal years 1926 and 1925	1926	warrant	429
Receipts and exp. for fiscal years 1925 and 1926 (int. on foreign obl.)		unrevised	176
Comparison of receipts, fiscal years 1927 and 1926	1927	warrant	431
Receipts and exp. for fiscal years 1926 and 1927 (int. on foreign obl.)		unrevised	30
Receipts and expenditures for the fiscal year 1928	1928	revised	391
Receipts and exp. for the fiscal year 1928 (int. on foreign obligations)		unrevised	19
Receipts and expenditures for the fiscal year 1929	1929	revised	375
Receipts and exp. for the fiscal year 1929 (int. on foreign obligations)		unrevised	20
Ordinary Receipts (monthly) (foreign obligations)		unrevised	535
Receipts and exp. for the fiscal year 1930	1930	revised	469
Receipts and exp. for the fiscal year 1930 (int. on foreign obligations)		unrevised	35
Ordinary Receipts (monthly) (foreign obligations)		unrevised	631
Receipts and exp. for the fiscal year 1931	1931	warrant	426
Receipts and exp. for the fiscal year 1931 (int. on foreign obligations)		unrevised	25
Receipts and exp., by months (foreign obligations)		unrevised	575
Receipts and expenditures for the fiscal year 1932	1932	warrant	341
Receipts and exp. for the fiscal year 1932 (int. on foreign obligations)		unrevised	27
Details of receipts by sources and funds, for the fiscal year 1933	1933	warrant	310
Receipts and exp. for the fiscal year 1933 (int. on foreign obligations)		unrevised	19
Details of receipts by sources and funds, for the fiscal year 1934	1934	warrant	276
Receipts and exp. for the fiscal year 1934 (int. on foreign obligations)		unrevised	20
Details of receipts by sources and funds, for the fiscal year 1935	1935	warrant	296
Receipts and exp. for the fiscal year 1935 (int. on foreign obligations)		unrevised	32
Details of receipts by sources and funds, for the fiscal year 1936	1936	warrant	314
Receipts and exp. for the fiscal year 1935 (int. on foreign obligations)		unrevised	35
Classified receipts and expenditures, monthly		unrevised	339/344
Actual receipts for the fiscal year 1937	1937	warrant	380
Classified receipts and expenditures for the fiscal years 1932 to 1937		unrevised	338
Classified receipts and exp., monthly (int. on foreign obligations)		unrevised	320/326
Actual receipts for the fiscal year 1937	1938	warrant	457
Classified receipts and expenditures for the fiscal years 1932 to 1938		unrevised	401
Classified receipts and exp., monthly (int. on foreign obligations)		unrevised	379/387
Details of receipts, by sources and accounts	1939	warrant	314
Classified receipts and exp., monthly (int. foreign obligations)		unrevised	337/345
Details of receipts, by sources and accounts.	1940	warrant	587
Classified receipts and exp., monthly (int. foreign obligations)		unrevised	612/619

Table B.2: Table names and page numbers from the *Annual Reports of the Secretary of the Treasury* for interest receipts

B.2.2 Interest Expenditures Interest expenditures are available on a monthly basis starting in January 1922. For July 1919 to December 1921, interest expenditures are available on a quarterly frequency. We divide the quarterly data by three to interpolate monthly data for this time period.

Table name	Year	Page number
Preliminary Statement Showing Classified Expenditures (quarterly)...	1920	see 1921 357
Receipts and expenditures of the Government for fiscal (yearly)...		see 1926 448
Preliminary Statement Showing Classified Expenditures (quarterly)...	1921	357
Receipts and expenditures of the Government for fiscal (yearly)...		see 1926 448
Preliminary Statement Showing Classified Expenditures (monthly)...	1922	103
Receipts and expenditures of the Government for fiscal (yearly)...		see 1926 448
Preliminary Statement Showing Classified Expenditures (monthly)...	1923	110
Receipts and expenditures for fiscal years 1922 and 1923 (yearly)		107
Preliminary Statement Showing Classified Expenditures (monthly)...	1924	127
Receipts and expenditures for fiscal years 1923 and 1924 (yearly)		123
Preliminary Statement Showing Classified Expenditures (monthly)...	1925	145
Receipts and expenditures for fiscal years 1924 and 1925 (yearly)		142
Expenditures of the Government, by months for the fiscal year 1926	1926	452
Receipts and expenditures of the Government for fiscal years (yearly)		450
Expenditures by months, classified according to...	1927	463
Ordinary receipts, expenditures chargeable against... (yearly)		448
Expenditures by months, classified according to...	1928	425
Receipts and expenditures for the fiscal year 1928		19
Expenditures by months, classified according to...	1929	414
Receipts and expenditures for the fiscal year 1929 (yearly)		20
Expenditures by months, classified according to...	1930	510
Receipts and expenditures for the fiscal year 1930 (yearly)		35
Expenditures by months, classified according to...	1931	464
Ordinary receipts, expenditures chargeable against... (yearly)		446
Expenditures by months, classified according to...	1932	371
Receipts and expenditures for the fiscal year 1932 (yearly)		27
Expenditures by months, classified according to...	1933	313
Receipts and expenditures for the fiscal year 1933 (yearly)		280
Expenditures by months, classified according to...	1934	308
Receipts and expenditures for the fiscal year... (yearly)		305
Expenditures by months, classified according to...	1935	330
Expenditures by months, classified according to (yearly)...		334
Classified receipts and expenditures, monthly	1936	337
Classified receipts and expenditures, monthly (yearly)		339
Classified receipts and expenditures, monthly	1937	322/328
Classified receipts and expenditures, monthly (yearly)		328
Classified receipts and expenditures, monthly	1938	381/389
Classified receipts and expenditures, monthly (yearly)		389
Classified receipts and expenditures, monthly	1939	339/347
Classified receipts and expenditures, monthly (yearly)		347
Classified receipts and expenditures, monthly	1940	614/621
Classified receipts and expenditures, monthly (yearly)		621

Table B.3: Table names and page numbers from the *Annual Reports of the Secretary of the Treasury* for interest expenditures on an unrevised basis.

B.2.3 Calculating Monthly Net Interest

Because interest receipts are only available at a yearly frequency, our monthly series of net interest is imputed. We first calculate the ratio of yearly interest receipts to yearly interest expenditures and then multiply this ratio by monthly interest expenditures to impute monthly interest receipts for month t,

$$\text{Imputed Monthly Interest Receipts}_t = \frac{\text{Yearly Interest Receipts}}{\text{Yearly Interest Expenditures}} \times \text{Monthly Interest Expenditures}_t$$

Monthly net interest is then calculated as

$$\text{Imputed Monthly Net Interest}_t = \text{Monthly Interest Expenditures}_t - \text{Imputed Monthly Interest Receipts}_t$$

B.3 Federal Receipts and Expenditures

This section documents the differences between monthly federal receipts and expenditures used in other sources and those we construct from the *Annual Reports of the Secretary of the Treasury on the State of Finances*. The other sources are the chapter 15 of the NBER Macro History Database (NBER), Firestone's (1960) book, and Romer (1992) who uses the 1979 *Statistical Appendix to the Annual Report*, table 2, pp. 4-11. Additionally, aggregating our monthly series to a yearly frequency does not always match corresponding yearly series given elsewhere in the annual reports and we document these differences.

Figure B.4 shows our series of receipts and expenditures from July 1919 to June 1940 aggregated by fiscal year—July 1 of the previous year through June 30 of the current year.[9] Although these series are given on an unrevised cash basis, the expenditure series are revised in the 1933 annual report to "cover all expenditures of the Reconstruction Finance Corporation, including payments against credits established for the corporation through the purchase of its notes under section 9 of the Reconstruction Finance Corporation Act."[10]

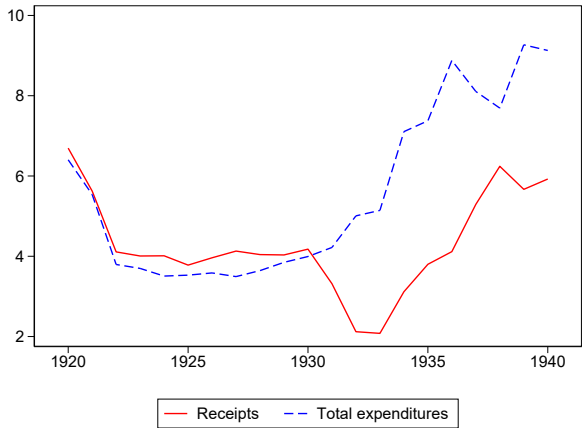


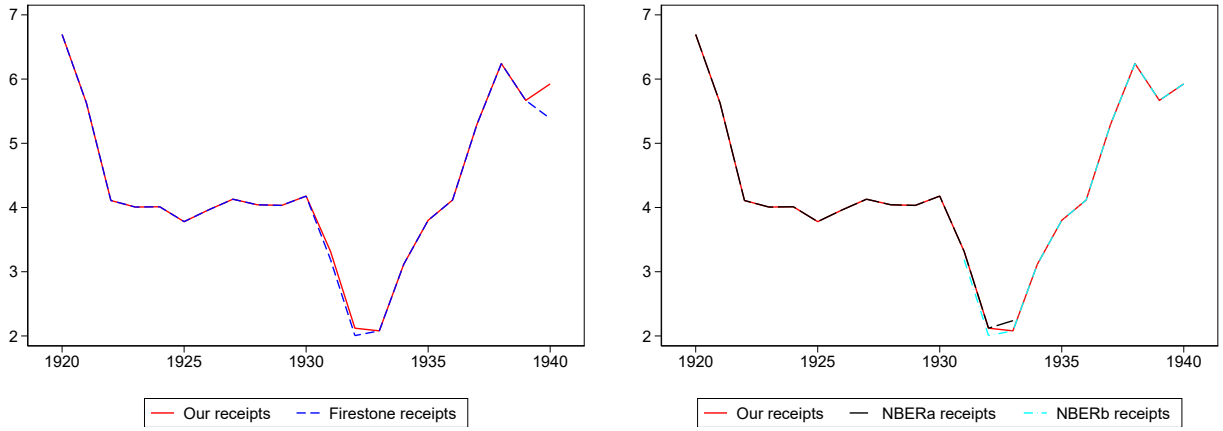
Figure B.4: Federal receipts and total expenditures aggregated by fiscal year, billions of dollars. Source: Department of the Treasury (various). See table B.4 for details.

[9] For example, the 1933 fiscal year is July 1, 1932 to June 30, 1933.

[10] See footnote 7 of this appendix for an explanation of accounting conventions. See footnote 1, Table 6, page 312 of *Annual Report of the Secretary of the Treasury on the State of the Finances for Fiscal year ended June 30, 1933* for the Reconstruction Finance Corporation revisions.

B.3.1 Federal Receipts Differences across and within sources of federal receipts are generally quite small.

