Recovery of 1933*

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Abstract

When Roosevelt abandoned the gold standard in April 1933, he converted what had been effectively real government debt into nominal government debt and opened the door to implementing an *unbacked fiscal expansion*. We argue that he followed a fiscal rule that ran primary deficits until the price level rose and economic activity recovered. VAR estimates suggest that primary deficits made quantitatively important contributions to raising both the price level and real GNP from 1933 through 1937. The evidence does not support the conventional monetary explanation that gold revaluation and gold inflows, which were permitted to raise the monetary base, drove the recovery independently of fiscal actions.

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1 Introduction

This paper hypothesizes that the source of America's recovery from the Great Depression, which began in early 1933, was an *unbacked fiscal expansion* made possible by the country's departure from the gold standard and President Roosevelt's commitment to raise the price level by achieving "...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 (1933b)]. Departure from gold was a necessary condition to free monetary and fiscal policies to, in Irving Fisher's (1934) term, "reflate" the economy.

Reflation arose from the combination of a monetary policy that pegged short-term nominal interest rates near zero and a fiscal policy that followed "sound finance" by balancing the "regular budget," while running chronic deficits on the "emergency budget." Emergency budgets were financed by sales of nominal government bonds, which more than doubled over Roosevelt's first seven years as president. By keeping the public's attention focused on the need to raise overall prices and reduce unemployment and away from the expectation that future surpluses will rise to pay off the debt, Roosevelt essentially implemented a fiscal rule that expanded government debt until the price level returned to some pre-depression level.[1]

From the start, Roosevelt envisioned fiscal expansion as a temporary response to severe economic and political crises. "Emergency expenditures" communicated the temporary nature of his deficit policy, as did Roosevelt's January 1936 budgetary address, where he said "...it is the deficit of today which is making possible the surplus of tomorrow."[2] Although Roosevelt never threw over his deeply-held belief in sound finance, his pragmatism permitted him to suspend those beliefs to fight "a war for the survival of democracy" [Roosevelt (1936a)].

By the early spring of 1933, output had fallen 25 percent from its peak, deflation was averaging seven percent a year, and the money supply dropped over 30 percent as waves of bank runs engulfed the financial system. Economists like Fisher and George F. Warren blamed the plummeting price level on constraints that the gold standard imposed on macroeconomic policy choices. Under the gold standard, the economy's price level is determined by balancing the world supply of gold against domestic demand for gold. With the price level largely beyond the control of both monetary and fiscal authorities, government bonds that pay in dollars are effectively *real* bonds because the dollars are convertible to gold. Under the gold standard, U.S. debt bore a clause explicitly stating that securities were gold-denominated obligations [Edwards (2015)]. A government that finds itself short of gold to back the debt must raise taxes to acquire the gold and maintain the credibility of the gold parity [Bordo and Kydland (1995)]. By leaving the gold standard, the U.S. government was free to declare any rate of conversion it desired. In the event, the dollar-price of gold went from $20.67 an ounce in January 1933 to $35.00 an ounce with passage of the Gold Reserve Act at the end of January 1934. Because the conversion rate itself was a policy choice, U.S.

[1] That reference price level was fluid. At times Roosevelt wanted to return prices to their 1929 level; at other times, it was their 1926 level. Fisher (1934, ch. VI) thoughtfully discusses how to arrive at a "just" level that balances the losses of borrowers and creditors.

[2] The full quotation from Roosevelt (1936c) is: "Our policy is succeeding. The figures prove it. Secure in the knowledge that steadily decreasing deficits will turn in time into steadily increasing surpluses, and that it is the deficit of today which is making possible the surplus of tomorrow, let us pursue the course that we have mapped."

government securities were both denominated in dollars and payable in dollars: the need to have sufficient gold reserves on hand to back these securities was no longer binding. Edwards (2015) recounts how on June 2, 1933 the U.S. government sold, for the first time in fifteen years, securities without a clause linking debts to the official price of gold. A few days later on June 5, 1933, Congress issued a Joint Proclamation abrogating the gold clause on all future and past public and private contracts signaling that the abandonment of the gold standard was hardly a temporary endeavor.[3]

Roosevelt's decision to leave the gold standard and reflate arose against a backdrop of a 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 the gold standard at the existing parity.[4] To avoid capital losses from the banking panic, foreign depositors in U.S. banks liquidated their dollar balances and converted them to gold, pushing gold reserves close to their statutory minimums, particularly at the New York Fed. The New York Fed would have had to raise its discount rate in the middle of a banking panic to attract gold from abroad to rectify dwindling gold reserves. To avoid further strain on the beleaguered financial sector, Senator Elmer Thomas advocated issuing unbacked currency to raise the price level to its 1920s 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.

Those realignments were echoed by a camp of economists who were agitating 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—lower asset prices, higher real interest rates, contraction of bank deposits, decrease in profits, reduction in output, rising unemployment, bank runs, and so on—driving the economy into depression. Viewing the 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) wrote, "No one is happier than I over the prospect of the passage of the reflation legislation," referring to the Agricultural Adjustment Act, which included the Thomas Amendment giving the president unprecedented powers to reflate. Warren, though, had the ear of the president. Even before Roosevelt was inaugurated, Warren characterized the new president as choosing between "...a rise in prices or a rise in dictators."[5] Pearson, Meyers, and Gans (1957, p. 5598), a detailed description of Warren's role in Roosevelt's inner circle, begins with the unequivocal, "George F. Warren was the first person who ever advised a President of the United States to raise the price of gold."

Keynes (1931) 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." Although today "Keynesian stimulus" often is

[3]see Edwards, Longstaff, and Marin (2015) for a discussion of the implications of the abrogation of the gold clause from U.S. debt.

[4]This exposition draws on Eichengreen (1992), particularly chapter 11.

[5]This quotation is found in Rauchway (2014, p. 4), which lays out Warren's influence in context. See also Sumner (2001).

narrowly construed to refer only to higher spending or lower taxes, Keynes's emphasis in this letter is on "governmental loan expenditure" as "the only sure means of obtaining quickly a rising output at rising prices." We interpret Keynes as prescribing an unbacked fiscal expansion: nominal debt-financed deficits with no promise to raise future taxes to pay off the debt.

The unbacked fiscal expansion interpretation of the recovery of the Great Depression also accounts for the increase in the money supply as banks substituted loans for government bonds as backing for demand deposits after the banking panic in early 1933. Gross debt outstanding grew on average at a six percent annualized rate from the end of 1929 through March 1933. For the rest of 1933, debt grew at an 18 percent annualized rate on average. Member banks of the Federal Reserve System increased their holdings of U.S. government securities by 10 percent a year from December 1932 to December 1933, suggesting that banks absorbed a substantial share of the newly issued debt.

After describing how this thesis connects to existing explanations of the recovery, the paper pulls together empirical facts about the U.S. economy from 1920 to 1940. We devote special attention to a set of new facts about fiscal policy: primary budget surpluses, market and par values of U.S. government debt, rates of return on the government bond portfolio, and the decomposition of surprise changes in real return on the portfolio into parts due to inflation and bond prices. The paper explains how this casual evidence supports an unbacked fiscal expansion interpretation.

The paper then uses a simple model of price level determination, integrating gold, monetary, and fiscal policies. The model establishes that an unbacked fiscal expansion requires sacrificing either gold parity or failing to meet gold-cover ratio limits. By eliminating gold-cover ratio requirements, which permits a substantially higher dollar price of gold, it is possible to adopt a monetary-fiscal mix—weak response of the policy interest rate to inflation and exogenous surpluses—amenable to significant fiscal expansion. Under those policies, an exogenous increase in the primary deficit, financed by nominal debt, raises the price level, the monetary base, and the monetary gold stock.

With the theory's predictions to inform empirical interpretations, the paper estimates an identified monthly VAR over the unbacked fiscal expansion period, April 1933 to June 1940. Shocks to primary deficits generate dynamics that match the theory well, but with the additional finding that real GNP rises. These shocks turn out to explain substantial fractions of the error variances of key variables. Counterfactuals that shut down all but primary surplus shocks show that fiscal deficits pushed up the price level and output until about 1938; then the shocks reduced both variables.

We do not claim that Roosevelt consciously engineered an unbacked fiscal expansion. Nor do we believe that he had in mind the precise economic mechanisms that we identify as the source of the recovery. 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 to sterilize gold inflows, which permitted the monetary base to grow without government indebtedness for monetary reasons.

2 Contacts with Literature

Our argument that the *joint* monetary-fiscal mix that underlies an unbacked fiscal expansion was the source of the recovery in the 1930s contrasts with existing explanations which attribute diminished roles to both monetary and fiscal policy. Existing 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 is in broad agreement with many of these arguments, but links them to the monetary and fiscal policies of the 1930s.

With the expansion of nominal government debt at the center of our interpretation of the recovery, our work contrasts sharply with the widespread perception that fiscal policy contributed little to the recovery. This perception grew largely from studies that observe fiscal deficits were small relative to the output gap the Great Depression produced. Based on calculations of policy multipliers and observed paths of policy instruments, Romer (1992, p. 781) concludes, "Fiscal policy . . . contributed almost nothing to the recovery before 1942."[6] Eichengreen (2000) emphatically summarizes the consensus view: "Monetary policy, not fiscal policy, was the force behind recovery from the Depression." Here Eichengreen is referring to interest-rate policy and active management of the money supply. These perspectives on fiscal policy overlook the intertemporal dimensions of fiscal financing and focus narrowly on fiscal multipliers of various sorts. That narrow focus neglects the role rapid growth in nominal debt may have played in reflating the economy.

Another distinction concerns the view that monetary policy made no substantive contribution to the recovery. Friedman and Schwartz (1963), for example, conclude—in contrast to Eichengreen—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."

We argue that the Fed, by pegging short-term interest rates throughout the 1930s, pursued a policy permitting an unbacked fiscal expansion to reflate the economy. Expansions in nominal debt that do not portend higher future taxes raise household wealth at prevailing prices and interest rates. Bond holders convert higher wealth into higher aggregate demand. Some of the increased demand shows up in aggregate price levels, but if prices do not adjust instantaneously, some demand raises real economic activity. By pegging interest rates, monetary policy prevents the nominal debt expansion from raising debt service enough to put debt on an explosive path, making fiscal policy unsustainable. Pegged rates also permit the price level to rise to bring the real market value of debt in line with the expected present value of the primary surpluses that back debt.[7] Federal Reserve policy performed the critical role of stabilizing government debt. Monetary and fiscal policy are equal partners in producing a successful unbacked fiscal expansion.

[6] Other studies, dating back to Brown's (1956) original work, arrive at similar conclusions. See also Chandler (1971), Peppers (1973), Beard and McMillin (1991), Raynold, McMillin, and Beard (1991), Steindl (2004), and Fishback (2010).

[7] This mechanism is described in detail in a growing literature that began with Leeper (1991), Woodford (2001), Sims (1994), and Cochrane (1999).

The economic consequences of the unbacked fiscal expansion that began in 1933 rationalize why, despite the outcry that expanding federal debt would threaten the U.S. government's creditworthiness, none of those fears were realized. As Studenski and Krooss (1952, p.428) put it

> In its early years, 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. The public credit did not collapse under the burden of increased public debt. On the contrary, government credit grew stronger, interest rates on new government borrowing declined steadily, and the Treasury found it increasingly easy to finance its operations.

The combination of higher inflation and higher economic growth that unbacked fiscal expansions spur ensures that an expansion of nominal debt does not transform into a higher debt-output ratio.

The consensus view is 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. We agree that these elements all contributed to the recovery, 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. Hausman (2013) provides evidence of Temin and Wigmore's hypothesis by showing that increased agricultural incomes bolstered auto sales in rural areas. Romer (1992), however, makes a forceful case that the dollar depreciation following the departure from the gold standard in late April 1933 cannot account for the sustained increase in inflation in subsequent years. We agree with Romer and point out—as do Jalil and Rua (2015)—that both Britain and France experienced similar depreciations in their currencies upon exit from gold, yet prices and output did not rise as in the United States.

We also agree with Eichengreen's (2000) general 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." Eichengreen, however, fails to mention that suspending convertibility of currency into gold completely changes the nature of price-level determination. Abandoning gold relaxed the requirement that real resources, such as gold, must back government debt. Once free from the gold standard's constraints, the government could choose whether to back debt with real resources, such as taxes, or with paper money.

Our work is complementary to Jalil and Rua's (2015) narrative evidence on the role of rising inflation expectations in the recovery of 1933, but aims to provide a rationale for those expectations grounded in the monetary-fiscal policy mix of the Great Depression. The argument differs from Eggertsson (2008), who emphasizes a regime change in "policy dogmas" from Hoover to Roosevelt and 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.[8]

[8]Leeper (1991) defines an active policy authority as free to pursue its objective, while a passive authority

Eggertsson's story rests on the coordinated action of monetary and fiscal policy to maximize household utility. In the presence of distortionary taxation, higher deficits provide an incentive for the Fed to keep interest rates low for an extended period of time, to manage the value of outstanding debt. Monetary policy mitigates the distortions of tax policy by committing to generate inflation when the Fed has the freedom to do so—that is, once the zero lower bound ceases to bind. In this way, the model generates the same stimulatory mechanisms of optimal commitment policy that Eggertsson and Woodford (2003) explicate. The difficulty with this interpretation of the recovery is the absence of evidence of explicit coordination, and, specifically, that monetary policy was conducted in a way that sought to diminish the effects of distortionary tax policy on the macroeconomy. The Fed frequently voiced concerns about the prospect of inflation, resulting from "imprudent" fiscal policy, early in Roosevelt's first term.[9] Marriner Eccles, after being appointed Fed Chairman in November 1934, viewed the role of monetary policy as maintaining the value of outstanding debt—consistent with the requirements of an unbacked fiscal expansion. It is unlikely his overriding concern was efficient taxation.

The history was not nearly as linear as our unbacked fiscal expansion interpretation makes it seem. Disparate viewpoints about the depression battled for "the soul of FDR," in Stein's (1996, ch. 6) memorable phrase. Those disparate views are nicely summarized in a 1932 "Memorandum" written by three young Harvard economists who denounced "the failure on the part of the government to adopt other than palliative measures" to combat the depression [Currie, White, and Ellsworth (2002, p. 534)]. Viewpoints Roosevelt contended with included: (1) economists who believe the depression cannot be stopped and any efforts to do so interfere with the "natural" functions of the economy; (2) those who believe the economy is so poorly understood that government efforts are likely to make matters worse; (3) some who adopt the view that depressions are cleansing and purge inefficiencies; (4) a group, like the Memorandum's authors, who "believe that recovery can and should be hastened thru [sic] adoption of proper measures."[10]

Roosevelt clearly sided with the fourth group, at least in the early years of the recovery. But as FDR grew increasingly uncomfortable with fiscal deficits, he began to backtrack on the unbacked fiscal expansion, a point that Jalil and Rua (2015) emphasize. That backtracking contributed to making the recovery incomplete and created the sharp recession in 1937–1938.

is constrained by the behavior of the active authority and optimizing private behavior. In conventional models, a determinate bounded rational expectations model requires either an active monetary policy with a passive fiscal policy or vice versa.

[9]After leaving his position as Fed Chairman on May 10, 1933, Eugene Meyer 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" [Meyer (1934)]. Adolph Miller, one of the original governors of the Federal Reserve System, who served until 1936, was vociferous in calling for a return to gold, fearing the discretion that underlies a "managed currency," which he called "human nature money" [Miller (1936, p. 4)].

[10]Two authors went on to play critical roles in policy: Currie at the Federal Reserve Board, Treasury and the White House; White at the Treasury where, together with Keynes, created the Bretton Woods system.

3 Empirical Facts

This section presents a variety of facts about the state of the U.S. economy throughout the 1920s and 1930s focusing on corroborative evidence that points towards interpreting the recovery as an unbacked fiscal expansion. In the figures that follow, we contrast the performance of economic variables during the "gold standard" (January 1920 to March 1933) to their behavior during the "unbacked fiscal expansion" (April 1933 to June 1940). Data are quarterly. Vertical bars in the figures at April 1933 mark America's departure from the gold standard.

3.1 Macroeconomic Indicators

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 United States abandoned the gold standard (right panel figure 1). Although consumer and wholesale prices rose through most of the 1930s, they never regained the 1920s target levels proposed by various policymakers.

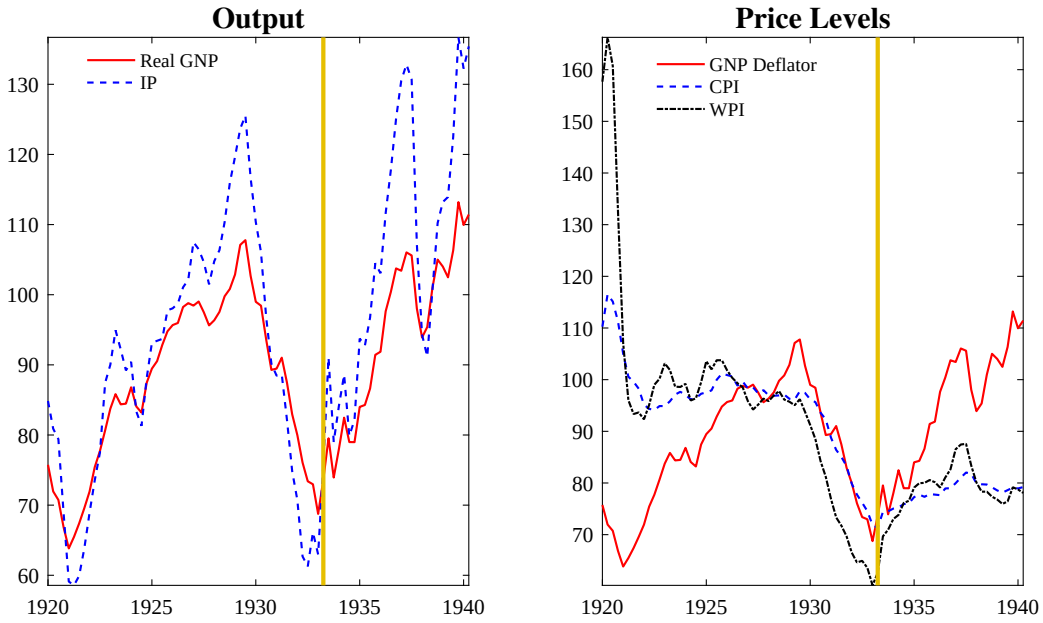

Figure 1: Measures of real economic activity and price levels. All series use 1926 base year. Vertical line marks when the United States abandoned the gold standard. Sources: Balke and Gordon (1986), Federal Reserve Board, BEA and BLS from NBER Macrohistory Database.

Like prices, output also plunged after the stock market crash and rebounded with the abandonment of the gold standard. The left panel of figure 1 shows that real GNP fell by roughly 25 percent from peak to trough, as measured on an annual basis. GNP hits its trough in the first quarter of 1933. Industrial production dropped 45 percent from peak to trough and, like consumer and wholesale prices, began a sustained recovery in April 1933. Unlike those prices, GDP and industrial production eventually surpassed their pre-recession peaks later in the decade.

The left panel of figure 2 shows the dollar-sterling and dollar-franc exchange rates. The first vertical line marks when the United Kingdom left gold in September 1931, which triggered a very large dollar appreciation that was reversed in April 1933. Note that sterling's depreciation against the dollar is roughly comparable to its subsequent appreciation.

The figure's right panel plots the level of the GNP deflator along with two interest rates—the commercial paper rate for New York and the New York Fed's discount rate. Although during the gold standard period 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. For example, in October 1931, concerns about gold outflows induced most Federal Reserve Banks to raise their discount rates after Britain left the gold standard, even though prices were in free fall. The Federal Reserve banks aimed to mitigate gold outflows resulting from the appreciation of the dollar vis-à-vis the pound. Meltzer (2003, p. 280) claims that Federal Reserve policy decisions were mostly consistent with the Riefler-Burgess and real bills doctrines.[11] But these interest-rate hikes were clear attempts by the Federal Reserve to follow the gold standard's "rules of the game" [p. 273].

After the abandonment of the gold standard in April 1933, the Federal Reserve pegged interest rates near zero. Meltzer (2003, p. 413) notes that the Federal Reserve made few changes to the market portfolio and discount rate from 1933 to 1941. If anything, rates moved against the price level, so the Fed was certainly not following what today we might call a price-level target. This raises the theoretical question of how the price level was determined after America left the gold standard. Eggertsson (2008) claims that Fed policy anchored expectations on the belief that once monetary policy exited the zero lower bound, it would follow a now-standard active monetary/passive fiscal policy mix. These beliefs can, in principle, uniquely determine the price level.

The top panel of figure 3 plots the monetary base and the monetary gold stock and the bottom panel plots the gold cover ratio. Monetary aggregates fell in the early 1930s as financial unrest lead to contractions in deposits and cash hoarding by the public. Table 1 reports that total deposits in all banks fell 30 percent between 1929 and the low point in 1932–33. Deposits bounced back to their pre-depression levels by 1937. 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.

The large jump in gold stock and the ratio in 1934 stem from the revaluation of gold to $35 an ounce. Steady increase in the two monetary measures during the unbacked fiscal expansion period reflects the Roosevelt Administration'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 more details on sterilization).

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

[11] Meltzer (2003, p. 282) elaborates that under the Riefler-Burgess framework, policymakers focused on borrowed reserves and short-term market interest rates as key signals of bank demand.

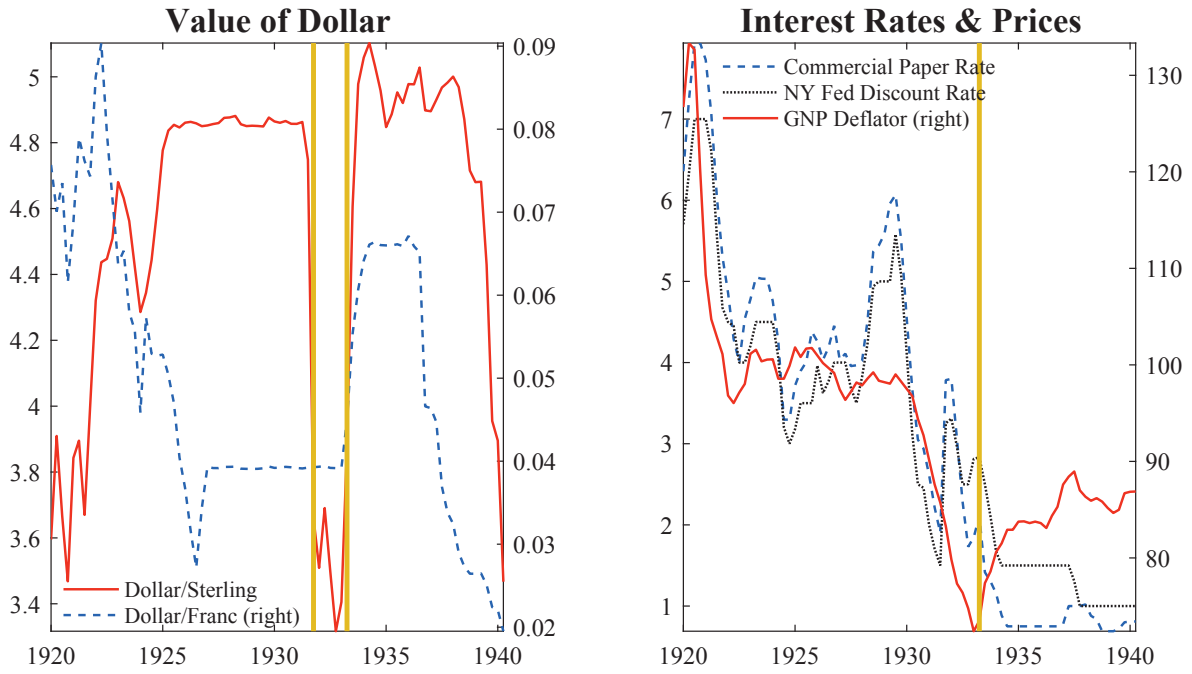

Figure 2: Exchange rates, inflation, and interest rates. Exchange rates in dollars per foreign currency; inflation is annual (quarter over four quarters prior). First vertical line marks when the United Kingdom abandoned the gold standard; second line marks when the United States abandoned the gold standard.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

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.

