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ABSTRACT

Outside of the recent past, excess reserves have only concerned policymakers in one other period: the Great Depression. The data show that excess reserves in the 1930s were never actively unwound through a reduction in the monetary base. Nominal economic growth swelled required reserves while an exogenous reduction in monetary gold inflows due to war embargoes in Europe allowed excess reserves to naturally decline towards zero. Excess reserves fell rapidly in early 1941 and would have unwound fully even without the entry of the United States into World War II. As such, policy tightening was at no point necessary and could have contributed to the 1937-1938 Recession.

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1. Introduction

The search to understand the recent recession and its aftermath has led many economists to look back at the Great Depression (Almunia et al. 2010; Eichengreen and O'Rourke 2009; Crafts and Fearon 2010). However, while most studies have focused on the actions of the Federal Reserve (Fed) during the downturn, the Great Depression also offers insight on how to unwind the substantial excess reserves that built up as a result of Quantitative Easing (QE). Just as in the late 2000s, short-term interest rates quickly hit the zero lower bound in the early 1930s and central banks considered non-traditional monetary policies to stimulate the economy. These policies led to a massive expansion of the Fed's balance sheet. And while we have not yet seen the unwinding of the current QE program, we can study the unwinding of a similar monetary expansion during the Great Depression.[1]

Even though the Fed did not provide interest on reserves, the depreciation of the dollar in 1934 and large inflows of foreign gold before the Second World War (WWII) resulted in a massive buildup of excess reserve balances.[2] Over $14.5 billion of unsterilized gold flowed into the United States on net between May 1934 and December 1941, more than in any other period. While gold inflows were not directly controlled by the Federal Reserve, the decision not to sterilize gold inflows and to immediately convert them into currency was effectively a Quantitative Easing program as they engendered an enormous increase in the monetary base when short-term rates were close to zero. Many authors have considered these large scale asset purchases to be essentially QE programs. Bernanke, Reinhart, and Sack (2004, p. 18) have characterized these as a "successful application of quantitative easing" whereas authors such as Anderson (2010) and Hanes (2014) use the period to study the effects of QE policies. Additionally, Bordo and Sinha (2016) argue that the 1932 open market operations were an effective QE program that would have mitigated the Depression had they continued.

The literature on excess reserves during the 1930s is extensive. Economists have examined the determinants of the rise in excess reserves (Friedman and Schwartz 1963; Wilcox 1982; Bernanke 1983) as well as the effect of reserve requirements changes (Calomiris, Mason,

[1] We study the decline of excess reserves to near zero rather than the return to a "normal" monetary policy environment. As described by Mitchener and Mason (2010), the Treasury's control over the Exchange Stabilization Fund and the pegging of interest rates during WWII delayed normal monetary policy until the 1950s.

[2] The current Fed policy of paying positive interest on excess reserves allows the Fed to influence financial markets despite the huge expansion in its balance sheet. Therefore, while lowering IOER might reduce excess reserves, it is not the primary tool the Fed intends to use for this purpose.

and Wheelock 2011; Park and Van Horn 2015). However, to our knowledge, no study has studied the determinants of the fall of excess reserves in the early 1940s.

Our analysis indicates that the cessation of the largely exogenous gold flows is the only factor that can explain the sudden decline in excess reserves in early 1941. Between the trough of the Great Depression in 1933 and the end of WWII, excess reserves fell in only two periods. As gold inflows were slowing after the gold bloc countries had devalued in 1936, excess reserves declined and had almost reached zero before the Recession of 1937-1938 increased them again. The cessation of gold flows from Europe during the war correspond to the more permanent decline in excess reserves started in early 1941. Excess reserves were on track to have unwound fully even without the issuance of war bonds or increase in reserve requirements in late 1941.[3] As such, policy tightening was unnecessary and may have been counterproductive. We take this as evidence that gold inflows were too large and the returns to alternative investments too low for banks to fully invest their excess reserves in other available assets.

We use three approaches to test this theory. First, we construct a residual model that is able to accurately predict changes in excess reserves from 1934 to 1941 using only gold flows, income, reserve requirements, and money in circulation. Second, we empirically show that gold inflows are the only variable robustly correlated with changes in excess reserves. Finally, we show that new excess reserves were disproportionately concentrated in New York City where gold flows entered the country, and that the effect of gold was several times larger for New York City banks than other banks around the country.

2. The Recovery from the Great Depression

While prices, income, and production declined steadily after the stock market crash in October of 1929 (Figure 1), the banking system remained relatively unaffected until November of 1930 when the failure of Caldwell and Company (a key southern financial institution) set off a chain reaction across the banking system.[4] Banking panics continued intermittently until March of 1933. Fears that the newly elected Roosevelt administration would depreciate the dollar after taking office led to a drain of gold out of the system. By March, the New York Federal Reserve

[3] A full counterfactual without United States entry into World War II is beyond the scope of this paper, but the downward trend of excess reserves appears unaffected by Pearl Harbor and does not appear to accelerate in 1942 either. If anything, the large gold inflows fleeing Nazi advances delayed the unwinding of excess reserves.
[4] Friedman and Schwartz (1963) provide an excellent overview of the period for the interested reader.

Bank had no more free gold and could not honor any additional gold withdrawals. Spilling over just after his inauguration, the panic gave Roosevelt the impetus to take dramatic action by implementing a Bank Holiday. Banks were closed, their books were examined, and only solvent banks were permitted to reopen. When the dust settled, over 4,000 banks were shut down permanently (Wicker 2000).

Roosevelt took additional steps to stabilize the currency and prevent gold outflows. In 1933, he suspended convertibility of the dollar into gold, restricted gold exports, and forced the sale of all private gold holdings to the Federal Reserve.[5] The Gold Reserve Act of 1934 formally lowered the value of the dollar from $20.67 to $35 per troy ounce of gold and ended the crawling depreciation that had begun in 1933. Significant gold inflows began almost immediately after capital controls were lifted and largely continued until the outbreak of WWII (Meltzer 2003).

The banking system began to recover after 1933 and the ratio of currency to deposits steadily declined. However, instead of returning to their prior portfolio allocations, banks began to hold tremendous amounts of excess reserves (Figure 2). While excess reserves had been near zero before 1929, they grew rapidly from about $400 million in April of 1933 to about $3 billion in December 1935. The Fed was extremely concerned about the large excess reserve balances. In a press release by the Federal Open Market Committee (FOMC) on December 17th, 1935, the Board of Governors argued the gold flows were "excessive", and the FOMC resolved to absorb the resulting excess reserves as soon as such action would be possible without undue risk (Meltzer 2003, p. 498).[6] Excess reserves began to decline in early 1936, and were on a path to reach zero by late 1937. The sudden decline of excess reserves, however, stoked the administration's fears about inflationary bottlenecks in 1936 and led to an increase in reserve requirements, the sterilization of gold inflows, and fiscal tightening as the federal budget moved

[5] Roosevelt instructed the Treasury to purchase gold at $29.62 an ounce and the Reconstruction Finance Corporation to purchase gold above that. The Thomas Amendment to the Agricultural Adjustment Act gave the President the authority to expand the monetary base and change the gold parity (Meltzer, 2003, p. 578, Footnote 74).

[6] The FOMC (December 1935, p.11) states: "It is the view of the Committee, however, that the amount of excess reserves of member banks constitutes a source of danger …. The Committee believes, therefore, that action should be taken as soon as possible without undue risk to absorb a part of these excess reserves as a safeguard against possible dangers …." The FOMC (January 21, 1936, p. 4) later reaffirmed their intentions: "The Committee recognizes that the risks of action are somewhat increased by the present budgetary situation, but it recognizes also that the longer action is delayed, the greater and the dangers resulting from the combination of inordinately large excess reserves and an unbalanced budgetary situation, and the greater will be the difficulty of taking remedial action. Viewing the situation as a whole, the Committee strongly believes that action looking towards a substantial reduction in excess reserves should be taken as soon as this may be feasible …."

towards balance (Bloomfield 1950, p. 233; Meltzer 2003, p. 505-509; Eggertsson 2008).[7] As the recession worsened, policymakers reversed these contractionary policies. The Treasury released the entire sterilization account balance of $1.2 billion, the Fed lowered reserve requirements back down in April 1938, Congress increased spending, and the Recession ended by the end of the year (Irwin 2012). While there was some discussion of reducing reserve balances in 1939, concerns about higher interest rates relating to imminent war in Europe meant that inaction largely prevailed until the United States entered WWII (Meltzer 2003, p. 547-548).

While excess reserves declined through 1936, the ensuing recession caused excess reserves to surge again. Over and above the return to the lower pre-1936 reserve requirements, the growth of excess reserves was further accelerated by the release of the sterilization account. It was not until early 1941 that the growth reversed. Excess reserves declined by 14 percent over the first quarter of the year and had been more than cut in half by the end of the year. Excess reserves continued their decline throughout the war before bottoming out in early 1944.

As argued by Eichengreen (1996), the Bank Holiday in 1933 and devaluation of the dollar against gold in 1934 were a major impetus for the recovery from the Great Depression. Authors such as Eggertsson (2008) portray these policy changes as leaving the gold standard, but the new regulations likely amplified the effect of monetary gold coming into the country. Unlike previous periods when gold inflows could be held outside the banking system, all the incoming gold after 1934 was immediately exchanged for newly created money base as private gold holdings were only permitted for nonmonetary uses (Bullock, 1934; Richardson et al. 2013).[8] Specifically, gold flowing into the United States came to New York City's gold market. The New York City bank holding this gold would then sell to the Federal Reserve Bank of New York (working on behalf of the Treasury) in exchange for credit to the banks' reserve accounts.[9] These

[7] There is an active debate over whether the rise in reserve requirements caused the recession. Friedman and Schwartz (1963) and Velde (2009) argue that the increase in reserve requirements caused tight monetary conditions, whereas Cargill and Mayer (2006), Calomiris, Mason, and Wheelock (2011), and Park and Van Horn (2015) argue it had little effect on bank behavior

[8] Section 2 of the Gold Reserve Act transferred all private monetary gold to the Treasury at the old rate of $20.67. As the gold was immediately devalued by 59 percent, these capital gains were used to fund the Treasury's Exchange Stabilization Fund (Section 10) which could buy or sell gold, securities, and foreign currencies to stabilize the dollar's value at the new parity of $35 per troy ounce. Section 5 and 6 prohibited the Treasury from redeeming gold for dollars on demand, and instead forced all gold to be redeemed for dollars (Richardson et al. 2013).

[9] The Treasury issued a gold certificate in order to purchase the gold from the Federal Reserve Bank (Bloomfield 1950, p. 229). The Exchange Equalization Fund, a division of the Treasury, could have made purchases or sold gold, but in practice most sales occurred directly with the Treasury (Bloomfield 1950, p. 151).

funds could be used to purchase goods and securities, make loans, or remain at the Fed as excess reserves. Monetary gold increased from $8.19 to $22.76 billion between 1934 and 1941.

Romer (1992) shows that this increase in the money stock was the main factor driving the economic recovery and that Real GNP would have been nearly 50 percent below its pre-Depression trend rather than back to normal in 1942 if the growth of money supply had continued at the pre-Depression trend. Only two periods since 1918 have seen monetary base increases averaging over 20 percent a year: 1933-1945 and 2008-2014. While the Fed and Treasury still had the ability to directly create high-powered money, increases in monetary gold constituted 96 percent of the all new high-powered money created between February 1934 and November 1941, as can be seen in Figure 3.

The Fed used open-market operations sparingly during this period and it was not until they pegged interest rates during the war that open market operations returned with any regularity. Instead, reserve requirements were the Fed's primary remaining tool (Carlson and Wheelock 2014). The question is then: If the Fed was not responsible for the unwinding of excess reserves than what was? The rest of the paper attempts to understand what factors caused the large rise in excess reserves and what caused their precipitous fall in the early 1940s.

3. Explanations for the Rise and Fall of Excess Reserves

There is a large literature on reserves during the Great Depression. While many papers argue that the supply of gold was responsible for the rise in money supply and total reserves (e.g., Hanes 2006), this literature by and large has not explicitly examined the effect on excess reserves. Moreover, there are several other theories for the rise of excess reserves that also must be examined. We start by examining the importance of gold flows and then explore whether any other hypothesis can explain the sudden unwinding of excess reserves in early 1941.

3.1. Gold Inflows

The inflow of international gold between 1934 and 1941 dramatically increased the amount of high powered money in the economy. To the extent that banks did not have a large variety of good investment options, the sheer magnitude of expansion could have overwhelmed banks and fluctuations in gold flows thus might correspond to the fluctuations in excess reserves.

While domestic production was stimulated by the gold price increase and unlimited Treasury purchases, Figure 4 shows that their increase was small compared to international flows. As labeled in the Figure and discussed in Section 6, the spikes in gold inflows correspond to international events or currency speculation rather than domestic events. The New York Federal Reserve (1936, pp. 10, 12) was well aware of these flows and their effect on reserves:

> The principal cause of the continued increase in member bank reserve in 1936, as in 1934 and 1935, was a heavy inflow of capital to this country from abroad, accompanied by gold shipments to the United States on a large scale… therefore, an increasing amount of attention was directed to the consideration of means of preventing gold imports from causing further increases in bank reserves, and there was also renewed discussion of the advisability of further action by the Federal Reserve System to reduce the existing volume of excess reserves.

Indeed, the Figure shows a tight connection between international gold flows and excess reserves. The early rise in excess reserves from 1934-1937 corresponds to gold inflows from counties before they went off gold, and the late rise from 1938-1941 corresponds to gold inflows from counties fearing the start of WWII (Bloomfield 1950, p. 15).[10] Even though gold did not stop flowing into the country, the period of sterilization corresponds to a sudden drop in excess reserves and its release corresponds to a sudden rise. Gold flows also can explain the specific timing of the unwinding of excess reserve, as gold flows dried up due to international capital controls right before excess reserves dramatically declined in early 1941.

