

How was the Quantitative Easing Program of the 1930s Unwound?

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Abstract: Outside of the recent past, excess reserves have only concerned policymakers in one other period: The Great Depression of the 1930s. This historical episode thus provides the only guidance about the Fed's current predicament of how to unwind from the extensive Quantitative Easing program. 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 banks to naturally reduce their excess reserves. Excess reserves fell rapidly in 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 likely was even responsible for the 1937-1938 recession.

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 Fed during the downturn, the Great Depression offers another important policy prescription for modern regulators: how to unwind Quantitative Easing (QE). Just like in the 1930s, following the start of the recession in 2008, short-term interest rates quickly hit the zero lower bound and central banks considered non-traditional monetary policies to stimulate their economies. These policies led to a massive buildup of excess reserves and have not quickly dispersed after QE ended. Since no modern country has begun to reverse their policies, policymakers are left with the question of how best to deal with excessive reserves. This paper looks to the past to see how excess reserves unwound during the Great Depression in order to better inform modern decision-making.²

The Federal Reserve implemented QE policies in several rounds starting in 2008, as have other countries. Japan implemented QE as early as 2001, the United Kingdom started in 2009,

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² While the Fed has introduced a new monetary policy tool (i.e., interest on reserves) since 1930, the Great Depression shows that excess reserves might still exist when interest rates are zero. Note that we study the decline of excess reserves to near zero but not the return to a "normal" monetary policy environment. The reason for this is that just after excess reserves neared zero the Fed began to peg interest rates in response to WWII. This tied the hands of Fed officials and prevented a return to normal monetary policy for many years.

and the European Central Bank began its policies in 2015. Excess reserve balances ballooned under these policies, and the concern now is how to unwind these reserves. One difference between these two periods is that central banks currently are varying the interest they pay on excess and required reserves to be positive or negative, while the interest rate on reserves was implicitly zero during the 1930s. The use of Large-Scale Asset Purchases (LSAPs), often referred to as QE, to expand the monetary base was a feature in both periods.³ Many countries have ceased their QE programs, but none have begun to eliminate the buildup of reserves (Carpenter et al., 2015).⁴ To put even finer of a point on its economic importance, even the mention of slowing the third round of QE purchases in the United States resulted in a “taper tantrum” which saw increased interest rates, an appreciated dollar, decreased equity prices (i.e., typical signs of tighter monetary policy) (Neely, 2014). Such a sharp reaction to even the suggestion of tighter policy has led to the fear that a formal reversal of quantitative easing would cause a recession. Indeed, similar monetary tightening during the Great Depression has been linked to the 1937-1938 recession (Friedman and Schwartz, 1963, p. 525-27, 544-545 and Meltzer, 2003, p. 574).

While we have not yet seen the unwinding of the current QE program, we can study a similar monetary expansion during the 1930s which resulted in a huge expansion of excess reserve balances. The depreciation of the dollar in 1934 and large inflows of foreign gold before the Second World War (WWII) resulted in the massive buildup of excess reserve balances. While not directly controlled by the Federal Reserve (which played no role in the increase of the monetary base), these policy actions were essentially a Quantitative Easing program as they engendered an enormous increase in the monetary base under conditions when short-term rates were close to zero. Between the start of recovery from the Great Depression and the end of the WWII, there were two periods when excess reserves fell. Both occurred naturally due to a slowdown in gold inflows that allowed increased nominal incomes and investment opportunities to naturally reduce reserves. As such, policy tightening was at no point necessary. Excess

³ While the modern period involved purchases of securities, the Great Depression involved unsterilized international gold inflows that were immediately purchased by the Treasury and turned into bank reserves. Bernanke, Reinhart, and Sack (2004, p. 18) for instance, characterized this as a “successful application of quantitative easing. Studies such as Hanes (2014) also use the period to study the effects of QE policies.