Official revaluation of gold in January 1934 increased the cover ratio sharply and it remained close to 0.90 for the remainder of the decade. Gold no longer constrained policy behavior as it had before April 1933, a point that is central to the theory of an unbacked fiscal expansion presented in section 4.4.

3.2 Policy Behavior

Many authors have noted that adherence to the gold standard imposed severe constraints on monetary and fiscal policies by focusing policy authorities on international considerations at the expense of domestic conditions [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."[12]

Figure 4 illustrates precisely the constraint on monetary policy that Eichengreen has

[12] Apropos of fiscal policy under the gold standard, when government debt is effectively real, is the Eichengreen statement: "Deficit spending could not be used... if deficit spending could not be financed."

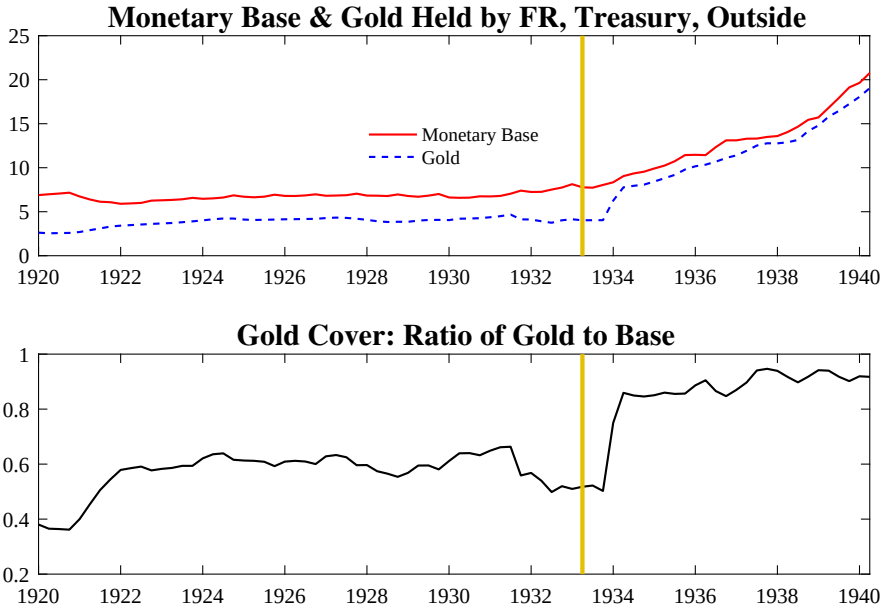

Figure 3: Monetary base and gold held by Federal Reserve Banks. Vertical line marks when the United States abandoned the gold standard. Source: Federal Reserve Board (1943) from NBER Macrohistory Database.

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

in mind. Dashed lines are interest rates and the solid line is the growth rate of the gold stock. A shrinking gold stock usually induced Federal Reserve Banks to raise interest rates to attract gold from abroad, which arrived with a lag. And when Federal Reserve Banks lowered interest rates, gold would flow out of the United States. But in the 1920s, as figure 2 shows, these interest-rate movements occurred in the face of a steadily falling price level. The Fed's actions were designed to stabilize exchange rates at the expense of domestic prices.

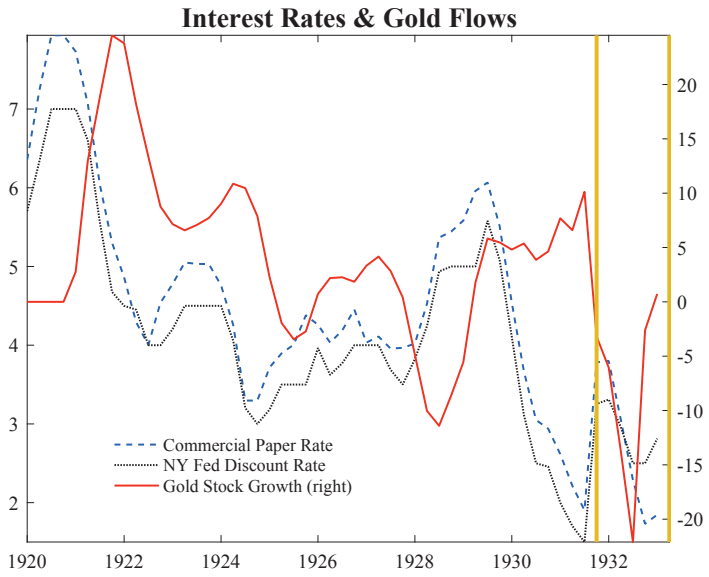

Figure 4: Interest rates and growth rate of monetary gold stock. Growth rate annual (quarter over four quarters prior). The vertical line marks when the United Kingdom abandoned the gold standard. Sources: Federal Reserve Board (1943).

Our interpretation of the 1930s recovery relies on a joint monetary-fiscal policy mix that was possible only after abandoning the gold standard. The top panel of figure 5 plots three measures of the federal budget surplus: gross, primary, and "ordinary," defined as total receipts less what are labeled "ordinary" expenditures. All three measures of deficits as a share of GNP deteriorated sharply as economic activity contracted in the early 1930s. Falling surpluses stemming from declining revenues due to lower corporate and income tax receipts and rising expenditures due to increased public works spending.[13] Although Roosevelt touted the evils of deficits and was more outspoken than President Herbert Hoover in his promise to cut expenditures, until the second half of the decade he did little to convert primary deficits to primary surpluses.[14]

Deficits remained sizeable until 1936, despite growing receipts from 1934 onward [table 2]. To reassure the public that fiscal finances were "sound," Roosevelt's Treasury drew a clear line between "ordinary" and "emergency" government expenditures. With the exception of 1936, when large veterans' bonuses were paid out, Roosevelt could claim that he balanced the "ordinary" budget [figure 5]. The bottom panel of the figure plots the primary surplus excluding and including seigniorage revenues: evidently, seigniorage did not make significant dents in the budget deficit.

Two insights about Roosevelt's fiscal strategy emerge from the distinction between the two types of expenditures. First, Roosevelt harbored mixed feelings about fiscal deficits, but in the face of precipitous declines in tax receipts, he argued that "To balance our budget in 1933 or 1934 or 1935 would have been a crime against the American people" [Roosevelt

[13]Stein (1996, p. 25), Studenski and Krooss (1952, p. 359), and Garbade (2012, p. 2).

[14]Stein (1996, p. 87) notes that, at least initially, Roosevelt was able to "rise above" his belief in reducing expenditures to do what he considered necessary which was increasing spending.

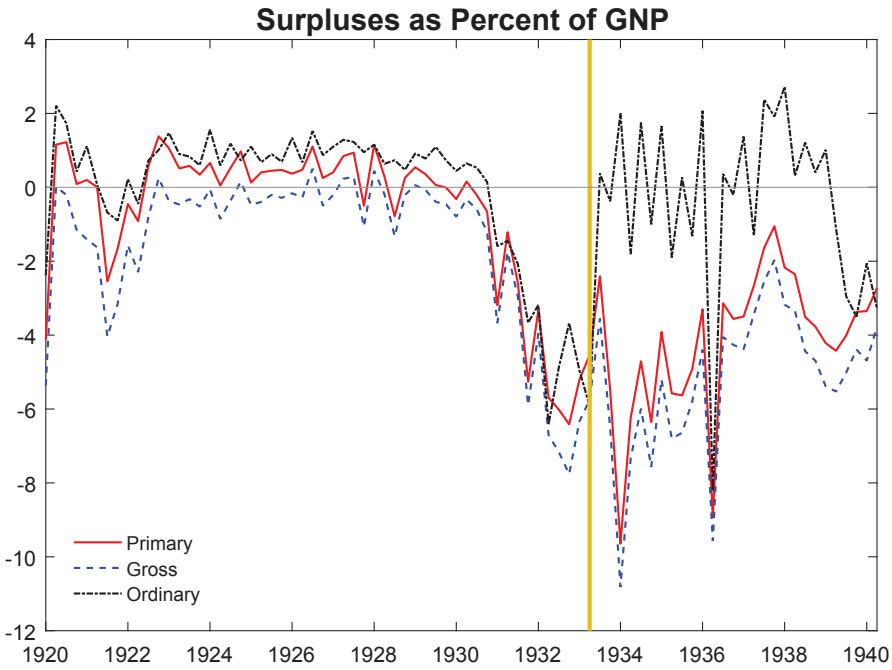

Figure 5: Surpluses defined as total receipts less expenditures, ordinary or total. Primary surplus is gross surplus less net interest payments. Seigniorage is defined as $(M_t - M_{t-1})/P_t$ where M is monetary base and P is the GNP deflator. Vertical line marks when the United States abandoned the gold standard. Sources: Federal Reserve Board (1943) from NBER Macrohistory Database, and Balke and Gordon (1986). See Appendix A for more details on the data series.

(1936b)]. At the same time, candidate Roosevelt was known for his "Pittsburgh pledge" to balance the budget by reducing expenditures [Roosevelt (1932)].[15] Six days after taking office, Roosevelt sent to Congress a proposal to cut federal spending by an amount equal to nearly 14 percent of total expenditures. Cuts eliminated government agencies, reduced federal worker pay, and, most critically in light of the politics of the time, shrank veterans' benefits by half. In the event, when the Economy Act of 1933 was finally signed into law, the spending cuts amounted to a little under 7 percent of expenditures. Politically, though, the legislation helped establish the president's bona fides as a "sound finance" man.

Second, FDR viewed the emergency expenditures as both essential and temporary. As Rosen (2005, p. 85) reports, in response to budget director Lewis W. Douglas's argument that the only way to project a balanced budget in 1936 was to cut spending, Roosevelt

[15]Roosevelt's conflicted feelings about budget balancing are revealed in remarks he made at an early press conference: "Yes, it depends entirely on how you define the term, 'balance the budget.' 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 (1933a, pp. 13–14)

replied, "No, I do not want to taper off [spending programs] until the emergency is passed."

These insights are consistent with the argument that FDR intended to run debt-financed deficits until the economy had recovered sufficiently. But they also portend a lack of single-mindedness, which resulted in Roosevelt supporting legislation in 1935 and 1937 to increase revenues, ultimately ending the period of unbacked fiscal expansions until World War II spending ramped up.

	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 2: 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).

Emergency expenditures drove budget deficits. Before 1934, non-ordinary expenditures consisted entirely of debt retirements. From 1934 to 1939, monthly expenditures were classified as general or emergency, where emergency spending was associated with relief measures under the New Deal. Annual Treasury reports retroactively categorize emergency expenditures only back to 1933 [see appendix A.2 for details]. Figure 6 (top panel) shows that emergency expenditures rose dramatically during Roosevelt's first year in office before falling back to an annual average of $3.4 billion per year until the end of 1939.

Emergency expenditures are strongly correlated with real GNP growth and inflation during the unbacked fiscal expansion period. Figure 6 (bottom panel) reports rolling correlations between emergency expenditures as a share of GNP and those two macroeconomic aggregates. Contemporaneous correlations are computed with a fixed rolling window of 28 quarters, beginning with the sample 1920Q1–1926Q4 and ending with the sub-period 1933Q3–1940Q2. Correlations early in the sample, therefore, reflect the fact that debt retirement is uncorrelated with inflation and economic growth. But as the window moves forward in time, emergency expenditures increasingly reflect New Deal spending on relief and those expenditures are very strongly linked to inflation and real GNP growth.

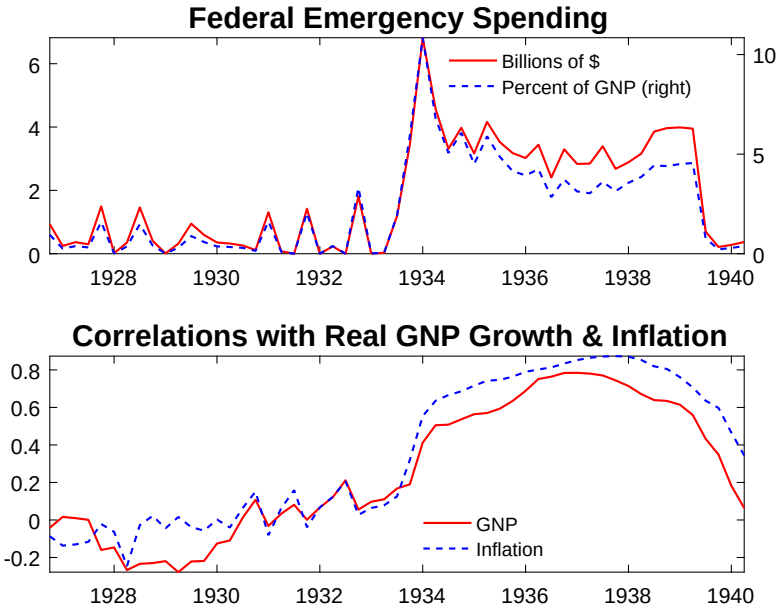

Figure 6: Emergency expenditures are total expenditures in excess of ordinary expenditures. Rolling correlations between inflation and real GNP growth and emergency federal expenditures as a share of GNP computed over a seven-year window. Source: Authors' calculations.

3.3 Developments in Government Debt

To interpret data related to the government's bond portfolio, we require some notation.[16] With a complete and general maturity structure, the government's budget identity is

$$\sum_{j=0}^{\infty} \left(Q_t^D(t+j) + IP_t(t+j)\right) B_{t-1}(t+j) = P_t s_t + \sum_{j=1}^{\infty} Q_t^D(t+j) B_t(t+j) \tag{1}$$

where $Q_t^D(t) \equiv 1$ and $IP_t(t+j)$ is the interest payable on bonds outstanding at t that mature in $t+j$. $Q_t^D(t+j)$ is the dirty price of bonds, defined as the clean price plus accrued interest.

The market value of debt outstanding in period t is

$$P_t^M B_t^M \equiv \sum_{j=1}^{\infty} Q_t^D(t+j) B_t(t+j) \tag{2}$$

so the budget identity may be rewritten as

$$R_t^M P_{t-1}^M B_{t-1}^M = P_t s_t + P_t^M B_t^M \tag{3}$$

or, in real terms

$$r_t^M P_{t-1}^M b_{t-1}^M = s_t + P_t^M b_t^M \tag{4}$$

[16] Appendix A.3 details the definitions and calculations that follow.

where $b_t^M \equiv B_t^M/P_t$ is the real par value of debt outstanding at t. The nominal and real rates of return on the portfolio—R_t^M and r_t^M—reflect *ex-post* returns.

With B_t^M the par value of debt and $P_t^M B_t^M$ the market value, $P_t^C B_{t-1}^M$ is the carry-over market value of debt. The growth rate in the market value of debt may be written as

$$\frac{P_t^M B_t^M}{P_{t-1}^M B_{t-1}^M} \equiv \underbrace{\frac{P_t^C B_{t-1}^M}{P_{t-1}^M B_{t-1}^M}}_{\substack{\text{nominal} \\ \text{rate of return}}} \cdot \underbrace{\frac{P_t^M B_t^M}{P_t^C B_{t-1}^M}}_{\text{size ratio}} \tag{5}$$

where P_t^C, defined in the appendix, reflects intermediate coupon payments and is the carry-over price of the portfolio. The first ratio on the right side of (5) is the nominal return, R_t^M, in (3). An *ex-post* real return simply deflates the nominal return by the inflation rate between $t-1$ and t to give r_t^M in (4).

The surprise component in the real return on the bonds portfolio is

$$\eta_t \equiv r_t^M - E_{t-1} r_t^M \tag{6}$$

This innovation can be decomposed into surprise capital gains and losses on the bond portfolio due to inflation and bond prices as

$$\eta_t = R_t^M \underbrace{(1/\pi_t - 1)}_{\text{due to price level}} + R_t^M \underbrace{\left(\frac{\sum_{j=1}^{\infty} \big(Q_t(t+j) - Q_{t-1}(t+j)\big) B_{t-1}(t+j)}{P_t^C B_{t-1}^M} \right)}_{\text{due to bond prices}} \tag{7}$$

Because η_t is the surprise revaluation on bonds carried into period t, its dollar magnitude is given by $\eta_t P_{t-1}^M B_{t-1}^M$. We gage the quantitative importance of these revaluations by computing them as a percentage of the market value of debt at the end of period t, $P_t^M B_t^M$.

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 in office. For comparison, in the seven fiscal years since the financial crisis in 2008, U.S. gross federal debt increased by a factor of 1.8.

The left panel of figure 7 plots index numbers for nominal and real federal debt. Taken together, the two panels highlight central features of unbacked fiscal expansions: despite increases in nominal debt, real debt rises less dramatically and there may be no increase at all in debt as a share of income. The index equals 100 in 1932Q2 to 1933Q1, the year leading up to America's departure from the gold standard. After declining for a decade, nominal debt began to rise in 1931, while real debt started to increase a year earlier, due to deflation. From 1933Q2 until 1940Q2, the par value of nominal debt rose 112 percent, while real debt rose 82 percent. The ratio of these indexes reached its nadir when the country left gold and then rose 19 percent by 1940Q2, but 22 percent just before the 1937–1938 recession. Those changes in the ratio measure how much debt was devalued by a higher price level.[17]

More striking is the right panel of the figure. The debt-GNP ratio, whether measured at par or market value of debt, rose sharply from 15 percent in 1930 to 42 percent at the time gold was abandoned. Then it hovered around 40 percent for the next six years, until the

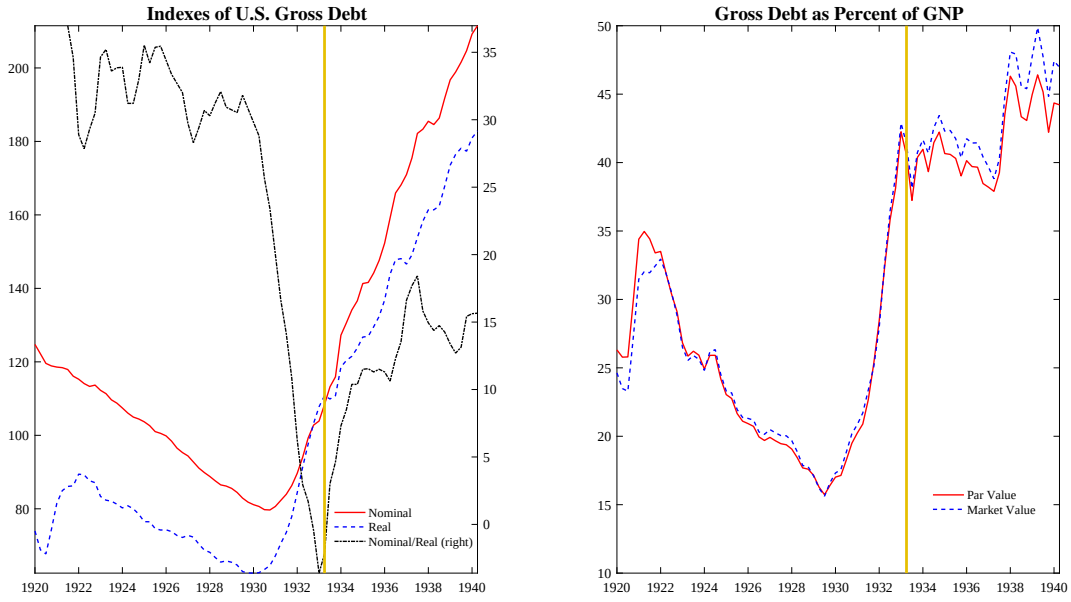

Figure 7: Par value of U.S. gross debt, real debt is par value deflated by GNP deflator. Converted to index numbers 100=1932Q2–1933Q1 (year before departure from gold standard). Nominal/Real is ratio of the two index numbers converted to percent. Par and market values of debt as percentage of nominal GNP. Vertical line marks when the United States abandoned the gold standard. Sources: Authors' calculations, Balke and Gordon (1986).

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

Table 3: Summary of returns on government bond portfolio at monthly and annual rates.

recession raised the ratio. In the last few years of the decade, when Roosevelt abandoned the unbacked fiscal expansion policy, the debt-GNP ratio rose.

Revaluation effects on nominal debt are a distinct feature of an unbacked fiscal expansion. An unanticipated increase in the primary deficit, financed by new bond issuance, does not trigger the expectation of higher surpluses in the future. The new bonds raise household nominal wealth and spending. Higher spending raises both the price level and production; the degree of nominal stickiness in the economy determines the precise split between the two. The maturity structure of government debt, together with how monetary policy reacts to the higher inflation, play a central role in the resulting inflation dynamics [Cochrane (2001), Leeper and Walker (2013), Sims (2013), Leeper and Leith (2017)].

Several patterns emerge from returns data in table 3. First, nominal returns are comparable across the gold standard and unbacked fiscal expansion period.[18] Second, 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 percent).[19] These patterns are fully consistent with surprise inflation devaluing government debt during Roosevelt's administration.

A key feature of an unbacked fiscal expansion is that exogenous declines in surpluses, financed by nominal debt issuance, lead to revaluation of government debt through surprise increases in inflation and declines in bond prices [Leeper and Leith (2017)]. Sims (2013) computes surprise capital gains and losses on U.S. government bonds since World War II to argue that these revaluation effects are important—the same order of magnitude as annual fluctuations in primary surpluses. And Sims (2013), Leeper and Zhou (2013), and Leeper and Leith (2017) show that surprise revaluations of debt are a generic feature of any equilibrium produced by jointly optimal monetary and fiscal policies in the presence of distorting taxes and long-term debt.[20]

Figure 8 plots the nominal and real rates of return on the government's bond portfolio (top panel) and the one-month-ahead surprise change in the real return. Not surprisingly,

[17] These numbers are nearly identical when measured in terms of the market value of debt.

[18] Return data start in 1926, so "gold standard" refers to 1926Q1 to 1933Q1.

[19] Romer (1992, p. 778) estimates the *ex-ante* real commercial paper rate to find that it is negative nearly the entire unbacked fiscal expansion period except the 1937–1938 recession.