3.2. Precautionary Demand and Risk-Aversion

A commonly reported motive for the buildup of excess reserves after 1933 is precautionary demand. Popularized by Friedman and Schwartz (1963), this theory argues that banks demanded excess reserves in response to the bank runs of the early 1930s. During the Great Depression, banks found it hard to borrow funds from other banks, and faced both stigma and rationing when using the Fed's discount window (Gorton and Metrick 2013). Banks thus might have increased their excess reserves to protect against additional bank runs.[11]

[10] Because gold inflows during the late 1930s were the result of WWII, it is possible that banks kept more reserves in anticipation of gold outflows after the war. However, this would have been an incorrect prediction. Monetary gold only declined from $22.79 to $20 billion between 1941 and 1945, and after the war, it swelled again as a result of large trade surpluses accumulated by the rebuilding effort. Monetary gold reached $24.6 billion by September 1949 and remained high until the end of the Bretton Woods System (Federal Reserve Board 1943, 1976).

[11] Morrison (1966) argues that banks wanted excess reserves as a buffer against future bank runs, but instead of suddenly liquidating assets, they allowed reserves to build up as deposits flowed back into the system.

Others have expanded on this view. Frost (1971) argues that banks have a kinked demand curve for excess reserves based on the level of short-term interest rates. When short-term interest rates are high, banks have an incentive to invest short term and pay the penalty if they need to borrow at the Fed. However, when short-term interest rates are low (as they were during the 1930s), then banks have an incentive to hold more reserves to avoid penalties. Calomiris and Wilson (2004) argue that banks used excess reserves as a positive signal to customers. Therefore, rather than holding excess reserves in anticipation of bank runs, banks held them to reassure depositors and thus lower the probability of a bank run. As discussed in other contexts (Muir 2017; Guiso et al. 2013), this precautionary demand effect can also be thought of as increased risk-aversion by banks in response to the extreme shocks of the Depression.

As predicted by these theories, excess reserves more than doubled over late-1933 and 1934. That said, the explanations are a stretch to explain the continued buildup after 1934.[12] Not only did the installation of the Federal Deposit Insurance Corporation calm nerves, but it is unlikely that banks and individuals were still fearful of illiquidity more than two years after the last bank run. Tobin (1965, p. 472) for instance posits: "Did bankers never take heart again, even when the deposit-currency ratio was rising and bank runs seemed to be a thing of the past?" Excess reserve growth only accelerated after 1934, leaving banks with significantly more reserves than could have been expected to walk out the door. For instance, the ratio of reserves to individual deposits in New York City reached over 45 percent by the end of the decade.

The theories also do not offer much insight into the sudden decline of excess reserves at the beginning of 1941. If anything, the lead up to WWII should have reduced confidence in financial markets rather than strengthened it. For instance, WWI caused a financial shock that led to the temporary closure of the New York stock market and the issue of emergency currency through the Aldrich-Vreeland Act (Silber 2007, Jacobson and Tallman 2015).

3.3. Alternative Assets

Another strand of the excess reserves literature points toward the costs and returns of non-reserve assets. As long as the cost of finding a good investment was higher than its return,

[12] Wilcox (1982) finds that this theory can only explain a small proportion of total reserve behavior after 1933.

banks would have held onto their reserves rather than invest.[13] Arguably the most well-cited of these views comes from Bernanke (1983). His "non-monetary" channel suggests that the Great Depression increased the costs of screening and monitoring borrowers.[14] As banks reduce costs by developing relationships with repeated customers, the large number of bank failures left a gap in knowledge. The theory posits that banks reduced their lending and built up excess reserves rather than pay the high costs of making loans. Wilcox (1982) also argues that banks were also discouraged from investing in long-term and relatively liquid bonds because yields were declining through most of the period. Banks thus received a lower return in the short-run, and risked a decline in asset values when interest rates returned to their pre-1929 values.

Looking at Figure 5, banks reduced their loan portfolios during the wave of banking panics, but had begun to increase their loans in 1935 and 1936. The Recession of 1937-1938 temporarily put an end to new loans, but they snapped quickly back, increasing by $1 billion from the first half of1938 to the second half of 1939, $2.77 billion in late 1940, and $5.6 billion by the second half of 1941 (Federal Reserve Board, 1943). Loan growth stalled again after 1941 as banks shifted into war bond purchases, and loans remained substantially below their pre-Depression values during the war. The figure also shows that banks shifted into relatively safe long-term government securities on either side of the 1937-1938 downturn and before the dramatic fall in excess reserves. As such, the alternative asset theory cannot explain the fall in excess reserves. Large portions of the rise in lending and bonds precede the fall in excess reserves. There is no large event that would have made bank lending suddenly safer or increased bond yields (Figure 1). [15] That said, while this theory cannot explain the movements of excess reserves, it potentially explains why gold flows might have been so important to excess reserves. When other assets have high costs or low returns, banks likely would have had few investment options for the massive rise in reserves and thus would have held onto a large portion of the new funds. The pattern of excess reserves would then be dictated by fluctuations in the money supply and money multiplier until investment returns had improved to the extent that the new funds could be fully used.

[13] Though subsuming theories related to liquidity and the zero-lower bound (e.g., Krugman 1998 and Blinder 2000), neither a liquidity preference nor a zero interest rate is required for banks to prefer reserves to alternative assets.
[14] Mounts, Sowell, and Saxena (2000) also argue that banks faced high internal adjustment costs.
[15] While Wilcox finds that interest rates explain a large proportion of excess reserves during the 1930s, Hanes (2006) posits that interest rates were influenced by the demand for reserves. Specifically, Hanes argues that since cash is an asset free of interest-rate risk, the demand for reserve is inversely related to the level of long-term interest rates when other short-term rates are zero. As such, the effect of interest rates on reserves is likely bidirectional.

3.4. Reserve Requirements

Changes in excess reserves are also mechanically tied to the reserve requirement. A rise in the reserve requirement could be met by either (1) depositing more money at the Fed thus raising total reserves but leaving excess reserves the same or (2) allowing excess reserves to be automatically converted into required reserves thus leaving total reserves the same. Since banks during the 1930s held ample excess reserves, even a large increase in the reserve requirement could have been fully met by a decline in excess reserves.

For each type of deposit (demand or time) and each class of bank (country, city, reserve city) there is an associated reserve requirement. The first reserve requirement increases since 1917 occurred in 1936 and 1937 with increases of 50 percent and 25 percent. The arrival of a recession quickly reversed the government's policies. The Fed also raised reserve requirements in November of 1941 in order to slow the post-Recession inflation. The change in reserve requirements in 1941 corresponds to a decline in excess reserves from $5 billion to $3.6 billion from October to November of 1941. However, this decline was just a continuation of the larger downward trend from $6.8 billion in January of 1941. While excess reserves did increase slightly as the war was winding down, they remained roughly constant for the rest of the WWII period. As such, reserve requirement increases cannot explain the unwinding of excess reserves.

3.5. Expansion of Income

The rebounding economy could also have had led to a natural decline in the banking system's excess reserves. Assuming banks were holding a target level of total reserves rather than as a fraction of deposits, new deposits could be used to make loans or purchase securities, and the only change would be that the level of required reserves would increase and the level of excess reserves would decrease. However, income fluctuations do not correspond well with the growth and decline in excess reserves. Personal income and deposits were rising through most of the period. This growth caused a steady rise in required reserves, but banks continued to expand their excess reserves. There was also no sudden spike in income that could explain the fall in excess reserves during early 1941, and the sudden rise in deposits occurs several months after excess reserves had begun to fall. Any decline in excess reserves caused by a rise in income was obscured by other factors until 1941.

3.6. War Financing

Rather than explaining the rise in excess reserves during the 1930s, the WWII bond campaign is one potential explanation for the decline in excess reserves during the 1940s. Because of the patriotic push to absorb the war bond issues, banks might have decided to use their excess reserves to absorb the new bond issues even if yields were low. The United States issued defense bonds during May of 1941 and issuance accelerated after the Pearl Harbor bombing of December 1941. The first of seven war loan drives occurred at the end of 1942.

The start of war financing clearly stands out in Figure 6, but most of the rise occurred after 1941 rather than with the initial issue of defense bonds. Bank holdings of government securities increased by $3.7 billion during 1941, yet increased by $18 billion during 1942 and by $15 billion in both 1943 and 1944. Instead it seems that something else changed in 1941 for banks. For instance, government bonds held by banks grew by $1.5 billion during 1940 yet excess reserves rose by 36 percent, whereas they grew by $3.7 billion during 1941 and excess reserves decreased by 51 percent. The increases in security holdings were not large relative to the changes in gold flows and required reserves in 1940. Government security holdings increased in 1941, but the declines in excess reserves were larger. Therefore, while the lead up to the war was responsible for the pattern of gold inflows, the issuing of U.S. government debt during the war does not match up to the decline of excess reserves.

4. A Residual Model of Excess Reserve Accumulation

Building off the statements of the Fed and other policy-makers as well as aggregate statistics, we previously observed that the level of gold inflows seems to match increases in the level of excess reserves. This appears to be consistent with a model where banks receive new reserves through gold inflows, but do not reallocate those reserves due to the lack of alternative assets presenting a more attractive risk-adjusted return. To examine the explanatory power of this residual hypothesis and understand the interplay between the banking and monetary systems, we construct a simple prediction model for excess reserves by breaking down how high powered money is created and how it flows through the banking system.

The Federal Reserve Board's (1943, p. 360-367) conceptual framework for reserve balances is the most straightforward approach for this task. The framework breaks down reserves

into its three "sources" and six "uses." New sources of reserves come from (1) net gold inflows, (2) the Fed creating new bank reserves, and (3) the Treasury creating new currency. The uses of reserves are (1) money in circulation, (2) member bank reserve balances (called total reserves), (3) Treasury cash, (4) nonmember bank deposits, (5) Treasury deposits as the Fed, and (6) other Fed accounts. The uses and sources must be equal by definition:

$$Total\ Reserves + Money\ in\ Circulation + Treasury\ Cash + NonMember\ Deposits + Treasury\ Deposits\ at\ the\ Fed + Other\ Fed\ Accounts = Gold + Fed\ Operations + Treasury\ Operations.$$

While the level of excess reserves is chosen by banks, the total value of reserves (i.e., all member bank reserve balances) and required reserves are largely exogenously determined by the money supply and individual behavior. Therefore, to judge the extent that excess reserves were a residual (i.e., determined by whatever was left of gold flows after required reserves and money in circulation are removed), we perform the following exercise. First, we estimate the expected value of total reserves and required reserves. We then use those values to obtain a measure of predicted excess reserves if banks simply chose not to keep the remainder as excess reserves. Using the entire set of sources and uses, total reserves would be:

$$Total\ Reserves = Gold + Fed\ Operations + Treasury\ Operations - Money\ in\ Circulation - Treasury\ Cash - Nonmember\ Deposits - Treasury\ Deposits\ at\ the\ Fed - Other\ Fed\ Accounts.$$

Figure 3, however, shows that many of these items were very small, meaning that total reserves between 1933 and 1942 are largely a function of high powered money and money in circulation. So, to a first approximation, the change in total reserves can be predicted using:

$$\Delta Predicted\ Total\ Reserves = \Delta Gold - \Delta Money\ in\ Circulation.$$

It is important to note that these two right-hand side factors are relatively exogeneous to individual banks, the Federal Reserve Banks, and the Treasury.

To obtain excess reserves, we subtract required reserves from total reserves. For a given category of deposits, required reserves will equal total deposits times the required reserve ratio:

$$Required\ Reserves = Reserve\ Ratio\ on\ Time\ Deposits * Time\ Deposits + Reserve\ Ratio\ on\ Demand\ Deposits * Demand\ Deposits.$$

However, because the required reserve ratios for both time and demand deposits nearly always changed in the same proportion, we can decompose total required reserves into the reserve

requirement multiplied by total deposits and attribute other movement in required reserves to a composition factor that accounts for changes in the proportion of time vs. demand deposits.

$$Required\ Reserves = Reserve\ Ratio * Composition * Deposits$$

Just like currency holdings, individual deposits are driven by a multitude of factors (e.g., confidence in the banking system, liquidity preference, interest rates, etc.). However, because of the close relationship between personal income and deposits in this period, we decompose deposits into the product of personal income and the deposits-to-personal income ratio.

$$Required\ Reserves = Reserve\ Ratio * Composition * \frac{Deposits}{Income} * Income$$

Despite other factors, over 94 percent of the increase in required reserves from March 1933 through December 1941 is explained by changes in the required reserve ratio and income.[16] We thus simplify the prediction model to:

$$\Delta Required\ Reserves = Required\ Reserves_{t-1} * (\%\Delta Reserve\ Ratio + \%\Delta Income)$$

Having constructed estimates of total reserves and required reserves, predicted excess reserves are:

$$\Delta Excess\ Reserves = \Delta Total\ Reserves - \Delta Required\ Reserves =$$
$$\Delta Gold - \Delta Money\ in\ Circulation - Required\ Reserves_{t-1} * (\%\Delta Reserve\ Ratio + \%\Delta Income).$$

The results for this prediction model in the top panels of Figures 9 and 10 closely correspond to the actual values between 1934 and 1941. Its poor performance outside of 1934-1941 is due to the exclusion of money issued by the Federal Reserve from the model. The bottom panels of Figures 9 and 10 shows that when Fed credit is added to the model the fit before 1934 and after 1941 is significantly improved, but there is little difference in between those years. The results thus indicate that the 1930s, when gold flows largely replaced other money creators, is an exception to the majority of the Fed's history, confirming our previous contentions.[17]

[16] The effect of all factors on required reserves can be seen in Figure A.1.

[17] Precautionary demand could explain some of this behavior, as perhaps banks were constrained by the amount of reserves available and so used gold inflows to increase their reserves to a preferred higher target. However, this is inconsistent with banks' behavior. First, when reserve requirements were increased, banks responded by maintaining their total reserve balances and reducing their excess reserves. Second, the sterilization of gold between February 1936 and August 1937 reduced excess reserves quickly, while excess reserves accumulated afterward as a slowing economy reduced income and deposit growth. If the trend continued, excess reserves would have dropped to zero by April 1938. Indeed, excess reserve balances at the trough in 1937 is quantitatively similar to that in the late 1940s.