Figure B.5 shows the receipts series across sources. Panel B.5a shows that receipts from Firestone (1960) match our series except for fiscal years 1931, 1932, and 1940.[11] Receipts from the NBER is split into three series a, b, and c. Panel B.5b shows that the NBERa series matches our series up to fiscal year 1932. The NBERb series matches that of Firestone (1960) for fiscal years 1931 and 1932 and then tracks our series through fiscal year 1940.[12]



(a) Comparing receipts to Firestone (1960) (b) Comparing receipts to the NBER

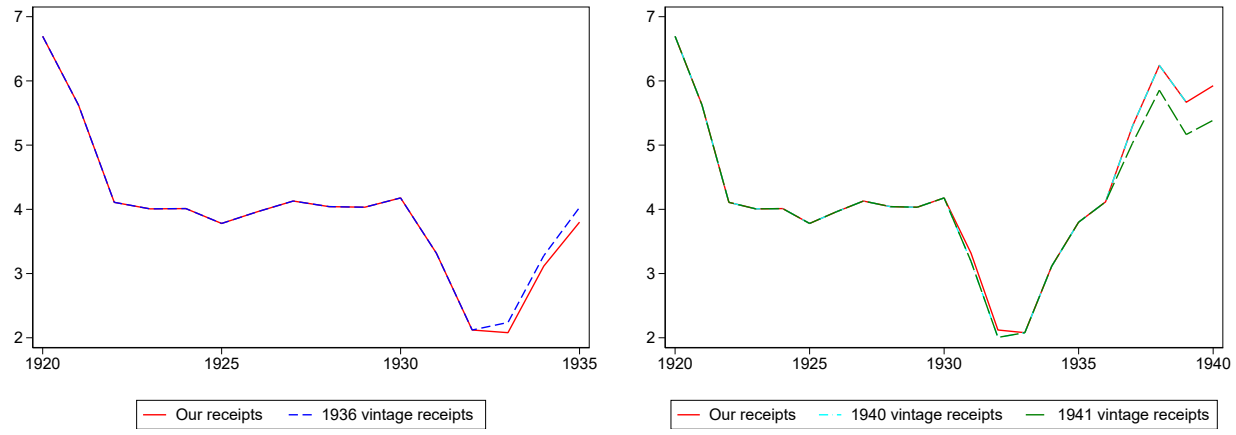
Figure B.5: Federal receipts aggregated by fiscal year, billions of dollars. Source: Department of the Treasury (various). See table B.4 for details; Firestone (1960); NBER Macrohistory database (m15004a, m15004b).

Within the annual reports, yearly totals of monthly receipts do not always match the yearly totals given in other tables, as shown in figure B.6. Although the yearly data is often revised, the monthly is not. Panel B.5a shows that yearly receipts are revised in the 1936 annual report which results in our series of aggregated monthly receipts being slightly lower from 1933 onward. Yearly receipts are revised in the 1940 and 1941 annual reports as shown in panel B.6b. The 1940 vintage of receipts was mostly revised downwards for fiscal years 1931 through 1935 and then matches our series from fiscal years 1933 through 1939. In the 1941 vintage, annual receipts were revised downwards for fiscal years 1937 through 1940.[13]

[11] Firestone (1960, p. 80) explains that trust fund receipts were eliminated from internal revenue after June 1932 and his series take into an account this revision back to July 1930. Firestone (1960, p. 82) also deducts net transfers from the Federal Old-Age and Survivors Insurance Trust Fund resulting in lower monthly receipts for fiscal year 1940.

[12] Like the series from Firestone (1960), the NBERb series also takes into account the elimination of trust fund receipts. The NBERc series (not shown) also deducts net transfers from the Federal Old-Age and Survivors Insurance Fund and thus tracks Firestone (1960) for fiscal year 1940.

[13] Footnote 14 on Page 649 of the 1940 Annual Report explains that: "In the fiscal year 1941 amounts representing appropriations equal to 'Social Security-Unemployment taxes' collected and deposited as provided under sec. 201 (a) of the Social Security Act Amendments of 1939, less reimbursements to the General Fund for administrative expenses, are deducted on the daily Treasury statement from total receipts. Such net amounts are reflected under trust account receipts as net appropriations to the Federal old-age and survivors insurance trust fund. The fiscal years 1937, 1938, and 1939, have been revised in this statement to reflect similar treatment. Fiscal year 1940 figures are also on this revised basis."



(a) Receipts, 1936 vintage

(b) Receipts, 1940 and 1941 vintages

Figure B.6: Federal receipts aggregated by fiscal year, billions of dollars. Source: Department of the Treasury (various). See table B.4 for details.

B.3.2 Federal Expenditures Relative to federal receipts, federal expenditures are much more likely to vary across and within sources and are subject to larger revisions.

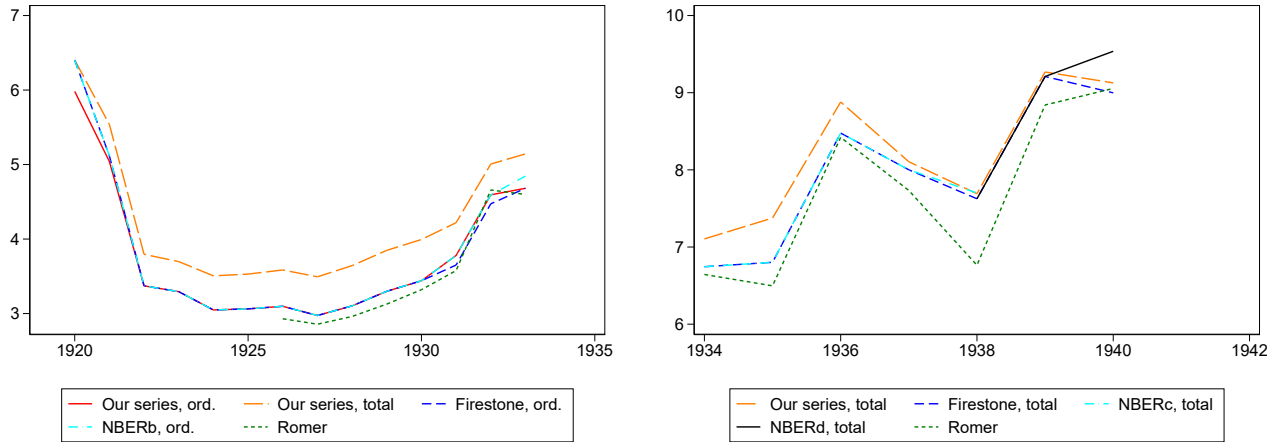
Figure B.7 shows a comparison of federal expenditures across sources. We use total expenditures in all analysis while other sources instead use ordinary expenditures until 1934 and total expenditures thereafter. Ordinary expenditures are a subset of total expenditures and exclude both public debt retirements for the period shown and purchase obligations of foreign governments for fiscal years 1920 to 1926. Panel B.7a shows that ordinary expenditures are, on average, roughly 13 percent lower than total expenditures until fiscal year 1934. Furthermore, panel B.7a shows that our series of ordinary expenditures closely tracks those of Firestone (1960) and the NBER.[14] Romer's (1992) series is actually ordinary outlays which are slightly different from expenditures and accounts for the series being almost always lower than our series and the others.[15]

Starting in fiscal year 1934, total expenditures are divided into general and emergency categories in the *Annual Report of the Secretary of the Treasury* so that Roosevelt could point to a balanced ordinary budget.[16] The sum of general and emergency expenditures

[14]The expenditure series from Firestone (1960) matches our series of ordinary expenditures from fiscal year 1922 through 1930. Firestone (1960, p. 82) explains that starting in fiscal year 1931, trust fund transactions were eliminated from ordinary expenditures chargeable against ordinary receipts. Trust fund expenditures were, however, still included in ordinary receipts through 1933. Firestone's (1960) data for January 1932 to June 1933 matches that of NBERc (not shown in panel B.7a) and our series of ordinary expenditures matches NBERb up to fiscal year 1933.

[15]Starting in the 1968 annual report (p. 8), the Treasury introduced the new unified budget concepts of outlays which is both expenditures and loans.

[16]The *Annual Report of the Secretary of the Treasury on the State of the Finances for Fiscal year ended June 30, 1934* (P. 316, Table 6, footnote 6) explains that "Emergency expenditures prior to the fiscal year 1934 (except Reconstruction Finance Corporation) are included in general expenditures, the classification of which emergency expenditures is not available for comparison with emergency expenditures for the fiscal year 1934. Therefore, neither the totals of general expenditures nor the totals of emergency fiscal expenditures for the fiscal year 1934 are comparable with the total of prior fiscal years."



(a) Total and ordinary expenditures, 1920-1933

(b) Total expenditures, 1934-1940

Figure B.7: Federal expenditures aggregated by fiscal year, billions of dollars. Source: Department of the Treasury (various). See table B.4 for details; Firestone (1960); NBER Macrohistory database (m15004b, m15004c, m15004d); Romer (1992).

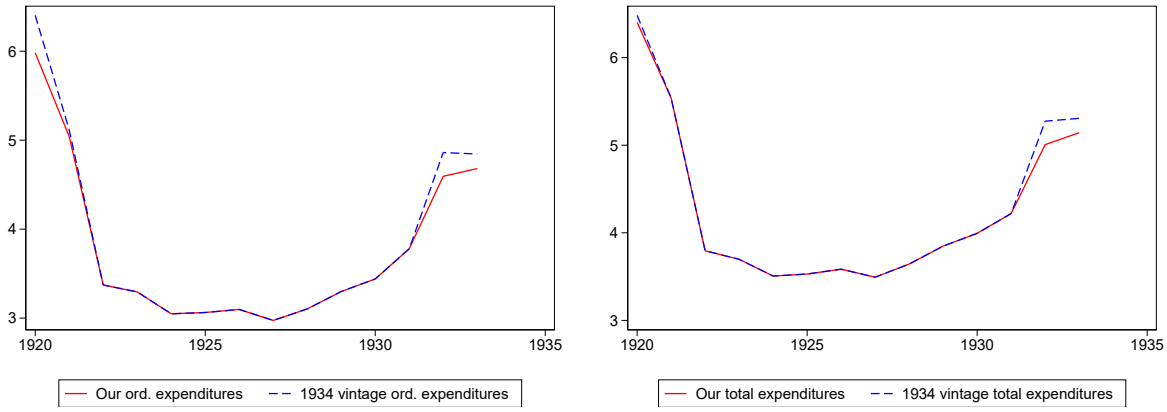
is total expenditures. Our series of total expenditures is larger than the series from either Firestone (1960) or NBERc from 1934 through 1938. Although the gap shrinks from 1938 through 1940, our series is slightly higher than all of the others shown in panel B.7b. Romer's (1992) series of total outlays is below all series for most years.[17]

As with the receipts series, our series of total and ordinary expenditures aggregated by fiscal year do not always match yearly data given elsewhere in the annual reports. Our expenditures series shown in figure B.8 match the yearly series from fiscal years 1922 to 1931, but are revised upwards in the 1934 annual report for 1932-1933.[18]

From 1934 to 1939, yearly tables continue to categorize expenditures into ordinary and total even though the monthly series do not maintain this distinction and are instead split into general and emergency categories. As a result, ordinary expenditures stop in 1934 where we switch to general expenditures for the remainder of the period shown in figure B.9. Panels B.9a-B.9b show that the 1936 and 1937 vintages are both revised up relative to our series. Panels B.9c-B.9d show that expenditures are also revised in the 1938, 1939, and 1941 vintages.