[20] Of course, *any* stochastic model with monetary and fiscal policy in which inflation and interest rates fluctuate will generate revaluation effects. This holds regardless of the monetary-fiscal policy regime, so merely finding revaluation effects during the recovery of the 1930s does not imply that the United States experienced an unbacked fiscal expansion. Such an inference requires identifying assumptions, which we turn to in section 5.

ex-post real returns were high during the deflation in the years before leaving gold and far lower once inflation picked up. But the bottom panel shows that surprise devaluations of the bond portfolio—η_t defined in (6)—were a distinct feature of the unbacked fiscal expansion period.[21]

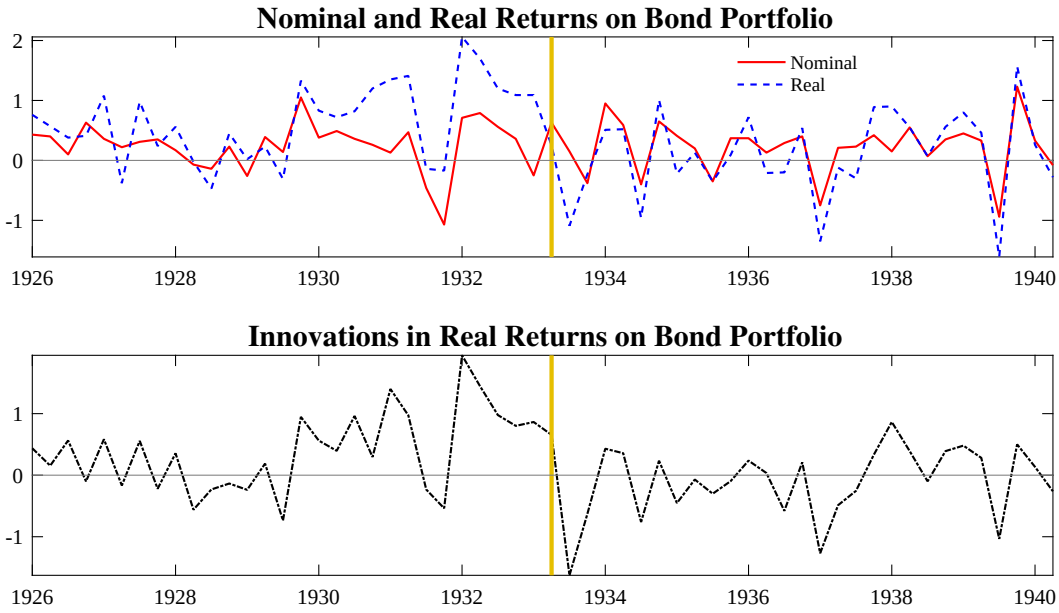

Figure 8: Quarterly averages of nominal and real net monthly returns on federal government bond portfolio and one-step-ahead unanticipated real monthly returns. See appendix A.3 for details. Vertical line marks when the United States abandoned the gold standard. Source: Hall and Sargent (2015), CRSP, and authors' calculations.

Surprise real returns on government debt are quantitatively important. Figure 9 shows that as a percentage of the market value of outstanding debt, these revaluations are quite large. These revaluations are about as large a fraction of debt as primary surpluses, making revaluations a central feature of fiscal financing. The figure also makes clear that after leaving the gold standard, these revaluations are both large and frequently negative.

The decomposition of surprise real returns, graphed in figure 10, confirms that before leaving the gold standard, high surprise real returns were driven by surprisingly low inflation. 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. In the period of unbacked fiscal expansions, again with the exception of the jump in early 1938, surprise devaluations of debt due to inflation dominate the surprise real returns.

The last informal piece of empirical evidence about the unbacked fiscal expansion appears in figure 11, which plots the relative price of the bond portfolio. This relative price is computed as the real market value of debt over the par value of debt, which yields P_t^M/P_t,

[21] Inspection of figure 8 may suggest that $\eta_t = r_t^M - 1$ indicating that innovations in real returns on the bond portfolio are a linear transformation of real returns. Appendix A.3 shows that when taking into consideration coupon payments and accrued interest, $\eta \neq r_t^M - 1$.

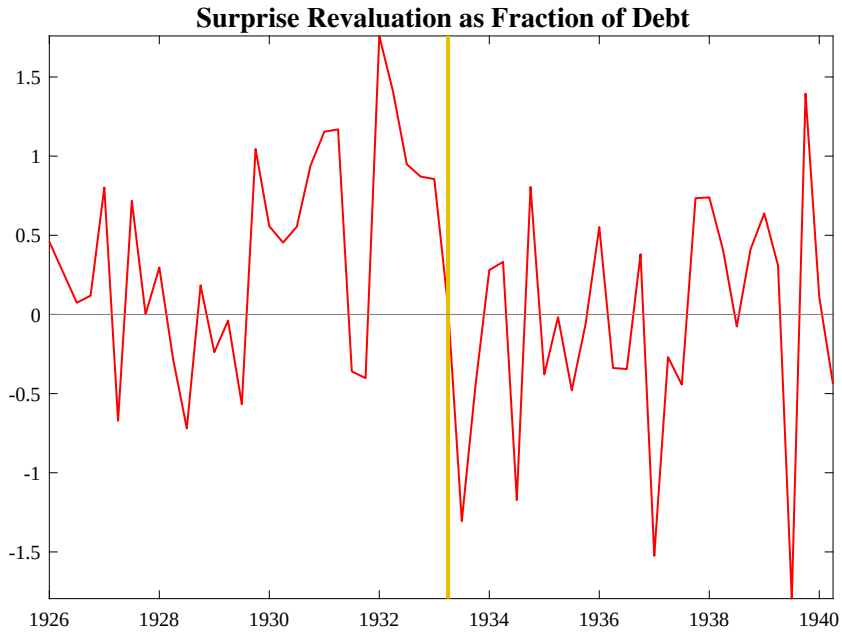

Figure 9: Surprises in real returns on bond portfolio as percentage of market value of outstanding debt, computed as $\eta_t P^M_{t-1} B^M_{t-1} / P^M_t B^M_t$. See appendix A.3 for details. Vertical line marks when the United States abandoned the gold standard. Source: Hall and Sargent (2015), CRSP, and authors' calculations.

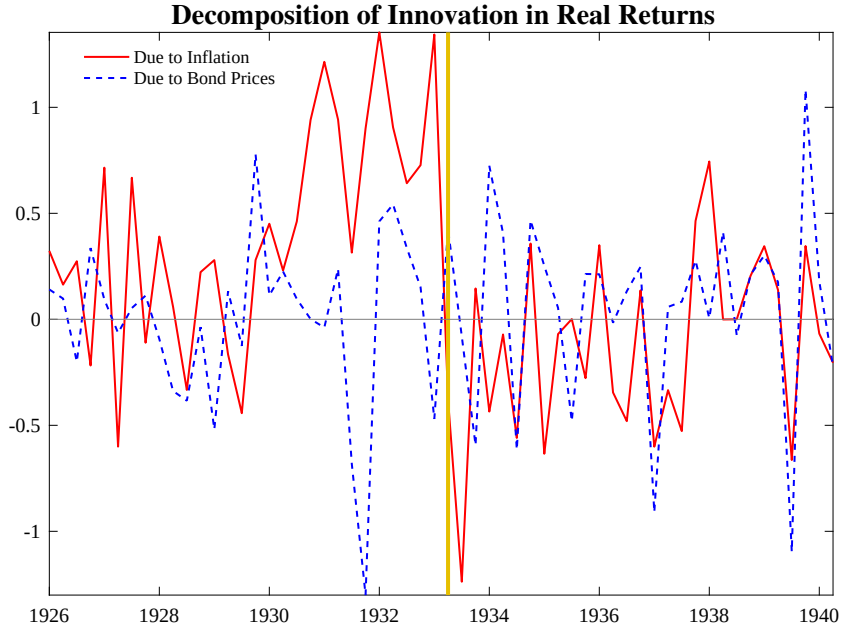

Figure 10: Decomposition of surprises in real returns on bond portfolio into components due to unanticipated inflation and unanticipated bond prices. See appendix A.3 for details. Vertical line marks when the United States abandoned the gold standard. Source: Hall and Sargent (2015), CRSP, and authors' calculations.

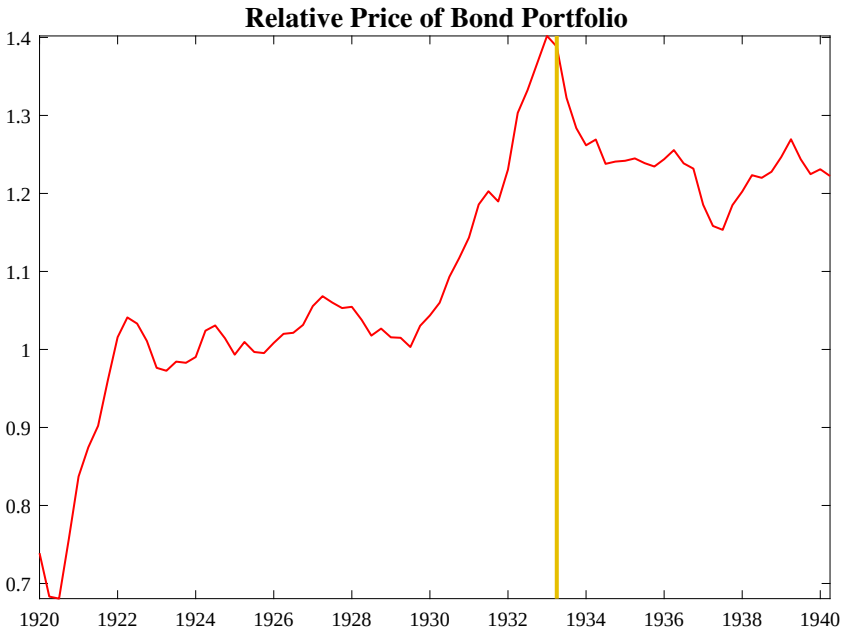

Figure 11: Relative price of the bond portfolio is the ratio of the real market value of debt to the par value of debt, roughly equivalent to the real "price" of the bond portfolio. Vertical line marks when the United States abandoned the gold standard. Source: authors' calculations.

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 1937–1938 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.

This informal presentation of empirical facts aims to provide the backdrop for the more formal analysis that follows. Before turning to empirical estimates, we introduce a simple theoretical framework that delineates the monetary-fiscal mixes that are possible under a gold standard with a fixed parity to contrast those with feasible policies after abandoning gold. The central insight is unbacked fiscal expansions are possible under the gold standard but require policies that contradict the "rules of the game." Abandonment of the gold standard liberates fiscal policy.

4 A Model of the Gold Standard

This section develops insights into the interactions of monetary and fiscal policy under the gold standard. The basic modeling framework is taken from Goodfriend (1988), which is a Lucas (1978) asset-pricing model adapted to the gold standard as proposed by Barro (1979). The model aims to provide greater understanding of fiscal backing in a gold standard monetary regime and to deliver explicit conditions on the feasibility of an unbacked fiscal expansion.

4.1 Basic Environment

Household's maximize

$$E_t \sum_{T=t}^{\infty} U\left(C_T, M_T/P_T, G_T^p\right)$$

where

$$U\left(C_T, M_T/P_T, G_T^p\right) = u\left(C_T\right) + v\left(\frac{M_T}{P_T}\right) + \omega\left(G_T^p\right)$$

so that utility is additively separable over consumption, C_T, real money balances, M_T/P_T, and private holdings of gold, G_T^p. Choices over these sequences must satisfy the budget constraint

$$C_T + \frac{M_T}{P_T} + \frac{P_T^s B_T^s}{P_T} + \frac{P_T^l B_T^l}{P_T} + \frac{P_T^g G_T^p}{P_T} + T_T = Y_T + \frac{M_{T-1}}{P_T} + \frac{B_{T-1}^s}{P_T} + \frac{\left(1+\rho P_T^l\right) B_{T-1}^l}{P_T} + \frac{P_T^g G_{T-1}^p}{P_T}$$

where $R_T = 1/P_T^s$ defines the one-period interest rate, P_T^g the dollar price of gold, T_T lump-sum taxes, and Y_T the endowment, taken to be an exogenous process to be specified. In addition to money balances, households have access to nominal government debt markets: B_T^s and B_T^l are one-period and multiple-period instruments, with respective prices P_T^s and P_T^l. Following Woodford (2001), a long-term bond has pay-off structure ρ^{T-t-1} for all $T > t$. This portfolio then has average duration $(1-\beta\rho)^{-1}$.

Optimality implies four asset-pricing conditions

$$1 = \beta E_t R_t \frac{u'\left(C_{t+1}\right)}{u'\left(C_t\right)} \frac{P_t}{P_{t+1}} \tag{8}$$

$$1 = \beta E_t \frac{\left(1+\rho P_{t+1}^l\right)}{P_t^l} \frac{u'\left(C_{t+1}\right)}{u'\left(C_t\right)} \frac{P_t}{P_{t+1}} \tag{9}$$

$$\frac{u'\left(C_t\right)}{P_t} = \beta E_t \frac{u'\left(C_{t+1}\right)}{P_{t+1}} + \frac{v'\left(m_t\right)}{P_t} \tag{10}$$

$$u'\left(C_t\right) \frac{P_t^g}{P_t} = \beta E_t u'\left(C_{t+1}\right) \frac{P_{t+1}^g}{P_{t+1}} + \omega'\left(G_t^p\right). \tag{11}$$

which together with the flow budget constraint and transversality conditions completely characterize household behavior. The first and second conditions are standard Euler equations for short and long-term debt. The third and fourth relations price the assets real money balances and gold, which have service flows $v'\left(m_t\right)$ and $\omega'\left(G_t^p\right)$. Arbitrage between the two nominal assets—equations (8) and (10)—delivers the "liquidity preference schedule"

$$\frac{v'\left(m_t\right)}{u'\left(C_t\right)} = 1 - \frac{1}{R_t} \tag{12}$$

where $m_t = M_t/P_t$, to yield the usual money demand function in which demand for real money balances is increasing in consumption and decreasing in the nominal interest rate, which is the opportunity cost of holding money. Arbitrage between the two types of government debt forge an equilibrium relation between their respective prices.

The model is closed by a set of market clearing conditions and a description of policy. In addition to demand for money and bonds equaling their respective supply, the goods and gold markets require

$$C_t + F_t = Y_t$$

and

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

where F_t is government spending, G_t^m is gold used for monetary purposes, and G_t is the supply of gold. Government spending and the supply of gold are taken to be exogenous processes.[22] In subsequent discussion, one-period government debt is assumed to be in zero net supply.

4.2 The Log-linear Model and Policy

Before describing policy, take a log-linear approximation to the model in the neighborhood the deterministic steady state. This yields

$$R_t = E_t P_{t+1} - P_t + \sigma E_t \left(C_{t+1} - C_t\right) \tag{13}$$

$$\beta E_t P_{t+1} = \left[\varphi\left(1-\beta\right)+\beta\right] P_t - \varphi\left(1-\beta\right) M_t - \sigma E_t \left(\beta C_{t+1} - C_t\right) \tag{14}$$

$$P_t - P_t^g = \beta E_t \left(P_{t+1} - P_{t+1}^g\right) + \left(1-\beta\right)\kappa G_t^p - \sigma E_t \left(\beta C_{t+1} - C_t\right) \tag{15}$$

$$\begin{aligned}\left(B_t^l - P_t\right) = {} & \beta^{-1}\left(B_{t-1}^l - P_{t-1}\right) - \left(1-\rho\right) P_t^l - \beta^{-1}\left(P_t - P_{t-1}\right) \\ & -s^m\left(M_t - M_{t-1}\right) + s^G\left(G_t^m - G_{t-1}^m\right) + s^F F_t - s^T T_t\end{aligned} \tag{16}$$

$$P_t^l = \rho\beta E_t P_{t+1}^l - R_t \tag{17}$$

$$Y_t = s_C C_t + s_F F_t \tag{18}$$

$$G_t^p = \left(1+\theta^m\right) G_t - \theta^m G_t^m \tag{19}$$

with all variables now interpreted as deviations from steady state. and where we have defined: σ, φ and κ as the intertemporal elasticity of substitution for consumption, real money balances and private gold demand. The remaining parameters are the steady state ratios

$$s^M \equiv \frac{M}{P^l B^l};\ s^G \equiv \frac{P^g G^m}{P^l B^l};\ s^F \equiv \frac{PF}{P^l B^l};\ s^T \equiv \frac{PT}{P^l B^l}.$$

[22] By abstracting from the endogenous supply of output and gold the analysis provides clean analytical insight. In the case of output, the model can be thought of as a simple new Keynesian framework in the neighborhood of flexible-price equilibrium. Staggered-pricing would not alter the results, though would provide more realistic predictions about output. In the case of the gold supply, the assumption should be thought of as a reduced-form description of the consequences of world demand and supply of gold.

The model describes the evolution of nine endogenous variables

$$\{C_t, R_t, P_t, M_t, B_t, T_t, G_t^p, G_t^m, P_t^g\}$$

given the exogenous processes

$$\{Y_t, F_t, G_t\}$$

To the above six optimality and market clearing conditions we add a description of policy to close the model. There are three degrees of freedom. Throughout, assume that lump-sum taxes are described by the rule

$$T_t = \frac{\gamma_b}{s^T}\left(B_{t-1} - P_{t-1}\right) + \frac{s^G}{s^T}\left(G_t^m - G_{t-1}^m\right) - \frac{s^m}{s^T}\left(M_t - M_{t-1}\right) \tag{20}$$

Taxes are adjusted in response to the previous period's outstanding real debt, according to the policy parameter γ_b, and to facilitate any relevant adjustments in monetary gold and money supply using transfers, rather than debt issuance. The two remaining policy assumptions, along with any possible restrictions on the policy parameter γ_b, comprise the focus of the model analysis.

4.3 The Classical Gold Standard

To begin, consider the classical gold standard as Goodfriend defines it. This monetary regime comprises the following policy assumptions. First, the dollar price of gold is fixed, $P_t^g \equiv \bar{P}^g$, which to a log-linear approximation implies

$$P_t^g \equiv 0$$

Second, money supply is backed by the monetary gold stock in fixed proportion so that

$$\frac{\bar{P}^g G_t^m}{M_t} = \alpha$$

where α is called the cover ratio. To a log-linear approximation

$$G_t^m = M_t \tag{21}$$

Before discussing the dynamic properties of the model, the analysis addresses three questions. What are the properties of the model under this policy regime? What are the requirements for determinacy of equilibrium? What restrictions does a fixed gold price impose on tax policy?

Given the assumptions on gold policy, the asset pricing relations for money and gold define a linear relation between monetary gold, G_t^m, and the price level, P_t. This arbitrage relationship between money balances and gold holdings must hold in equilibrium, and takes the form

$$G_t^m = \frac{(\varphi - 1)}{\varphi + \kappa\theta^m} P_t \tag{22}$$

The correlation between goods prices and monetary gold depends critically on the elasticity of demand for real money balances, φ.

Substitution back into the money asset price equation gives

$$\beta E_t P_{t+1} = \left[\frac{(\varphi (1-\beta) + \beta) \kappa \theta^m + \varphi}{\varphi + \kappa \theta^m} \right] P_t$$

This relation, combined with the debt equation (16), gold policy (21), tax policy (20), and a log-linear approximation to the liquidity preference schedule (12) defines a system in the price level and government debt. Because debt is a pre-determined variable, determinacy requires one eigenvalue inside the unit circle, and one eigenvalue outside the unit circle. If tax policy satisfies

$$\gamma_b > \beta^{-1} - 1 \tag{23}$$

then debt dynamics are stable. This policy is called passive, since lump-sum tax policy adjusts to ensure the present discounted value of structural surpluses backs outstanding debt. It also delivers the fiscal backing required to maintain gold parity in the face of exogenous disturbances. If this restriction is not satisfied, for example if taxes are exogenous, then changes in government debt are not backed by changes in future taxation—this is an *unbacked fiscal expansion*. Then tax policy is active, and intertemporal solvency of the government imposes restrictions on other dimensions of policy, such as monetary or gold policies.

Given a passive fiscal policy that satisfies (23), the remaining eigenvalue must be outside the unit circle, requiring

$$\kappa \theta^m > 0 \tag{24}$$

which necessarily holds under maintained assumptions. Because of this, an unbacked fiscal expansion is not feasible under the classical gold standard. Tax policy must necessarily adjust to ensure intertemporal solvency of the government accounts. This theoretical insight underpins our notion of regime change: leaving the gold standard "liberated fiscal policy" in the words of Stein (1996, ch. 3).

The characterizations of policy as active or passive have direct analogues to standard models of monetary and fiscal policy, such as the canonical new Keynesian framework. Here there are three difference equations in the model: two forward-looking (in the gold and goods prices, both non-predetermined variables) and one-backward looking (in government debt, a predetermined variable). Three eigenvalues need to be pinned down by policy. Assume for the moment that fiscal policy is passive. The two unstable eigenvalues have to be suppressed by some combination of active policies. Under the gold standard P^g is fixed, so $P_t^g \equiv \bar{P}^g$ is a target criterion. This is a form of active policy for monetary gold that suppresses the unstable root in the gold price asset equation. Using (15) and (19), the target criterion defines the implicit instrument rule for monetary gold

$$\theta^m G_t^m = \frac{\beta}{(1-\beta)\kappa} E_t \left(P_{t+1} - P_t \right) + (1 + \theta^m) G_t$$

One unstable eigenvalue remains which is suppressed by the assumption of gold policy being dictated by a fixed cover ratio, which makes G^m and M proportional. Policy requires monetary gold stocks to be adjusted by a rule that moves one-for-one with money supply. This is an active rule for the money supply.

This discussion provides our first theoretical result.

Proposition 1. *Under the classical gold standard, a unique bounded rational expectations equilibrium requires passive fiscal policy. An unbacked fiscal expansion is not feasible.*

A further implication of this result regards the dynamics of interest rates and goods prices. Equilibrium determines these variables as functions of the exogenous processes for the endowment, fiscal spending and the gold supply. Under the classical gold standard neither goods prices nor interest rates can be stabilized—they necessarily respond to all model disturbances. Policy cannot independently adjust interest rates, preventing either the choice of an interest rate peg, or adjustments in the interest rate to facilitate equilibrium movements in monetary gold and the money supply.

Corollary 1. *Under the classical gold standard, goods prices cannot be fully stabilized and policy cannot independently determine the path of the nominal interest rate.*

4.4 A Pure Gold Standard and Alternative Gold Policies

The assumption of a fixed cover ratio clearly imposes a tight restriction on the evolution of endogenous variables, specifically monetary gold and the money supply. For an unbacked fiscal expansion to be feasible, this constraint must be relaxed. One possibility is to abandon entirely the requirement that money supply be backed by government holding of monetary gold. Goodfriend (1988) calls this a "pure gold standard." Another assumption on policy is now required. Suppose the central bank conducts interest rate policy according to

$$R_t = \gamma_p P_t$$

a form of Taylor rule in terms of the price level. Combined the with the debt Euler equation, and ignoring exogenous disturbance terms for simplicity, yields the difference equation

$$(1 + \gamma_p) P_t = E_t P_{t+1}$$

Once again, with the price of gold fixed, the model has one predetermined and one non-predetermined variable in the level of debt and prices. If fiscal policy is passive, so that restriction (23) holds, then determinacy of equilibrium requires

$$\gamma_p > 0$$

which constitutes active monetary policy and stabilizes the price level.