For the unwinding of reserves in the early 1940s, the cessation of gold flows, rebounding income, and reserve requirements all combine to rapidly shrink excess reserve balances. From the local peak in October 1940 to the local trough in May of 1944, total reserves only increased by $235 million, while excess reserves fell by $5.6 billion and required reserves rose by $5.7 billion. Gold flows dried up and the $85.7 billion increase in personal income and the November 1941 rise in reserve requirements accelerated the natural reduction excess reserves.

5. An Econometric Model of the Determinants of Excess Reserve Behavior

The residual model of excess reserve accumulation was based on the assumption that banks held onto all gold inflows. However, we know from previous sections that other behavioral factors (i.e., interest rates and national debt) might have influenced this decision. In this section, we empirically test the connection between gold and excess reserves while controlling for the other macroeconomic factors that could have influenced the decisions of banks. Because of the condensed number of years and observations, we are forced to estimate a parsimonious linear model. We select variables based on the previously described theories for excess reserve accumulation. We control for income growth using United States' personal income and population growth, interest rates using the rate on AAA bonds, changes in the reserve requirement using the fraction of demand deposits required to be held at the Fed, precautionary demand using the volatility of the Dow Jones Industrial Average as a proxy for risk/uncertainty following Romer (1990),the spread between BAA and AAA rates as a measure of financial risk following Caldara et al. (2016), and new issues of government bonds using the logarithm of the national debt. The linear regression model takes the form:

$$\Delta Y_t = a + \beta_1 \Delta Gold_t + \beta_2 \Delta X_t + \beta_3 Y_{t-1} + e_t \quad (1)$$

where ΔY_t is either the change in total reserves, total excess reserves, total reserves as a fraction of individual deposits, or total excess reserves as a fraction of individual deposits, $Gold_t$ is the overall monetary gold stock, X_t is the vector of control variables described above, and e_t is the robust error term. The variety of dependent variables is important to account for the fact that gold inflows mechanically increase deposits and by extension total and required reserves. While the model accounts for any serial correlation using the lag of the dependent variable, we show in Appendix Table A.1 that the results hold when we drop the variable or when we extend the data

earlier in time. We also show the results are robust to including the 1929-1933 years of the Great Contraction in Appendix Table A.2.

As highlighted in previous sections, the amount of total reserves is going to be mechanically tied to gold inflows. However, the multiplier on gold will vary based on the actions and choices of individuals and banks. The exact size of the coefficient thus tells us about the environment of the banking system. This coefficient size is even more important for the gold multiplier on excess reserves as banks do not have to hold onto excess reserves, and in most periods they do not. The more banks are hoarding the newly created reserves the closer to one the coefficient will be.

Table 1 provides the estimated coefficients on equation (1). The table confirms that gold inflows increased both total and excess reserves even after controlling for other factors. A 10 percent increase in gold increased total reserves by 4.0 percent and excess reserves by 8.8 percent. There thus was almost complete pass through from gold to excess reserves. The inflows even increased reserves beyond the growth of deposits during the period. A 10 percent increase in gold increased the ratios of total reserves and excess reserves to individual deposits by 64 percent and 52 percent respectively. Changes in required reserves are the only non-gold variable that has a robust and significant effect on both measures of excess reserve accumulation. For instance, the 3.5 percentage point increase in county bank reserve requirements from 7 percent to 10.5 percent implemented by the Fed in August of 1936 is estimated to have decreased total excess reserves by 29 percent and the ratio of excess reserves to deposits by over 200 percent. The larger effect on excess reserves to deposits is the result of deposits being relatively unaffected by reserve requirement changes.[18]

The growth in the national debt also deserves mention. While it does not significantly affect the size of total reserves or excess reserves, it is negatively correlated with the ratios of total and excess reserves to deposits. The pattern matches the literature. The issue of national debt provided banks with a place to earn a safe return on assets, but rises in deposits caused by increased government spending partially offset the effect. The results weaken when we use the

[18] Using monthly data on gold flows from 1929 to 1941, we can test whether the structural breaks in gold come close to the structural breaks in total and excess reserves. We estimated the observations with the two highest probabilities of being structural breaks using the method outlined in Clemente, Montanes, and Reyes (1998). Given the high frequency of the data and likelihood of some delay in the effects, the results match up reasonable well with expectations. Gold experiences structural breaks in December of 1933 and July 1938, excess reserves experiences breaks in May of 1933 and February of 1938, and total reserves experiences breaks in Jan 1934 and February of 1939, which correspond to major policy changes which affected reserve behavior in 1933-1934 and 1938-1939.

level of the national debt rather than the growth in debt, suggesting new debt issues helped to reduced excess reserves rather than total borrowing.

As with any analysis at the aggregate level, it is difficult to judge whether the effect of one variable is masking a simultaneous change amongst many variables or is the result of an omitted variable. However, because gold flows were concentrated in one location (e.g., New York City) we can add further evidence for the role of gold by examining disaggregated data. As stated by the New York Federal Reserve (1936, p. 11):

> Most of the imported gold was received at New York and, at the outset, had the effect of increasing the reserves of the New York City banks. As in the preceding two years, however, the proceeds were distributed rapidly throughout the country, through Treasury borrowing in the New York market and disbursements of these borrowed funds in other parts of the country.

While the Federal Reserve Board does not provide data on bond flows across the period, the Federal Reserve Bank of New York's *Annual Report* provides the flows between New York City and the rest of the country in two years: 1934 and 1935. Reserves gained through gold inflows for both years are smaller than reserves lost to the government (largely from sales of securities). However, the reserve flow from the rest of the country due to sales of the securities was so large that the reserve balance of New York City banks still surged.[19] To be sure that gold flows were driving excess reserves, we test whether excess reserves were disproportionately concentrated in New York City and whether gold flows had their largest effect on banks in the city.

Total reserves and excess reserves in New York City banks were nearly as large as the totals of all other banks combined. Indeed, the rise in excess reserves after 1938 and extent of unwinding during the early 1940s was concentrated in New York City. The unwinding of excess reserves was also stronger in New York City than the rest of the country. New York City banks reduced their excess reserves to near zero by mid-1943, while banks elsewhere kept some. New York City banks were thus central to the accumulation and distribution of excess reserves.

[19] Because of this mechanism, the geographic distribution of reserves across the United States would be determined by the geographic distribution of the Treasury's net spending and the relative demand for government securities across the United States. This process shows that the level of excess reserves balances was chosen by banks in general equilibrium based on the value of excess reserves relative to other alternative assets that banks could hold Indeed, even though gold inflows were significant during this period, this period also saw large deficits so this recycling process was distributing more than the entire amount of the gold flows in most years. In every year from 1934-1941 debt issuance exceeded gold inflows except for 1938 when the budget was near balance and 1940 when gold inflows swelled due to several Axis victories in Europe.

We further check the gold mechanism by estimating separate reserve regression equations separately for New York City, Chicago and Reserve Cities, and Country Banks.[20] As Treasury distributions and bond purchases were disproportionally made in large cities, we would expect to find gold inflows influence excess reserves in New York City most strongly followed by Chicago and Reserve Cities and finally by Country banks. The pattern of coefficients in Table 2 shows just that. The coefficient on gold is multiple times larger for New York City than Chicago and Reserve Cities which in turn are larger than Country Banks. A 10 percent rise in gold would lead to a 6.7 percent increase in total reserves in New York City, but only 2.6 and 2.7 percent increases in Chicago and Reserve Cities and Country banks respectively. Gold has an even stronger effect on excess reserve growth. A 10 percent increase in aggregate gold would increase the excess reserves by 25.5 percent for New York City banks, 6.8 percent for Chicago and Reserve Cities, and an insignificant 3.4 percent for Country banks.

Confirming the Federal Reserve reports, national debt issues had their largest effect on New York City banks. These banks purchased the initial issue of the bonds and helped to distribute them throughout the nation. The coefficient on the change in national debt is statistically significant and large for New York City banks regardless of the reserves measure, yet is only marginally significant in a few other specifications. Similarly, the effect of reserve requirements is larger in New York City than Chicago, Reserve Cities and Country banks.[21]

6. The Determinants of Gold Flows

Up until now, we have focused on the explanatory power of gold inflows on excess reserves, arguing that the flows were due to largely exogenous political or foreign events. This exogeneity is important to separate the arrival of gold from domestic factors that could encourage excess reserves holdings. In this section, we provide narrative and empirical evidence that exchange rate risk, speculation, and war drove the gold inflows rather than domestic events.

We start by examining the determinants of the large spikes in gold inflows seen in the monthly data in Figure 4. After Roosevelt raised the gold price at the Treasury, there are nine

[20] Because it was not a center for gold inflows, we combined Chicago with the Reserve City Banks. However, when Chicago is combined with New York City, the effect of gold still holds.

[21] Shown in Appendix Table A.3, we re-estimate the regressions using required reserves as the dependent variable instead of total or excess reserves. Required reserves are positively correlated with gold, but as predicted, the magnitudes are much smaller than those found for total or excess reserves and are relatively similar across locations. As the coefficients on the remaining variables are not significant in more than one specification, the required reserve ratio seems to be the primary determinant of required reserve behavior.

spikes of monthly gold inflows above 200 million: (1) June 1935, (2) October 1935, (3) June 1936, (4) October 1936, (5) June 1937, (6) September 1938, (7) May 1939, (8) September 1939, and (9) August 1940.[22] We consult archival evidence and the secondary literature around each of these dates.

The New York Federal Reserve (1936, p.11) describes that the gold flows in the mid-1930s were driven by "the persistence of uncertainties in the European monetary and economic situation and more especially in the European political situation." Many of the originating gold exporting nations were part of the gold bloc and were among the last countries to remain on the gold standard (Bernanke and James 1991; Eichengreen 1996).

Large gold flows in June 1935 were reportedly driven by the fallout caused by the devaluation of the Belgian belga in April 1935. Gold inflows arrived specifically from Netherlands and Switzerland that feared the eventual devaluation of their gold standards. October of 1935 marked the start of the Second Italo-Ethiopian War which reportedly spread additional instability and fear through European markets (New York Federal Reserve 1935, p. 8).

Belgium's devaluation put intense pressure on France to do the same as it made the franc even more overvalued in late 1935 and early 1936 (Bloomfield, 1950, p.15). A trickle of gold out of France turned into a rush in June 1936 with the signing of the Matignon Accords in France. These labor agreements, signed in the wake of a left-wing electoral victory, strengthened labor's right to collective bargaining, reduced hours, and raised wages. This in turn led to a burst of inflation and a further overvaluation of the franc. Indeed, France devalued before the end of the year.

Gold inflows spiked again in the Fall of 1936 on speculation that there would be a retreat from the gold standard in the gold bloc countries. The spike in October of 1936, corresponds to the signing of the tripartite agreement and the devaluation of the French franc and other gold bloc currencies on September 26, 1936 (New York Federal Reserve 1936, p. 11-12). It might seem strange to see net gold inflows to the United States rather than large outflows towards France after devaluation, but the franc was considered "sick". In the context of labor unrest and

[22] While this section focuses on the largest spikes, most of the other high inflow months also corresponded to international events. Most of the months with outflows also correspond to negative effects. For instance, outflows in February 1935 correspond to speculation that the gold price would be lowered due to Supreme Court striking down Roosevelt's actions. For additional information on events see Rauchway (2015) and Bloomfield (1950).

balance of payment deficits, the franc continued a steady depreciation until it was pegged to the pound in November 1938 (Bloomfield 1950, p. 16).

While in hindsight the United States was committed to $35 an ounce price for gold, this did not prevent speculative gold flows due to expectations that this price would be changed. The June 1937 spike in gold inflows corresponded to the so-called "gold scare". Speculators feared a reduction in the dollar price of gold and preferred to lock in the old, higher price (Kindleberger 1986, pp. 265-269). The New York Federal Reserve (1937, p. 19) describes that the inflows were "due to a large transfer of short term banking funds to New York, stimulated partly by rumors abroad of an upward revaluation of the dollar through a reduction in the American gold price". Conversely, as the United States' Recession worsened in the Fall of 1937 and policymakers indicated a return to expansionary policies, there was a "dollar scare" that caused large reductions in gold flows. Specifically, speculators postponed gold shipments to the United States in case of another devaluation intended to stimulate the American economy (New York Federal Reserve 1938, p. 7; Bloomfield 1950, p. 146).

Gold flows picked up again in 1938 as a direct result of the run up to WWII. The New York Federal Reserve (1938, pp. 7-8) reports:

> [H]eavy flight of capital from Europe to the United States … started with the development of tension between Germany and Czecho-Slovakia over the Sudeten issue, and increased rapidly when that situation led, in September, to fears of a general European war. Some moderation of the inflow of capital followed immediately upon the Munich agreement, but continued unsettlement in the European political situation, and the accompanying weakness in sterling exchange, resulted in a further flow to the United States during the last quarter of the year.

The cancelation of the German-Polish Non-Aggression Pact in April 28, 1939, as well as the Pact of Steel between Germany and Italy on May 22nd corresponds to the next large gold spike in May 1939. In early 1940, gold flows accelerated during the invasion of Denmark and Norway and peaked with the Fall of France in June along with the defeat of the Benelux countries in May.

Not all of the gold flows were seeking the safety of United States bank vaults. The New York Federal Reserve (1940, p.7) discusses:

> The unprecedented volume of the gold movement to this country during 1940 was attributable largely to (1) heavy shipments for British account to provide dollar assets for the purchase of war materials and for the construction and equipment of plants with which to produce such materials, (2) large shipments from France for similar purposes during the first half of the year, (3) the transfer of monetary reserves from a number of

> European countries to the United States for safekeeping, and (4) gold shipments from other countries for the settlement of adverse balances of payments in the international accounts of such countries.

As the quote suggests, in addition to the inflow of monetary gold we consider, transfers of gold from foreign governments' official holdings surged from $8.8 million in 1935 to $1.2 billion in 1939 and $2.2 billion in 1941, suggesting that the United States was considered by foreign governments to be a safe haven (Federal Reserve Board of Governors 1943, p. 536). Money also flowed in to take advantage of the United States' developed and still functioning securities markets.