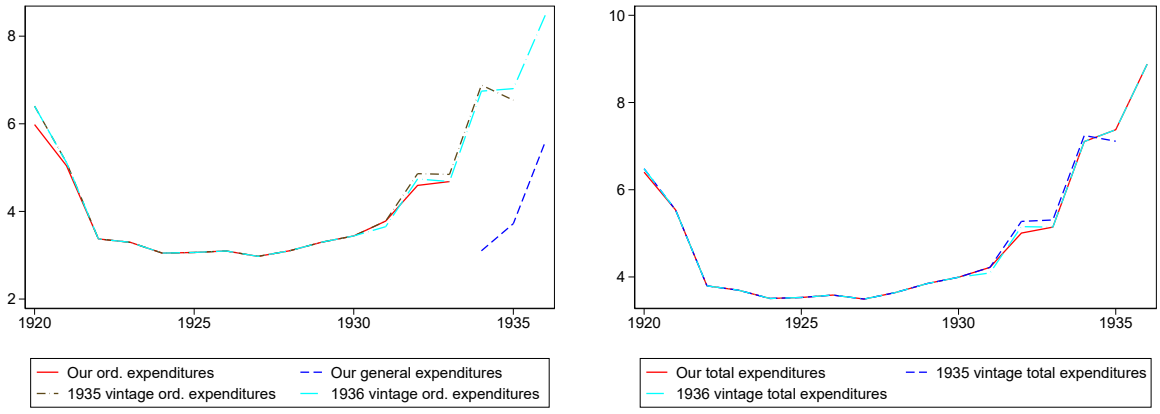
[17]The total expenditure series from Firestone (1960) matches that of NBERc from fiscal year 1934 through fiscal year 1937. From fiscal year 1937 through 1939, Firestone's (1960) series matches that of NBERd. Firestone (1960, p. 84) explains that under an act of February 1938, the Secretary of the Treasury canceled $2.7 billion of obligations purchased from the Reconstruction Finance Corporation which they could not repay. As a consequence, expenditures show only amounts spent from funds allocated by the Reconstruction Finance Corporation for purposes for which no provisions for repayment to the Treasury were made. The series from Firestone (1960) matches that of NBERe (not shown in panel B.7b) for fiscal year 1940.

[18]These revisions differ from those of the 1933 expenditures of the Reconstruction Finance Corporation.

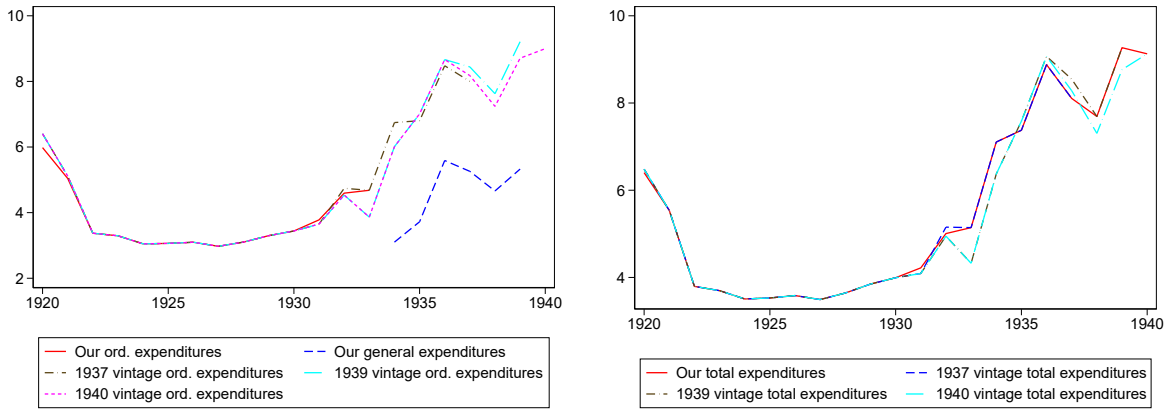


(a) Ordinary expenditures, 1920-1933 (b) Total expenditures, 1920-1933

Figure B.8: Federal expenditures aggregated by fiscal year, billions of dollars. Source: Department of the Treasury (various). See table B.4 for details.



(a) Ordinary expenditures, 1920-1936 (b) Total expenditures, 1920-1936



(c) Ordinary expenditures, 1920-1940 (d) Total expenditures, 1920-1940

Figure B.9: Federal expenditures aggregated by fiscal year, billions of dollars. Source: Department of the Treasury (various). See table B.4 for details.

Table name	Year	Page number Receipts	Expenditures
Ordinary receipts, and expenditures chargeable against (monthly)	1920	see 1921	
Ordinary receipts, and expenditures chargeable against (yearly)		see 1922	
STATEMENT SHOWING CLASSIFIED RECEIPTS...	1921	240	241
Ordinary receipts, and expenditures chargeable against (yearly)		see 1922	
Ordinary receipts, and expenditures chargeable against (monthly)	1922	270	271
Ordinary receipts, and expenditures chargeable against (yearly)		270	271
Ordinary receipts, and expenditures chargeable against (monthly)	1923	512	513
Receipts and expenditures of the United States Government...		512	513
Ordinary receipts, and expenditures chargeable against (monthly)	1924	378	379
Receipts and expenditures of the United States Government...		378	379
Ordinary receipts, and expenditures chargeable against (monthly)	1925	472	474
Receipts and expenditures of the United States Government...		472	474
Ordinary receipts, and expenditures chargeable against (monthly)	1926	445	447
Ordinary receipts, and expenditures chargeable against (yearly)		443	443
Ordinary receipts, and expenditures chargeable against (monthly)	1927	462	462
Ordinary receipts, and expenditures chargeable against (yearly)		445	445
Summary of ordinary receipts, expenditures chargeable (monthly)...	1928	424	424
Summary of ordinary receipts, expenditures chargeable (yearly)...		407	407
Summary of ordinary receipts, expenditures chargeable (monthly)...	1929	412	412
Summary of ordinary receipts, expenditures chargeable (yearly)...		394	394
Summary of ordinary receipts, expenditures chargeable (monthly)...	1930	506	506
Summary of ordinary receipts, expenditures chargeable (yearly)....		488	488
Summary of ordinary receipts, expenditures chargeable (monthly)...	1931	462	462
Ordinary receipts, expenditures chargeable against (yearly)...		448	448
Summary of ordinary receipts, expenditures chargeable (monthly)...	1932	370	370
Receipts and expenditures for the fiscal years 1789 to...		365	369
Summary of ordinary receipts, expenditures chargeable (monthly)...	1933	312	312
Receipts and expenditures for the fiscal years 1789 to...		306	310
Summary of ordinary receipts, expenditures chargeable (monthly)...	1934	306	306
Receipts and expenditures for the fiscal years 1789 to...		301	305
Summary of ordinary receipts, expenditures chargeable (monthly)...	1935	328	328
Receipts and expenditures for the fiscal years 1789 to...		323	327
Classified receipts and expenditures, monthly...	1936	337	339/342
Receipts and expenditures for the fiscal years 1789 to...		359	363
Classified receipts and expenditures, monthly...	1937	320	322/324
Receipts and expenditures for the fiscal years 1789 to...		349	353
Expenditures by major functions for the fiscal years 1930-1937			354
Classified receipts and expenditures, monthly...	1938	379	381/384
Receipts and expenditures for the fiscal years 1789 to...		413	417
Expenditures by major functions for the fiscal years 1931-1938			418
Classified receipts and expenditures, monthly...	1939	337	339/342
Receipts and expenditures for the fiscal years 1789 to...		361	365
Expenditures by major functions for the fiscal years 1931-1939			367
Classified receipts and expenditures, monthly...	1940	612	615/616
Receipts and expenditures for the fiscal years 1789 to...		645	649
Expenditures by major functions for the fiscal years 1933-1940			653
Receipts in general and special accounts, by major sources...		651	

Table B.4: Table names and page numbers from the *Annual Reports of the Secretary of the Treasury* for federal receipts and expenditures

C Additional VAR Results

	Percent of P Due to Shocks in				
Months	$\boldsymbol{F^o}$	$\boldsymbol{F^e}$	**T**	**P**	**Y**
6	5.1	8.9	0.5	85.3	0.2
36	5.5	27.7	6.0	60.7	0.1
	Percent of Y Due to Shocks in				
Months	$\boldsymbol{F^o}$	$\boldsymbol{F^e}$	**T**	**P**	**Y**
6	0.5	7.2	0.6	5.5	86.2
36	0.4	29.1	3.5	3.9	63.1
	Percent of $\boldsymbol{F^o}$ Due to Shocks in				
Months	$\boldsymbol{F^o}$	$\boldsymbol{F^e}$	**T**	**P**	**Y**
6	98.2	0.3	0.3	0.2	1.2
36	97.1	1.1	0.3	0.2	1.4
	Percent of $\boldsymbol{F^e}$ Due to Shocks in				
Months	$\boldsymbol{F^o}$	$\boldsymbol{F^e}$	**T**	**P**	**Y**
6	2.7	92.5	0.6	0.3	3.9
36	2.7	90.3	1.4	1.0	4.5
	Percent of T Due to Shocks in				
Months	$\boldsymbol{F^o}$	$\boldsymbol{F^e}$	**T**	**P**	**Y**
6	0.8	0.4	96.8	1.9	0.2
36	1.6	0.5	94.0	3.1	0.6

Table C.1: Percentage of forecast error variance in GNP deflator (P), real GNP (Y), ordinary expenditures surplus (F^o), emergency expenditures (F^e), and tax receipts (T) attributable to shocks to each equation. Columns may not sum to 100 due to rounding.

$$
\begin{aligned}
\underset{(1.133,2.101)}{1.989i} &= \underset{(-.014,.037)}{.022M^s} + \underset{(-.006,.010)}{.004G^m} + \varepsilon^{MP} \\
\underset{(.061,.080)}{.073M^d} &= \underset{(-1.155,.318)}{-.688i} + \underset{(.004,.044)}{.028P} + \underset{(.001,.016)}{.009Y} + \varepsilon^{MD} \\
\underset{(.0045,.0054)}{.0050S} &= \underset{(-.039,-.006)}{-.023B} - \underset{(-.040,.001)}{.020P} - \underset{(-.009,.006)}{.001Y} + \varepsilon^{FP} \\
\underset{(.013,.019)}{.018G^m} &= \underset{(-1.262,.602)}{-.457i} + \underset{(-.010,.030)}{.013P} + \underset{(.001,.017)}{.010Y} + \varepsilon^{GS} \\
\underset{(.077,.094)}{.087B} &= \underset{(-1.061,-.563)}{-.826i} - \underset{(-.035,-.018)}{.027M} - \underset{(-.0019,.0004)}{.0008S} + \underset{(.003,.007)}{.005G^m} \\
&\quad - \underset{(-.048,-.008)}{.028P} + \underset{(-.001,.014)}{.007Y} + \varepsilon^{B} \\
\underset{(.159,.186)}{.172P} &= \underset{(.007,.022)}{.015Y} + \varepsilon^{P} \\
\underset{(.060,.070)}{.065Y} &= \varepsilon^{Y}
\end{aligned}
$$

Table C.2: Posterior mode estimates of parameters in the A_0 matrix. 68-percent probability intervals appear in parentheses base on 500,000 draws from the posterior distribution. Coefficients and probability intervals in the table are divided by 1000.