Of course, determinacy of equilibrium can also be obtained under the alternative assignment of policy, in which monetary policy is passive

$$\gamma_p \leq 0$$

and fiscal policy is active

$$0 < \gamma_b < \beta^{-1} - 1$$

This assignment implies unbacked fiscal expansions are feasible. This discussion is summarized by the following proposition.

Proposition 2. *Under a pure gold standard, unbacked fiscal expansions are feasible so long as monetary and fiscal policy satisfy* $\gamma_p \leq 0$ *and* $0 \leq \gamma_b < \beta^{-1} - 1$.

Unbacked fiscal expansions of the kind just characterized will likely imply counterfactual movements in the cover ratio to produce dynamics at odds with the usual "rules of the game" under a gold standard. One way to see this is to consider the following cover-ratio policy in the context of the classical Gold Standard model. The government seeks to implement

$$G_t^m - M_t = \alpha_t$$

where the cover ratio α_t is now time-varying. Suppose the desired cover ratio varies systematically with the monetary gold stock according to

$$\alpha_t = \gamma_g G_t^m$$

Analogous calculations to those used to derive (24) underlying proposition 1 imply goods price dynamics are given by

$$\beta E_t P_{t+1} = \left[\frac{(\varphi(1-\beta)+\beta)\kappa\theta^m + \varphi(1-\gamma_g)}{\varphi(1-\gamma_g) + \kappa\theta^m} \right] P_t$$

For an unbacked fiscal expansion to be feasible the eigenvalue of this expression must lie outside the unit circle. This occurs if and only if

$$\gamma_g > \kappa\theta^m + 1$$

The cover ratio must be sufficiently responsive to movements in monetary gold. Under this gold policy

$$M_t = (1-\gamma_g) G_t^m$$

which implies that money supply must *fall* in response to an increase in monetary gold. This is a surprising prediction. The "rules of the game" under what could be reasonably described as standard practice in a classical gold standard, dictate that the money supply change one-for-one with monetary gold. But an unbacked fiscal expansion requires not only that money supply should not increase one-for-one, but that it should decline in response to positive movements in monetary gold. This is not simply sterilizing the monetary consequences of increases in gold holdings, but rather actively reducing money supply in response to such developments.

Proposition 3. *Under a gold standard an unbacked fiscal expansion requires failure to comply with the "rules of the game."*

4.5 Gold Sterilization and Balanced Budgets: Discussion

Much commentary on the Great Depression underscores systematic failure to observe the rules of the game, with gold flows often sterilized throughout the 1920s into the earlier 1930s. Not until the height of the banking crisis in March 1933 was there serious concern that the Federal Reserve might not have inadequate reserves to support gold parity. And

even then this represented coordination failure amongst the Reserve Banks, with the New York Fed facing significant gold losses and unable to secure additional reserves from system Banks, principally the Chicago Fed.[23] In view of this, one might question the proposed notion of regime change: that going off the gold standard was required to liberate fiscal policy. Indeed, if no specific rule was in place governing the evolution of the cover ratio, then theoretical results underscore the feasibility of an unbacked fiscal expansion. Why didn't Hoover engineer an unbacked fiscal expansion to stimulate aggregate demand?

Our view, which is influenced by Eichengreen's (1992) analysis, is that much of the design and execution of policy evolved to ensure the credibility of the gold standard. Numerous examples of policy adjustment which appear questionable with hindsight—such as the increase in interest rates in the early 1930s and Hoover's insistence on raising taxes in 1932—can be understood only in this light. Policymakers regarded government debt as real debt, and therefore necessarily backed by current and future taxes. In the wake of the hyperinflations in Germany and France in the 1920s, the deleterious consequences of unsound fiscal policy underpinned a preference for balanced budgets, which may even have tilted in favor of deflation over inflation.

In the context of the model, a balanced budget policy, in which surpluses are sufficient to cover the interest cost of outstanding debt, is an example of a passive fiscal policy. As shown above, gold parity can be maintained without holding gold reserves, so long as monetary policy is set to determine the price level. Of course, the zero lower bound on nominal interest rates then becomes an important constraint. Moreover, as discussed in section 3, casual empiricism suggests Federal Reserve Banks were not adjusting interest rates in response to the price level throughout the gold standard period. This, and the additional requirement that fiscal policy would have to frictionlessly implement transfers to accommodate shifting portfolio demands of the private sector, make the maintenance of gold parity without gold reserves unlikely in historical context.

4.6 Model Dynamics under an Unbacked Fiscal Expansion

To inform subsequent empirical analysis, consider the model's impulse response functions under an unbacked fiscal expansion. Assume the gold price is fixed (it is largely irrelevant, although it would affect the dynamics of monetary and privately held gold when time-varying). Parameter values are reported in appendix B. The key assumptions are that monetary policy fails to satisfy the Taylor principle and taxes are completely unresponsive to outstanding debt.

Figures 12 and 13 show the effects of a serially correlated one-unit fiscal expenditure shock in the unbacked fiscal expansion regime. Higher spending, financed by nominal debt issuance and with no prospect of higher taxes or declining spending to pay off the debt, raises wealth. Bondholders seek to convert that wealth into consumption goods, raising demand and goods prices. Monetary policy raises the short-term interest rate less than one-for-one with inflation causing a capital loss on long-term debt as bond prices fall. The market value of debt declines slightly on impact, even though the par value rises to finance

[23]There may have been broader stress on the system earlier in the crisis, given the collapse of the commercial paper market and limited bills of exchange. For each $100 of reserves, the Fed was required to hold $40 in gold and $60 in eligible paper.

the increased expenditures. Concomitantly, higher nominal interest rates see a decline in real money demand and private gold holdings. The initial fall in the price of debt and in nominal money balances largely reflect interest rate policy: a weaker response to inflation attenuates these declines, with a pure interest rate peg giving a constant bond price and a rise in money balances equal to the initial price rise.

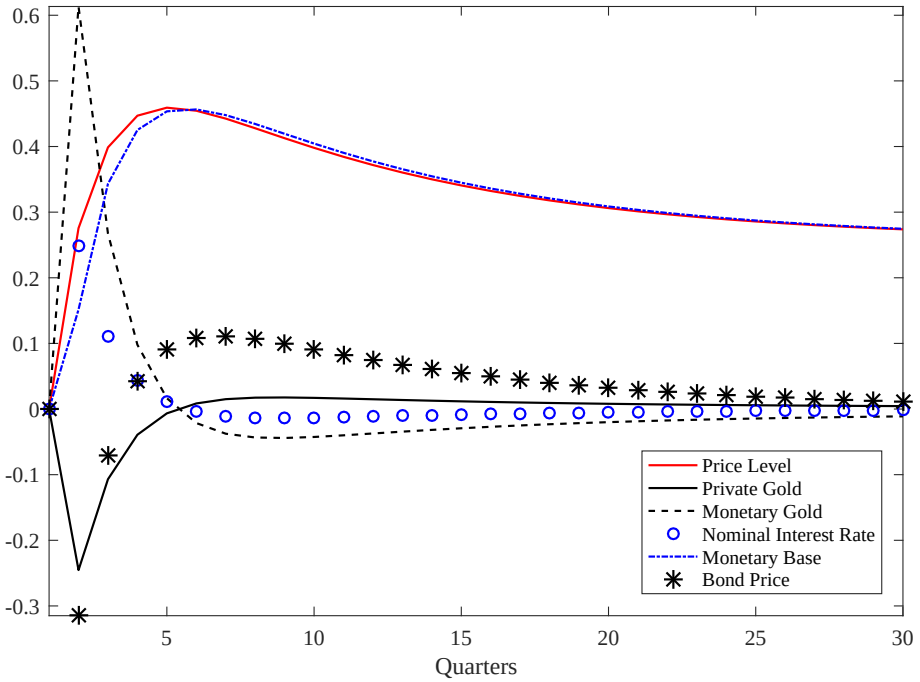

Figure 12: Theoretical responses to a surprise increase in government purchases.

Over time, the price level rises for several periods then falls somewhat—inflation is positive but declining after the period of impact, ultimately becoming negative—interest rates decline, real and nominal money demand tend to rise, along with private gold holdings. With sufficient goods price inflation, gold holdings become positive, a substitution effect induced by the fall in the relative price of gold. After the initial period, both the market and par value of debt rise for several quarters before declining slightly, converging to a permanently higher level. Finally note that after the initial surprise fall in the price of long-term debt, the bond price rises, reflecting a period of below steady state nominal interest rates and falling goods prices. This leads to a larger rise in the market value relative to par value of the debt portfolio. As interest rates revert to steady state, these quantities converge.

A distinguishing feature of these dynamics, relative to the classical gold standard, is nominal drift: the price level rises permanently in response to a deficit shock—under the classical gold standard prices are stationary. Because real variables necessarily converge to steady state, the cumulative price rise in response to the disturbance can be inferred from the terminal value of either the nominal money demand or nominal debt dynamics. This model property lies at the heart of the explanation of recovery from the Great Depression. Using structural vector-autoregressions, the next section adduces empirical evidence establishing the quantitative importance of this mechanism.

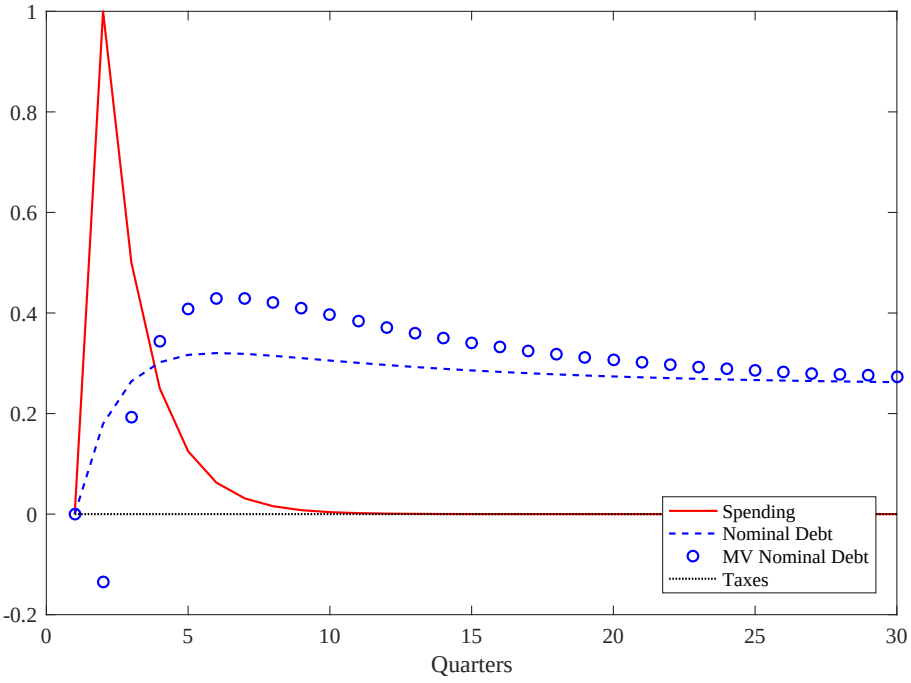

Figure 13: Theoretical responses to a surprise increase in government purchases.

5 Structural VAR Analysis

We turn now to more formal analysis of fiscal and monetary impacts over the period of unbacked fiscal expansions. Because the identified VAR methodology is well understood, we review it only briefly here.[24]

5.1 VAR Methods

Let y_t be an $(m \times 1)$ vector of time series described by the structural model

$$\sum_{s=0}^{\infty} A_s y_{t-s} = \varepsilon_t \tag{25}$$

where ε_t is a vector of exogenous *i.i.d.* structural disturbances, including policy and non-policy shocks. To use the model for policy prediction, we require that the policy shocks, ε_t^P, be uncorrelated with all non-policy disturbances [Marschak (1953)]. Errors are Gaussian with

$$E\left(\varepsilon_t \varepsilon_t' | y_{t-s}, s > 0\right) = I, \quad E\left(\varepsilon_t | y_{t-s}, s > 0\right) = 0, \quad \text{all } t$$

When the matrix of contemporaneous coefficients, A_0, is non-singular, y may be represented in terms of impulse response functions

$$y_t = \sum_{s=0}^{\infty} C_s \varepsilon_{t-s} + E_0 y_t \tag{26}$$

[24] See Leeper, Sims, and Zha (1996) or Christiano, Eichenbaum, and Evans (1999) for detailed surveys.

Elements of C_s report how each component of y responds dynamically to the shocks ε. $E_0 y_t$ is the projection of y_t conditional on initial conditions. The reduced form of (25) is

$$\sum_{s=0}^{p} B_s y_{t-s} = u_t \tag{27}$$

with $B_0 = I$ and the covariance matrix of the reduced-form errors, the u's, is $\Sigma = A_0^{-1} A_0^{-1\prime}$.

Expressions (25) and (27) imply the linear mapping from the reduced-form errors to the structural shocks

$$u_t = A_0^{-1} \varepsilon_t \tag{28}$$

Identification of the structural model entails imposing sufficient restrictions on A_0 to enable the freely estimated coefficient in that matrix to be obtained from Σ. With $m(m-1)/2$ moments in Σ, identification requires imposing at least $m(m+1)/2$ restrictions.

5.2 Data and Identification

We estimate a seven-variable monthly VAR from April 1933 to June 1940. The seven variables are: the commercial paper rate, R, (NSA), the monetary base, M, (NSA), federal primary surplus, S, (SA), the market value of nominal gross federal government debt, B, (NSA), the monetary gold stock, G, (NSA), monthly interpolated GNP deflator, P, (100 = 1926), and monthly interpolated real GNP, Y.[25]

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). When restrictions are imposed on lagged variables, estimation follows Cushman and Zha (1997) and Zha (1999). All variables except the primary surplus and the interest rate are logged; the interest rate is divided by 100. VARs include six lags and a constant.[26]

The results that follow are based on the identification that appears in table 4 for A_0. Each column of the table represents a model equation and $\times$'s denote freely estimated parameters. Blank elements in the matrix reflect zero restrictions. Money demand in the second column is a demand for the real monetary base, with the $\times_1$ symbol denoting that the coefficients on M and P are imposed to be equal but of opposite sign. Demand for real base depends on the nominal interest rate and real income.

Monetary policy behavior is identified with the innovation in the interest rate—the first column of A_0. Identifying the monetary policy shock with the innovation in the commercial paper rate is a reasonable first stab. Economic historians generally ascribe to the Federal

[25]Primary surpluses 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).

[26]In notation analogous to that in Sims and Zha (1998), these results set the hyperparameters for the prior as $\mu_1 = 1.0, \mu_2 = 0.5, \mu_3 = 0.1, \mu_4 = 1.0, \mu_5 = 1.0, \mu_6 = 1.0$.

	MP	MD	FP	B	G	P	Y
R	×	×	×	×	×		
M		$\times_1$	×	×	×		
S			×	×	×		
B				×	×		
G					×		
P		$\times_1$				×	×
Y		×					×

Table 4: Identifying restrictions on A_0, the contemporaneous interactions among variables in VAR.

Reserve a passive role during the recovery.[27] Chandler (1971) notes that the role of the Fed was "reduced markedly" compared to the previous decade. One formal representation of passive monetary policy is an interest-rate rule that does not aggressively adjust rates in response to economic developments. That certainly seems an apt description of Fed behavior, at least until 1937. Our identification of monetary policy permits reactions of the interest rate to past information, but not to current news.

The system of variables consisting of the surplus, government bonds, and gold is triangularized. As it happens, surplus innovations have very little correlation with other innovations contemporaneously, so allowing for fiscal policy to adjust the surplus in response to R and M makes no difference for outcomes. Referring to the first equation as "monetary policy" is a bit of a misnomer: the triangularized system treats the set of equations as a mix of monetary and gold policies. Finally, the two goods market variables, the price level and real GNP, are not permitted to respond immediately to shocks in other sectors and are triangularized in a bivariate system. This is a plausible restriction for data at a monthly frequency.

Because this specification imposes no restrictions on lagged coefficients, variables interact dynamically in an unrestricted manner. In this seven-variable system, there are 28 distinct moments in the covariance matrix of innovations, from which the 19 free parameters in the table are estimated. The identification in table 4 imposes 29 zero restrictions plus the equality restriction in money demand, making the model overidentified.

5.3 Primary Surplus Impacts

Figure 14 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 \$0.17 billion, which is about 3 percent of the average deficit in the sample. Because the deficit decays rapidly, the total increase over the three-year forecast horizon is only \$0.29 billion. This is a relatively small and transitory fiscal impulse. Importantly, there is no evidence that higher deficits bring forth higher future surpluses, lending support to the interpretation that the figure depicts an unbacked fiscal expansion.

Higher deficits have classically Keynesian impacts. Prices and output, which the identification prevents from rising contemporaneously, steadily increase and significantly so. The

[27] See the references in section 2.

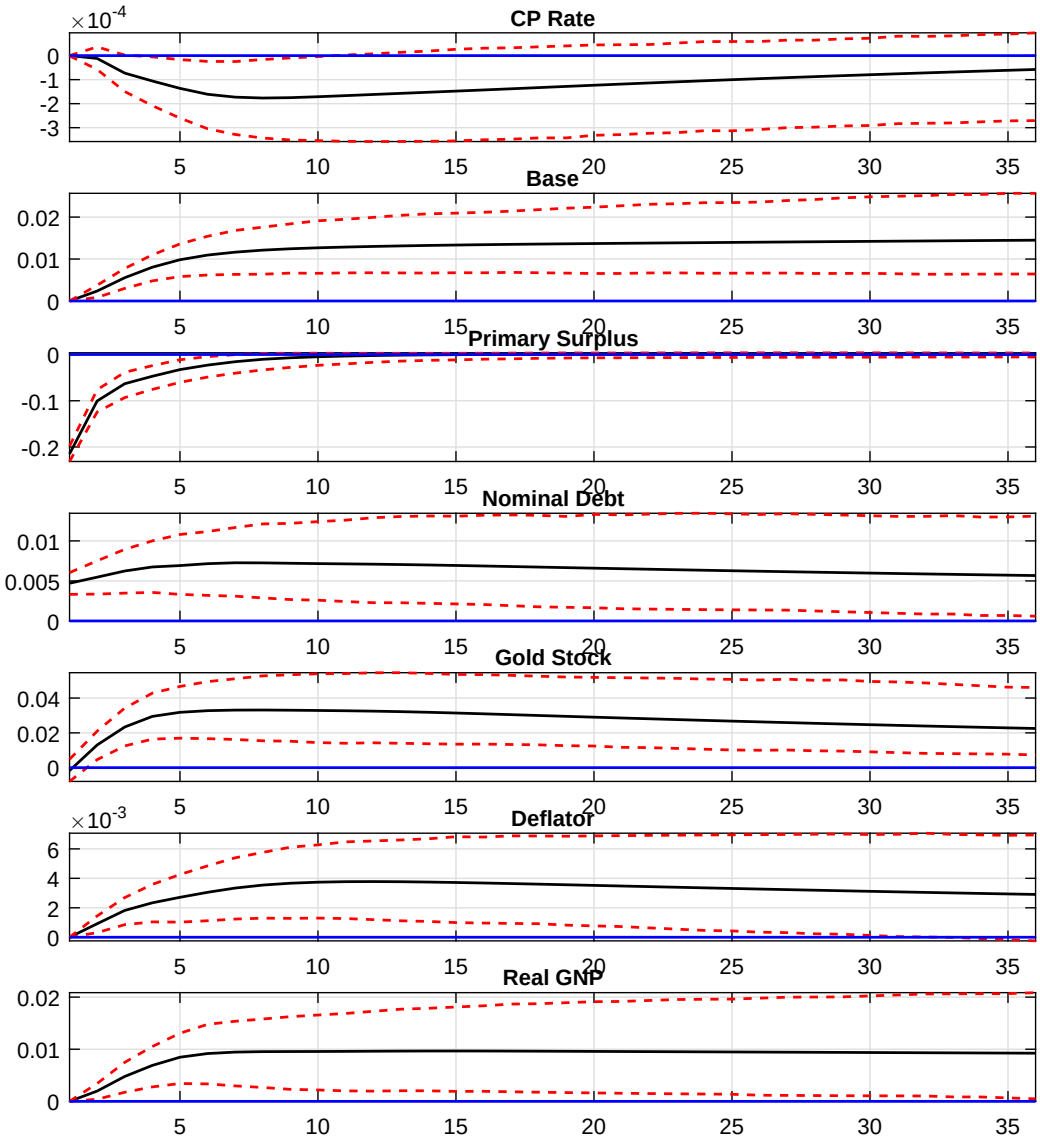

Figure 14: Responses to an unanticipated increase in the primary surplus in the unbacked fiscal expansion (April 1933 to June 1940) period. Solid lines are maximum likelihood estimates; dashed lines are 68 percentile probability bands based on 1000 draws from the posterior distribution of all the VAR parameters.

impacts peak at 0.0046 percent for the price level and 0.0098 for real GNP, but the persistence of the responses implies that the total increases over the three-year horizon are substantial: 0.12 percent for the price level and 0.26 percent for output.

Monetary policy is passive, showing no effort to offset the inflationary consequences of the fiscal expansion. 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.

Higher deficits are financed by an expansion in nominal debt that jumps on impact and remains elevated. Economic recovery encourages gold to flow into the United States, which then is allowed to expand the monetary base to at least partially accommodate rising demand for money.

Looking down the column in figure 14 it is easy to see the conventional monetary narrative of the recovery that Friedman and Schwartz (1963), Romer (1992), and Steindl (2004) recount.[28] The initial revaluation of gold, together 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 high-powered money 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.

But the impulse responses create a problem for this conventional 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 fully integrated with the monetary interpretations of the recovery.

5.4 Monetary Impacts

Higher deficits generate positive comovements among output, the price level, the monetary base, and the gold stock. But that interpretation ascribes to fiscal policy a causal role. Perhaps those fiscally-induced correlations are but a small part of the story about the recovery. Perhaps other disturbances, unrelated to fiscal policy, generate the same comovements, but account for the bulk of fluctuations in output and prices.

We address these concerns by examining the remaining impulse response functions. Figure 15 reports the dynamic impacts of four shocks related to the monetary sector—monetary policy, money demand, "government debt," and "the gold stock." Our identification does not attach any distinct behavioral interpretation to the shocks in the equations for debt and gold.

Focus first on responses of the monetary base—the second row in the figure. Two disturbances generate strong and persistent movements in the base: monetary policy and money

[28] Friedman and Schwartz give this narrative a different twist than Romer. Friedman and Schwartz (1963, p. 499) write that "...the rise in the money stock [from 1933 to 1937] was produced not by the monetary authorities but by gold 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, in contrast, attributes much of the growth in base money to the Treasury's decision not to sterilize the inflows, which was a policy choice.