⁴ The Bank of Japan ended its program in 2006 but has since returned to QE policies under the recent “Abenomics” stimulus program (Hausman and Wieland, 2014), the Bank of England has not made any new net asset purchases since 2012, and the Federal Reserve ended its program in 2014.

reserves were unwinding starting in 1941 and were on track to have unwound fully even without the issuance of war bonds or increase in reserve requirements.⁵

The literature on the rise of excess reserves is quite extensive. Economists have argued that the rise is due to precautionary demand (Friedman and Schwartz 1963; Morrison 1966) or lack of other assets (Wilcox 1982; Bernanke 1983). Other studies have examined changes on reserve requirements during the late 1930s (Cargill and Meyer 2006; Calomiris, Mason, and Wheelock 2011). Therefore, to our knowledge, no study has examined the determinants of the fall of excess reserves in the early 1940s. Even after controlling for the other previously examined factors, our analysis indicates that gold flows are the only factor that can explain the sudden decline in excess reserves in early 1941. The data suggest that the gold inflows were just too large and the returns to alternative investments too low for banks to fully invest the excess reserves in other available assets. We test this theory using three approaches. First, we construct a residual model that is able to accurately predict changes in excess reserves for the 1934-1941 using only gold flows, income, reserve requirements, and money in circulation. Moreover, these factors only explain a large portion of reserves during that specific period, and other factors mattered more before and after. Second, we empirically show that gold inflows are the only variable that is robustly correlated with changes in excess reserves. Finally, we show that most new excess reserves were disproportionately concentrated in New York City where gold flows entered the country and were converted into reserves. Indeed, the effect of gold is several times larger for New York City banks than other banks around the country.

The rest of the paper is as follows. Section 2 provides an overview of aggregate factors that mattered in this period. Section 3 provides explanations for the rise and fall of excess reserves. Section 4 provides an accounting model of excess reserve changes 1934-1941. Section 5 is an econometric model of excess reserves at the national-level. Section 6 shows how excess reserves flowed across the United States using disaggregated data. Section 7 concludes.

2. The Recovery from the Great Depression

While prices, income, and production also declined steadily after the Stock Market Crash in October of 1929 (Figure 1), the banking system remained relatively unaffected until relatively

⁵ A full counterfactual without US 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 not appear to accelerate in 1942 either. If anything, the large gold inflows fleeing Nazi advances from 1938-1941 delayed the unwinding of excess reserves.

late in 1930 when the failure of Caldwell and Company (a key southern financial institution) set off a chain reaction across the banking system.⁶ Banking panics would continue off and on until March of 1933. Coming just after his inauguration, the Banking Panic of 1933 gave Roosevelt the impetus to take dramatic action. Coupled with the domestic downturn and shaky banking system, the bank run was caused by fear that the new administration would depreciate the dollar. By March, the New York Federal Reserve Bank had no more free gold and could not honor any more gold withdrawals. In response, the Roosevelt administration implemented 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 (Jabaily, 2013, Wicker, 2000).

Roosevelt took additional steps to stabilize the currency and prevent gold outflows. He suspended convertibility of the dollar into gold, prevented gold exports, and forced the sale of all private gold holdings to the Federal Reserve.⁷ Finally, 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 of the dollar that had begun in 1933. This Act relinquished capital controls and allowed international gold shipment to resume. Significant gold inflows began almost immediately and largely continued until the outbreak of WWII. (Wigmore 1987, 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). Whereas excess reserves had been near zero before 1929, they doubled over late 1933 and 1934 and continued to grow into 1935. It was only in early 1936 that they had begun to decline, and were on a path to reach zero by late 1937. However, worries about inflationary bottlenecks began to develop. The concerns in addition to Administration fears of inflation led to the reserve requirement increases of 1936-1937 and the sterilization of gold inflows by trading securities for new gold purchases started around the same time (Bloomfield 1950, p. 233; Meltzer, 2003, p. 505-509), and also fiscal

⁶ Friedman and Schwartz (1963) provide an excellent overview of the period for the interested reader.

⁷ Towards the end of the year, he even instructed the Treasury to purchase gold at \$29.62 an ounce and instructed the Reconstruction Finance Corporation to begin gold purchases above market. The Thomas Amendment to the Agricultural Adjustment Act gave the President the authority to expand the monetary base and to change the gold parity. (Meltzer, 2003, 578, Footnote 74)

tightening as the federal budget moved towards balance.⁸ 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 (Irwin 2012), government spending increased and the recession ended later in the year.⁹

While excess reserves declined through 1936, the ensuing recession caused excess reserves to rise again, which was accelerated by the sudden reduction of reserve requirements coupled with the release of the sterilization account in 1938. Excess reserves growth then suddenly reversed in early 1941, and declined by over 50 percent over the course of the year.¹⁰ Excess reserves continued their decline throughout the war before bottoming out in early 1944. These large excess reserves meant a low money multiplier and prevented most types of monetary policy from being effective (Carlson and Wheelock 2015).