Unfortunately, little data exist on the origin country of gold flows that would allow us to trace a path from each corresponding event to the United States. Instead, data only exist on the direct country from which the gold entered the United States. Even before the War, most gold went directly or indirectly through the major gold markets of France, the UK, the Netherlands, Switzerland, and Belgium. Therefore, many transfers that appear to be from the UK, for example, actually represent non-UK residents with British bank accounts acquiring dollar deposits or securities (Bloomfield 1950, pp. 9-10). France, having a fixed exchange rate to gold, is the main intermediary country from 1933-1936. The UK becomes more important as an intermediary from 1937 to 1939 once France left the gold standard and conditions on the European continent became much more dangerous. Finally, Canada becomes the dominant intermediary in 1940 and 1941 once the safety of the UK was in doubt due to Germany's planned invasion (McDowall 1997). For example, the UK transferred $1.8 billion in gold in 1939 just before the UK joined the war, yet, only $633 million in 1940. Instead flows from the UK government and citizens came in from British gold holdings in Canada.[23] By 1941, the United States was the only major developed country not involved in fighting, and controlled over three-fourths of the world's reported gold reserves, a share which would higher if we excluded countries with gold embargoes.[24]

The archival evidence suggests that the large inflows of gold into the United States were the result of exogenous international factors relating to concern of devaluation or war. If true,

[23] Under Operation Fish in 1939 and 1940, the UK transferred nearly all of its gold reserves by boat to Canada for safekeeping and to allow for purchase of American goods (Draper 1979). The cessation of gold inflows after 1941 also was assisted by the Lend-Lease Agreement in 1941 meant that allowed the UK to purchase armaments with alternate payments to gold (Friedman and Schwartz 1963, p. 550-551).

[24] The United States gold reserves increases from 37 percent of reported world gold reserves in February 1934 to 54 percent in October 1937 to 78 percent in December 1941 (Board of Governors 1943, pp. 546-549, 552-555).

then the flows of gold should not be related to any of the United States macroeconomic factors that we have examined in previous sections. We, therefore, re-estimate equation (1) putting the change in gold on the left-hand side instead of on the right. The results in Table A.3 provide additional evidence that gold flows were not significantly related to changes in any of the macroeconomic variables. Therefore, while international depositors might have chosen the United States for its relatively stable economy, the relative differences were not primarily "pulled" by domestic conditions in the United States.

7. Conclusion

Several conclusions arise from our examination of excess reserves during the Great Depression. One is that banks largely responded to developments outside of the banking system. The primary impetus for monetary stimulus, gold flows from abroad, occurred due to instabilities in Europe related to either the ongoing breakdown of the interwar gold standard or the run up to WWII. In turn, banks made loans based on economic conditions, but kept large excess reserve balances as gold flows exceeded their appetite for new investment. While we cannot show causality directly, investment seems to have responded to economic developments at the national or world-level, rather than being the primary cause for the acceleration in economic growth. As a result, a simple residual model based on factors exogeneous to the banking system predicts actual reserve changes well. In fact, the model only performs well during the Great Depression when these very specific conditions were operative. At no point did the unwinding of excess reserves cause an explosion of lending or inflation as critics of these QE policies fear.

The narrative even suggests that Fed policy-makers exacerbated issues with excess reserves by prematurely pursuing contractionary policy. A coordinated monetary and fiscal policy tightening meant to reduce excess reserves and insure against a rise in inflation—including sterilizing gold inflows, a return to a more balanced budget, and a reserve requirement increase—corresponds to the Recession of 1937-1938 and a rebound in excess reserves. As such, it seems that it was not until the inflows of gold ceased and policy-makers allowed excess reserves to fall naturally that the problem was resolved.

Facing a similar large balance sheet and excess reserves in the 2010s as it did in the 1930s, the Fed has indicated how it intends to "normalize" policy. The primary tool that will prevent a burst of lending once credit conditions normalize is the Fed's ability to pay a positive

interest rate on reserve balances. This interest rate, which will rise in tandem with the fed funds rate, will increase the opportunity cost of lending and allow for expanded excess reserve balances despite positive lending rates (Keister and McAndrews 2009; Kahn 2010). This policy will also allow the Federal Reserve's expanded balance sheet to shrink gradually as its assets come due over time rather than with massive open-market sales (Ihrig et al. 2015).

Based on our findings, the Fed's policy seems historically grounded. The decline in excess reserves in the Great Depression occurred when the government did not try to force the money supply back to normal and instead allowed economic growth to absorb the additional money supply. The Fed's plans for an unwinding without tightening, therefore, resembles the stance taken in the 1940s, and suggests that it has learned from the premature tightening before the 1937-1938 Recession.

Naturally though there are differences between the QE programs in the 1930s and in the modern day. First, the size and expansion of the Fed's modern balance sheet is larger than in the Great Depression. Excess reserves in 1935 were about 4 percent of GDP, compared to about 15 percent in 2014. Second, the modern Fed has used many additional policy instruments, including the payment of interest on reserves, forward guidance, and non-Treasury purchases. These alternative instruments have different effects on the banking system and enable alternative approaches to unwinding excess reserves. For example, Krishnamurthy and Vissing-Jorgensen (2011) found that the Fed's purchases of mortgage backed securities were more effective at lowering mortgage rates in the 2000s than purchases of Treasury securities were at lowering Treasury rates in the 1930s for example. Though this point is opposed by Bordo and Sinha (2016) who find that these Treasury purchases were effective at lowering rates, in the few instances they chose to do so. As a result of these factors and other open empirical questions, care must be taken when drawing too strong conclusions from the historical period.

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Table 1: Linear Determinants of Reserves (1933-1945)

	D.Total Reserves	D.Total Reserves/ Individual Deposits	D.Excess Reserves	D.Excess Reserves/ Individual Deposits
D.ln(Pop)	-1.258	39.912	29.033	54.329
	[4.525]	[100.286]	[23.326]	[96.624]
D.Ln(US PI)	-0.048	-5.578**	-0.147	-1.779
	[0.145]	[2.641]	[0.463]	[2.915]
D.Ln(Total Gold)	0.402***	6.367***	0.882***	5.184***
	[0.072]	[1.718]	[0.211]	[1.296]
D.AAArate	-0.027	2.215	-0.268	1.352
	[0.114]	[2.274]	[0.331]	[2.101]
D.Reserve Requirement for Demand Deposits	0.837	4.119	-8.513***	-60.049***
	[1.138]	[23.088]	[2.669]	[16.733]
D.Stock Volatility	-1.166	-3.399	-4.764	-3.437
	[1.186]	[21.962]	[3.799]	[22.130]
D.Bond Spread	0.025	-0.040	0.093	-0.070
	[0.026]	[0.487]	[0.086]	[0.440]
D.Ln(National Debt)	-0.243	-7.724*	-0.843	-8.523**
	[0.155]	[4.445]	[0.677]	[3.344]
L. Dependent Variable	-0.010	-0.028	-0.087	-0.033
	[0.021]	[0.035]	[0.059]	[0.050]
Observations	46	46	46	46
R-Squared	0.334	0.295	0.390	0.351

Notes: Table presents the results of an OLS regression. The dependent variable is provided in the column heading. Each observation is a specific call report. Robust standard errors are provided in brackets. * denotes significance at a 10% level; ** at a 5% level, and *** at the 1% level.

Table 2: Linear Determinants of Reserves By Bank Type (1933-1945)

	D.Total Reserves			D.Total Reserves/Individual Deposits		
	NYC	RC	Country	NYC	RC	Country
D.ln(Pop)	-4.095	1.037	-1.325	-130.780	127.001	6.339
	[5.853]	[4.633]	[5.541]	[182.352]	[107.068]	[60.135]
D.Ln(US PI)	-0.361**	0.286**	-0.053	-16.464***	-0.532	-1.638
	[0.164]	[0.125]	[0.127]	[5.999]	[1.845]	[1.217]
D.Ln(Total Gold)	0.671***	0.258***	0.266***	14.739***	5.200***	1.716***
	[0.130]	[0.061]	[0.063]	[3.630]	[1.521]	[0.322]
D.AAArate	-0.120	0.046	0.013	1.512	3.517	1.482**
	[0.141]	[0.109]	[0.088]	[4.986]	[2.099]	[0.654]
D.Reserve Requirement	0.053	0.203	3.221***	-5.443	-2.664	16.821*
for Demand Deposits	[0.821]	[0.914]	[1.067]	[32.399]	[17.215]	[9.190]
D.Stock Volatility	-1.554	-1.343	-0.169	-1.992	-6.724	11.479
	[1.475]	[1.165]	[0.952]	[42.269]	[21.736]	[7.876]
D.Bond Spread	0.020	0.030	0.018	0.497	-0.061	-0.055
	[0.029]	[0.029]	[0.024]	[0.975]	[0.493]	[0.161]
D.Ln(National Debt)	-0.704***	-0.093	0.289*	-23.134**	-3.584	2.161
	[0.234]	[0.184]	[0.164]	[10.414]	[4.495]	[1.393]
L. Dependent Variable	0.009	-0.030	0.003	-0.009	-0.076*	-0.116***
	[0.026]	[0.024]	[0.016]	[0.035]	[0.042]	[0.033]
Observations	46	46	46	46	46	46
R-Squared	0.493	0.222	0.300	0.346	0.180	0.295
	D.Excess Reserves			**D.Excess Reserves/Individual Deposits**		
	NYC	RC	Country	NYC	RC	Country
D.ln(Pop)	14.451	59.661**	11.937	-103.138	152.605	76.178
	[34.134]	[24.489]	[17.244]	[156.750]	[96.861]	[56.535]
D.Ln(US PI)	-0.982	0.755*	0.704	-12.097**	1.723	-1.094
	[0.866]	[0.431]	[0.554]	[5.882]	[2.435]	[1.490]
D.Ln(Total Gold)	2.552***	0.688***	0.340	11.673***	4.171***	1.847***
	[0.484]	[0.205]	[0.252]	[2.746]	[1.131]	[0.424]
D.AAArate	-0.673	0.106	0.654**	-0.211	1.981	0.949
	[0.588]	[0.310]	[0.305]	[4.392]	[2.110]	[0.875]
D.Reserve Requirement	-17.472***	-8.860***	-1.045	-56.483***	-57.901***	-4.526
for Demand Deposits	[6.292]	[2.381]	[2.541]	[17.405]	[13.176]	[8.596]
D.Stock Volatility	-6.700	-4.290	8.170*	-5.572	-20.642	3.778
	[6.663]	[3.676]	[4.184]	[42.380]	[23.929]	[10.604]
D.Bond Spread	0.174	0.090	-0.052	0.362	-0.123	-0.078
	[0.164]	[0.083]	[0.082]	[0.807]	[0.506]	[0.201]
D.Ln(National Debt)	-4.240*	-0.716	0.523	-17.455**	-7.438*	0.660
	[2.404]	[0.724]	[0.478]	[7.155]	[3.759]	[1.410]
L. Dependent Variable	-0.015	-0.135**	-0.199***	-0.017	-0.059	-0.137**
	[0.040]	[0.053]	[0.055]	[0.045]	[0.056]	[0.061]
Observations	46	46	46	46	46	46
R-Squared	0.516	0.353	0.327	0.351	0.281	0.096

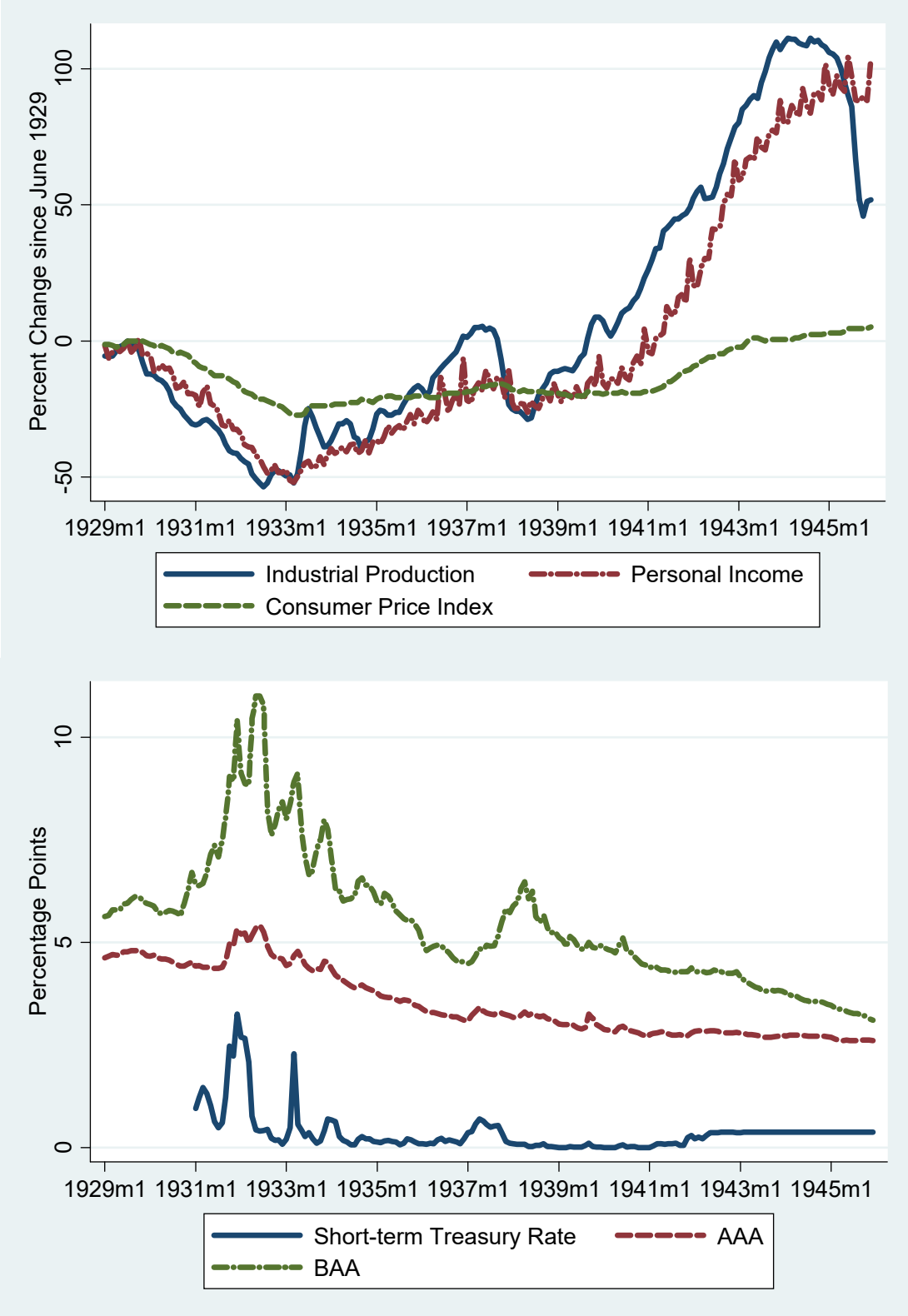
Notes: Table presents the results of an OLS regression. The dependent variable is provided in the column heading. Each observation is a specific call report. Chicago is included with the Reserve Cities because it was not a gold center, but the results hold when including it with New York City. Robust standard errors are provided in brackets. * denotes significance at 10%; ** at 5% level and *** at 1% level.