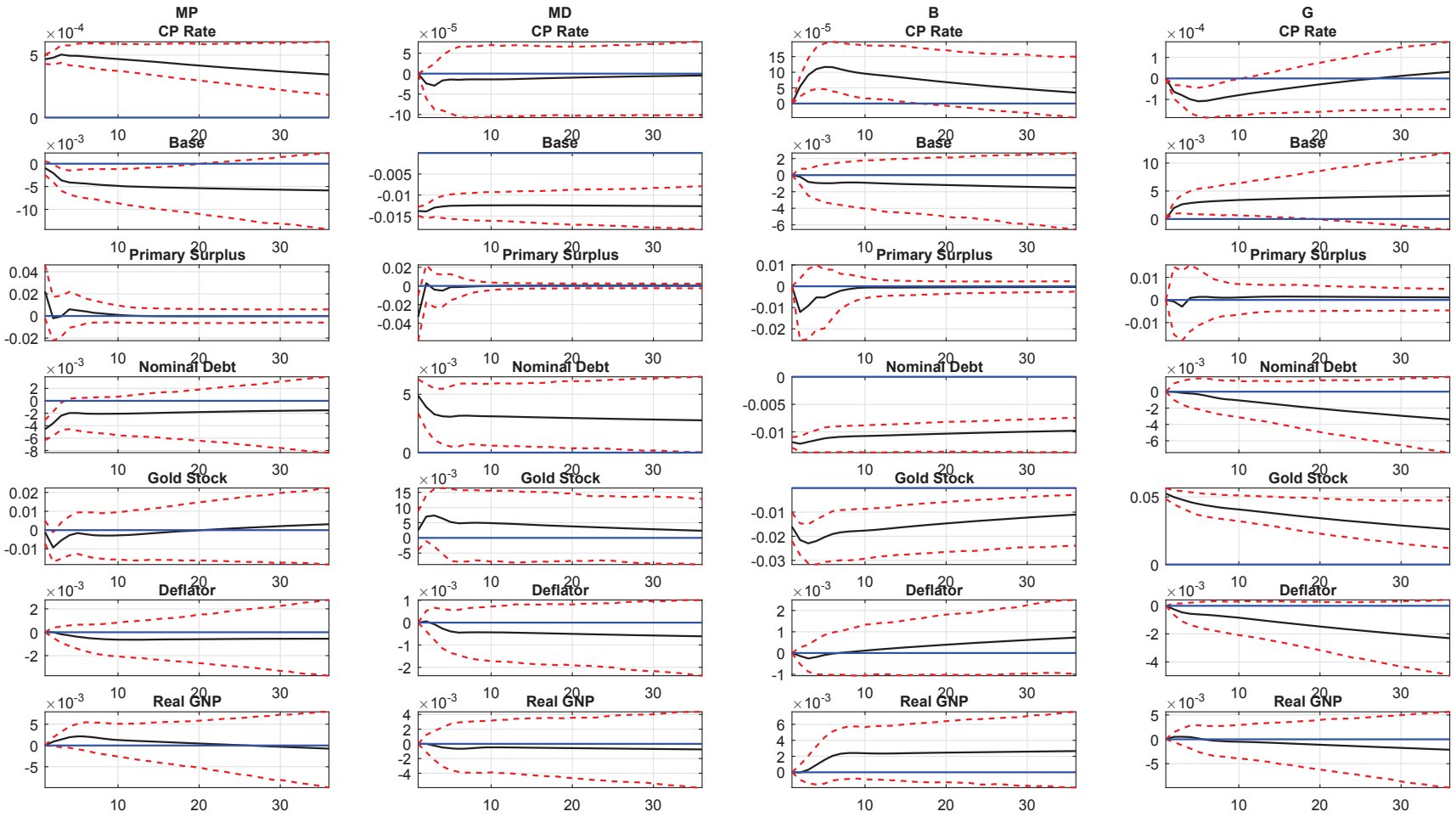

Figure 15: Responses to a unanticipated shocks in the "monetary sector," which includes monetary policy (MP), money demand (MD), government debt (B), and the gold stock (G). Unbacked fiscal expansion period (April 1933 to June 1940). Solid lines are maximum likelihood estimates; dashed lines are 68 percentile probability bands based on 1000 draws from the posterior distribution of all the VAR parameters.

demand. The monetary policy shock generates responses that look very much like what emerges from VARs estimated to modern data. A contraction raises the nominal interest rate and reduces the money stock. Output and the price level decline smoothly; those declines are marginally significant in the short run. The budget turns to a deficit briefly with the economic downturn and higher interest rates reduce bond prices and the market value of debt temporarily. Monetary gold appears to decline, but only very transitorily. Monetary policy does not generate the strong comovement in base money and gold that lie at the heart of the conventional monetary narrative.

A negative shock to money demand lowers the base for an extended period. But it does nothing to the gold stock, output, and the price level. The decline in base is associated with an increase in nominal debt and a higher (though insignificant) nominal interest rate, suggesting that this shock may be closer to an open-market operation than a shift in the demand for money.[29]

Turning to the fifth row, responses of the gold stock to these disturbances, only shocks to the last two equations—debt and gold—generate sizeable movements in gold. Neither of these produces movements in the monetary base. Those two shocks, though, generate the follow patterns of correlation: a positive shock to the gold stock is associated with lower commercial paper rates, higher market value of nominal debt, and lower output and price level. Higher interest rates are equivalent to lower bond prices, so the negative comovement between interest rates and the market value of debt is natural, although one might expect the interest rate to jump with the jump in debt in the third column of the figure.[30]

Only disturbances to the primary surplus generate the full set of movements in assets, the price level, and real GNP that would seem to align with existing explanations of the recovery. But in the VAR, those movements are initiated by an exogenous shift in fiscal behavior. These impacts of a shock that raise the primary deficit are fully consistent with what the theory in section 4 predicts for the consequences of an unbacked fiscal expansion. We turn now to how important these fiscal disturbances are in generating fluctuations in the variables of interest.

5.5 Importance of Shocks

Table 5 reports variance decompositions by shock of the seven variables in the VAR. Fiscal disturbances play a central role in fluctuations in all variables except the interest rate. Shocks to monetary policy, money demand, and the gold stock have only minor impacts on output and prices. Surpluses account for over a quarter of price-level movements during the unbacked fiscal expansion period. Other than goods market disturbances, which contribute more than 50 percent, only shocks to gold seem to matter at all (13 percent) for price-level fluctuations.

Surplus shocks explain 16 percent of the error variance of real GNP, with disturbances to the debt equation picking up another 9 percent. The remainder of output fluctuations stem

[29] On the other hand, aside from the open-market purchases in 1932 and from May to November 1933, Federal Reserve Bank holdings of government securities were almost constant until February 1937. Chandler (1971) discusses this in detail.

[30] Appendix C reports the full moving-average representation for the VAR. The two remaining shocks to the price level and real GNP equations also do not generate comovements that correspond to the conventional monetary narrative.

from shocks to goods markets.

Primary surpluses are key sources of fluctuations in the monetary base, gold stock, and government debt. This underscores that the impulse responses that figure 14 reports are also quantitatively important for interpreting comovements among these variables.

The period after suspension of convertibility was marked by massive gold inflows, which Roosevelt's Treasury chose not to sterilize. It seems natural to recognize that a government's decision to sterilize (or not sterilize) gold inflows is as much a *fiscal* choice as a monetary one. Johnson (1939, p. 133) explains the fiscal implications of sterilizing gold flows:

> The mechanics of this so-called "sterilization" program were as follows: the Treasury continued to buy all newly-offered gold at $35 per ounce, paying for it by drafts on its balance with the Reserve Banks, but instead of replenishing its balance by depositing gold certificates in equal amount with the Reserve Banks, it henceforth set the metal aside in an "inactive account," where it was sterilized, and replenished its balance through its ordinary borrowing operations; the increase in member bank deposits resulting from the sale of the gold to the Treasury was then offset by an increase in earning assets (the Treasury obligations), and the increase in bank reserves resulting from the payment for the gold by a Treasury draft on a Reserve Bank was counteracted by the decrease caused by the subscription to the Treasury securities (when paid by drafts on Reserve Banks). Thus the newly mined or imported gold no longer passed through the Treasury into the credit base.

Importantly, when gold is not sterilized, there is no increase in Treasury indebtedness to the private sector. Instead, the Treasury buys the gold from a bank that is a member of the Federal Reserve System by "creating money" in the form of gold certificates. Those certificates appear as a Federal Reserve asset that supports the member bank's increase in reserves.[31] With the Roosevelt Administration financing emergency spending by issuing new debt, it is natural that the Treasury would have opted not to sterilize gold inflows. Sterilization would have further increased government indebtedness and raised still stronger political opposition to the government's fiscal stance.

The VAR results show that on average primary surplus disturbances were an important source of fluctuations during the recovery period. But do they actually help to explain the observed paths of the price level and real GNP? To answer this question, we compute historical decompositions of the forecast errors of these two series into components due to various exogenous shocks.

A historical decomposition of the variables in the VAR falls immediately out of expression (26). y_t on the left is the vector of realized variables in the system and $E_0 y_t$ on the right is the forecast of y_t conditional only on the system's initial conditions. The decomposition answers the question: how much does some element of the ε_t vector of structural shocks contribute to the time path of some element of y_t? Figures 16 and 17 report the VAR's answers for the price level and real GNP elements of y_t.

[31] See appendix D for further details, including T accounts of the Treasury, the Federal Reserve, and member banks. Irwin (2012) is a nice discussion of this issue. He argues that the decision to sterilize gold inflows during 1937 exerted a powerful contractionary effect on the economy.

	Percent of P Due to Shocks in						
Months	**MP**	**MD**	**FP**	**B**	**G**	**P**	**Y**
6	0.2	0.1	9.1	0.1	0.5	89.6	0.5
18	0.5	0.3	18.3	0.1	1.4	78.7	0.8
36	0.5	0.4	17.8	0.3	3.8	76.3	1.0
	Percent of Y Due to Shocks in						
Months	**MP**	**MD**	**FP**	**B**	**G**	**P**	**Y**
6	0.6	0.0	9.2	0.3	0.0	4.9	84.9
18	0.4	0.1	16.6	1.0	0.1	3.4	78.5
36	0.2	0.1	17.7	1.0	0.3	2.9	77.6
	Percent of M Due to Shocks in						
Months	**MP**	**MD**	**FP**	**B**	**G**	**P**	**Y**
6	4.2	60.1	18.6	0.2	2.2	11.8	3.0
18	5.8	45.1	36.3	0.3	2.9	7.3	2.4
36	6.6	40.1	41.3	0.3	3.3	6.2	2.3
	Percent of R Due to Shocks in						
Months	**MP**	**MD**	**FP**	**B**	**G**	**P**	**Y**
6	87.9	0.1	3.8	3.1	2.7	0.2	2.3
18	84.3	0.1	7.8	3.2	2.2	0.4	2.1
36	86.3	0.1	6.8	2.6	1.4	0.5	2.3
	Percent of PS Due to Shocks in						
Months	**MP**	**MD**	**FP**	**B**	**G**	**P**	**Y**
6	0.9	1.7	96.2	0.5	0.0	0.6	0.2
18	0.9	1.7	96.2	0.5	0.1	0.6	0.2
36	0.9	1.7	96.1	0.5	0.1	0.6	0.2
	Percent of G Due to Shocks in						
Months	**MP**	**MD**	**FP**	**B**	**G**	**P**	**Y**
6	0.7	1.0	18.2	12.4	67.3	0.4	0.2
18	0.3	0.8	29.1	10.8	58.3	0.5	0.2
36	0.3	0.7	32.2	10.3	55.8	0.6	0.2
	Percent of B Due to Shocks in						
Months	**MP**	**MD**	**FP**	**B**	**G**	**P**	**Y**
6	4.3	6.6	19.8	67.9	0.0	0.8	0.5
18	3.0	5.8	24.8	64.9	0.7	0.4	0.4
36	2.4	5.5	24.3	64.3	2.6	0.4	0.6

Table 5: Percentage of forecast error variance in GNP deflator (P), real GNP (Y), monetary base (M), commercial paper rate (R), monetary gold stock (G), and nominal market value of debt (B) attributable to shocks to each equation. Columns may not sum to 100 due to rounding.

Solid black lines graph the actual values of the price level and output. Each of the other lines reflects the paths that the price level and output would have followed had some set of shocks been identically zero; that is, had some shocks made no contribution to the evolution of the variables. Lines with circle markers depict the paths in the absence of surplus disturbances. Until some time in 1938, both the price level and real GNP would have been lower if there had been no fiscal disturbances. After 1938, fiscal shocks acted to reduce the price level and output.

Monetary shocks combine the effects of monetary policy and money demand. Until 1935, these contributed nothing to the price level and real GNP. For about the next year and a half, monetary shocks raised both variables, but by less than fiscal shocks. Through mid-1937, the monetary sector again contributed nothing and until 1939 they actually reduced prices and output.

Debt and gold disturbances contribute to raising the price level from about 1937 to 1940, but their role is also less than that of surpluses. In other periods, these shocks either contribute nothing or serve to reduce the two macro variables. Their contribution to output is, if anything, to reduce it.

Goods-market shocks, whose economic meaning is not identified, appear to be the most important drivers of prices and output in some periods. From 1935 to 1937, these shocks reduced the price level substantially. Because the identification does not try to ascribe behavioral interpretations to these disturbances, they amount to "non-policy" influences.

Figures 18 and 19 plot the actual time paths of the GNP deflator and real GNP, along with the counterfactual time paths that include only the influence of primary surplus shocks, setting all other shocks in the VAR identically zero. Dotted lines in the figures plot the "unconditional" forecast from the VAR (conditional only on initial conditions). Counterfactual paths emerge by adding the contributions of surpluses to those forecasts. Whenever the forecast with the surplus lies above the dotted lines, fiscal deficits are contributing to raising prices and output.

Surpluses drove up prices over the period until about 1938, when they began to bring prices down. For most of the two-year period beginning in September 1934 when price increases stalled, debt-financed primary deficits would have produced a higher price level, had it not been for other deflationary disturbances. Deficits continued to raise the price level, but their contribution declined with the recession that hit in May 1937. By that time the government was running a positive gross surplus and primary surplus disturbances served to reduce the price level below the unconditional forecast.

Broadly similar patterns apply to the contribution of surpluses to real GNP. Debt-financed deficits brought output above its forecasted level until 1938, when they reduced real GNP.

This VAR analysis offers scant evidence in favor of the conventional monetary explanation of the recovery. But it favors the unbacked fiscal expansion story. How much these inferences hinge on the particular identification employed remains to be explored. Experimentation with a variety of other schemes—including a purely recursive identification—however, did not overturn the dynamic responses to and the relative importance of primary surplus disturbances.

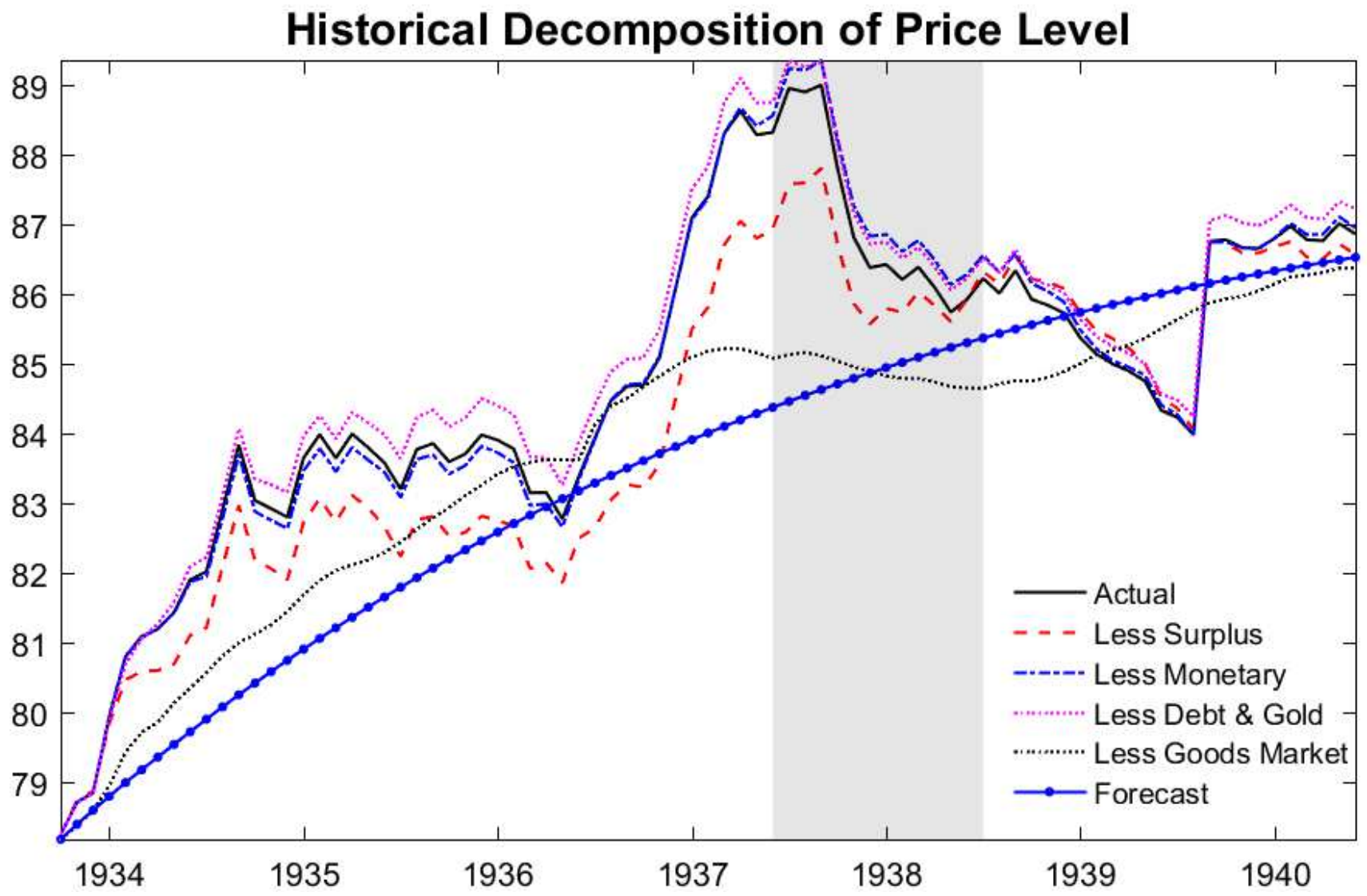

Figure 16: Decomposition of the multi-period error in forecasting the GNP deflator into parts due to various shock combinations. "Less surplus" removes effects of primary surplus shocks; "Less monetary" removes the effects of monetary policy and money demand shocks; "Less Debt & Gold" removes effects of shocks from equations for the nominal market value of debt and the monetary gold stock; "Less goods market" removes effects of shocks for the equations for the price level and real GNP.

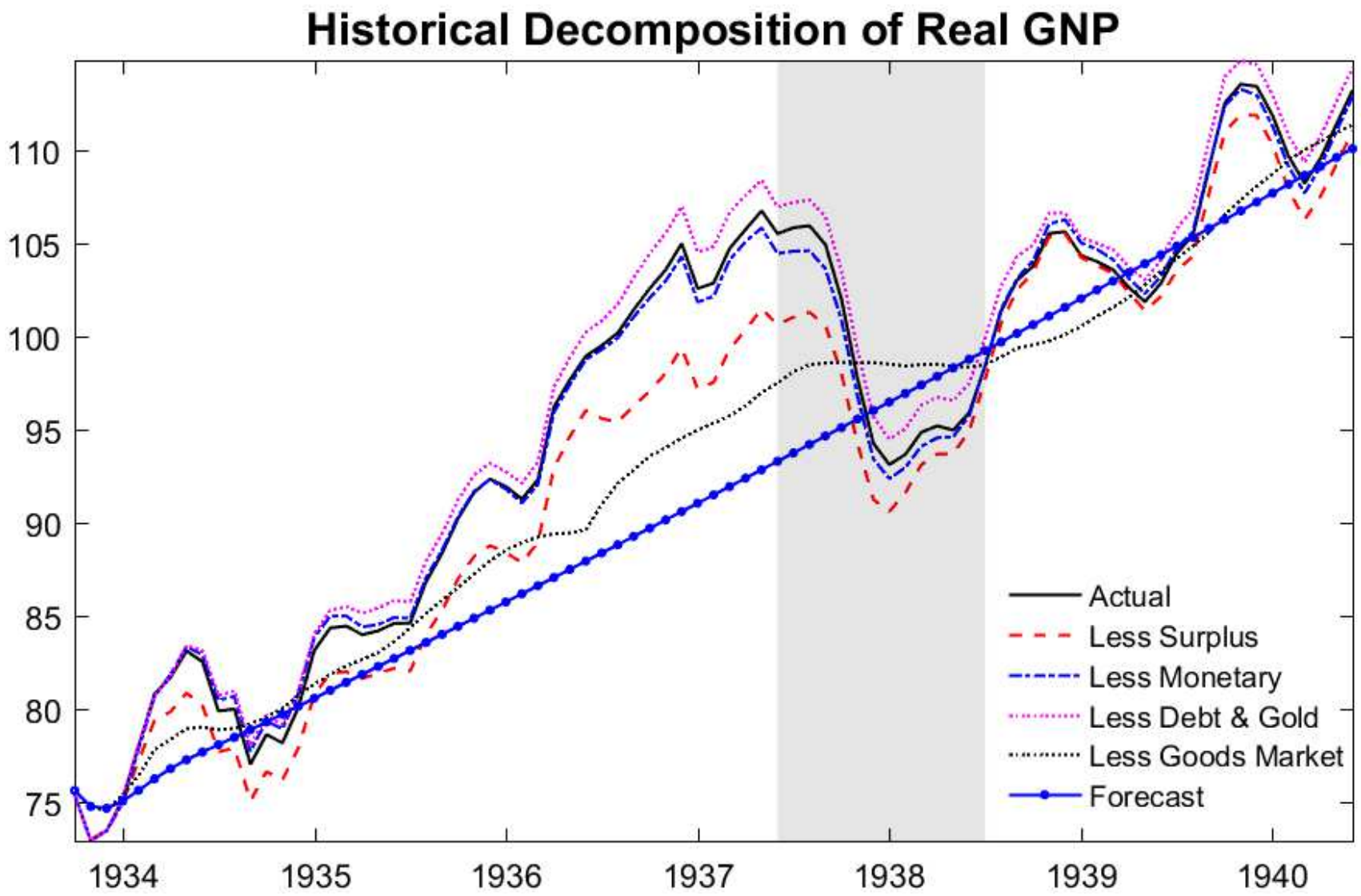

Figure 17: Decomposition of the multi-period error in forecasting real GNP into parts due to various shock combinations. "Less surplus" removes effects of primary surplus shocks; "Less monetary" removes the effects of monetary policy and money demand shocks; "Less Debt & Gold" removes effects of shocks from equations for the nominal market value of debt and the monetary gold stock; "Less goods market" removes effects of shocks for the equations for the price level and real GNP.