As argued by Eichengreen (1992) and evidenced in Figure 1, 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. While many authors portray these policy changes as “leaving the gold standard,” the reality is more subtle.¹¹ In fact, the new regulations likely amplified the effect of gold coming into the country. Unlike previous periods when gold flows could be held outside the banking system and most gold that came into the banking system was sterilized by open market operations, all the incoming gold after 1934 was immediately exchanged for newly created money base and the Treasury did not generally sterilize any gold purchases.¹² Specifically, gold

⁸ See the discussion in Eggertsson (2008) for further discussion of the Administration’s fears. As the reserve requirement was not binding, the Fed expected that the changes would have little to no effect on banks. There is an active debate over whether the rise in reserve requirements caused the recession. Friedman and Schwartz (1963) and Cargill and Meyer (2006) argue that the increase in reserve requirements caused banks to reduce lending, whereas studies such as Van Horn (2007) and Calomiris, Mason, and Wheelock (2011) find that the changes had little effect on bank behavior.

⁹ Determining the exact cause of the recession of 1937-1938 is beyond the scope of this paper, but given the coordination in policy tightening prior to the recession and loosening before the recovery, it is likely that one or all of these changes was a major determinant of the course of this recession. There are also theories of the recession of 1937-1938 based on wage increases such as Cole and Ohanian (2001, p. 49). Roose (1954) also considers the wage theory, among many others, and finds that fiscal policy largely accounts for this episode and Velde (2009) finds some support for the monetary and fiscal theories and little support for the wage increase theory.

¹⁰ Lend-Lease in 1941 meant that the UK could purchase armaments with alternate payments to gold, which also played a major role in reducing gold inflows (Friedman and Schwartz, p. 550-551).

¹¹ Eggertsson (2008) goes so far as to say that FDR “abolished” the gold standard, though the new fixed gold-dollar exchange rate persisted until the early 1970s.

¹² This program strongly resembled the “foolproof” strategy for exiting a liquidity trap as described in Svensson (2003), where the government commits to monetary expansion through a depreciated but fixed exchange rate.

flowing into the United States came to New York City's gold market. The New York City bank holding the gold would then sell the gold to the Federal Reserve Bank of New York on behalf of the Treasury in exchange for credit to banks' reserve accounts. These funds could be used to purchase securities or make loans or remain at the Fed as excess reserves. Through this process, monetary gold increased from \$8.19 billion to \$22.76 billion from 1934 to 1941.

Romer (1992) shows that this increase in money stock was the main factor driving the economic recovery. She finds 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. Indeed, since 1918, only two periods have seen increases in the money base at over a 20% annual rate: 1933-1945 and 2008-2014. While new high-powered money could have been created by the Fed or the Treasury, Figure 3 shows that essentially all of the increase stems from monetary gold.¹³ The Fed played almost no role in expanding the money supply during the 1930s (Meltzer, 2003, p. 458), and even slightly decreased bank reserves by retiring discounted loans.¹⁴

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

¹³ We use the term high-powered money to distinguish from the money base, which includes only currency in circulation and bank reserves, as there are important uses for high-powered money not included in the money base.

¹⁴ The relative inaction of the Fed is primarily due to two factors. First, the Fed historically followed the "Riefler-Burgess" doctrine of loosely targeting borrowed reserves. The view was that member banks would borrow heavily when monetary conditions were tight and borrow fewer reserves when monetary conditions were easy (Brunner and Meltzer 1968), and assumed that banks only borrowed out of "need" when there were no alternatives. Second, the economy had hit the zero lower bound. Mariner Eccles became head of the Federal Reserve Board of Governors in 1934 and he would continue as chairman after the 1936 reorganization until the 1951 Treasury-Fed accord. His views of excess reserves can be characterized as based on the liquidity trap which would later be associated with Keynes's *General Theory*. Eccles agreed during 1935 testimony that the Federal Reserve could pull on a string and cause the economy to contract but that "one cannot push on a string." Thus excess reserve should simply be monitored in case they led to a large expansion of credit (Meltzer, 2003, p. 478). He thus championed the strategy of keeping rates as low as possible while keeping an eye on inflation. It should be noted that the Federal Reserve was not independent at the time and was required to follow the Treasury's directives (Meltzer 2003) so the Fed's preferred policies could not be implemented without Treasury approval in any case.