Table 3: Linear Determinants of U.S. Monetary Gold (1933-1945)

	D.Total Gold
D.ln(Pop)	2.840
	[4.102]
D.Ln(US PI)	0.111
	[0.200]
D.AAArate	-0.136
	[0.138]
D.Reserve Requirement	0.099
for Demand Deposits	[0.705]
D.Stock Volume	-0.202
	[2.086]
D.Bond Spread	-0.022
	[0.040]
D.Ln(National Debt)	-0.122
	[0.140]
L. Dependent Variable	-0.038
	[0.049]
Observations	46
R-squared	0.044

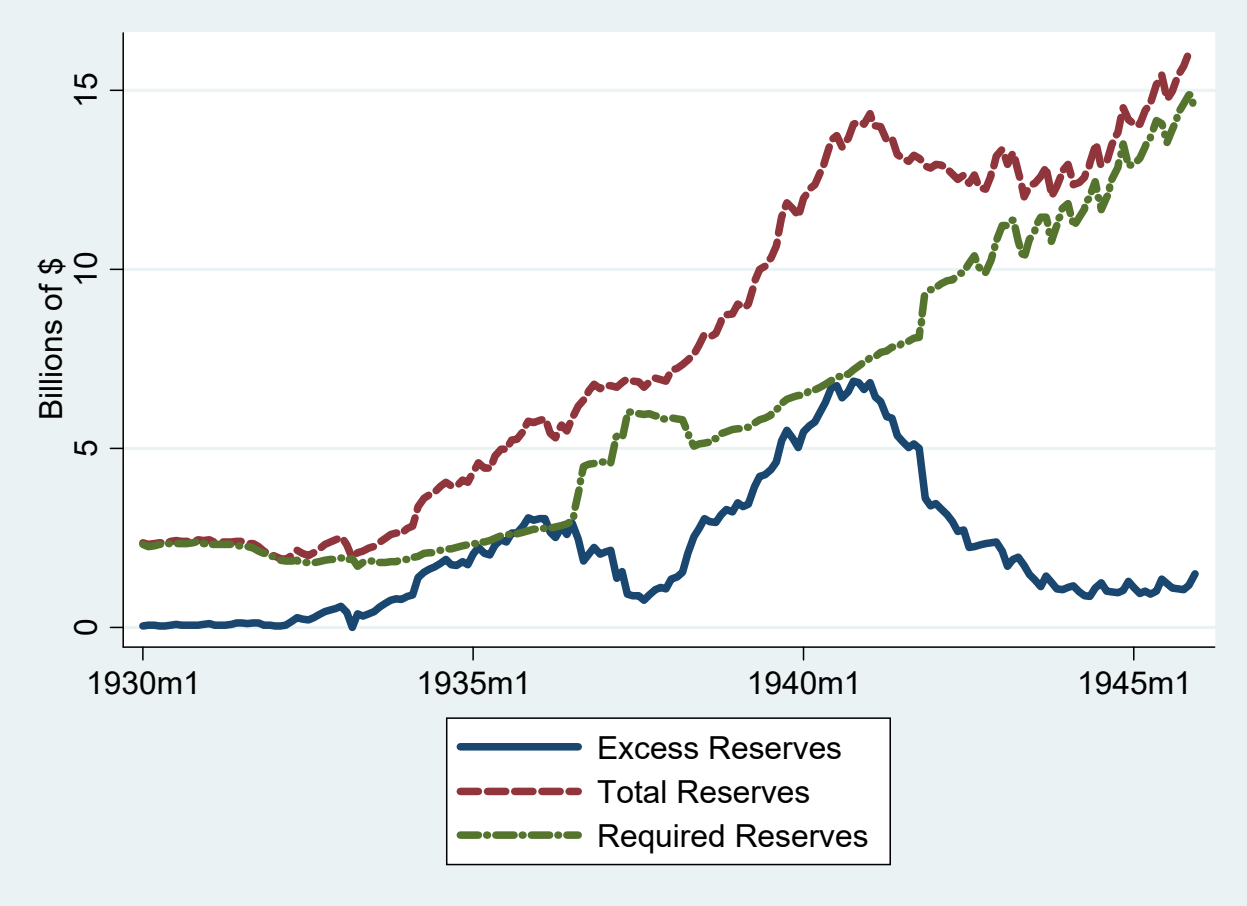
Notes: Table presents the results of an OLS regression. The dependent variable is provided in the change in total gold. Each observation is a specific call report. Robust standard errors are provided in brackets. * denotes significance at 10%; ** at 5% level and *** at 1% level.

Figure 1: Macroeconomic Indicators and Interest Rates, 1929-1945



Source: BLS/BEA/Department of Commerce/Moody's/NBER Macrohistory Database.

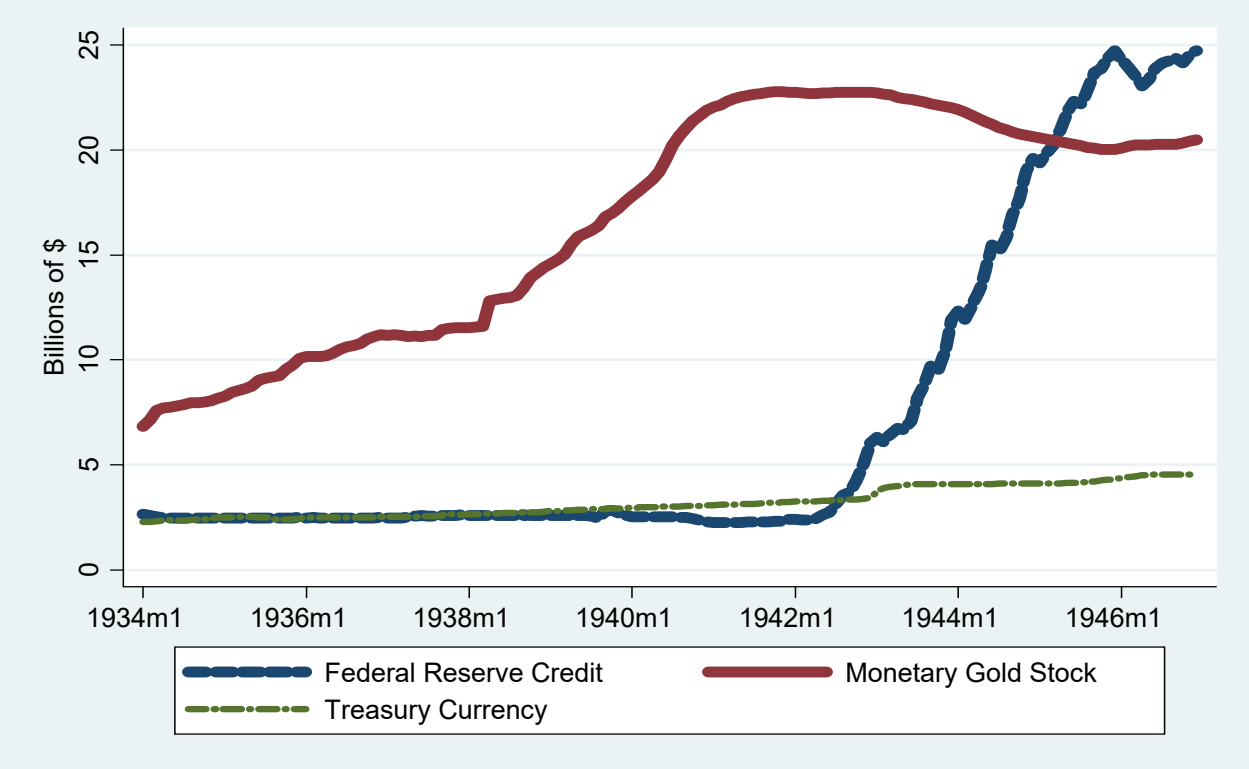
Figure 2: Reserves, 1931-1945



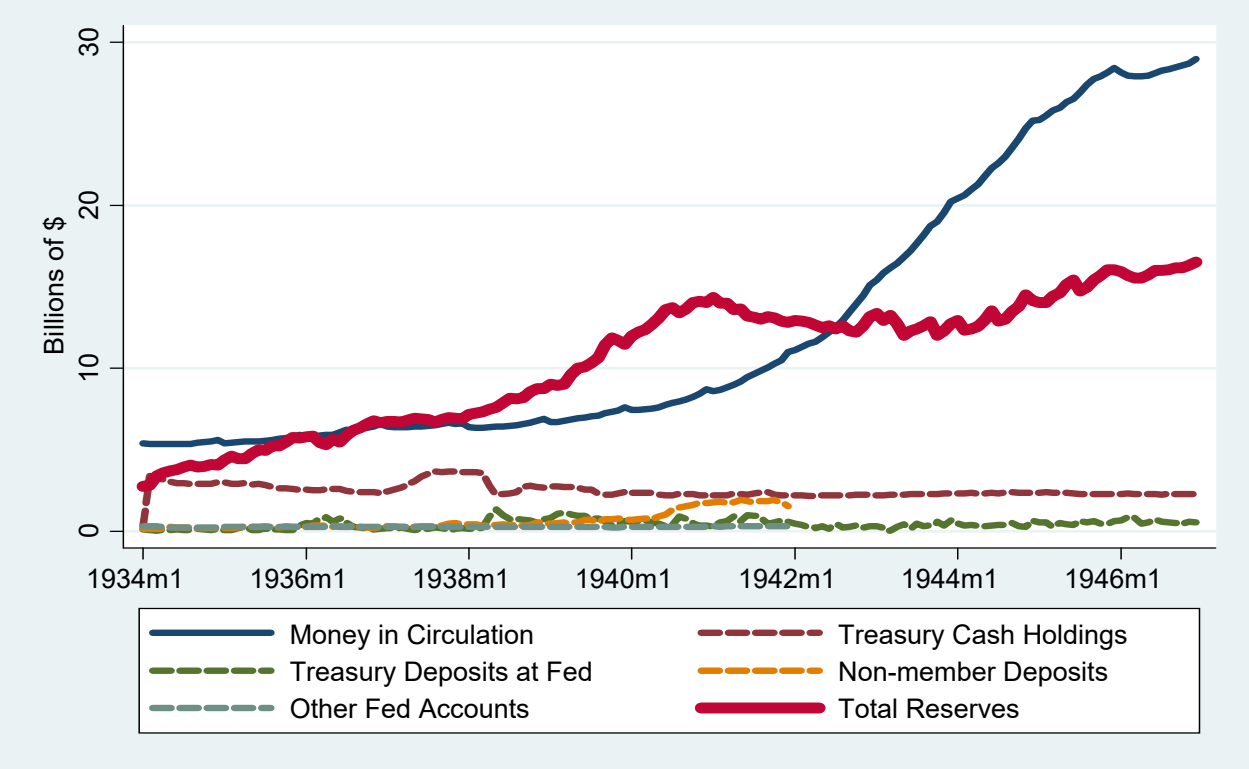
Source: Federal Reserve *Banking and Monetary Statistics, 1914-1941*.