Correlations Among Exogenous Shocks							
Shock	ε^{MP}	ε^{MD}	ε^{PS}	ε^{B}	ε^{GS}	ε^{P}	ε^{Y}
ε^{MP}	1.0	$(-.09, .13)$	$(-.07, .10)$	$(-.11, .11)$	$(-.10, .12)$	$(-.02, 13)$	$(-.09, .11)$
ε^{MD}		1.0	$(-.05, .15)$	$(-.14, .08)$	$(-.14, .06)$	$(-.10, .12)$	$(-.13, .08)$
ε^{PS}			1.0	$(-.16, .06)$	$(-.04, .12)$	$(-.16, .08)$	$(-.15, .08)$
ε^{B}				1.0	$(-.12, .10)$	$(-.13, .09)$	$(-.14, .08)$
ε^{GS}					1.0	$(-.13, .09)$	$(-.14, .09)$
ε^{P}						1.0	$(-.10, .10)$
ε^{Y}							1.0

Table C.3: Correlations computed from 500,000 draws from the posterior distribution of the model that table C.2 reports.

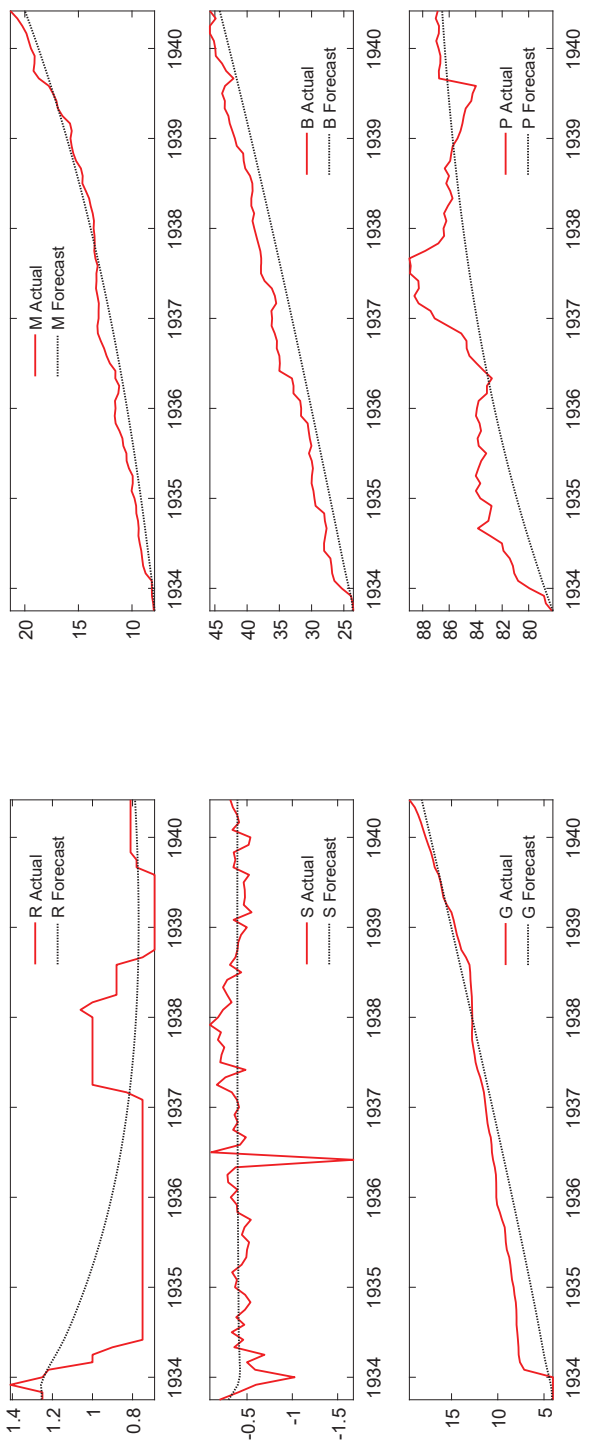


Figure C.1: Actual and unconditional forecasts of variables in VAR using the hyperparameters $\lambda_0 = 0.6, \lambda_1 = 0.3, \lambda_3 = 1.0, \lambda_4 = 1.75, \mu_5 = \mu_6 = 2.0$, in the notation of Sims and Zha (1998).

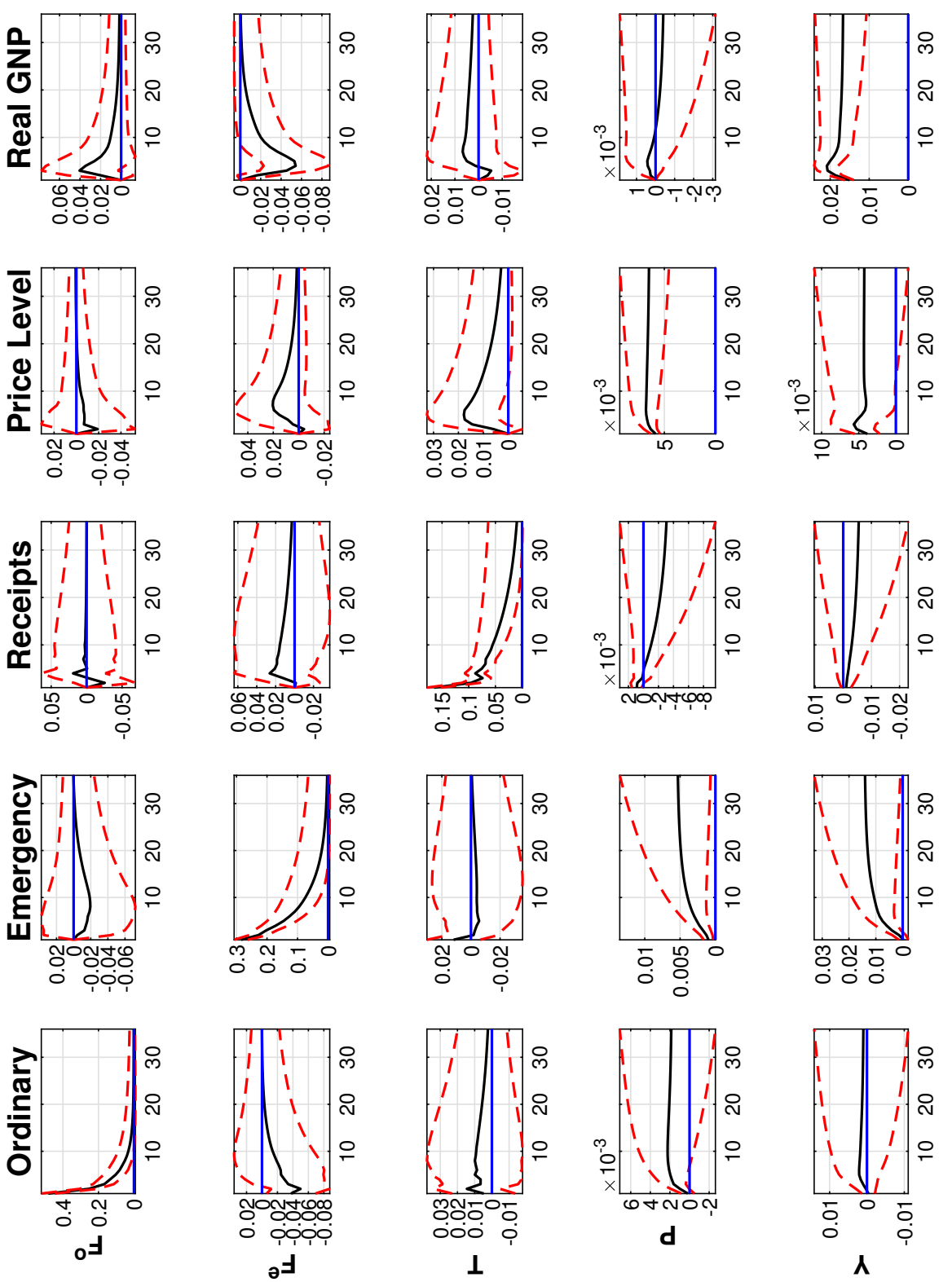


Figure C.2: Full moving average representation of the five-variable identified VAR estimated over the period April 1933 to June 1940. Identification is recursive with variables ordered $F^o/B, F^e/B, T/B, P, Y$. Solid lines are maximum likelihood estimates; dashed lines are 68 percentile probability bands based on 500,000 draws from the posterior distribution of all the VAR parameters.