There is a large literature on reserves during the Great Depression. While many papers argue that the supply of gold was directly responsible for the rise in money supply and total reserves (e.g., Hanes 2006), they have not explicitly examined its effect on excess reserves. Moreover, there are several additional theories for the rise of excess reserves during the early 1930s that also must be examined. We thus start by examining the importance of gold flow and then explore whether any of these other hypotheses also can explain the sudden unwinding of excess reserves in early 1941.

3.1. Gold Inflows

The inflow of international gold dramatically increased the amount of high powered money in the economy, and the sheer magnitude of monetary expansion could have overwhelmed banks. To the extent that banks did not have a large variety of good investment options, the fluctuations in gold flows thus might match the fluctuations in excess reserves.¹⁵

While domestic production was stimulated by the increase in the gold price and unlimited Treasury purchases, Figure 6 shows that their increase was small compared to international flows.¹⁶ In particular, the majority gold flows seem to be related to key international events. At first, real depreciation and precautionary motives related to Hitler's rise explain most of the flows (Friedman and Schwartz, p. 545). As countries moved off the gold standard during the 1930s and depreciated relative to the dollar the impetus to ship gold abroad was diminished.¹⁷ While in hindsight the US seemed to have been 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 "gold scare" of April-June 1937 caused an acceleration of gold inflows to the United States as speculators feared a reduction in the dollar price of gold and preferred to lock in the old, higher price (Kindleberger 1986, p. 265-269). As the recession worsened in the United States in the Fall of 1937 and policymakers indicated a return to expansionary policies, there was a "dollar scare" when speculators postponed gold shipments to the United States in case of another devaluation.

¹⁵ Banks might also have worried that any gold deposits made during the lead up to WWII would be suddenly withdrawn after the war was over.

¹⁶ There were also significant gold inflows from foreign governments keeping their gold in the United States for safekeeping, but this earmarked gold did not become part of the money supply and thus is not part of our measures.

¹⁷ Many of the major gold exporting nations other than the United Kingdom were part of the gold bloc and were some of the last countries to remain on the gold standard. (Bernanke and James 1991; Eichengreen 1993)

The gold flows, however, picked up again in 1939 and 1940 in the run-up to WWII.¹⁸ The largest flows occurred during the Munich crisis and during the cancellation of Hitler's non-aggression pact with Poland.¹⁹ The flows then slowed as countries declared war and fighting began.

There is a relatively tight connection between the fluctuations in gold inflows and excess reserves. The early rise in excess reserves corresponds to gold inflows from countries before they went off gold, and the late rise in reserves corresponds to the inflow of gold fleeing the coming war. The period of sterilization even 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 right before excess reserves dramatically declined in early 1941.

3.2. Precautionary Demand

The most commonly reported motive for the buildup of excess reserves during the Great Depression 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.²⁰

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.

¹⁸ The majority of gold flows came through Canada, France, and particularly Great Britain, and transactions were generally undertaken for the sake of other European individuals, firms, or nations (Bloomfield, 1950, p. 8-9).

¹⁹ While this is not a primary focus of this study, these gold inflows are exogenous monetary shocks and thus provide the possibility for better identification of monetary shocks than with conventional monetary policy.

²⁰ Morrison (1966) argues that banks wanted excess reserves as a buffer against future bank runs, but did not want to suddenly liquidate assets in order to achieve this goal. Rather they allowed their reserves to build up rather than investing as deposits flowed back into the system.

As predicted by these theories, excess reserves declined with each subsequent banking panic, and more than doubled over late-1933 and 1934. That said, the explanations do not do a good job of predicting the continued buildup of excess reserves after 1934.²¹ Not only did the installation of the FDIC 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 reserves growth only continued to accelerate 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. Indeed, the precautionary motive should have declined over time as banks and individuals became more confident in the banking system. If anything, the lead up to WWII should have reduced confidence in financial markets rather than strengthened it. For instance, the start of 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

The second 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, banks would have held onto their reserves rather than invest.²²

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.²³ 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

²¹ Wilcox (1982) finds that this theory can only explain a small proportion of total reserve behavior after 1933.