Figure 3: Changes in High Powered Money Sources and Used, 1934-1946

Panel A: Sources of High Powered Money

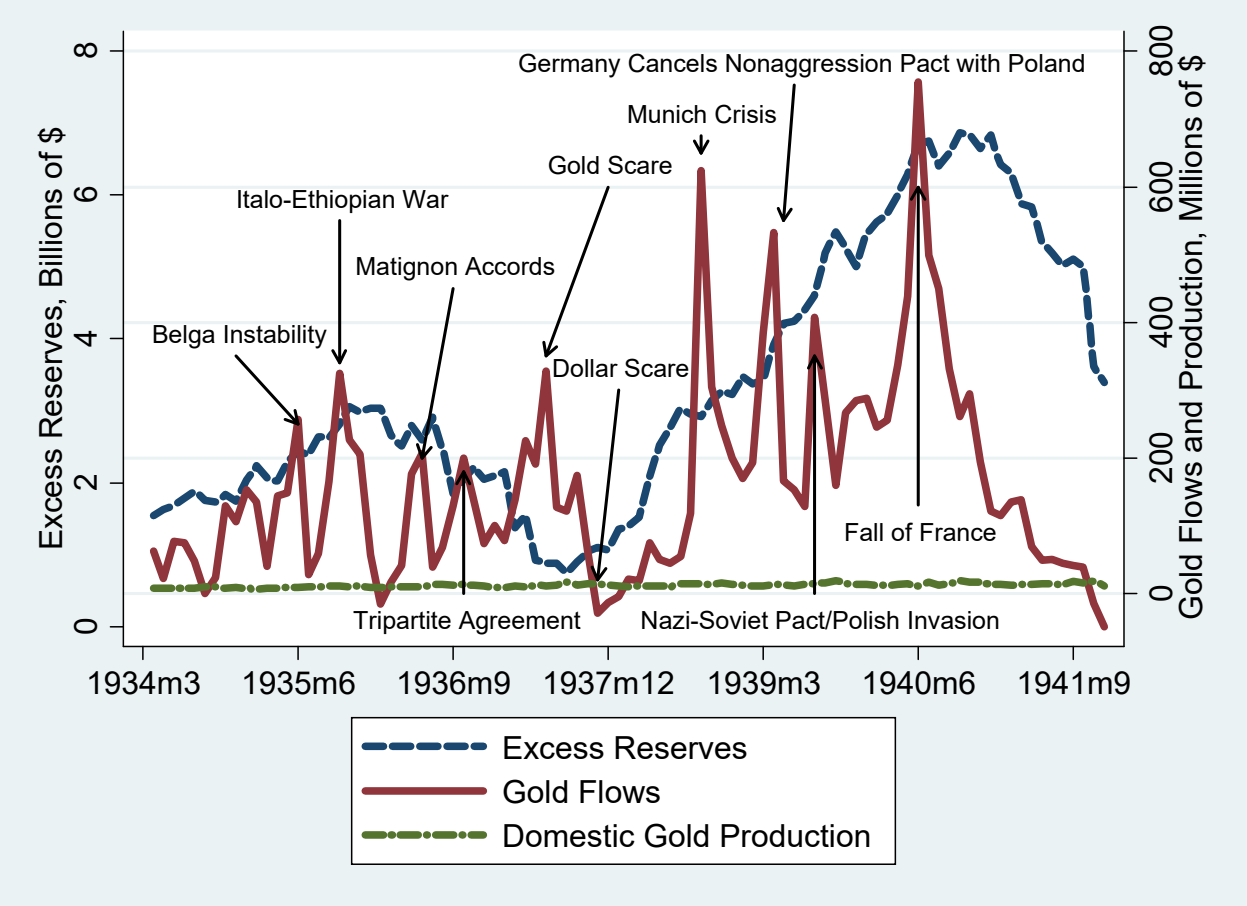


Panel B: Uses of High Powered Money



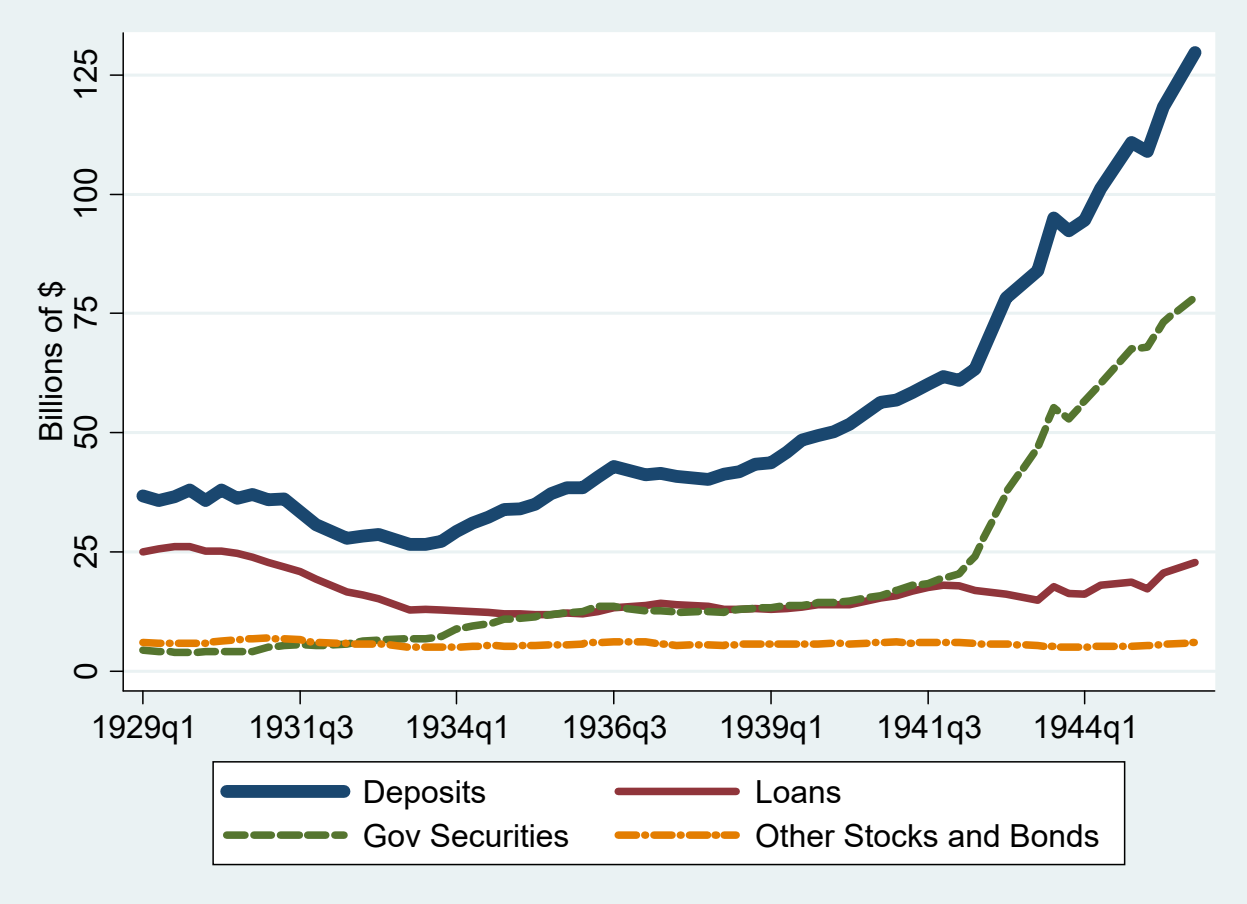
Source: Federal Reserve *Banking and Monetary Statistics, 1914-1941* and *1941-1970.*

Figure 4: Gold Flows and Domestic Gold Production, 1934-1941



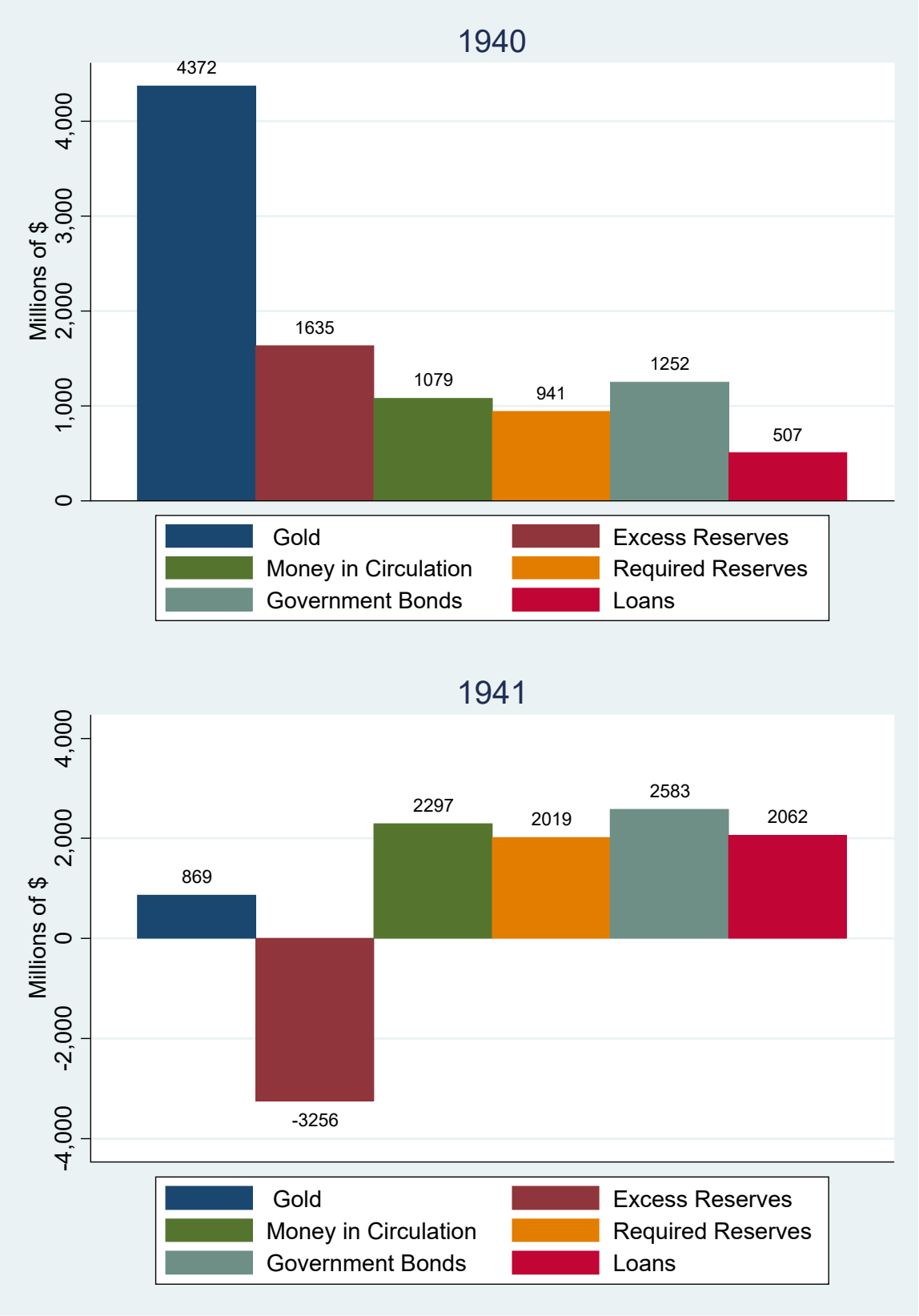
Source**:** Federal Reserve *Banking and Monetary Statistics, 1914-1941*. Units are Millions of Dollars. See Section 6 for a description of the various events labeled in the figure.

Figure 5: Bank Balance Sheet Categories, 1929-1945



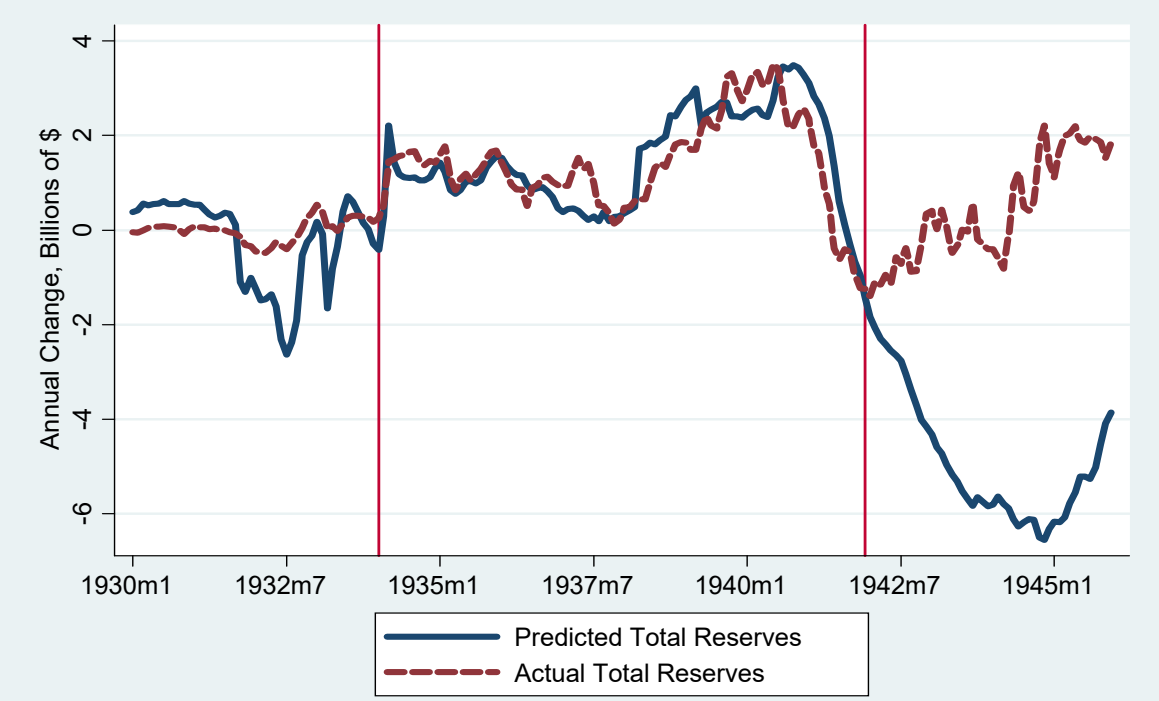
Source**:** Federal Reserve *Banking and Monetary Statistics*, *1914-1941* and *1941-1970*.

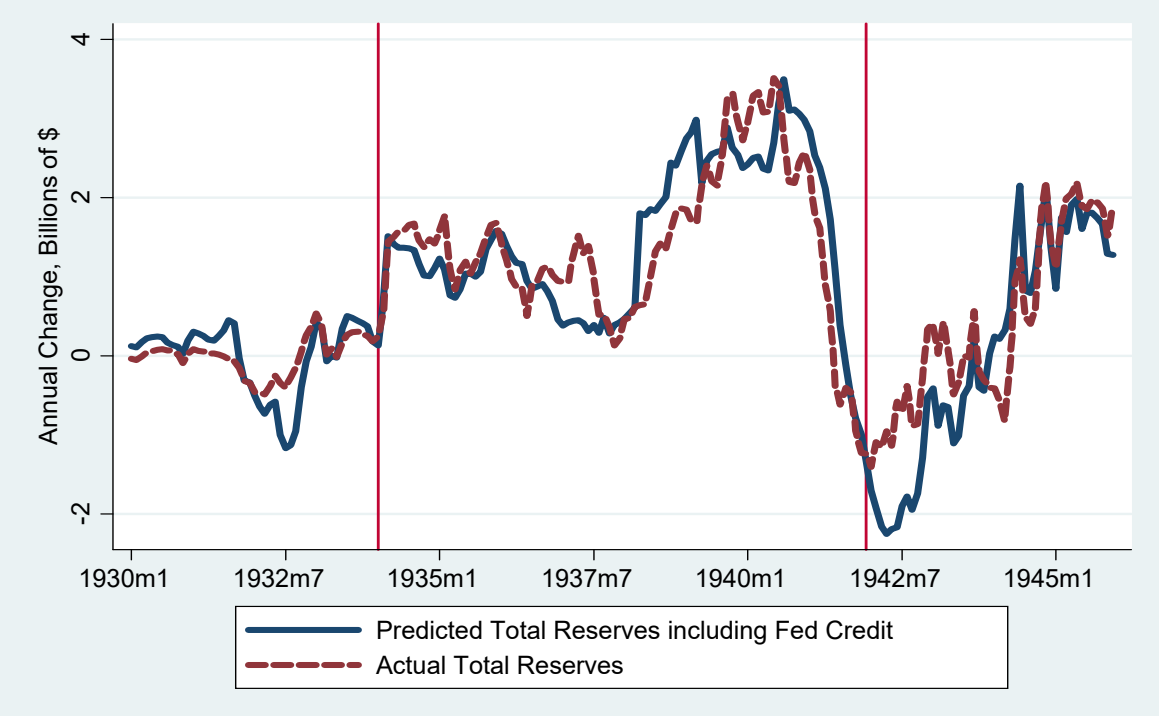
Figure 6: Changes in Bank Balance Sheets: 1940 and 1941



Source: *Banking and Monetary Statistics, 1914-1941*.