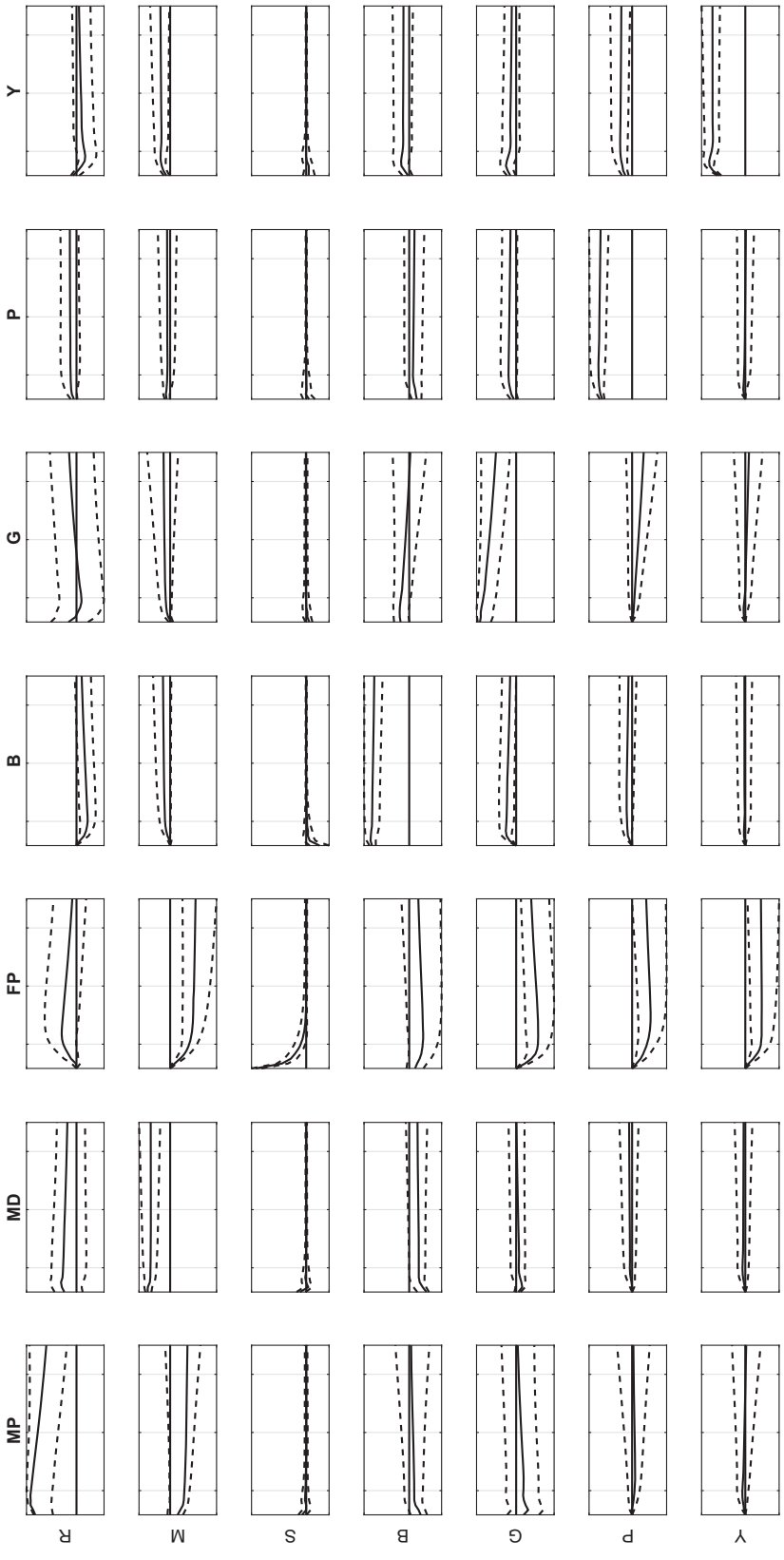


Figure C.3: Full moving average representation of the identified VAR estimated over the period April 1933 to June 1940. Identification from table C.2. Solid lines are maximum likelihood estimates; dashed lines are 68 percentile probability bands based on 500,000 draws from the posterior distribution of all the VAR parameters.

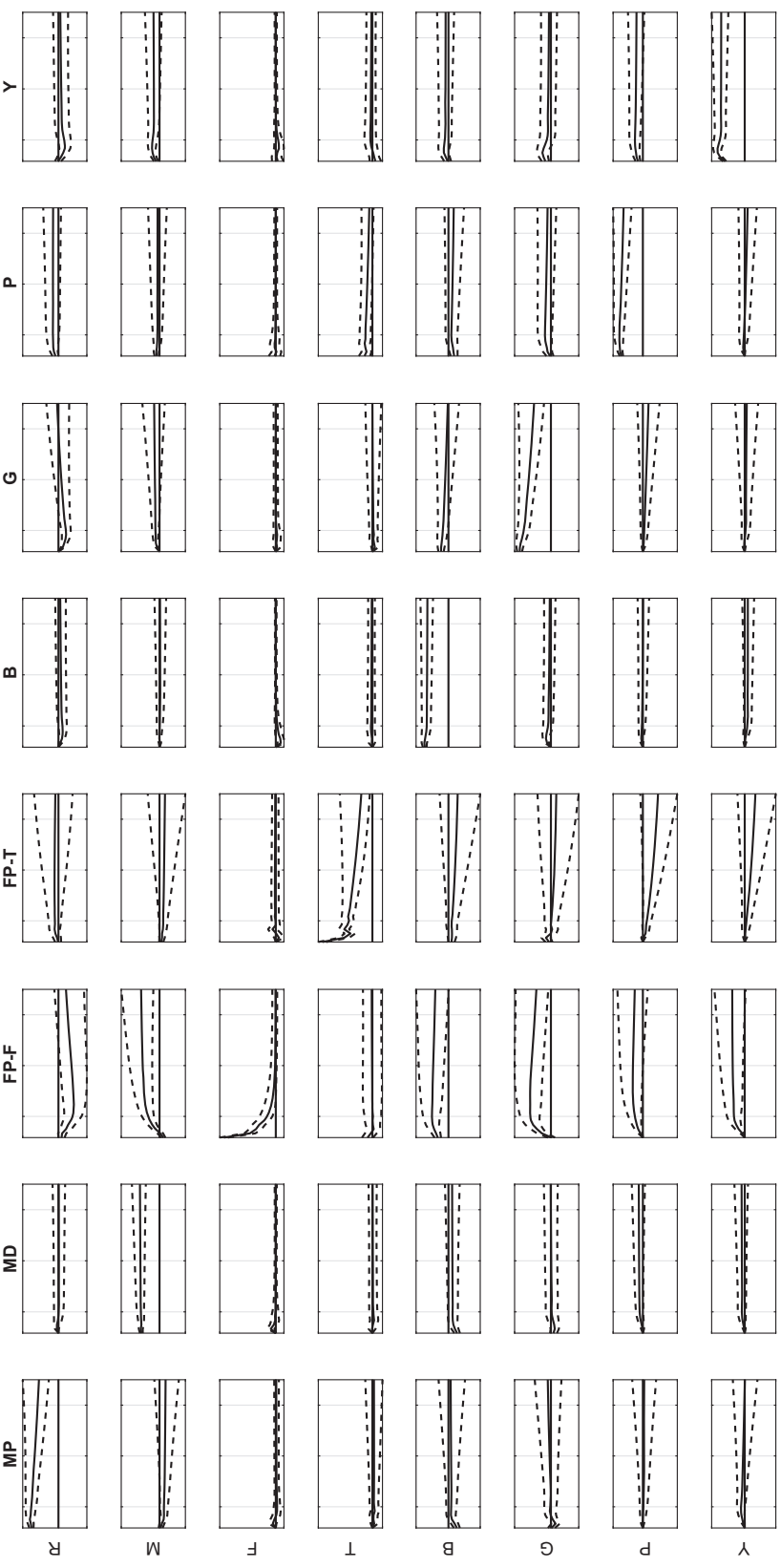


Figure C.4: Full moving average representation of 8-variable VAR ordered recursively—P, Y, F, T, R, M, G, B—estimated over the period (April 1933 to June 1940). F is government expenditures net of interest payments and T is tax receipts. Solid lines are maximum likelihood estimates; dashed lines are 68 percentile probability bands based on 500,000 draws from the posterior distribution of all the VAR parameters.

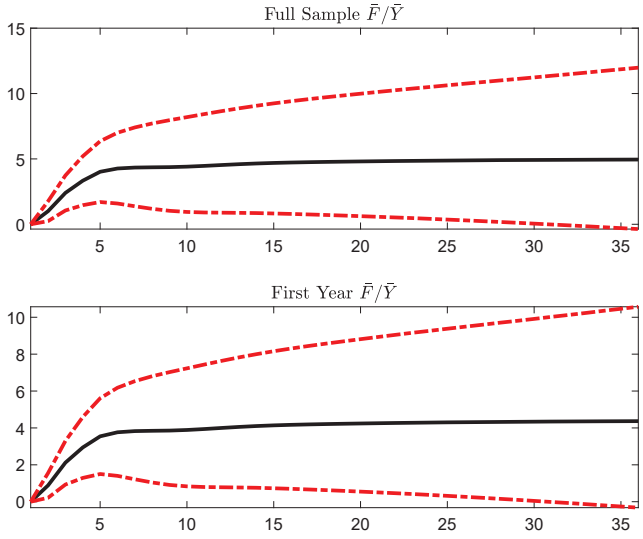


Figure C.5: Blanchard and Perotti (2002) output multipliers for government expenditures net of interest payments. Solid lines are posterior modes; dashed lines are 68 percent credible sets. Top panel takes mean of expenditures to output from full sample; bottom panel takes mean from first year of sample.

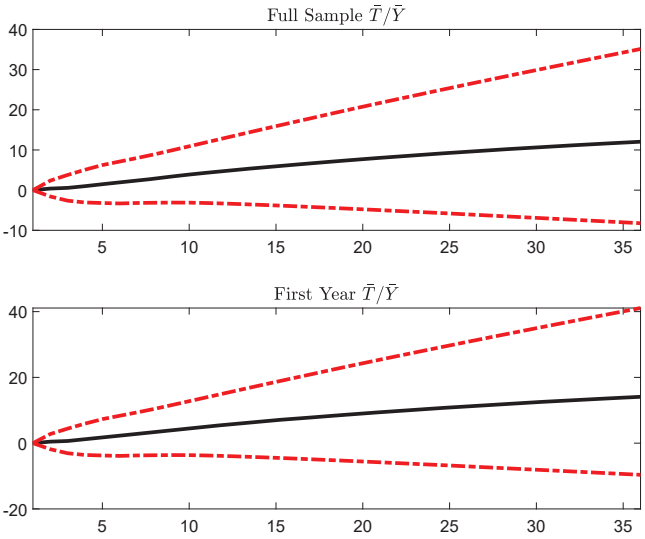


Figure C.6: Blanchard and Perotti (2002) output multipliers for government tax receipts. Solid lines are posterior modes; dashed lines are 68 percent credible sets. Top panel takes mean of receipts to output from full sample; bottom panel takes mean from first year of sample.

	Percent of P Due to Shocks in						
Months	**MP**	**MD**	**FP**	**B**	**GS**	**P**	**Y**
6	0.2	0.2	7.9	1.2	0.2	82.4	8.0
36	0.3	0.4	16.3	1.4	3.4	70.0	8.2
	Percent of Y Due to Shocks in						
Months	**MP**	**MD**	**FP**	**B**	**GS**	**P**	**Y**
6	0.4	0.3	8.9	0.1	0.1	0.2	90.0
36	0.1	0.3	17.8	0.1	0.3	0.0	81.4
	Percent of M Due to Shocks in						
Months	**MP**	**MD**	**FP**	**B**	**GS**	**P**	**Y**
6	17.7	50.9	19.4	1.4	1.4	1.4	7.9
36	18.9	29.8	39.1	2.8	2.4	0.7	6.3
	Percent of i Due to Shocks in						
Months	**MP**	**MD**	**FP**	**B**	**GS**	**P**	**Y**
6	82.8	8.0	2.7	2.7	0.9	1.1	1.7
36	79.9	7.2	5.2	3.5	1.0	2.1	1.2
	Percent of S Due to Shocks in						
Months	**MP**	**MD**	**FP**	**B**	**GS**	**P**	**Y**
6	0.5	1.1	92.2	5.1	0.3	0.2	0.5
36	0.5	1.1	92.1	5.1	0.4	0.2	0.5
	Percent of G^m Due to Shocks in						
Months	**MP**	**MD**	**FP**	**B**	**GS**	**P**	**Y**
6	4.3	1.0	15.3	4.1	69.3	2.2	3.8
36	2.5	0.4	26.9	4.9	59.3	3.3	2.6
	Percent of B Due to Shocks in						
Months	**MP**	**MD**	**FP**	**B**	**GS**	**P**	**Y**
6	3.0	7.6	6.2	75.1	4.3	1.7	2.2
36	1.2	5.5	8.1	79.9	1.6	1.4	2.2

Table C.4: Percentage of forecast error variance in GNP deflator (P), real GNP (Y), primary surplus (S), monetary base (M), commercial paper rate (i), monetary gold supply (G^m), and nominal market value of debt (B) attributable to shocks to each equation. Columns may not sum to 100 due to rounding.