²² This view subsumes many theories related to liquidity and the zero-lower bound such as Krugman (2003) and Blinder (2000), though neither a preference for liquid assets nor a zero interest rate is required for banks to prefer reserves to alternative assets.

²³ Mounts, Sowell, and Saxena (2000) also argue that banks faced high internal adjustment costs.

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 4, banks reduced their loan portfolios during the wave of banking panics, but had begun to issue more loans in 1935 and 1936. The Recession of 1937 and 1938 temporarily put an end to new loans, but they snapped quickly back, increasing by \$1 billion from mid-1938 to 1939, \$1.4 billion in 1940, and \$2.7 billion in 1941 (Calomiris 2011). 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 did shift into relatively safe long-term government securities on either side of the 1937 downturn and before the dramatic fall in excess reserves. Bank holdings of government securities increased by almost \$10 billion between 1933 and the end of 1940. As such, the 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).²⁴ That said, while the 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 would likely have had little options for the massive rise in reserves and thus have held onto a large portion of the new funds. The pattern of excess reserves would then be dictated by the rise and fall of the money supply and money multiplier until investments had improved to the extent that the new funds could be fully used.

3.4. Reserve Requirements

Changes in excess reserves are also mechanically tied to the reserve requirement. As discussed above, one of the only monetary policy tools the Fed used during the 1930s was adjusting reserve requirements. A rise in the reserve requirement could be met by either (1) depositing more money into 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

²⁴ While Wilcox finds that interest rates explains 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.

leaving total reserves the same. Since banks during the 1930s held ample excess reserves, even a large increase in the reserve requirement might have been 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 reserve requirements prevailing in each period are displayed in Table 1. As previously described, the first increase occurred in 1936 and 1937 and the arrival of the Recession quickly forced the Fed to reverse these policies. The Fed also raised reserve requirements in November of 1941 in order to slow the post-Recession inflation.²⁵ While reserve requirements were lowered for central reserve city bank throughout 1942, reserve requirements stayed roughly the same until 1948 (Carlson and Wheelock 2014). The change in reserve requirements corresponds to a decline in excess reserves from \$8.3 billion to \$6.3 billion. However, this decline was just a continuation of the larger decline that started in early 1941. While excess reserves rebounded for a short-period, they remained roughly at the same level for the rest of the WWII period. As such, neither reserve requirement increase can explain the unwinding of excess reserves in early 1941.

3.5. Expansion of Income

The economy could also have had grown out of 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 data does not correspond well with 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. The rise in income was simply obscured by other factors until 1941.

3.6. War Financing

²⁵ While it is difficult to identify the effects of this reserve requirement increase from the start of American involvement in the war a month later, no decline in lending can be seen from this requirement increase (Romer and Romer 1989) which was acknowledged as "ironic" by Friedman and Schwartz (1963, p. 139).

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 for banks 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 bond issuance accelerated after Pearl Harbor. The first of seven war loan drives occurred at the end of 1942. Moreover, if the Treasury issues a bond, this simply redistributes reserves from the bank that purchased the bond to the bank where the government's spending takes place. So for excess reserve balances to fall, excess reserves would need to be lent out by the banking system and then not used for spending or paying down debt.²⁶

The start of war financing clearly stands out in Figure 5, but most of the rise occurred after 1941 rather than with the initial issue of defense bonds. Bank holdings of government securities increased \$3.7 billion during 1941, yet increased \$18 billion during 1942, \$15 billion during 1943, and \$15 billion during 1944, so it was not the war drives and sudden increase of war bond holdings that pushed banks to spend their excess reserves on securities. Instead it seems like something else changed in 1941 for banks. For instance, government bonds held by the banks grew by \$1.5 billion during 1940 yet excess reserves rose by 36 percent, whereas bonds 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. While government security holdings increased in 1941, the declines in excess reserves were larger.

4. A Residual Model of Excess Reserve Accumulation

We construct a simple prediction model for excess reserves by combining the gold inflow, expansion of income, and alternative asset theories outlined above with simple accounting identities related to gold inflows, the monetary base, and reserves. We observed that gold inflows seem to match increases in excess reserves, and that increases in deposits create increases in required reserves and thus subtract from excess reserves. In general, when monetary gold rises faster than deposits, excess reserves rise, and when the reverse is true, excess reserves

²⁶ Naturally Treasury spending may not have coincided exactly with Treasury bond sales, but this should not have played a large role in reserve determination.

fall. This appears to be consistent with a model where banks are receiving new reserves through gold inflows, but are not reallocating their portfolios away from 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 break down how high powered money is created and how it flows through the banking system.