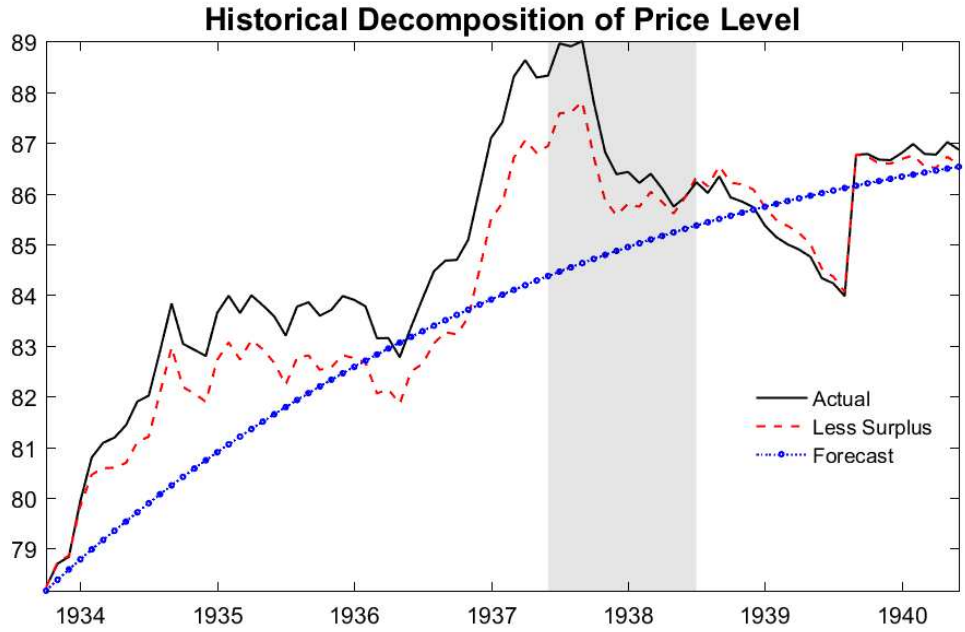

Figure 18: Actual price level and price level with only contributions from primary surplus shocks, setting all other shocks to zero. Dotted line is forecast conditional only on initial conditions for lags from April to September 1933. Shaded area is May 1937 to June 1938 recession.

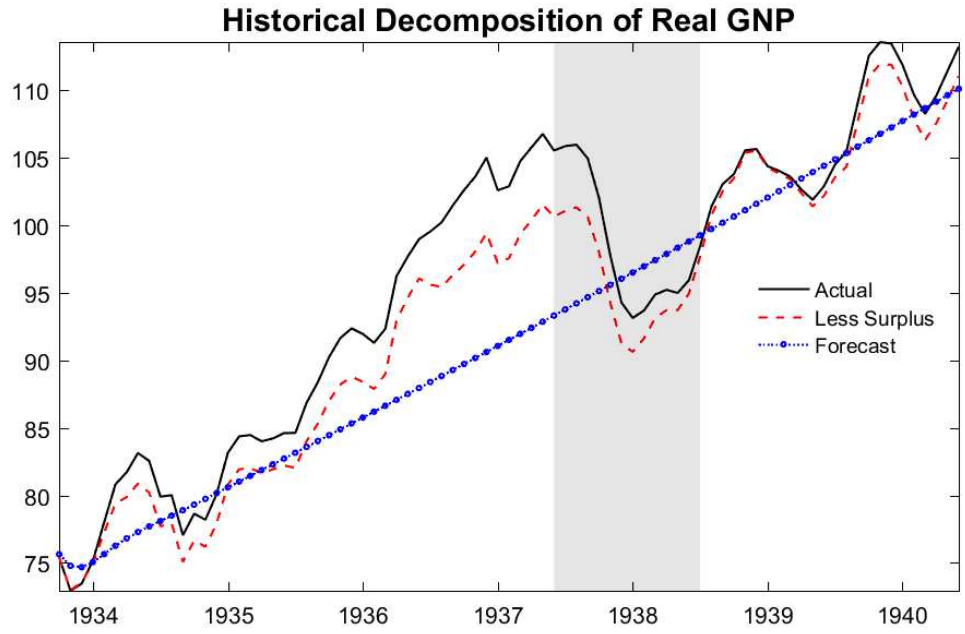

Figure 19: Actual real GNP and real GNP with only contributions from primary surplus shocks, setting all other shocks to zero. Dotted line is forecast conditional only on initial conditions for lags from April to September 1933. Shaded area is May 1937 to June 1938 recession.

6 Lessons for Today

We have argued that unbacked fiscal expansion was the source of the recovery from the Great Depression. Roosevelt's "try anything" policies produced debt-financed primary deficits that remained in place until recovery was underway. Monetary policy combined with that fiscal policy to stabilize debt by preventing nominal interest rates from rising with inflation. The paper offered a variety of evidence that debt-financed deficits generated gold inflows and expanded the monetary base at the same time that they raised prices and output. Gold inflows and higher base money that were not associated with higher deficits and nominal debt have little predictive power for the GNP deflator and real GNP. Despite rapid growth in nominal debt between 1933 and 1937, the debt-GNP ratio was stable at about 40 percent, the level it had reached before the United States abandoned gold. This leads to the conclusion that unbacked fiscal expansion lifted the U.S. economy out of the depression without endangering the creditworthiness of the country.

Roosevelt's successful, if incomplete, reflation carries two important lessons for policymakers today. Many countries now suffer from low—below-target—inflation rates and tepid economic growth. Rather than relying on a joint monetary-fiscal attack on the problem, as Roosevelt did, these countries are leaning entirely on monetary policy. Central banks in the Euro Area, Sweden, Switzerland, and Japan have set policy interest rates below zero and undertaken large-scale asset purchases in an effort to reduce real interest rates and stimulate aggregate demand and inflation. This policy relies on intertemporal substitution induced by low real rates, rather than the wealth effects of an unbacked fiscal expansion. Fiscal policies in those areas, meanwhile, have lacked Roosevelt's initial single-minded goal to stimulate the economy, fluctuating between fiscal stimulus and fiscal austerity. Despite the Herculean efforts of monetary authorities for several years, there is little evidence of reflation in those countries.

Ironically, those same countries and the United Kingdom, like the United States in the 1930s, are well positioned to undertake unbacked fiscal expansions. Monetary policies are already passive and central banks are on board to achieve higher inflation rates.[32]

A second lesson from the Roosevelt policies is that fiscal stimulus and fiscal sustainability need not be in conflict. 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. The two goals go hand-in-hand: higher inflation reduces the real value of the debt and higher economic growth raises surpluses and reduces debt-output ratios. But to engineer an unbacked fiscal expansion, governments must understand that rapid growth in *nominal* debt need not threaten fiscal sustainability, just as it didn't in 1930s America.

In the current atmosphere of what Sims (2016) calls "hyper-Ricardian" beliefs about policy in which the public sees higher debt as bringing forth much higher surpluses in the future, it may be difficult for policymakers to credibly commit to an unbacked fiscal expansion. Here, too, FDR may have something to teach. Roosevelt never claimed to be aiming for what even he might have regarded as "irresponsible" fiscal policy. But his communications

[32]Because individual Euro Area countries do not control their monetary policy, it would require a coordinated unbacked fiscal expansion across member nations together with the ECB's pegging of interest rates.

and actions made clear that he was willing to do whatever it took to bring the country out of the depression. Roosevelt was also agnostic, willing to experiment, even with what at the time seemed to be radical policies, until economic recovery was underway. He kept the public's attention on the policy *objectives*, objectives over which there was nearly universal agreement, rather than on the policy tools.

Roosevelt's eventual backtracking on fiscal stimulus also carries a valuable message for policy makers today. Successful recovery from severe economic downturns mandates single-minded pursuit of economic recovery objectives. Allowing ancillary concerns to enter the calculus confuses economic decision makers and can undermine that success.

Appendices

A Data

A.1 Net Interest

A.1.1 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.[33] Disaggregated components of this series are available in tables based on warrants issued or revised daily Treasury statements.[34]

[33]From 1928 to 1933, interest receipts are split into general and special funds categories. We use total interest receipts.

[34] 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 can not 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 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.

Figure 20: 1928 Annual Report, page 391

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)[2]	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

Figure 21: 1929 Annual Report, page 374

In 1927, interest receipts are only available based on warrants issued.[35] Although the aggregate total of "Interest, premium, and discount" is no longer provided, the disaggregated elements of this total are included. We continue to included dividends, premiums, discounts, and exchanges to be consistent with the years when only the aggregate series is available.

[35]See footnote 34 for a description of warrants versus unrevised cash basis.

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 22: 1927 Annual Report, page 431

Starting in 1922, interest receipts, premium, discounts, and exchanges are no longer given as separate categories. The components of federal receipts are listed alphabetically.[36]

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	14,439,985.93	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	954,835.00	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	2,696,502.46	178,510.69	
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] $4,000.00		$1,000.00
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 $4,369,007.49 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 23: 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 6.

[36]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 number
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 expenditures for fiscal years 1920 and 1921 (int. on foreign obligations)		unrevised	152
Comparison of receipts, fiscal years 1922 and 1921	1922	warrant	107
Receipts and expenditures for fiscal years 1921 and 1922 (int. on foreign obligations)		unrevised	100
Comparison of receipts, fiscal years 1923 and 1922	1923	warrant	114
Receipts and expenditures for fiscal years 1922 and 1923 (int. on foreign obligations)		unrevised	107
Comparison of receipts, fiscal years 1924 and 1923	1924	warrant	131
Receipts and expenditures for fiscal years 1923 and 1924 (int. on foreign obligations)		unrevised	123
Comparison of receipts, fiscal years 1925 and 1924	1925	warrant	150
Receipts and expenditures for fiscal years 1924 and 1925 (int. on foreign obligations)		unrevised	141
Comparison of receipts, fiscal years 1926 and 1925	1926	warrant	429
Receipts and expenditures for fiscal years 1925 and 1926 (int. on foreign obligations)		unrevised	176
Comparison of receipts, fiscal years 1927 and 1926	1927	warrant	431
Receipts and expenditures for fiscal years 1926 and 1927 (int. on foreign obligations)		unrevised	30
Receipts and expenditures for the fiscal year 1928	1928	revised	391
Receipts and expenditures for the fiscal year 1928 (int. on foreign obligations)		unrevised	19
Receipts and expenditures for the fiscal year 1929	1929	revised	375
Receipts and expenditures for the fiscal year 1929 (int. on foreign obligations)		unrevised	20
Ordinary Receipts (monthly) (foreign obligations)		unrevised	535
Receipts and expenditures for the fiscal year 1930	1930	revised	469
Receipts and expenditures for the fiscal year 1930 (int. on foreign obligations)		unrevised	35
Ordinary Receipts (monthly) (foreign obligations)		unrevised	631
Receipts and expenditures for the fiscal year 1931	1931	warrant	426
Receipts and expenditures for the fiscal year 1931 (int. on foreign obligations)		unrevised	25
Receipts and Expenditures, by months (foreign obligations)		unrevised	575
Receipts and expenditures for the fiscal year 1932	1932	warrant	341
Receipts and expenditures 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 expenditures 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 expenditures 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 expenditures 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 expenditures 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 expenditures, 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 expenditures, monthly (int. on foreign obligations)		unrevised	379/387
Details of receipts, by sources and accounts	1939	warrant	314
Classified receipts and expenditures, monthly (int. foreign obligations)		unrevised	337/345
Details of receipts, by sources and accounts.	1940	warrant	587
Classified receipts and expenditures, monthly (int. foreign obligations)		unrevised	612/619

Table 6: Table names and page numbers from the *Annual Reports of the Secretary of the Treasury* for interest receipts

A.1.2 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	Basis	Page number
Preliminary Statement Showing Classified Expenditures (quarterly)...	1920	unrevised	see 1921 357
Receipts and expenditures of the Government for fiscal (yearly)...		unrevised	see 1926 448
Preliminary Statement Showing Classified Expenditures (quarterly)...	1921	unrevised	357
Receipts and expenditures of the Government for fiscal (yearly)...		unrevised	see 1926 448
Preliminary Statement Showing Classified Expenditures (monthly)...	1922	unrevised	103
Receipts and expenditures of the Government for fiscal (yearly)...		unrevised	see 1926 448
Preliminary Statement Showing Classified Expenditures (monthly)...	1923	unrevised	110
Receipts and expenditures for fiscal years 1922 and 1923 (yearly)		unrevised	107
Preliminary Statement Showing Classified Expenditures (monthly)...	1924	unrevised	127
Receipts and expenditures for fiscal years 1923 and 1924 (yearly)		unrevised	123
Preliminary Statement Showing Classified Expenditures (monthly)...	1925	unrevised	145
Receipts and expenditures for fiscal years 1924 and 1925 (yearly)		unrevised	142
Expenditures of the Government, by months for the fiscal year 1926	1926	unrevised	452
Receipts and expenditures of the Government for fiscal years (yearly)		unrevised	450
Expenditures by months, classified according to...	1927	unrevised	463
Ordinary receipts, expenditures chargeable against... (yearly)		unrevised	448
Expenditures by months, classified according to...	1928	unrevised	425
Receipts and expenditures for the fiscal year 1928		unrevised	19
Expenditures by months, classified according to...	1929	unrevised	414
Receipts and expenditures for the fiscal year 1929 (yearly)		unrevised	20
Expenditures by months, classified according to...	1930	unrevised	510
Receipts and expenditures for the fiscal year 1930 (yearly)		unrevised	35
Expenditures by months, classified according to...	1931	unrevised	464
Ordinary receipts, expenditures chargeable against... (yearly)		unrevised	446
Expenditures by months, classified according to...	1932	unrevised	371
Receipts and expenditures for the fiscal year 1932 (yearly)		unrevised	27
Expenditures by months, classified according to...	1933	unrevised	313
Receipts and expenditures for the fiscal year 1933 (yearly)		unrevised	280
Expenditures by months, classified according to...	1934	unrevised	308
Receipts and expenditures for the fiscal year... (yearly)		unrevised	305
Expenditures by months, classified according to...	1935	unrevised	330
Expenditures by months, classified according to (yearly)...		unrevised	334
Classified receipts and expenditures, monthly	1936	unrevised	337
Classified receipts and expenditures, monthly (yearly)		unrevised	339
Classified receipts and expenditures, monthly	1937	unrevised	322/328
Classified receipts and expenditures, monthly (yearly)		unrevised	328
Classified receipts and expenditures, monthly	1938	unrevised	381/389
Classified receipts and expenditures, monthly (yearly)		unrevised	389
Classified receipts and expenditures, monthly	1939	unrevised	339/347
Classified receipts and expenditures, monthly (yearly)		unrevised	347
Classified receipts and expenditures, monthly	1940	unrevised	614/621
Classified receipts and expenditures, monthly (yearly)		unrevised	621

Table 7: Table names and page numbers from the *Annual Reports of the Secretary of the Treasury* for interest expenditures

A.1.3 Calculating Monthly Net Interest Because interest receipts are only available on a yearly basis, we are only able to calculate net interest on a yearly basis. We then use the yearly net interest series to impute monthly net interest. 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. Let the expression for imputed interest receipts in month t be given as:

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

Monthly net interest is then calculated as:

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

A.2 Federal Receipts and Expenditures

This section details how our series of monthly federal receipts and expenditures from July 1919 to June 1940 from the *Annual Reports of the Secretary of the Treasury on the State of Finances* differ from other sources. We use data for receipts and expenditures that was revised in 1933 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."[37] We use data on an unrevised cash basis for receipts and expenditures.[38]

Our three main sources of comparison are data from the NBER Macro History Database (NBER)[39], Firestone's (1960) book, and Romer (1992) who uses receipts and outlays[40] from the 1979 *Statistical Appendix to the Annual Report*, table 2, pp. 4-11 [Romer (1992)].

A.2.1 Federal Receipts Receipts from Firestone correspond to our series except for fiscal years 1931, 1932, and 1940. On page 80, Firestone explains that trust fund receipts were eliminated from internal revenue after June 1932 and his series take into a account this revision back to July 1930. Firestone (page 82) also deducts net transfers from the Federal Old-Age and Survivors Insurance Trust Fund from receipts to obtain lower monthly receipts for fiscal year 1940. The NBER receipts data is split into three receipt series a, b, and c. NBERa matches our series up to fiscal year 1932. NBERb matches Firestone for fiscal years 1931 and 1932 – also taking into account the elimination of trust fund receipts – and then tracks our series through fiscal year 1940. NBERc (not shown) also deducts net transfers from the Federal Old-Age and Survivors Insurance Fund and thus tracks Firestone for fiscal year 1940.

[37] 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*

[38] See footnote 34 for an explanation of accounting conventions.

[39] Accessed via the NBER's Macrohistory Database, Chapter 15

[40] Starting in 1968, the Department of the Treasury (various) introduced new unified budget concepts including outlays. On page 8, the report explains that federal outlays include loans and expenditures.

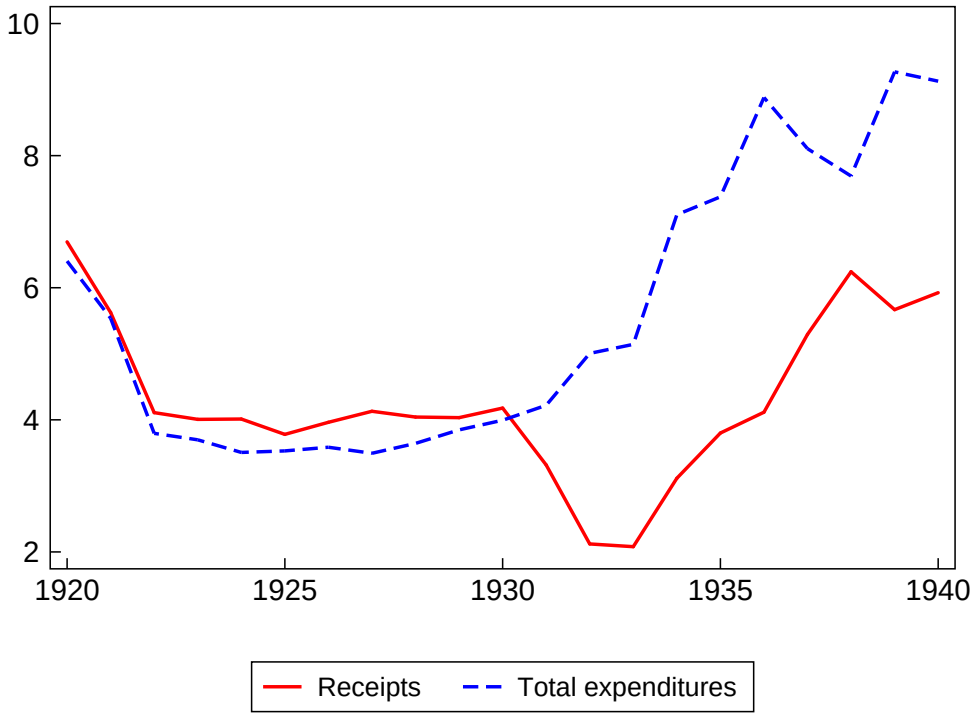

Figure 24: Fiscal Year Totals of Monthly Receipts and Total Expenditures, billions of dollars. Source: Department of the Treasury (various). See Table 8 for details.

Figure 25: Fiscal year totals of monthly receipts and total expenditures, billions of dollars. Source: Department of the Treasury (various) (see Table 8 for details); Firestone (1960); NBER Macrohistory database (m15004b,m15004c).

Our yearly totals of monthly receipts data do not always match the yearly totals in other tables in the annual reports. Although the yearly data is revised throughout various annual reports, the monthly is not. The yearly receipts data is unrevised from fiscal years 1920 to

1935. In 1936, the data is revised starting in 1931. Our series of annual totals of monthly receipts data matches the yearly data until fiscal year 1933 when our series turns slightly lower.

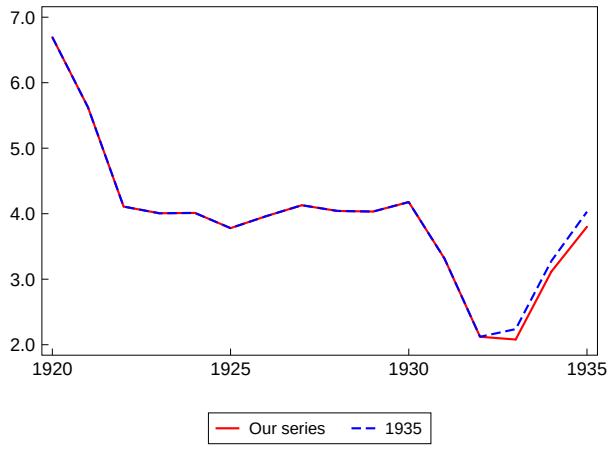

Figure 26: Fiscal year totals of monthly receipts and receipts by fiscal year, billions of dollars. Source: Department of the Treasury (various). See Table 8 for details.

Annual receipts data remains unrevised from fiscal years 1936 to 1939. In 1939, receipts were mostly revised downwards for fiscal years 1931 through 1935. This revised series matches our series from fiscal years 1933 through 1939. In 1940, receipts data was revised downwards for fiscal years 1937 through 1940.[41]

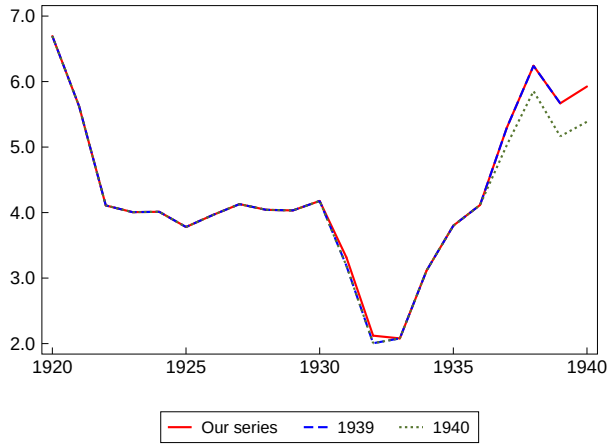

Figure 27: Fiscal year totals of monthly receipts and receipts by fiscal year, billions of dollars. Source: Department of the Treasury (various). See Table 8 for details.

[41] 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.2.2 Federal Expenditures Firestone and the NBER use ordinary expenditures for their expenditure series starting in December 1920 through fiscal year 1933 (June 1933). Romer uses ordinary outlays through fiscal year 1933.[42] Ordinary expenditures are a subset of total expenditures and exclude public debt retirements. For fiscal years 1920 through 1926, ordinary expenditures exclude purchases of obligations of foreign governments in addition to public debt retirements. Starting in fiscal year 1934, the *Annual Report of the Secretary of the Treasury* divides total expenditures into general and emergency categories.[43] Starting in 1934, Firestone, the NBER, and Romer begin using total expenditures for their expenditures series. We use total expenditures throughout the entire sample. Prior to fiscal year 1934, total expenditures are on average roughly 13 percent higher than ordinary expenditures.