D Fiscal Implications of Gold Sterilization

When following either the classical gold or gold exchange standard, gold imports have the potential to increase the monetary base. By sterilizing gold inflows, i.e. paying for imported gold in government bonds rather than bank reserves, policymakers can partially offset the increase in the monetary base. By June of 1934, both gold import operations and sterilization decisions shifted from the Federal Reserve to the Treasury. A series of presidential proclamations, executive orders, joint-resolutions, and Acts culminated in an embargo on gold exports[19] and the Treasury seizing the entire monetary gold stock including coins and bullion held by private citizens, business, and the Federal Reserve banks.[20]

Massive gold imports more than tripled the monetary gold stock from $4.3 billion at the start of 1933 to $14.4 billion at the end of 1938. Friedman and Schwartz (1963, p. 545) attribute the gold imports to the depreciation of the dollar, Hitler's rise to power, and the outbreak of war in Europe. Studenski and Krooss (1952, p. 394) include the Treasury's $35 an ounce purchase price for gold, favorable trade balances, and the creditor position of the United States as additional factors that increased gold imports.[21] To our knowledge, banks were required to sell newly imported gold to the Treasury due to the Gold Reserve Act of 1934's ban on private citizens holding monetary gold.[22] With gold inflows pushing up excess reserves, policymakers feared that the growing monetary base could ignite inflationary forces [Jaremski and Mathy (2018)]. Sterilization from December 1936 to April 1938 attempted to curb the growth of excess reserves and hence the monetary base.

Expanding on the example provided by Johnson (1939, p. 144), we illustrate the effects of the Treasury's non-sterilized and sterilized gold purchases on the balance sheets of the Treasury, the Federal Reserve, and member banks.

1. Gold imports by member banks: $1,000 worth of imported gold is funded by issuing $1,000 worth of deposits. Member bank assets and liabilities rise by $1,000.

Treasury

Assets	Liabilities

Federal Reserve

Assets	Liabilities

Member Banks

Assets	Liabilities
+$1,000 gold	+$1,000 deposits
+$1,000	+$1,000

[19] Executive Order 6111 on Transactions in Foreign Exchange was implemented on April 20, 1933. See http://www.presidency.ucsb.edu/ws/index.php?pid=14621

[20] See Bordo, Humpage, and Schwartz (2015, pp. 56–57) for a detailed timeline of events. Jaremski and Mathy (2018, p. 6) report that most gold imports came through New York City's gold market and New York City banks continued to sell their gold to the Federal Reserve Bank of New York who acted as fiscal agent to the Treasury, the ultimate purchaser of the gold.

[21] Meltzer (2003, p. 459) notes that the Treasury purchased more than $4 billion of gold from 1934-1936.

[22] Bordo, Humpage, and Schwartz (2015, p. 65) explain that the Treasury issued special licenses for commercial banks to obtain gold for customers which suggests that banks were not allowed to keep gold on their balance sheets.

2. High powered money creation: member banks sell $1,000 of imported gold to the Federal Reserve in exchange for reserves that increase high-powered money by $1,000. Swapping gold for reserves does not change the aggregate asset position of member banks—both assets and liabilities remain elevated by the original $1,000. Prior to the Gold Act of 1934, the Federal Reserve maintained the sterilization decision which is shown in step 2b.

Treasury		Federal Reserve		Member Banks	
Assets	Liabilities	Assets	Liabilities	Assets	Liabilities
		+$1,000 gold	+$1,000 reserves	-$1,000 gold +$1,000 reserves	$1,000 deposits
		+$1,000	+$1,000	$1,000	$1,000

3. Gold transferred to Treasury: under the Gold Act of 1934, imported gold had to be turned over from the Federal Reserve to the Treasury. As noted by Jaremski and Mathy (2018, p. 6), the Treasury paid for the gold by drafting on its balances at the Federal Reserve. The transaction only changed the composition of the balance sheets of the Federal Reserve and the Treasury, but not their aggregate asset position.

Treasury		Federal Reserve		Member Banks	
Assets	Liabilities	Assets	Liabilities	Assets	Liabilities
+$1,000 gold -$1,000 due from Fed		-$1,000 gold	$1,000 reserves -$1,000 due to Treasury	$1,000 reserves	$1,000 deposits
				$1,000	$1,000

4a. No sterilization under the Treasury: the Treasury replenished its balances at the Federal Reserve by issuing gold certificates and depositing them as final payment for gold purchases. Without sterilization, gold imports ultimately increase the balance sheets of the Treasury, the Federal Reserve, and member banks while leaving the amount of free-gold at the Treasury unchanged. There is no increase in Treasury indebtedness to the private sector because the Treasury transacts with the Federal Reserve via gold certificates.

Treasury		Federal Reserve		Member Banks	
Assets	Liabilities	Assets	Liabilities	Assets	Liabilities
+$1,000 due from Fed	+$1,000 gold certificates to Treasury	+$1,000 gold certificates from Treasury	$1,000 reserves	$1,000 reserves	$1,000 deposits
+$1,000	+$1,000	+$1,000	+$1,000	$1,000	$1,000

4b. Sterilization under the Treasury: when sterilizing gold imports, the Treasury sells government securities to member banks rather than issuing gold certificates to the Federal Reserve. Member banks pay for government securities by retiring outstanding reserves held at the Federal Reserve who then credits their own balances due to the Treasury to settle the transaction. By retiring reserves, the high powered money created in step 2 is withdrawn. In summary, sterilization of gold imports increases Treasury indebtedness to the private sector while also increasing the aggregate balance sheets of the Treasury and member banks, but not the Federal Reserve.

Treasury

Assets	Liabilities
+$1,000 due from Fed	+$1,000 gov't securities
+$1,000	+$1,000

Federal Reserve

Assets	Liabilities
	-$1,000 reserves +$1,000 due to Treasury

Member Banks

Assets	Liabilities
-$1,000 reserves +$1,000 gov't securities purchased from Treasury	$1,000 deposits
$1,000	$1,000

2b. Sterilization under the Federal Reserve: when sterilizing gold imports, the Federal Reserve pays for gold by selling government securities to member banks rather than creating reserves as seen in 2. Sterilization leaves the aggregate balance sheets of the Federal Reserve and the Treasury unchanged while the balance sheet of member banks is expanded. In the case of sterilization under the Federal Reserve, there is no increase in Treasury indebtedness. Because security sales by the Federal Reserve prevent the creation of reserves, sterilization by the Federal Reserve is equivalent to contractionary open market operations.

Treasury

Assets	Liabilities

Federal Reserve

Assets	Liabilities
+$1000 gold -$1000 gov't securities	

Member Banks

Assets	Liabilities
-$1000 gold +$1000 gov't securities	$1000 deposits
$1000	$1000

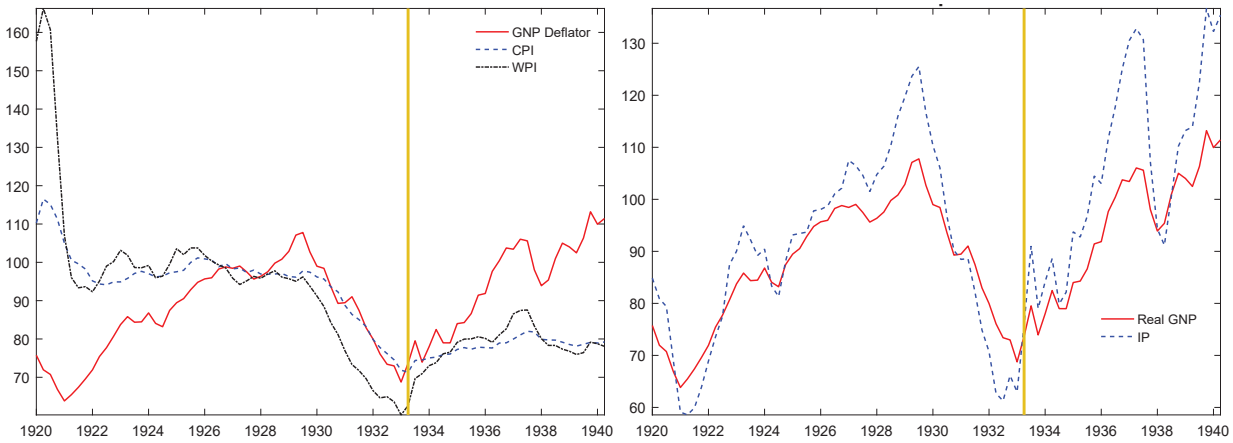
E Macroeconomic Indicators

This Appendix presents empirical facts about the state of the U.S. economy throughout the 1920s and 1930s. It offers evidence corroborating the interpretation that unbacked fiscal expansion spurred recovery. In the figures that follow we use quarterly data to contrast the performance of economic variables during the "gold standard" (January 1920 to March 1933) to their behavior during "unbacked fiscal expansion" (April 1933 to June 1940).

Panel E.1a shows that the price level, however measured, decreased by roughly 30 percent from the stock market crash in October 1929 to its trough in April 1933 when the gold

standard was abandoned. Although the GNP deflator and consumer and wholesale prices rose through most of the 1930s, they never regained the 1920s levels per Roosevelt's goal.

Like prices, output also plunged in 1929 and began a sustained recovery when gold was abandoned in April 1933. Panel E.1b shows that real GNP and industrial production fell by roughly 25 and 45 percent, respectively, from peak to trough, as measured on an annual basis. In contrast to prices, output eventually surpassed its pre-recession peak.