The Federal Reserve's conceptual framework for the determinants of reserve balances is the most straight-forward approach for this task. The framework breaks down reserves into its three "uses" and six "sources" (Federal Reserve Board 1943, p. 360-367). As previously described, new sources of reserves came from net gold inflows, the Federal Reserve creating new bank reserves, or the Treasury creating new currency. Graphed in Figure 7, the uses of reserves are money in circulation, member bank reserve balance, Treasury cash, nonmember deposits, and other Federal Reserve accounts.²⁷ Because the uses and sources of reserves must be equal by definition, we can decompose them into their various parts and predict reserve behavior.

While excess reserves are a choice amongst 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., that excessive reserves were determined by whatever was left of gold flows after required reserves and money in circulation are removed), we first estimate the expected value of total reserves, then estimate the expected value of required reserves, and finally use those values to obtain a measure of predicted excess reserves if banks did not choose to spend the residual from gold.

Total reserves are a function of high powered money and money in circulation.

$$\textit{Total Reserves} = \textit{Gold} + \textit{Fed} + \textit{Treasury} - \textit{Money in Circulation}.$$

However, during the period, the Fed and Treasury were quite small and relatively unchanging. So to a first approximation, the change in total reserves can be predicted using the following equation:

$$\Delta\textit{Predicted Total Reserves} = \Delta\textit{Gold} - \Delta\textit{Money in Circulation}$$

²⁷ Money in circulation refers to currency and coin held by households. Nonmember deposits refer to deposits by Federal Reserve member banks in nonmember banks. The other categories are essentially small cash holdings by the Treasury and Federal Reserve to conduct minor transactions. Member bank reserves balance are any balances of high powered money held by banks at the Federal Reserve for safekeeping or to satisfy regulatory requirements.

It is important to note that both of these factors are relatively exogeneous to the banking system and not directly controlled by individual banks. Changes in gold during the period were largely due to international factors and the choice of individuals to hold money outside of the bank was the result of a large number of macroeconomic factors.

Required reserves must be held against deposits in case of a bank run or other sudden withdrawal of reserves. For a given category of deposits, required reserves will equal total deposits times the required reserve ratio. A complete decomposition of required reserves is simply to multiply each type of deposit by the associated reserve requirement and sum the result over each type of reserve. However, it is simpler to simply decompose total required reserves into the reserve requirement multiplied by total deposits and then attribute any other changes in required reserves into a composition factor that accounts for shifts between various types of deposits.

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

Reserve requirements thus increase as demand deposits became a larger share of deposits. Deposits are driven by a multitude of factors (e.g., confidence in the banking system, liquidity preference, interest rates, etc.). However, because most of the variation in deposits is driven by personal income, we decompose deposits into the product of personal income and the deposits-to-personal income ratio. The former measures the amount that the rebound after the banking panics had on reserves and the later provides a measure of confidence in the banking system.

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

Plotted in Figure 8 for 1933-1945, it is clear that reserve requirements and personal income growth are the main determinants of changes in total required reserves.²⁸ The changes in composition are small and while the deposit-to-income ratio changes quite often they are relatively small changes.²⁹ For estimating required reserves, we thus only consider changes in the required reserve ratio and changes in personal income. The equation to predict changes in required reserves is:

$$\begin{aligned} \Delta \text{Required Reserves} \\ = \text{Required Reserve Ratio} * (\% \Delta \text{Required Reserve Ratio} + \% \Delta \text{Income}) \end{aligned}$$

²⁸ While gold flows only begin in January of 1934, income and deposits begin recovering in March of 1933 with the economic recovery and banking stability, so this explains the different starting date.

²⁹ The ratio of deposits to personal income did not experience large changes. The fraction returned to normal by 1934 and also quickly rebounded after the Recession of 1937 and 1938.