The expenditure series from Firestone matches our series of ordinary expenditures from 1922 through fiscal year 1930. Firestone explains on page 82 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 for comparison purposes. Our yearly totals of monthly ordinary expenditures diverge from Firestone's from fiscal years 1931 to 1933. Firestone's data for January 1932 to June 1933 matches that of NBERc (not shown). Our series of ordinary expenditures matches NBERb up to fiscal year 1933. Romer's series of ordinary outlays is almost always lower than our series and those given by the NBER and Firestone.

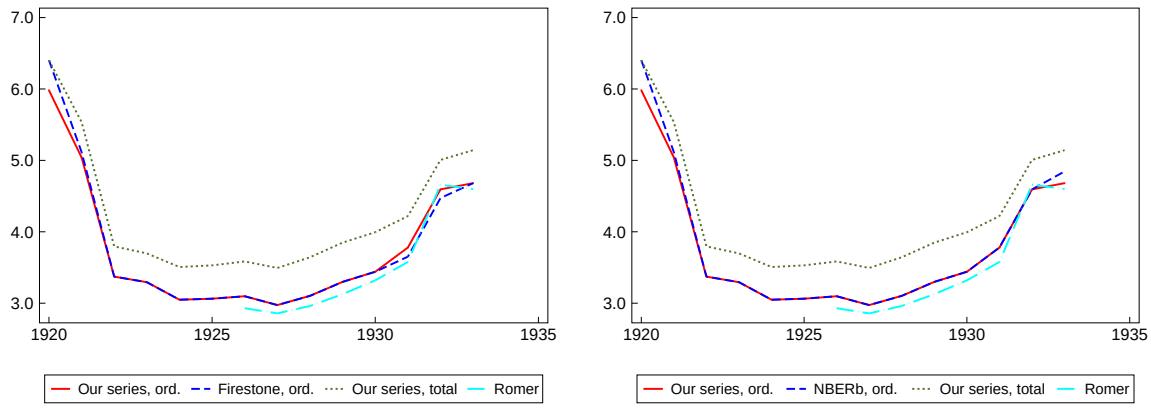

Figure 28: Fiscal year totals of monthly ordinary expenditures, billions of dollars. Source: Department of the Treasury (various) (see Table 8 for details); Firestone (1960); NBER Macrohistory database (m15004b,m15004c).

The total expenditure series from Firestone matches NBERc from fiscal year 1934 through fiscal year 1937. From fiscal year 1937 through 1939, Firestone's data matches NBERd. Firestone explains on page 84 that under an act of February 1938, the Secretary of the

[42] See footnote 40 for the difference between outlays and expenditures.

[43] Table 6 Footnote 6 on page 316 from the *Annual Report of the Secretary of the Treasury on the State of the Finances for Fiscal year ended June 30, 1934* 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."

Treasury canceled $2.7 billion of obligations purchased from the RFC which the RFC could not repay to the Treasury. As a consequence, budget expenditures show only amounts spent from funds allocated by the RFC for purposes for which no provisions for repayment to the Treasury were made.The series from Firestone matches NBERe (not shown) for fiscal year 1940. Our series is larger than Firestone's and NBERc from 1934 through 1938. Although the gap shrinks from 1938 through 1940, our series is slightly higher than the other three series. Romer's series of total outlays is below our series and those given by the NBER and Firestone for most years.

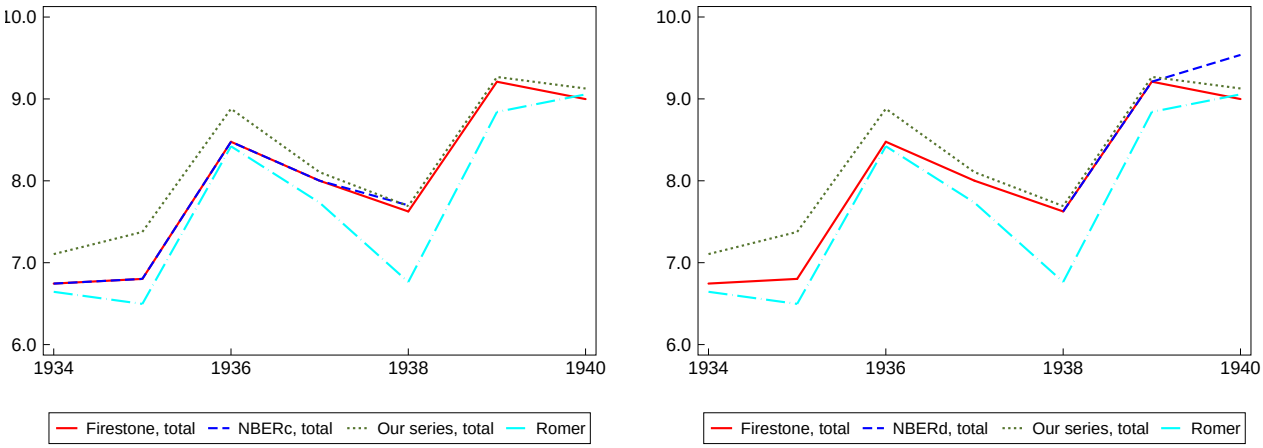

Figure 29: Fiscal Year Totals of Monthly Total Expenditures, billions of dollars. Source: Department of the Treasury (various) (see Table 8 for details); Firestone (1960); NBER Macrohistory database (m15004b,m15004c).

As with the receipts series, our series for total and ordinary expenditure do not always match yearly data given elsewhere in the annual reports. From fiscal year 1922 to fiscal year 1931 our series of yearly totals of monthly expenditures data match yearly totals given elsewhere in the annual reports on an unrevised cash basis. In the 1927 annual report, ordinary expenditures are revised upwards. In the 1933 annual report, total and ordinary expenditures are revised for fiscal years 1932 and 1933. These revisions differ from revisions covering the expenditures of the Reconstruction Finance Corporation in 1933.

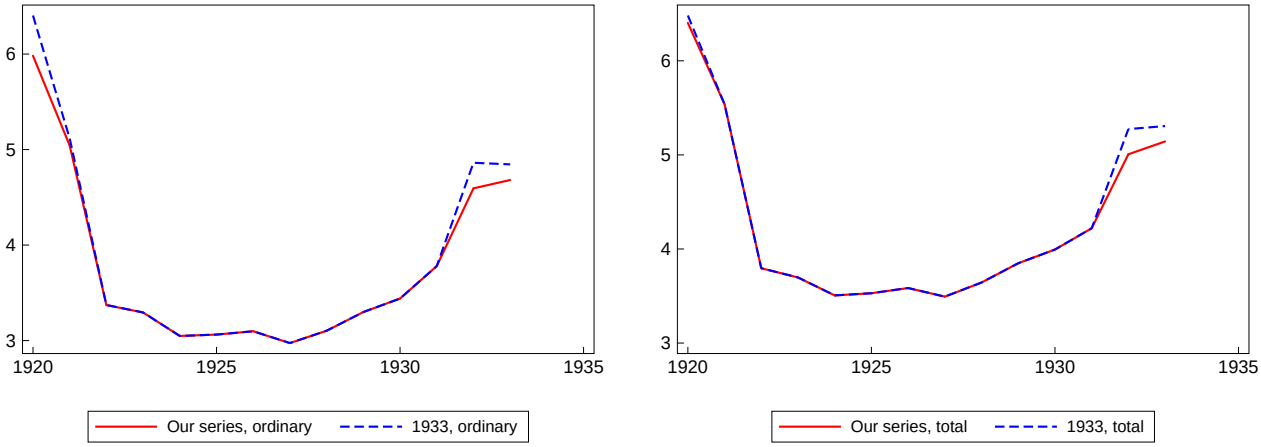

Figure 30: Fiscal year totals of monthly ordinary and total expenditures and ordinary and total expenditures by fiscal year, billions of dollars. Source: Department of the Treasury (various) (see Table 8 for details).

As mentioned previously, starting in 1934 until 1939, monthly expenditures are split into general and emergency expenditures categories rather than ordinary and total expenditures categories. Tables of yearly totals continue to categorize expenditures into ordinary and total even though the monthly series does not maintain this distinction. Our yearly totals of monthly ordinary expenditures stop in 1934 and we instead compute general expenditures for 1934-1939. Yearly ordinary and total expenditure series in the table are not revised from 1933 to 1935. Starting in 1936, the yearly ordinary and total expenditure series are revised back to 1930. Our series of total expenditures is lower than the 1935 and 1936 yearly series.

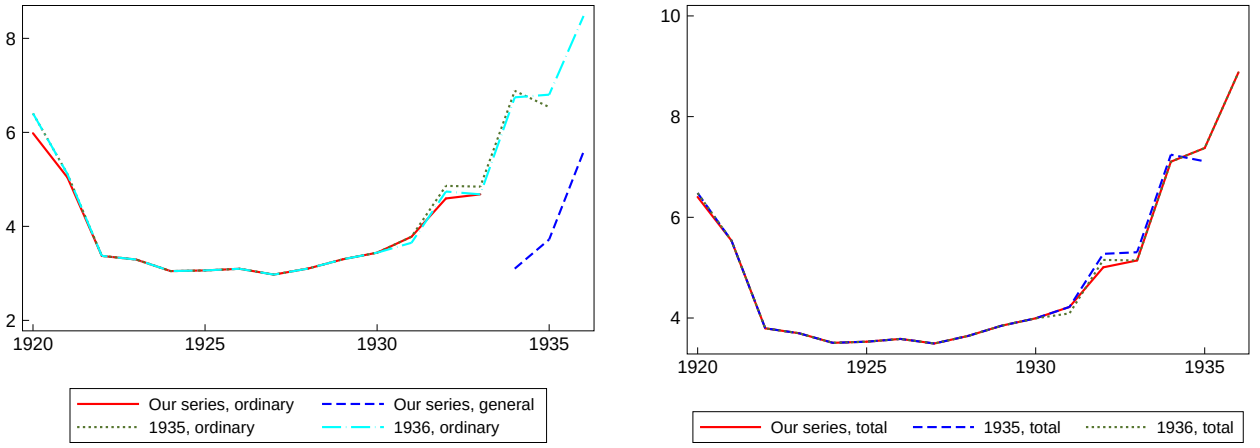

Figure 31: Fiscal year totals of monthly ordinary and total expenditures and ordinary and total expenditures by fiscal year, billions of dollars. Source: Department of the Treasury (various) (see Table 8 for details).

Yearly ordinary and total expenditures are revised in 1937, 1939, and 1940. The 1937 total expenditure series matches our series of yearly totals of monthly data the best.

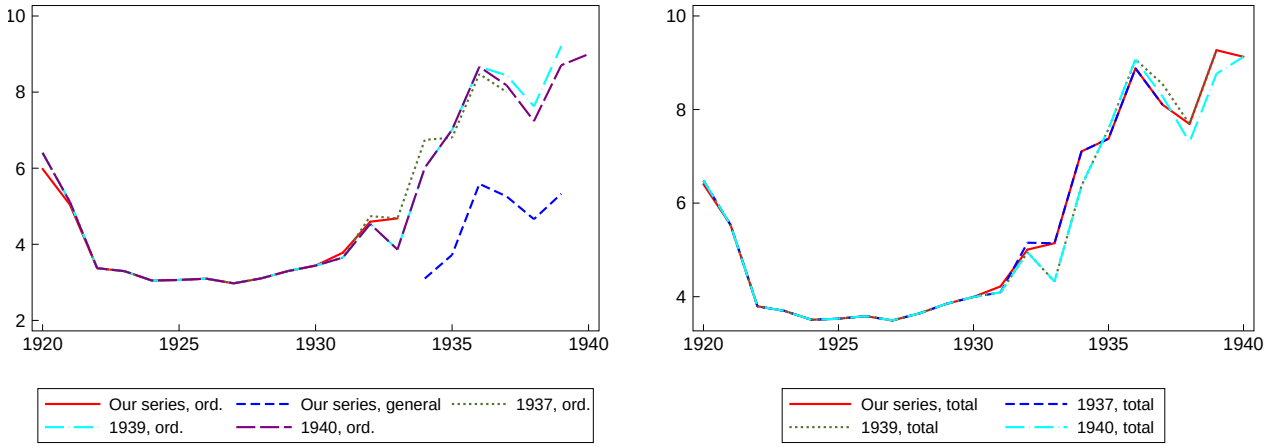

Figure 32: Fiscal year totals of monthly total expenditures, billions of dollars. Source: Department of the Treasury (various) (see Table 8 for details).

Table name	Year	Receipts page	Expenditures page
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 8: Table names and page numbers from the *Annual Reports of the Secretary of the Treasury* for federal receipts and expenditures

A.3 Market Value and Returns

The following section details our calculation of market value and return on the United States's bond portfolio. We use data from Hall and Sargent (2015), provided to us by the authors, as well as the CRSP to obtain the quantity, price, accrued interest, interest rate, and coupon frequency of each government security outstanding in a given month.

Let $B_{it}(t+j)$ denote the dollar value of type i bonds outstanding in period t that mature in period $t+j$ and $Q^D_{it}(t+j)$ be the dirty price (price+accrued interest) of such bonds. Because the number of types of bonds of a certain maturity each period can vary over time, we let $N_t(t+j)$ represent the number of such bonds in period t.

Let $B_t(t+j)$ denote the dollar value of all bonds outstanding in period t that mature in period $t+j$, defined as

$$B_t(t+j) = \sum_{i=1}^{N_t(t+j)} B_{it}(t+j) \tag{29}$$

Then the par value of all debt outstanding at the end of period t—the face value of the bond portfolio—is

$$B^M_t = \sum_{j=1}^{\infty} \sum_{i=1}^{N_t(t+j)} B_{it}(t+j) = \sum_{j=1}^{\infty} B_t(t+j) \tag{30}$$

Define $\nu_i(t+j)$ as the share of security of type i that is outstanding at t and matures at $t+j$

$$\nu_i(t+j) = \frac{B_{it}(t+j)}{\sum_{i=1}^{N_t(t+j)} B_{it}(t+j)} = \frac{B_{it}(t+j)}{B_t(t+j)} \tag{31}$$

where $\sum_{i=1}^{N_t(t+j)} \nu_i(t+j) = 1$. Then the weighted dirty price of bonds outstanding at t that mature in $t+j$ is

$$Q^D_t(t+j) = Q_t(t+j) + AI_t(t+j) = \sum_{i=1}^{N_t(t+j)} \Big(Q_{it}(t+j) + AI_{it}(t+j)\Big)\nu_i(t+j) \tag{32}$$

where $Q_t(t+j)$ is the clean price of bonds outstanding at t that mature in $t+j$, $AI_t(t+j)$ is the accrued interest on bonds outstanding at t that mature in $t+j$. For zero-coupon bonds, the dirty price is equal to the clean price.

We also define $\mu_t(t+j)$ as the share of the total par value of bonds outstanding at the end of t that matures in $t+j$

$$\mu_t(t+j) = \frac{B_t(t+j)}{B^M_t} \tag{33}$$

where $\sum_{j=1}^{\infty} \mu_t(t+j) = 1$. This permits us to define the nominal price of the bond portfolio, P^M_t, as

$$P^M_t = \sum_{j=1}^{\infty} Q^D_t(t+j)\mu_t(t+j) \tag{34}$$

With a complete and general maturity structure, the government's budget identity is

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

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

The market value of debt outstanding in period t is

$$P_t^M B_t^M \equiv \sum_{j=1}^{\infty} Q_t^D(t+j) B_t(t+j) \tag{36}$$

so that the comparable expression at $t-1$ is

$$P_{t-1}^M B_{t-1}^M \equiv \sum_{j=1}^{\infty} Q_{t-1}^D\big((t-1)+(j+1)\big) B_{t-1}\big((t-1)+(j+1)\big) = \sum_{j=1}^{\infty} Q_{t-1}^D(t+j) B_{t-1}(t+j) \tag{37}$$

The carry-over market value uses the same bonds as the market value for period $t-1$ but using period t dirty prices and intermediate coupon payments. The carry-over price, P_t^C, reflects coupon payments that were paid between periods $t-1$ and t. The carry-over market value is defined as

$$P_t^C B_{t-1}^M \equiv \sum_{j=0}^{\infty} \Big(Q_t^D(t+j) + IP_t(t+j)\Big) B_{t-1}(t+j) \tag{38}$$

$IP_t(t+j)$ is the interest payable on bonds outstanding at t that mature in $t+j$. P_t^C differs from its dirty-price analog only when there is a coupon payment in month t. Figure 33 illustrates the timing of coupon payments.

Figure 33: Timing of actual and carry-over market value

Using the definitions of market value and carry over market value, (35) can be written as:

$$P_t^C B_{t-1}^M = P_t s_t + P_t^M B_t^M \tag{39}$$

Multiplying and dividing the left hand side by last period's market value allow the government budget identity to be expressed in terms of the rate of return on government debt:

$$\underbrace{\frac{P_t^C B_{t-1}^M}{P_{t-1}^M B_{t-1}^M}}_{\text{rate of return}} P_{t-1}^M B_{t-1}^M = P_t s_t + P_t^M B_t^M \tag{40}$$

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 period t to period $t-1$ market value

$$\frac{P_t^M B_t^M}{P_{t-1}^M B_{t-1}^M} \equiv \underbrace{\frac{P_t^C B_{t-1}^M}{P_{t-1}^M B_{t-1}^M}}_{\text{rate of return}} \cdot \underbrace{\frac{P_t^M B_t^M}{P_t^C B_{t-1}^M}}_{\text{size ratio}} \tag{41}$$

The expression for the rate of return is the same as (40) and can be expressed as

$$\frac{P_t^C B_{t-1}^M}{P_{t-1}^M B_{t-1}^M} = \frac{\sum_{j=1}^{\infty} \Big(Q_t(t+j) + AI_t(t+j) + IP_t(t+j) \Big) B_{t-1}(t+j)}{\sum_{j=1}^{\infty} \Big(Q_{t-1}(t+j) + AI_{t-1}(t+j) \Big) B_{t-1}(t+j)} \tag{42}$$

This rate of return reflects the percentage change in the value of the bond portfolio between period $t-1$ and t, holding the bond portfolio fixed.

The size ratio can be expressed as

$$\frac{P_t^M B_t^M}{P_t^C B_{t-1}^M} = \frac{\sum_{j=1}^{\infty} \Big(Q_t(t+j) + AI_t(t+j) \Big) B_t(t+j)}{\sum_{j=1}^{\infty} \Big(Q_t(t+j) + AI_t(t+j) + IP_t(t+j) \Big) B_{t-1}(t+j)} \tag{43}$$

Changes in size incorporates new issues, redemptions, and coupon payments that occur between periods $t-1$ and t. The size ratio reflects the percentage change in the value of the bond portfolio that arises from changes in the bond portfolio itself, including any changes in maturity structure.

$$r_t^M = \frac{P_t^C B_{t-1}^M / P_t}{P_{t-1}^M B_{t-1}^M / P_{t-1}} = \frac{\sum_{j=1}^{\infty} Q_t(t+j) B_{t-1}(t+j) / P_t}{\sum_{j=1}^{\infty} Q_{t-1}(t+j) B_{t-1}(t+j) / P_{t-1}} \tag{44}$$

Of course, the identity (40) can be expressed in real terms as:

$$r_t^M P_{t-1}^M b_{t-1}^M = s_t + P_t^M b_t^M \tag{45}$$

where $b_t^M \equiv B_t^M / P_t$ is the real par value of debt outstanding at t.

The surprise component in the real return on the bonds portfolio is:

$$\eta_t^D \equiv r_t^M - E_{t-1} r_t^M \tag{46}$$

Using $E_{t-1}[Q_t^D(t+j)/P_t] = \big(Q_{t-1}(t+j) + AI_t(t+j) + IP_t(t+j)\big)/P_{t-1}$, then the expectation is of no real capital gain or loss on the portfolio. Accrued interest, $AI_t(t+j)$, and interest payable, $IP_t(t+j)$, of bonds outstanding in period t that mature in period $t+j$ is known in period $t-1$. Hence, $E_{t-1}[AI_t(t+j) + IP_t(t+j)] = AI_t(t+j) + IP_t(t+j)$. The surprise in the real return becomes

$$\eta_t^D = \sum_{j=0}^{\infty} \left(\frac{\big(Q_t(t+j) + AI_t(t+j) + IP_t(t+j)\big)/P_t}{\big(Q_{t-1}(t+j) + AI_t(t+j) + IP_t(t+j)\big)/P_{t-1}} - 1 \right) \frac{\big(Q_{t-1}(t+j) + AI_t(t+j) + IP_t(t+j)\big) B_{t-1}(t+j)}{P_{t-1}^M B_{t-1}^M} \tag{47}$$

Real returns can be scaled by components isolating changes in the price level and changes in bond prices. Re-writing (47) as:

$$\eta_t^D = \underbrace{\frac{P_t^c B_{t-1}^M / P_t}{P_{t-1}^M B_{t-1}^M / P_{t-1}}}_{r_t^D} - \underbrace{\frac{P_t^c B_{t-1}}{P_{t-1}^M B_{t-1}}}_{R_t^D} + \frac{\sum_{j=1}^{\infty} \big(Q_t(t+j) - Q_{t-1}(t+j)\big) B_{t-1}(t+j)}{P_{t-1}^M B_{t-1}^M} \tag{48}$$

Which can be further re-arranged to:

$$\eta_t^D = R_t^D \underbrace{(1/\pi_t - 1)}_{\text{due to price level}} + R_t^D \underbrace{\left(\frac{\sum_{j=1}^{\infty} \big(Q_t(t+j) - Q_{t-1}(t+j)\big) B_{t-1}(t+j)}{P_t^C B_{t-1}^M} \right)}_{\text{due to bond prices}} \tag{49}$$

If there are no changes in the price level between periods $t-1$ and t, i.e. $\pi = 1$ and weighted changes in bond prices sum to zero $\sum_{j=1}^{\infty} Q_t(t+j) - Q_{t-1}(t+j) = 0$, then $\eta_t^D = 0$ indicating no capital gains or losses. If there is no change in the price level ($\pi_t = 1$) then $R_t^D(1/\pi_t - 1) = 0$ then 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 weighted changes in bond prices sum to zero, $\big(\sum_{j=1}^{\infty} \big(Q_t(t+j) - Q_{t-1}(t+j)\big) = 0$, then capital gains or losses are changes in the price level scaled by nominal returns.