(a) Price levels (b) Output

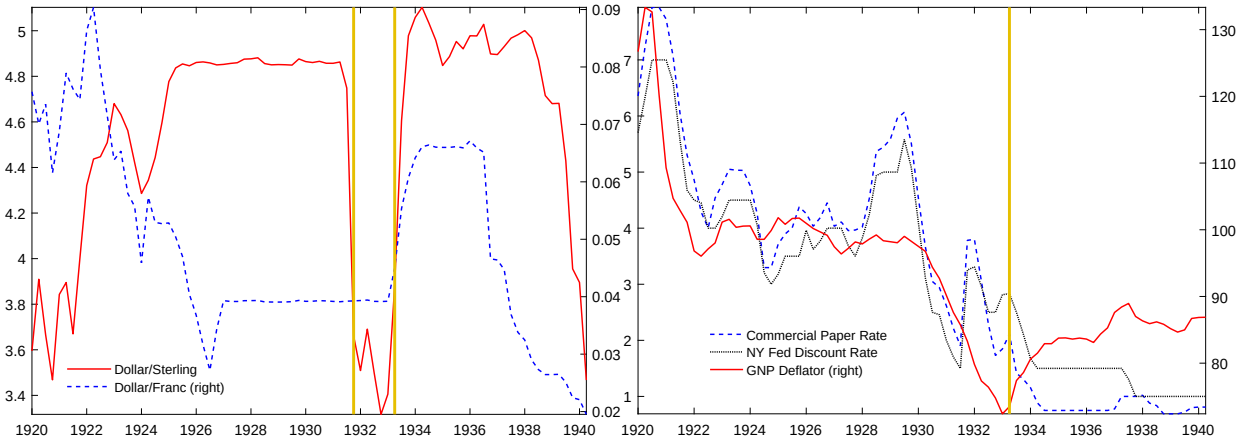
Figure E.1: Measures of price levels and real economic activity. All series use 1926 base year. Vertical line marks when the United States abandoned the gold standard. Sources: Balke and Gordon (1986), Federal Reserve Board, BEA and BLS from NBER Macrohistory Database.

Figure E.2 shows how the gold standard's focus on international considerations at the expense of domestic conditions affected exchange rates, interest rates, and the price level. Panel E.2a shows that the United Kingdom's departure from the gold standard in September 1931 (first vertical line) triggered a very large dollar appreciation. When the U.S. also left gold in April 1933 (second vertical line), this appreciation was completely reversed.

Panel E.2b shows that during the gold standard period interest rates generally followed the decline in the price level, albeit with several distinct deviations when rates rose sharply despite a flat or declining price level. For example, in October 1931, concerns about gold outflows after Britain left the gold standard induced most Federal Reserve banks to raise their discount rates even though prices were in free fall. Meltzer (2003, p. 280-282) claims that Federal Reserve policy decisions were mostly consistent with the Riefler-Burgess and real bills doctrines where policymakers focused on borrowed reserves and short-term market interest rates as key signals. But interest-rate hikes in the early 1930s were clear attempts by the Federal Reserve to follow the gold standard's "rules of the game" [p. 273] and stabilize exchange rates at the expense of domestic prices.[23] After the abandonment of the gold

[23]See Wicker (1966) for discussions of monetary policy constraints. Eichengreen (2000) argues that the gold standard prevented governments from reflating: "So long as the gold standard remained in place, the commitment to defend the central bank's gold reserves and stabilise the gold parity was an insurmountable obstacle to the adoption of expansionary policies." Apropos of fiscal policy under the gold standard, when taxes must back government debt, is Eichengreen's statement: "Deficit spending could not be used. . . if deficit spending could not be financed."

standard in April 1933, the Federal Reserve pegged the discount rate, changing it infrequently and certainly not adjusting it to combat higher prices.[24]



(a) Dollar valuation (b) Interest rates & price level

Figure E.2: Exchange rates, inflation, and interest rates. Exchange rates in dollars per foreign currency; inflation is annual (quarter over four quarters prior). First vertical line marks when the United Kingdom abandoned the gold standard; second line marks when the United States abandoned the gold standard. Sources: Federal Reserve Board (1943).

Figure E.3 shows the effects of Roosevelt's gold programs on the monetary base, the gold stock, and gold cover ratio. The large jumps in gold stock (top panel) and the cover ratio (bottom panel) in 1934 stem from the revaluation of gold to $35 an ounce—almost 60 percent above its previous covertibility price. The steady increase in the gold stock and the monetary base during the unbacked fiscal expansion period reflects Roosevelt's decision not to sterilize gold inflows. That decision was reversed in 1937, reducing the growth rate of the base [Irwin (2012)] (see Appendix D for details on sterilization). Because the gold cover ratio remained close to 0.90 from April 1933 onward, gold no longer constrained policy behavior.[25]

Table E.1 reports the highs and lows of GNP and its components along with banking aggregates. By 1937, nominal GNP exceeded its 1929 high, but investment remained below. In current dollars, GNP and its components did not regain their 1929 peaks. Total deposits in all banks bounced back by 1937 after falling 30 percent between 1929 and the low point in 1932–33 as financial unrest lead to cash hoarding by the public. Loans, which declined over 50 percent never regained their previous level. Bank holdings of U.S. government obligations largely filled the asset void left by loans, tripling between 1929 and 1937.

[24]The Fed also made few changes to its market portfolio from 1933 to 1941 [Meltzer (2003, p. 413)].

[25]For a couple of years before the gold revaluation, the cover ratio was precariously low, imposing a severe constraint on the level of the monetary base. Eichengreen (1992) recounts events during February and March 1933 when the New York Fed was at its statutory 40 percent minimum gold cover ratio, which prevented it from rediscounting bills. Initially, other reserve banks discounted bills on New York's behalf. By March 3 the Chicago Fed, which held the bulk of the System's excess gold, refused to provide further assistance to New York for fear that it would be unable to help banks in the Chicago district. These tensions, which stemmed from the absence of a coherent *national* monetary policy, exacerbated the already tenuous state of commercial banks and raised doubts about the credibility of the System's commitment to gold parity.

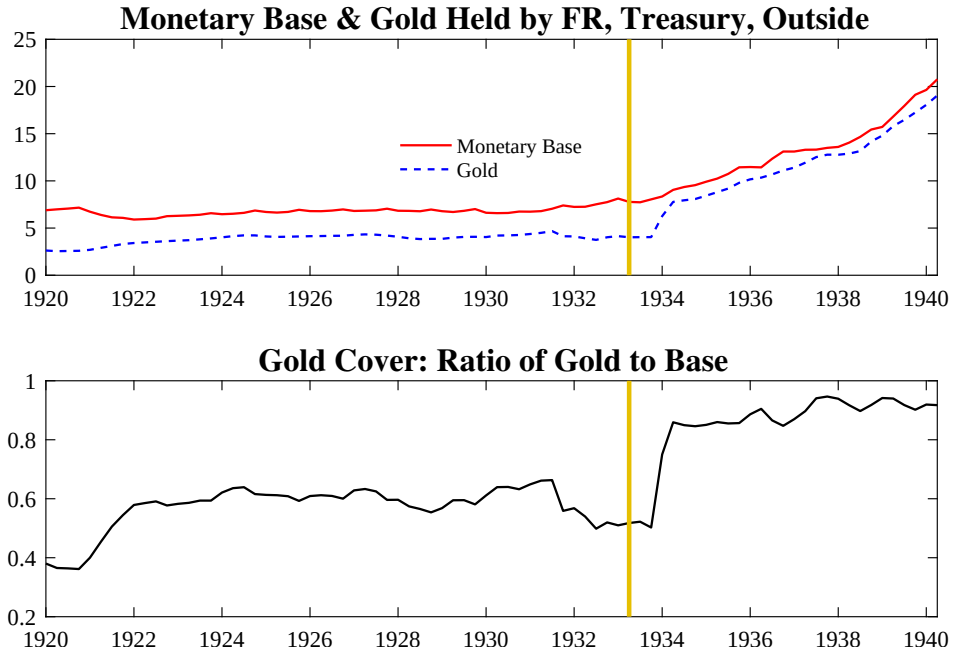


Figure E.3: Monetary base and gold held by Federal Reserve banks. Monetary base is currency in circulation plus non-borrowed reserves. Vertical line marks when the United States abandoned the gold standard. Source: Federal Reserve Board (1943) from NBER Macrohistory Database.

	1929 High	1932-33 Low	1937 High
Annual data			
In 1939 prices, billions of dollars			
GNP	85.9	61.5	87.9
Gross domestic investment	14.9	1.1	11.4
In current prices, billions of dollars			
GNP	103.8	55.8	90.2
Gross domestic investment	15.8	0.9	11.4
Consumption	78.8	46.3	67.1
Biannual data			
All banks, billions of dollars			
Total deposits	59.8	41.5	59.2
Loans	41.9	22.1	22.1
U.S. government obligations	5.5	8.2	17.0

Table E.1: Sources: Gordon (1952, p. 390) and Federal Reserve Board (1943).

F Market Value and Returns

This Appendix details calculations of the market value and the return on the U.S. bond portfolio. We use data from Hall, Payne, Sargent, and Szőke (2021), provided to us by the authors, as well as CRSP to obtain the quantity, price, accrued interest, interest rate, and coupon frequency of each government bond outstanding in a given month.

We begin by showing how we aggregate both prices and quantities across initial and

outstanding maturities. Let $B_{it}(t+j)$ denote the dollar value of bonds with initial maturity i that are outstanding at time t and maturing at time $t+j$. $B_t(t+j)$ thus aggregates over initial maturities.

$$B_t(t+j) = \sum_{i=1}^{N} B_{it}(t+j)$$

Because bonds maturing at time $t+j$ may not span all initial maturities $i = 1, \ldots, N$, it is possible for $B_{it}(t+j) = 0$ for some i.

The par value of all bonds outstanding at the end of time t—the face value of the bond portfolio—is the sum over all maturities.

$$B_t^M = \sum_{j=1}^{\infty} B_t(t+j) = \sum_{j=1}^{\infty} \sum_{i=1}^{N} B_{it}(t+j)$$

To calculate prices for bonds, we first define $\nu_{it}(t+j)$ as the share of bonds with initial maturities i that are outstanding at time t and maturing at time $t+j$,

$$\nu_{it}(t+j) = \frac{B_{it}(t+j)}{B_t(t+j)} = \frac{B_{it}(t+j)}{\sum_{i=1}^{N} B_{it}(t+j)}$$

where $\sum_{i=1}^{N} \nu_{it}(t+j) = 1$. The weighted dirty price $Q_t^D(t+j)$ is the price plus accrued interest of bonds outstanding at time t and maturing at time $t+j$,

$$Q_t^D(t+j) = Q_t(t+j) + AI_t(t+j) = \sum_{i=1}^{N} \Big(Q_{it}(t+j) + AI_{it}(t+j) \Big) \times \nu_{it}(t+j)$$

$Q_t(t+j)$ and $AI_t(t+j)$ are the clean price and accrued interest, respectively. For zero-coupon bonds, the dirty price is equal to the clean price.