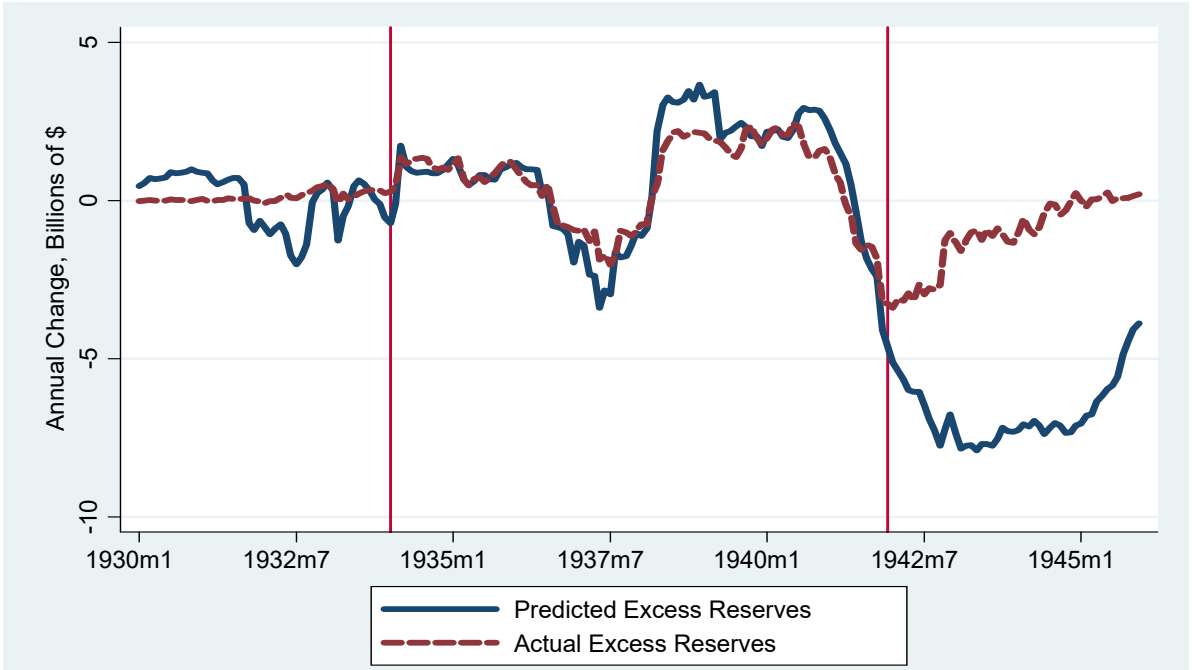
Figure 9: Actual and Predicted Total Reserve Changes, 1930-1945

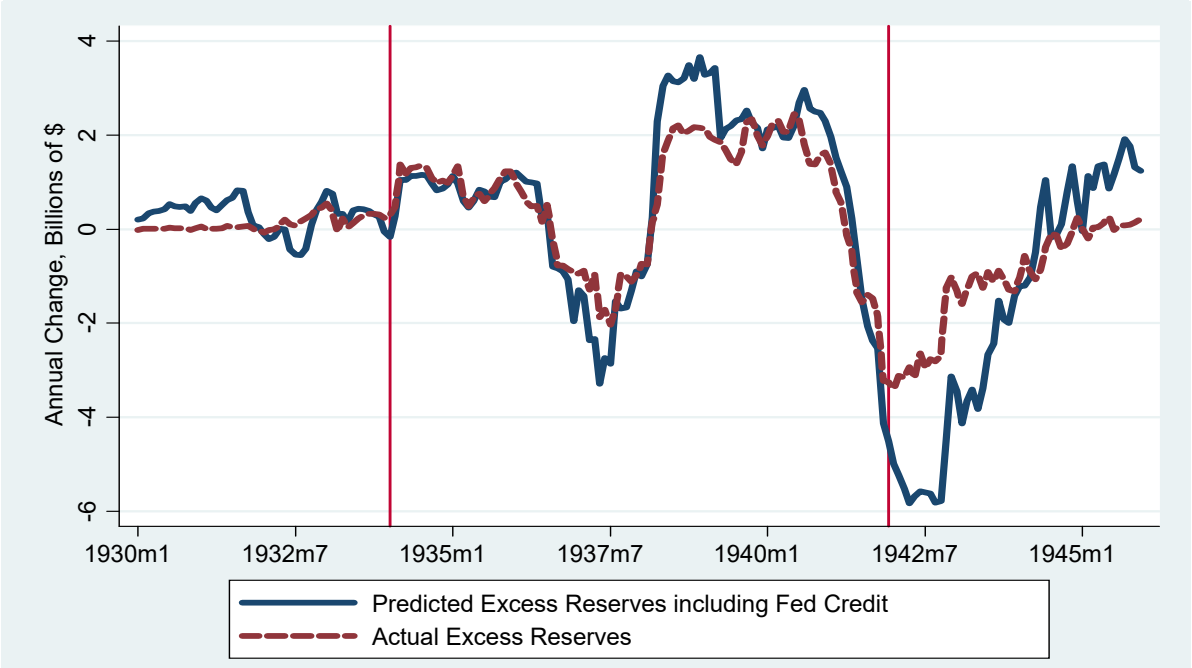




Source**:** Federal Reserve *Banking and Monetary Statistics, 1914-1941* and *1941-1970* and authors' calculations. Predicted Total Reserves equals the change in Monetary Gold minus the change in Money in Circulation. Predicted Total Reserves including Fed Credit equals Predicted Total Reserves plus Fed Credit. Red lines denote the 1/34-12/41 period of interest.

Figure 10: Actual and Predicted Excess Reserve Changes, 1930-1945





Source**:** Federal Reserve *Banking and Monetary Statistics, 1914-1941* and *1941-1970* and authors' calculations. Predicted Total Reserves equals the change in Monetary Gold minus Money in Circulation. Predicted Total Reserves including Fed Credit equals Predicted Total Reserves plus Fed Credit. Predicted Required Reserves are equal to Required Reserves lagged by one year times the annual percent change in personal income and the annual percent change in the Required Reserve Ratio. Predicted Excess Reserves are the difference between Predicted Total Reserves and Predicted Required Reserves. Predicted Excess Reserves including Fed Credit is the difference between Predicted Total Reserves including Fed Credit and Predicted Required Reserves. Red lines denote the 1/34-12/41 period of interest.

Table A.1: Linear Determinants of Reserves By Bank Type Without Lagged Dependent Variable (1933-1945)

	D.Total Required Reserves				D.Total Required Reserves/Individual Deposits			
	All	**NYC**	**RC**	**Country**	**All**	**NYC**	**RC**	**Country**
D.ln(Pop)	-1.044	-3.736	2.463	-1.558	10.654	-157.394	82.039	23.116
	[4.468]	[5.605]	[4.518]	[5.287]	[96.566]	[182.087]	[103.797]	[66.449]
D.Ln(US PI)	-0.067	-0.346**	0.232**	-0.049	-6.083**	-16.688**	-1.697	-2.459**
	[0.133]	[0.160]	[0.112]	[0.130]	[2.677]	[6.215]	[1.939]	[1.042]
D.Ln(Total Gold)	0.410***	0.664***	0.282***	0.263***	6.293***	14.688***	5.068***	1.873***
	[0.062]	[0.132]	[0.046]	[0.060]	[1.531]	[3.430]	[1.270]	[0.475]
D.AAArate	-0.046	-0.104	-0.011	0.017	1.777	1.285	2.418	0.690
	[0.108]	[0.124]	[0.123]	[0.093]	[2.387]	[4.917]	[2.343]	[0.768]
D.Reserve Requirement	0.905	0.034	0.374	3.206***	5.702	-5.133	0.067	19.741*
for Demand Deposits	[1.094]	[0.807]	[0.860]	[1.063]	[22.871]	[32.117]	[17.145]	[10.351]
D.Stock Volatility	-1.409	-1.364	-2.094*	-0.105	-7.824	-3.836	-19.262	0.828
	[1.010]	[1.374]	[1.130]	[1.042]	[20.252]	[39.351]	[21.181]	[8.241]
D.Bond Spread	0.026	0.020	0.032	0.017	-0.045	0.497	-0.082	-0.082
	[0.026]	[0.029]	[0.031]	[0.024]	[0.500]	[0.958]	[0.554]	[0.214]
D.Ln(National Debt)	-0.255*	-0.684***	-0.126	0.289*	-8.632**	-23.589**	-6.072	1.299
	[0.148]	[0.213]	[0.178]	[0.162]	[3.974]	[9.946]	[4.098]	[1.486]
Observations	46	46	46	46	46	46	46	46
R-Squared	0.346	0.504	0.188	0.319	0.302	0.363	0.124	0.123
	D.Excess Reserves				**D.Excess Reserves/Individual Deposits**			
	All	**NYC**	**RC**	**Country**	**All**	**NYC**	**RC**	**Country**
D.ln(Pop)	17.789	6.749	42.709*	20.873	19.789	-143.307	100.204	53.744
	[22.219]	[31.012]	[24.363]	[21.346]	[80.078]	[149.607]	[72.657]	[60.678]
D.Ln(US PI)	-0.446	-1.027	0.355	-0.019	-2.221	-12.471**	1.068	-2.114
	[0.408]	[0.878]	[0.462]	[0.534]	[2.882]	[5.820]	[2.371]	[1.447]
D.Ln(Total Gold)	0.816***	2.527***	0.503***	0.279	4.992***	11.533***	3.758***	1.585***
	[0.179]	[0.469]	[0.173]	[0.382]	[1.136]	[2.462]	[1.002]	[0.554]
D.AAArate	-0.477	-0.696	-0.161	0.084	1.166	-0.393	1.760	0.507
	[0.365]	[0.602]	[0.396]	[0.348]	[2.101]	[4.241]	[2.168]	[0.964]
D.Reserve Requirement	-8.502***	-17.669***	-9.357***	-0.014	-60.422***	-56.874***	-59.784***	-4.516
for Demand Deposits	[2.482]	[5.975]	[2.204]	[2.824]	[16.371]	[16.996]	[13.200]	[8.850]
D.Stock Volatility	-6.740*	-6.759	-6.791	0.959	-4.399	-5.957	-21.925	-1.391
	[3.487]	[6.484]	[4.282]	[4.855]	[20.227]	[39.174]	[22.844]	[9.689]
D.Bond Spread	0.099	0.173	0.090	-0.059	-0.068	0.375	-0.137	-0.103
	[0.091]	[0.162]	[0.107]	[0.135]	[0.444]	[0.787]	[0.529]	[0.234]
D.Ln(National Debt)	-1.092	-4.358*	-1.301*	0.471	-9.075***	-17.839**	-8.698**	-0.142
	[0.658]	[2.216]	[0.710]	[0.574]	[3.200]	[7.090]	[3.344]	[1.510]
Observations	46	46	46	46	46	46	46	46
R-Squared	0.354	0.528	0.262	-0.124	0.360	0.366	0.281	0.010

Notes: Table presents the results of an OLS regression. The dependent variable is provided in the column heading. Each observation is a specific call report. Chicago is included with the Reserve Cities because it was not a gold center, but the results hold when including it with New York City Robust standard errors are provided in brackets. * denotes significance at 10% level, ** at 5% level, and *** at 1% level.