Real and nominal returns are denominated in percentage points of market value outstanding at B_{t-1}

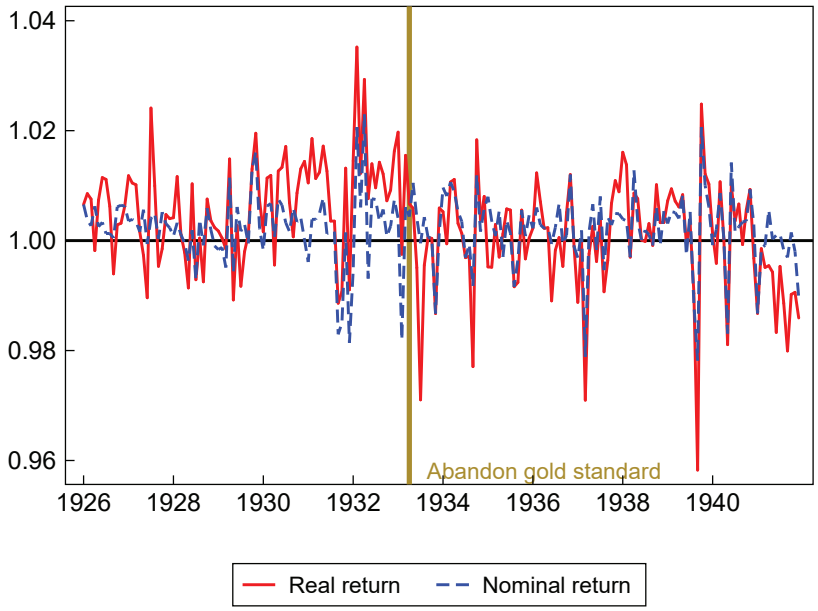

Figure 34: Real and nominal price returns

Real returns to U.S. debt show a much larger drop than nominal returns to U.S. debt after the departure form the gold standard.

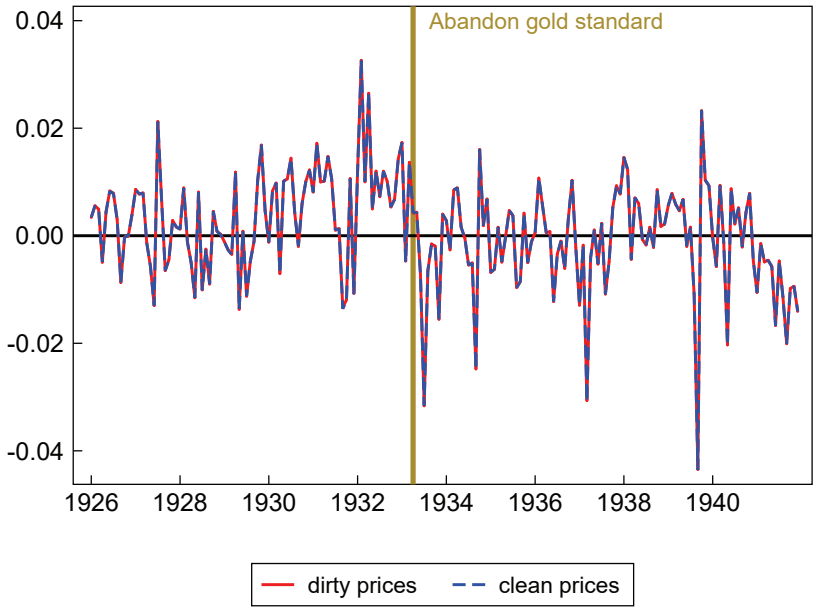

Figure 35: Real innovations to price returns with clean and dirty prices

Innovations show large losses after the abandonment of the gold standard.

Innovations capture the unexpected losses or gains on U.S. debt due to bond prices or the price level. We multiplying innovations by the beginning of period market value ($P^M_{t-1}B^M_{t-1}$) to capture the dollar amount of the difference between real and expected real returns to holding U.S. debt. We then take this dollar amount as ratio of the current period market value ($P^M_t B^M_t$) to capture surprise capital gains or losses as a percent of market value. Figure 36 is thus:

$$\eta^D_t \frac{P^M_{t-1}B^M_{t-1}}{P^M_t B^M_t} * 100 \tag{50}$$

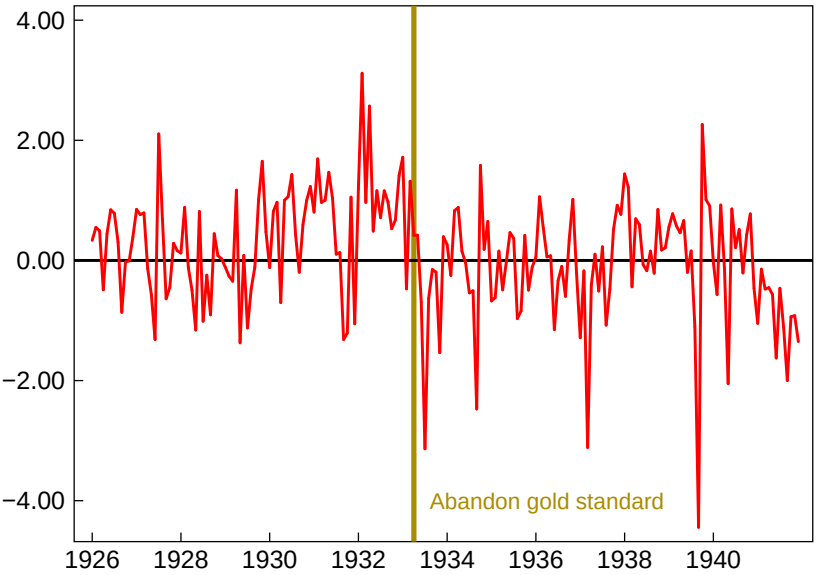

Figure 36: Capital gains and loss as a percent of market value (50)

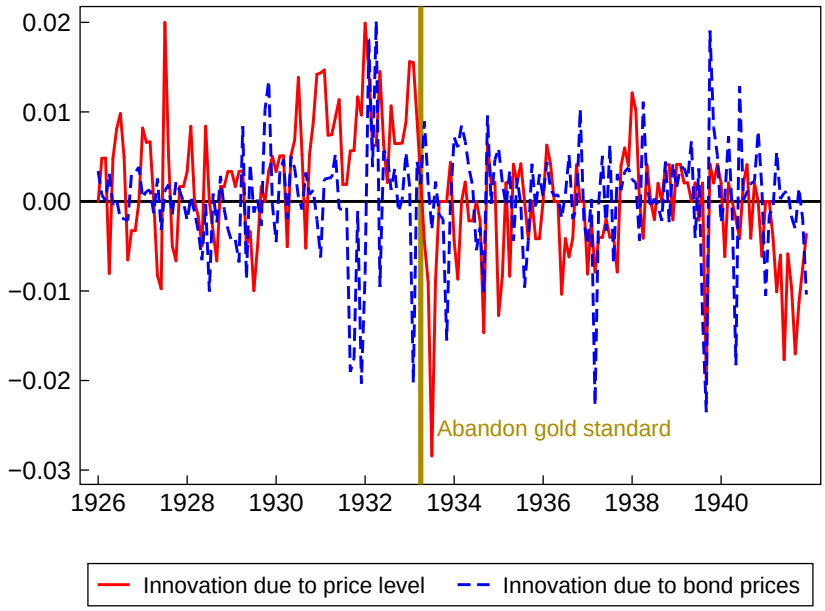

Figure 37: Innovations to price returns decomposed into changes from bond prices and changes from the price level (49)

After the abandonment of the gold standard, the price level is largely responsible for the capital loss on holding government debt.

B The Appendix

The following parametric assumptions are made section 4. Begin with the government's budget constraint in steady state

$$\frac{P^l B^l}{P}\left(1-\beta^{-1}\right) = F - T.$$

Then

$$\frac{P^l B^l}{PY}\left(\beta^{-1}-1\right) = \frac{T-F}{Y}$$

implies an assumption on the steady state debt to GDP ratio pins down the structural surplus. Assume an annual debt-to-GDP ratio of 30 percent. This implies

$$\frac{P^l B^l}{PY} = 1.2$$

in a quarterly model. Assuming

$$\frac{C}{Y} = 0.8 \text{ and } \frac{F}{T} = 0.2$$

determines the tax to GDP ratio residually. In turn an assumption on the fraction of government spending in output determines steady state taxation. Furthermore

$$\begin{aligned}\frac{PT}{B^l} &= \frac{T}{Y}\frac{YP}{B^l}\\ \frac{PF}{B^l} &= \frac{F}{Y}\frac{YP}{B^l}\end{aligned}$$

where the right hand sides of each expression are already determined ratios. To determine the other ratios in the government budget constraint calibrate

$$\frac{M}{P^l B^l} = 1$$

which corresponds to the ratio of $M1$ to the market value of debt in 1933. This permits

$$\frac{P^g G^m}{P^l B^l} = \frac{P^g G^m}{M}\frac{M}{P^l B^l} = \alpha \frac{M}{P^l B^l}$$

which completes the solution for required ratios.

Other parameter values which are picked fairly arbitrarily: $\beta = 0.99$, $\sigma = 1$, $\varphi = 20$, $\kappa = 100$, $\alpha = 0.4$, $\rho = 0.95$. The shocks all have auto regressive coefficient 0.5. From the liquidity preference schedule, (12),the elasticity of money demand with respect to the interest rate is

$$\frac{\beta}{(1-\beta)\,\varphi}.$$

For values of this elasticity around unity, the parameter φ must be of the order of 100. The basic patterns observed in the impulse responses don't depend much on the assumed calibration. Policy parameters are given by: $\gamma_b = 0.1$ under the gold standard. In the unbacked fiscal expansion $\gamma_b = 0$ and $\phi_\pi = 0.9$.

C Additional VAR Results

This appendix reports a more complete set of VAR results than those in the text. Figure 38 reports actual data and unconditional forecasts for the seven series in the VAR. Figure 39 shows the full moving average representations for the seven-variable VAR estimated over the unbacked fiscal expansion period (April 1933 to June 1940).

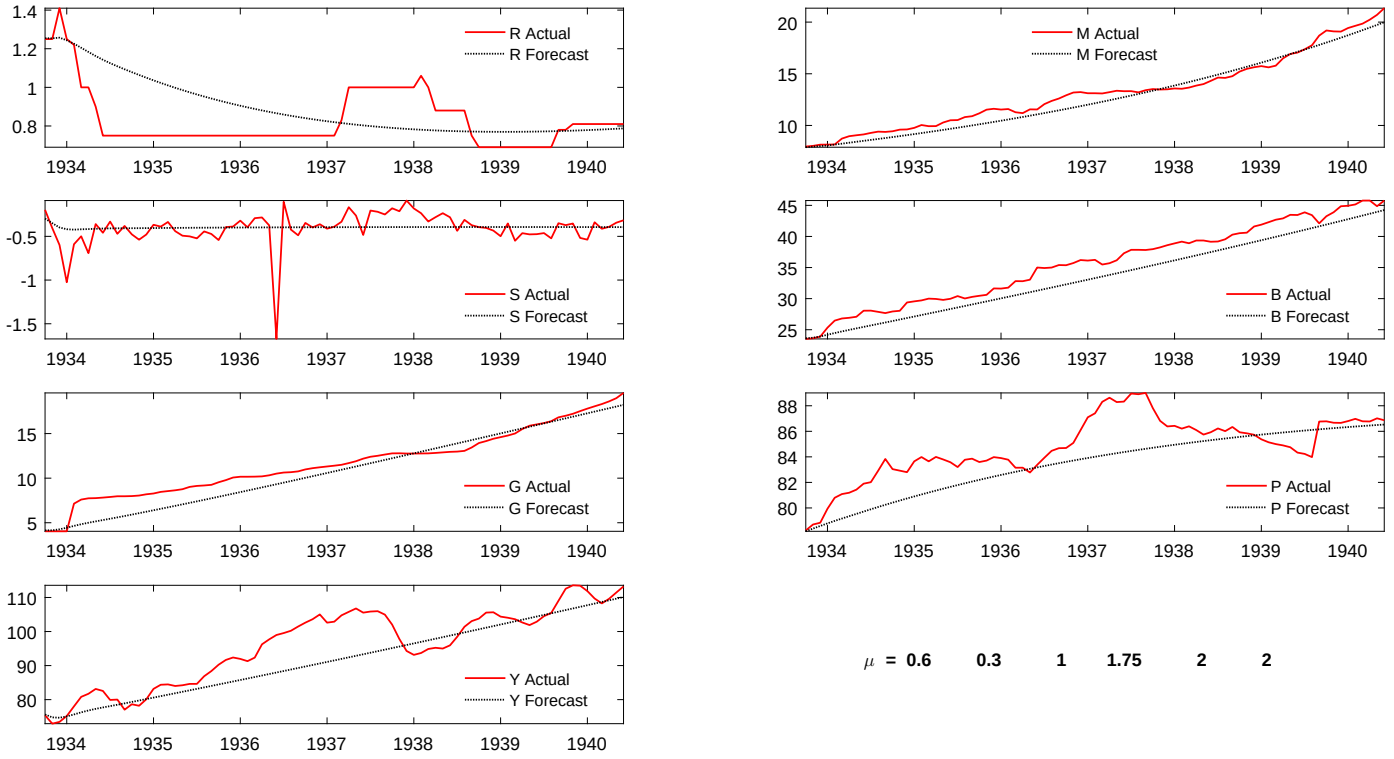

Figure 38: Actual and unconditional forecasts of variables in VAR using the hyperparameters $\lambda_0 = 0.6, \lambda_1 = 0.3, \lambda_3 = 1.0, \lambda_4 = 1.75, \mu_5 = \mu_6 = 2.0$, in the notation of Sims and Zha (1998).

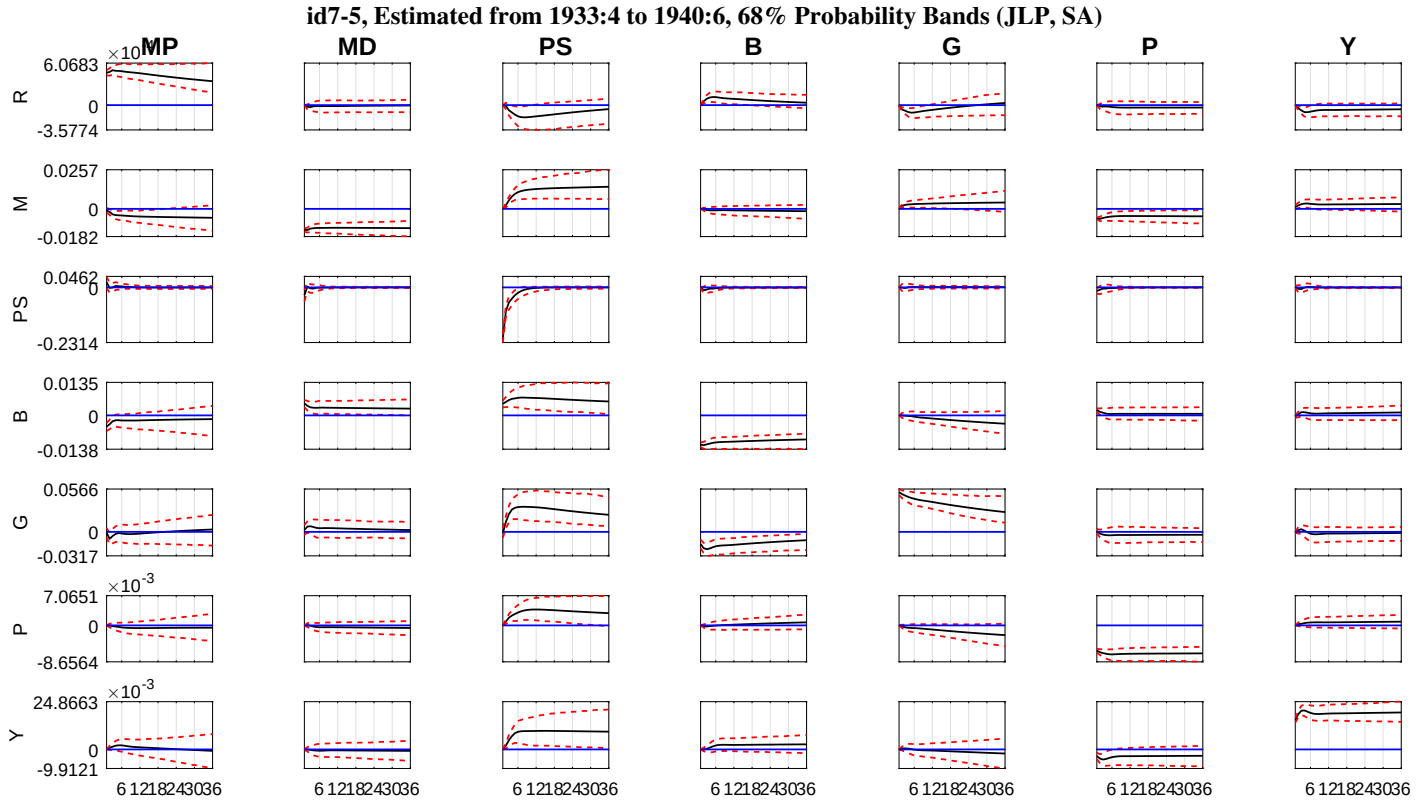

Figure 39: Full moving average representation of the identified VAR estimated over the unbacked fiscal expansion period (April 1933 to June 1940). Solid lines are maximum likelihood estimates; dashed lines are 68 percentile probability bands based on 1000 draws from the posterior distribution of all the VAR parameters.

D Fiscal Implications of Gold Sterilization

D.1 Gold Sterilization during the Great Depression

Gold imports have the potential to increase the monetary base of an economy following the classical gold standard or the gold exchange standard. Policymakers can counteract the increase in the monetary base by sterilizing gold inflows which entails paying for imported gold in government securities rather than bank reserves. Prior to 1933, the Federal Reserve conducted gold import operations and sterilization decisions. By June of 1934, these responsibilities shifted to the Treasury as the result of a series of presidential proclamations, executive orders, joint-resolutions, and Acts that culminated in an embargo on gold exports and the Treasury seizing the entire monetary gold stock including coins and bullion held by private citizens, business, and the Federal Reserve Banks.[44]

Massive gold imports more than tripled the monetary gold stock from $4.25 billion at the start of 1933 to $14.42 billion at the end of 1938. Meltzer (2003, p. 459) notes that the Treasury purchased more than $4 billion of gold from 1934-1936. Friedman and Schwartz (1963, p. 545) attribute the gold inflows throughout this period 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. To our knowledge, the Gold Reserve Act of 1934's ban on private citizens holding monetary gold required banks to sell newly imported gold to the Treasury.[45] With gold inflows pushing up excess reserves, policymakers feared that the growing monetary base could ignite inflationary forces [Jaremski and Mathy (2016)]. To curb the growth of excess reserves and hence the monetary base, the Treasury sterilized gold imports from December 1936 to April 1938.

D.2 Treasury Sterilization

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.

[44] See Bordo, Humpage, and Schwartz (2015, pp. 56–57) for a detailed time line of events. Jaremski and Mathy (2016, 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.

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

Stage 1: Member banks import $1000 worth of gold and fund it by issuing $1000 worth of deposits. Member bank assets and liabilities rise by $1000.

Treasury

Assets	Liabilities

Federal Reserve

Assets	Liabilities

Member Banks

Assets	Liabilities
+$1000 gold	+$1000 deposits
+$1000	+$1000

Stage 2: Member banks sell their imported gold to the Treasury for $1000. The Treasury pays for the gold by drafting on its balance at the Federal Reserve. The Federal Reserve acts as clearing agent between the Treasury and the member banks and settles their balances in reserves. The aggregate balance sheets of the Treasury and the Federal Reserve are unchanged, but because bank reserves—a Federal Reserve liability—have increased, high-powered money rises by $1000. For member banks, gold is swapped for reserves and their aggregate asset position is unchanged—both its assets and liabilities remain elevated by the original $1000 injection.

Treasury

Assets	Liabilities
+$1000 gold -$1000 due from Fed	

Federal Reserve

Assets	Liabilities
	+$1000 reserves -$1000 due to Treasury

Member Banks

Assets	Liabilities
-$1000 gold +$1000 reserves	$1000 deposits
$1000	$1000

Stage 3a, No Sterilization: The Treasury replenishes its balances at the Federal Reserve by issuing gold certificates and depositing them at the Federal Reserve as the final payment for gold purchases. Non-sterilized gold imports ultimately increase the balance sheets of the Treasury, the Federal Reserve, and member banks and leaves the amount of free-gold at the Treasury unchanged. Moreover, the Treasury creates high-powered money through the vehicle of increasing its deposits at the Federal Reserve.

Importantly, in the case of no sterilization, there is no increase in Treasury indebtedness to the private sector because the Treasury creates "money" through gold certificates.

Treasury		Federal Reserve		Member Banks	
Assets	Liabilities	Assets	Liabilities	Assets	Liabilities
+$1000 due from Fed	+$1000 gold certificates to Treasury	+$1000 gold certificates from Treasury	+$1000 due to Treasury	$1000 reserves	$1000 deposits
+$1000	+$1000	+$1000	+$1000	$1000	$1000

Stage 3b, Sterilization: When sterilizing gold imports, the Treasury replenishes balances at the Federal Reserve by selling government securities to member banks rather than issuing gold certificates and depositing them at the Federal Reserve. The Federal Reserve again settles the transaction between the Treasury and member banks through reserves. Member banks pay for security sales by retiring reserves outstanding at the Federal Reserve. The Federal Reserve then offsets this transaction by crediting their balance due to the Treasury/debiting the Treasury's balances held at the Federal Reserve. When the Treasury does not sterilize gold imports, reserves cannot be retired in such a manner. Sterilization increases the aggregate balance sheets of the Treasury and member banks, but not the Federal Reserve.

In this case, there is an increase in Treasury indebtedness to the private sector and there is no increase in bank reserves.

Treasury		Federal Reserve		Member Banks	
Assets	Liabilities	Assets	Liabilities	Assets	Liabilities
+$1000 due from Fed	+$1000 gov't securities		-$1000 reserves +$1000 due to Treasury	-$1000 reserves +$1000 gov't securities purchased from Treasury	$1000 deposits
+$1000	+$1000			$1000	$1000

D.3 Federal Reserve Sterilization

Prior to the gold policies of 1933 and 1934, the Federal Reserve was responsible for gold purchases and sterilization decisions. Gold could be freely imported and exported and circulated. Gold sales to the Federal Reserve were voluntary, rather than compulsory, decisions made by member banks.

Stage 1: Member banks import $1000 worth of gold and fund it by issuing $1000 worth of deposits. Bank assets and liabilities rise by $1000.

Treasury

Assets	Liabilities

Federal Reserve

Assets	Liabilities

Member Banks

Assets	Liabilities
+$1000 gold	+$1000 deposits
+$1000	+$1000

Stage 2a: No Sterilization Member banks sell their imported gold to the Federal Reserve for $1000. The Federal Reserve pays for the gold by issuing reserves to member banks which increases high-powered money by $1000. For member banks, gold sales are offset by reserves which leaves their aggregate asset position unchanged and elevated by the initial $1000.

Treasury

Assets	Liabilities

Federal Reserve

Assets	Liabilities
+$1000 gold	+$1000 reserves
+$1,000	+$1,000

Member Banks

Assets	Liabilities
-$1000 gold +$1000 reserves	$1000 deposits
$1000	$1000

Stage 2b: Sterilization When sterilizing gold imports, the Federal Reserve – like the Treasury – pays for gold by selling government securities to member banks. 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 Federal Reserve sterilization, there is no increase in Treasury indebtedness to the private sector and no increase in bank reserves. 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

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