To define the nominal price of the bond portfolio, we next define $\mu_t(t+j)$ as the share of bonds outstanding at time t and maturing at time $t+j$,

$$\mu_t(t+j) = \frac{B_t(t+j)}{B_t^M}$$

where $\sum_{j=1}^{\infty} \mu_t(t+j) = 1$. The nominal price of the bond portfolio P_t^M is obtained by aggregating all remaining maturities $t+j$,

$$P_t^M = \sum_{j=1}^{\infty} Q_t^D(t+j) \times \mu_t(t+j)$$

To define the market value of government debt and its returns, we next define the government's budget identity with a complete and general maturity structure,

$$\sum_{j=0}^{\infty} \big(Q_t^D(t+j) + IP_t(t+j) \big) \times B_{t-1}(t+j) = P_t s_t + \sum_{j=1}^{\infty} Q_t^D(t+j) \times B_t(t+j) \qquad \text{(F.35)}$$

Where $Q_t^D(t) \equiv 1$ and $IP_t(t+j)$ is the interest payable on bonds outstanding at time t and maturing at time $t+j$. Interest payable is a government expense at time t and is thus included in the government budget identity.

The market value of debt outstanding at time t is obtained by multiplying the prices of bonds by quantities and aggregating across all remaining maturities j

$$P_t^M B_t^M \equiv \sum_{j=1}^{\infty} Q_t^D(t+j) \times B_t(t+j)$$

The market value of debt outstanding at time $t-1$ is thus

$$P_{t-1}^M B_{t-1}^M \equiv \sum_{j=1}^{\infty} Q_{t-1}^D(t+j) \times B_{t-1}(t+j) = \sum_{j=1}^{\infty} Q_{t-1}^D\big((t-1)+(j+1)\big) \times B_{t-1}\big((t-1)+(j+1)\big)$$

To calculate returns, it is also useful to define the carry-over market value $P_t^C B_{t-1}^M$ which uses time $t-1$ bonds with time t dirty prices and intermediate coupon payments paid between time $t-1$ and t.

$$P_t^C B_{t-1}^M \equiv \sum_{j=0}^{\infty} \Big(Q_t^D(t+j) + IP_t(t+j)\Big) \times B_{t-1}(t+j)$$

$IP_t(t+j)$ is the interest payable on bonds outstanding at t that mature in $t+j$. P_t^C differs from its dirty-price analog P_t^M only when there is a coupon payment in month t. The timing of coupon payments is as follows:

Using the definitions of market value and carry over market value, the government budget identity given by equation (F.35) can be written as:

$$P_t^C B_{t-1}^M = P_t s_t + P_t^M B_t^M$$

Multiplying and dividing the left hand side by last period's market value $P_{t-1}^M B_{t-1}^M$ defines the rate of return on government debt:

$$\underbrace{\frac{P_t^C B_{t-1}^M}{P_{t-1}^M B_{t-1}^M}}_{\text{rate of return}} \times P_{t-1}^M B_{t-1}^M = P_t s_t + P_t^M B_t^M \tag{F.36}$$

The rate of return can also be derived by decomposing changes in market value into rates of return and changes in size. We start by expanding the ratio of time t market value to time $t-1$.

$$\frac{P_t^M B_t^M}{P_{t-1}^M B_{t-1}^M} \equiv \underbrace{\frac{P_t^C B_{t-1}^M}{P_{t-1}^M B_{t-1}^M}}_{\text{rate of return}} \times \underbrace{\frac{P_t^M B_t^M}{P_t^C B_{t-1}^M}}_{\text{size ratio}} \tag{F.37}$$

The rate of return is the same as that given in equation (F.36) and reflects the change in the value of the bond portfolio between time t and $t-1$, holding the bond portfolio fixed.

$$\frac{P_t^C B_{t-1}^M}{P_{t-1}^M B_{t-1}^M} = \frac{\sum_{j=0}^{\infty}\Big(Q_t(t+j) + AI_t(t+j) + IP_t(t+j)\Big) \times B_{t-1}(t+j)}{\sum_{j=1}^{\infty}\Big(Q_{t-1}(t+j) + AI_{t-1}(t+j)\Big) \times B_{t-1}(t+j)} \tag{F.38}$$

The size ratio in equation (F.37) incorporates new issues, redemptions, and coupon payments that occur between time t and $t-1$. The size ratio reflects the change in the value of the bond portfolio due to changes in the debt composition such as any changes in maturity structure.

$$\frac{P_t^M B_t^M}{P_t^C B_{t-1}^M} = \frac{\sum_{j=1}^{\infty}\Big(Q_t(t+j) + AI_t(t+j)\Big) \times B_t(t+j)}{\sum_{j=0}^{\infty}\Big(Q_t(t+j) + AI_t(t+j) + IP_t(t+j)\Big) \times B_{t-1}(t+j)}$$

Given the definition of the nominal return in equation (F.38), the real return can then be defined by dividing by the inflation rate $\pi_t = P_t/P_{t-1}$.

$$r_t^M = \frac{P_t^C B_{t-1}^M/P_t}{P_{t-1}^M B_{t-1}^M/P_{t-1}} = \frac{\sum_{j=0}^{\infty}\Big(Q_t^D(t+j) + IP_t(t+j)\Big) \times B_{t-1}(t+j)/P_t}{\sum_{j=1}^{\infty} Q_{t-1}^D(t+j) B_{t-1}(t+j)/P_{t-1}} \tag{F.39}$$

The government budget identity (F.36) can also be expressed in real terms as:

$$r_t^M P_{t-1}^M b_{t-1}^M = s_t + P_t^M b_t^M \tag{F.40}$$

where $b_t^M \equiv B_t^M/P_t$ is the real par value of debt outstanding at t.
Panel F.1a shows that real returns to U.S. debt have a larger decline than nominal returns after the departure from the gold standard. Real returns are on average more volatile than nominal returns over the period shown.

The surprise component in the real return on the bonds portfolio allows us to attribute changes in the real return to inflation and bond prices.

$$\eta_t \equiv r_t^M - E_{t-1} r_t^M$$

We assume adaptive expectations so that expected prices equal their past values and there are no real expected capital gains or losses on the portfolio, $E_{t-1}[P_t] = P_{t-1}$ and $E_{t-1}\left[Q_t(t+j)\right] = Q_{t-1}(t+j)$.[26] The surprise in the real return can be written as:

$$\eta_t = \frac{P_t^c B_{t-1}^M/P_t}{P_{t-1}^M B_{t-1}^M/P_{t-1}} - \frac{\sum_{j=0}^{\infty}\Big(Q_{t-1}(t+j) + AI_t(t+j) + IP_t(t+j)\Big) \times B_{t-1}(t+j)/P_{t-1}}{P_{t-1}^M B_{t-1}^M/P_{t-1}}$$

Adding and subtracting $Q_t(t+j)$ from the numerator of the last term:

$$\eta_t = \underbrace{\frac{P_t^c B_{t-1}^M}{P_{t-1}^M B_{t-1}^M}}_{R_t^M}(1/\pi_t - 1) + \frac{\sum_{j=0}^{\infty}\Big(Q_t(t+j) - Q_{t-1}(t+j)\Big) \times B_{t-1}(t+j)}{P_{t-1}^M B_{t-1}^M}$$

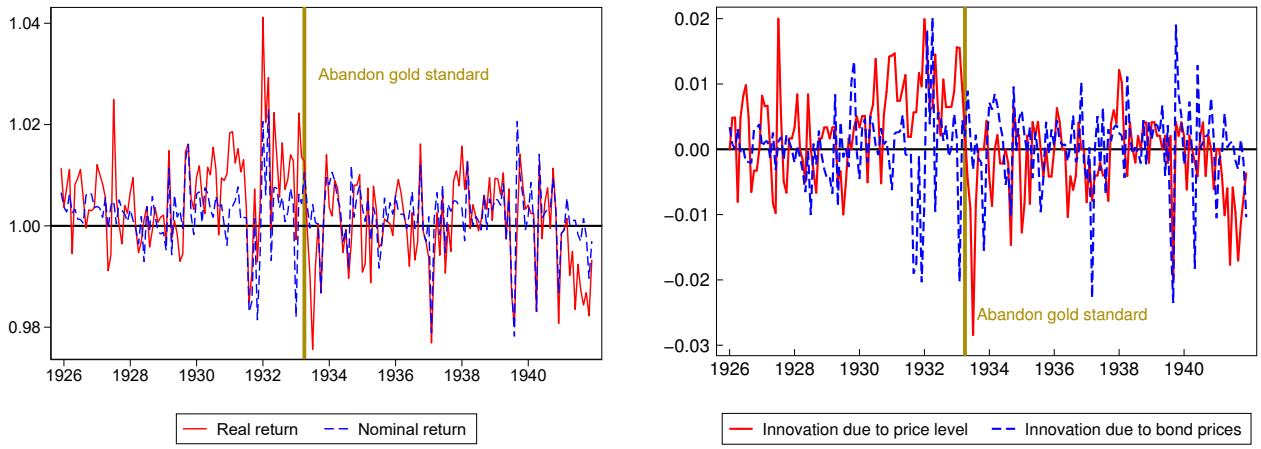
[26] Accrued interest, $AI_t(t+j)$, and interest payable, $IP_t(t+j)$, of bonds outstanding at time t and maturing at time $t+j$ are known in period $t-1$. Hence, $E_{t-1}[AI_t(t+j) + IP_t(t+j)] = AI_t(t+j) + IP_t(t+j)$.

Multiplying and dividing the final term by $P_t^c B_{t-1}^M$ yields the following decomposition[27]

$$\eta_t = R_t^M \underbrace{(1/\pi_t - 1)}_{\text{due to price level}} + R_t^M \underbrace{\left(\frac{\sum_{j=1}^{\infty} \big(Q_t(t+j) - Q_{t-1}(t+j)\big) \times B_{t-1}(t+j)}{P_t^c B_{t-1}^M} \right)}_{\text{due to bond prices}} \tag{F.41}$$

If there are neither changes in the price level between periods t and $t-1$, i.e. $\pi = 1$ nor aggregated bond prices, $\sum_{j=0}^{\infty} Q_t(t+j) - Q_{t-1}(t+j) = 0$, then $\eta_t = 0$ and there are no capital gains or losses. If there is only a change in aggregated bond prices but not the price level ($\pi_t = 1$), then $R_t^M(1/\pi_t - 1) = 0$ and capital gains or losses can be interpreted as the weighted change in bond prices as a share of market value scaled by nominal returns. If the opposite is true and $\big(\sum_{j=0}^{\infty} \big(Q_t(t+j) - Q_{t-1}(t+j)\big) = 0$, then capital gains or losses are changes in the price level scaled by nominal returns.

Panel (F.1b) shows that after the abandonment of the gold standard, the price level is largely responsible for the capital loss on holding government debt.



(a) Real and nominal price returns

(b) Innovations decomposition from eq. (F.41)

Figure F.1: Returns and innovations. Because there is a 0.99 correlation coefficient between returns with clean and dirty prices, the figure only shows series for dirty prices.

[27] Because $Q_t(t) = 1$ for all t, then then when $j = 0$, $Q_t(t) - Q_{t-1}(t) = 0$ and the maturity index j starts at value $j = 1$ instead of value $j = 0$.

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