Table A.2: Linear Determinants of Reserves By Bank Type with Entire Great Depression (1929-1945)

	D.Total Reserves				D.Total Reserves/Individual Deposits			
	All	**NYC**	**RC**	**Country**	**All**	**NYC**	**RC**	**Country**
D.ln(Pop)	-2.348	-4.961	0.116	-1.119	-23.634	-254.533	55.471	3.600
	[4.209]	[5.194]	[4.617]	[4.981]	[89.837]	[174.642]	[96.345]	[62.026]
D.Ln(US PI)	-0.002	-0.315**	0.275**	0.071	-5.572***	-15.873***	-1.172	-1.400
	[0.111]	[0.143]	[0.112]	[0.109]	[1.956]	[4.582]	[1.583]	[0.986]
D.Ln(Total Gold)	0.398***	0.656***	0.237***	0.294***	5.906***	13.667***	4.517***	1.819***
	[0.066]	[0.105]	[0.063]	[0.043]	[1.371]	[2.741]	[1.279]	[0.421]
D.AAArate	-0.096	-0.122	-0.094	-0.040	1.081	0.426	1.458	0.621
	[0.091]	[0.089]	[0.120]	[0.073]	[1.666]	[3.254]	[1.874]	[0.531]
D.Reserve Requirement	0.845	0.033	0.369	3.109***	6.003	-4.500	0.407	18.665*
for Demand Deposits	[1.037]	[0.806]	[0.794]	[0.975]	[21.253]	[31.094]	[15.665]	[9.313]
D.Stock Volatility	-0.463	-0.635	-0.551	-0.037	0.950	8.076	-0.878	0.882
	[0.419]	[0.520]	[0.500]	[0.330]	[7.423]	[16.060]	[8.512]	[2.727]
D.Bond Spread	0.020	0.018	0.027	0.007	-0.144	0.127	-0.142	-0.157
	[0.023]	[0.027]	[0.027]	[0.020]	[0.419]	[0.859]	[0.437]	[0.167]
D.Ln(National Debt)	-0.274*	-0.727***	-0.094	0.246*	-8.532**	-23.860**	-4.874	1.461
	[0.146]	[0.223]	[0.172]	[0.136]	[4.054]	[9.641]	[4.162]	[1.415]
L. Dependent Variable	0.010	0.014	-0.002	0.023*	0.007	0.015	-0.015	-0.025
	[0.013]	[0.015]	[0.015]	[0.013]	[0.024]	[0.025]	[0.026]	[0.025]
Observations	57	57	57	57	57	57	57	57
R-Squared	0.339	0.487	0.143	0.400	0.268	0.336	0.062	0.145
	D.Excess Reserves				**D.Excess Reserves/Individual Deposits**			
	All	**NYC**	**RC**	**Country**	**All**	**NYC**	**RC**	**Country**
D.ln(Pop)	13.120	1.874	37.468	11.237	4.490	-174.704	97.917	46.441
	[22.113]	[32.254]	[27.596]	[18.744]	[73.336]	[139.204]	[63.757]	[55.098]
D.Ln(US PI)	-1.365	-2.353*	-1.471	0.239	-2.317	-11.034**	0.580	-1.141
	[0.873]	[1.242]	[1.461]	[0.525]	[2.254]	[4.476]	[2.024]	[1.264]
D.Ln(Total Gold)	0.540	2.156***	-0.235	0.337	4.723***	11.394***	3.430***	1.688***
	[0.401]	[0.541]	[0.743]	[0.285]	[0.960]	[2.174]	[0.932]	[0.392]
D.AAArate	-0.870**	-1.377**	-1.018	0.147	0.739	-0.204	1.038	0.501
	[0.393]	[0.553]	[0.711]	[0.226]	[1.443]	[2.747]	[1.639]	[0.605]
D.Reserve Requirement	-6.428**	-16.541**	-5.534	0.123	-58.677***	-56.746***	-57.138***	-4.872
for Demand Deposits	[3.119]	[6.371]	[3.670]	[2.332]	[14.995]	[15.918]	[12.609]	[7.784]
D.Stock Volatility	-1.724	0.025	-2.406	0.613	-1.881	-1.741	-6.759	-0.798
	[2.044]	[3.239]	[4.166]	[2.149]	[7.248]	[13.401]	[8.657]	[3.347]
D.Bond Spread	0.180**	0.350**	0.164	-0.073	-0.084	0.197	-0.098	-0.148
	[0.085]	[0.155]	[0.124]	[0.111]	[0.363]	[0.683]	[0.421]	[0.186]
D.Ln(National Debt)	-0.387	-3.503	0.081	0.656	-8.276***	-17.482***	-7.179**	0.149
	[0.778]	[2.317]	[1.130]	[0.553]	[3.043]	[6.497]	[3.363]	[1.431]
L. Dependent Variable	-0.019	-0.016	-0.031	-0.046	-0.006	-0.001	-0.025	-0.041
	[0.025]	[0.035]	[0.041]	[0.035]	[0.040]	[0.041]	[0.039]	[0.044]
Observations	57	57	57	57	57	57	57	57
R-Squared	0.254	0.433	0.084	-0.008	0.346	0.360	0.244	0.036

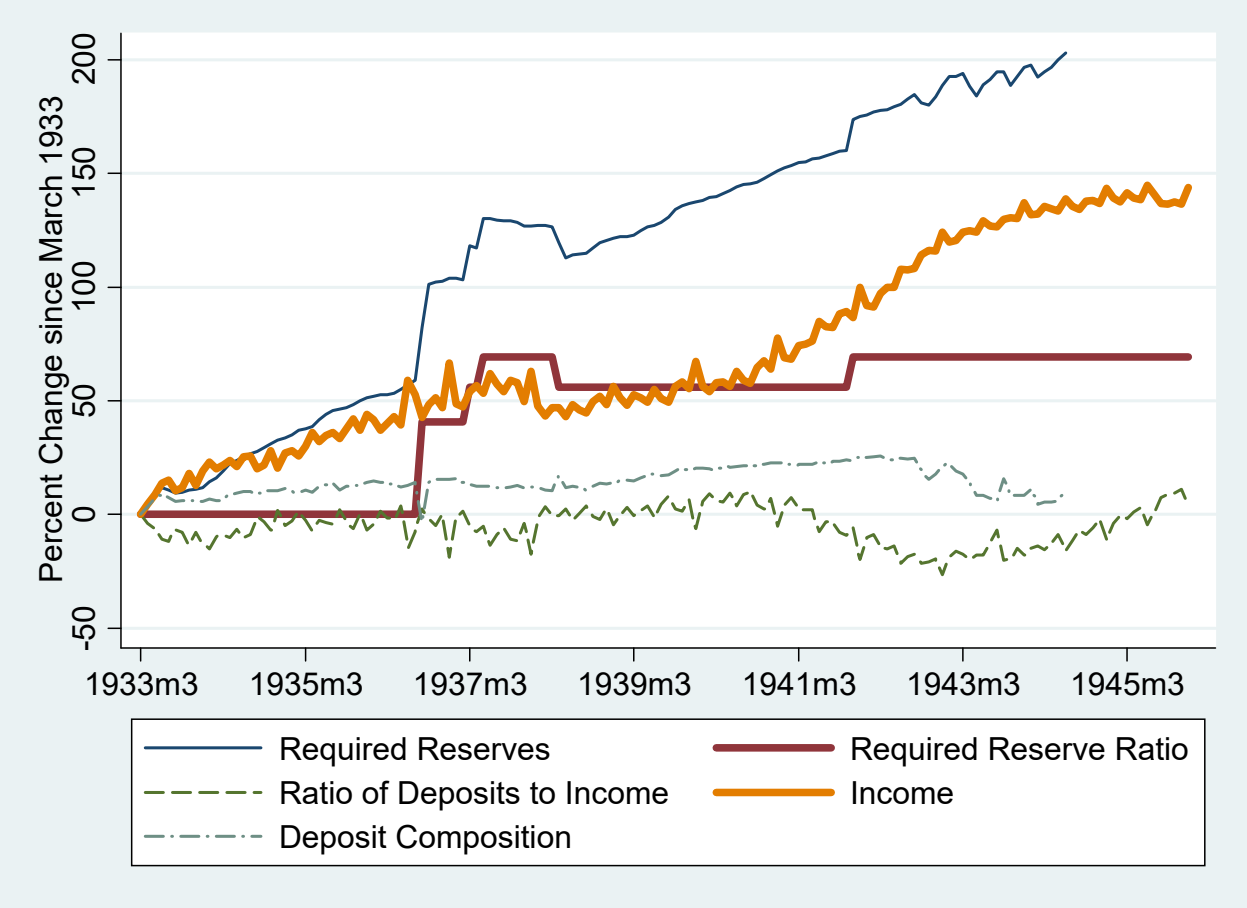
Notes: Table presents the results of an OLS regression. The dependent variable is provided in the column heading. Each observation is a specific call report. Chicago is included with the Reserve Cities because it was not a gold center, but the results hold when including it with New York City Robust standard errors are provided in brackets. * denotes significance at 10% level, ** at 5% level, and *** at 1% level.

Table A.3: Linear Determinants of Required Reserves By Bank Type (1933-1945)

	D.Total Required Reserves				D.Total Required Reserves/Individual Deposits			
	All	NYC	RC	Country	All	NYC	RC	Country
D.ln(Pop)	-0.628	1.821	-0.786	-3.194	-9.512	26.946	-29.733	-43.872
	[5.592]	[6.277]	[5.326]	[9.319]	[90.719]	[198.845]	[98.945]	[57.732]
D.Ln(US PI)	-0.036	0.040	0.103	0.082	-3.679**	-3.997	-2.601	-0.360
	[0.124]	[0.134]	[0.151]	[0.162]	[1.685]	[4.039]	[1.939]	[0.921]
D.Ln(Total Gold)	0.129***	0.140	0.113**	0.151**	1.171*	3.022	1.105**	0.148
	[0.046]	[0.088]	[0.044]	[0.073]	[0.614]	[1.792]	[0.471]	[0.260]
D.AAArate	-0.019	0.072	-0.035	-0.041	1.014	2.573	1.073	0.338
	[0.075]	[0.085]	[0.076]	[0.102]	[0.873]	[2.164]	[0.943]	[0.531]
D.Reserve Requirement for Demand Deposits	5.596***	2.399*	5.140***	5.644**	63.383***	48.348	57.217***	23.178*
	[1.794]	[1.216]	[1.774]	[2.263]	[19.094]	[29.124]	[18.169]	[11.936]
D.Stock Volatility	-0.911	-0.011	-0.897	-0.727	1.768	13.094	8.216	4.549
	[0.779]	[0.888]	[0.960]	[1.366]	[8.658]	[22.324]	[10.329]	[5.811]
D.Bond Spread	0.012	-0.017	0.022	0.031	0.033	0.166	0.056	0.023
	[0.019]	[0.021]	[0.021]	[0.028]	[0.219]	[0.482]	[0.221]	[0.102]
D.Ln(National Debt)	0.067	-0.324	0.246	0.279	1.071	-4.026	3.065	1.509
	[0.122]	[0.220]	[0.158]	[0.196]	[3.198]	[8.422]	[2.977]	[1.326]
L. Dependent Variable	0.008	-0.008	0.008	0.029	-0.041	-0.057	-0.039	-0.043
	[0.010]	[0.015]	[0.011]	[0.022]	[0.030]	[0.043]	[0.027]	[0.049]
Observations	46	46	46	46	46	46	46	46
R-Squared	0.526	0.298	0.502	0.310	0.349	0.117	0.341	0.113

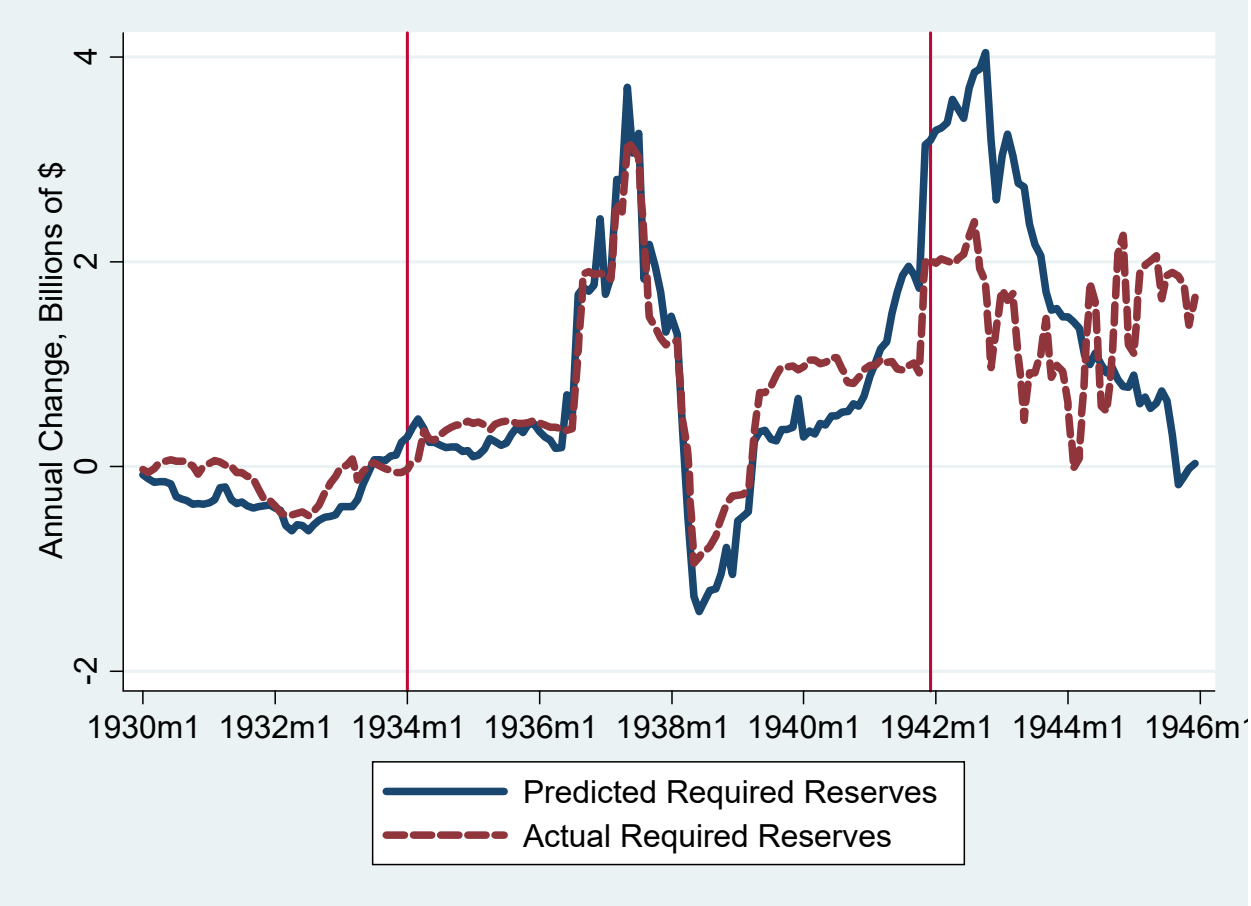
Notes: Table presents the results of an OLS regression. The dependent variable is provided in the column heading. Each observation is a specific call report. Chicago is included with the Reserve Cities because it was not a gold center, but the results hold when including it with New York City. Robust standard errors are provided in brackets. * denotes significance at 10% level, ** at 5% level, and *** at 1% level.

Figure A.1: Determinents of Required Reserve Changes, 1933-1945



Source**:** Federal Reserve *Banking and Monetary Statistics, 1914-1941* and *1941-1970*. Y-axis is cumulative percent change since March 1933.

Figure A.2: Actual and Predicted Required Reserve Changes, 1930-1945



Source**:** Federal Reserve *Banking and Monetary Statistics*, *1914-1941* and *1941-1970* and authors' calculations. Predicted Required Reserves are equal to Required Reserves lagged by one year times the annual percent change in personal income and the annual percent change in the Required Reserve Ratio. Red lines denote the 1/34-12/41 period of interest.