Having constructed estimates of total reserves and required reserves, predicted excess reserves are then just the difference between the two, or the residual.

$$\Delta Excess\ Reserves = \Delta Total\ Reserves - \Delta Required\ Reserves$$

The results for this simple prediction model correspond very closely to the actual values in Figures 9 and 10. Predicted total reserves conform very closely to total reserves. Required reserves also are close to predicted required reserves, though there is some divergence starting in 1938. This is due to smaller changes in reserve requirements and income, which mean that the other factors matter more. Also, after 1941, the composition of deposits changes and makes our accounting model fit less well.

We can draw several conclusions from the fact that very little seems to matter other than the factors mentioned above. Firstly, the primary determinants of excess reserves arise outside of decisions made in the banking system. Total reserves are driven by gold inflows from abroad and the decisions by households and businesses regarding their cash holdings. Required reserves are determined by income and thus are not being determined by loan growth, which is the standard channel for new reserves to expand the money supply. Given the low interest rates, excess reserve balances had little opportunity cost and so holding excess reserves passively until deposit growth reassigns these reserves to be legally required could be a perfectly rational choice for banks to make. This behavior is consistent with liquidity trap or zero-lower-bound type theories where increased reserves are not lent out, but increased loan demand will decrease excess reserves. However, we would require a theoretical framework to rule out that recovery was improved by the large build-up of excess reserves, as this would also drive income and deposit growth which would fit with our prediction model. But in any case, it is clear that large excess reserve balances can be unwound painlessly, as excess reserves disappeared during the 1940-1943 period and were well on their way to disappearing even if the war had not started. Thus the lessons for today are favorable, as large excess reserves could be unwound fairly painlessly, though the excess reserve balances of today dwarf those of the 1930s.

From February 1936 through August 1937 the sterilization of gold combined with a booming economy reduced excess reserve quickly, while after August 1937 excess reserves accumulate as a slowing economy reduced income growth and thus deposit growth. If the trend of excess reserve reduction had continued, excess reserves would have dropped to zero as soon as April 1938, and the buildup of excess reserves due to the 1930s quantitative easing program

would have been eliminated. If one compares the excess reserves at the trough in 1937, it is similar quantitatively to excess reserve balance in the late 1940s, so this may have been a “normal” positive level of reserve balances had the recession not increased excess reserves.

For the 1940-1944 final unwinding, the above factors come into play in a significant way. From the local peak in October 1940 to the local trough in May of 1944, total reserves only changed by 235 million, while excess reserves fell by 5.6 billion and required reserves rose by 5.7 billion. This was mainly driven by an \$85.7 billion increase in personal income, but an increase in reserve requirements by a factor of 1/6 in November of 1941 also sped this process along. Gold flows essentially stopped, with the gold stock shrinking by 640 million, while the Treasury more than offset this with an increase of \$1 billion in new high powered money. The Fed finally began to expand the monetary base during the period as they were directed by the Treasury to monetize the growing wartime deficits, and created \$15.2 billion in new high powered money during this period. However, money in circulation also rose by \$15.9 billion which roughly equals the Fed’s actions, and thus the main net contributor to the final reduction in excess reserves was the increase in nominal incomes.

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

The residual model of excess reserve accumulation was constructed based on accounting principles, assuming that banks held onto all gold inflows. However, we know from previous sections that other behavioral factors (i.e., interest rates and income growth) might have influenced this decision. We thus empirically test the connection between gold and excess reserves while controlling for the other macroeconomic factors that could have influenced banks. Because of the condensed number of years and observations, we are forced to estimate relatively simple, parsimonious linear model and cannot throw every conceivable variable into the model. Instead, we select variables based on the previously described theories for excess reserve accumulation. We control for population growth using the US population, income growth using US personal income, interest rates using the rate on AAA bonds, and changes in the reserve requirement using the actual fraction of demand deposits required to be held at the Fed. 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 thus increase reserves.

To be clear, 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 is even more important for the gold multiplier on excess reserves as banks do not necessarily have to hold onto excess reserves and in most periods they do not. The size of the coefficient for excess reserves thus tells us how banks dealt with the influx of gold. The closer to one the coefficient is the more banks are hoarding the newly created reserves.³⁰

Table 3 provides the estimated coefficients on equation (1). The table confirms that gold inflows dramatically increased both total and excess reserves even after controlling for other factors. A 10 percent increase in gold increased total reserves by 4.2 percent and excess reserves by 9.1 percent. There thus was almost complete pass through on 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 56 percent respectively. Only changes in required reserves have a robust and significant effect on excess reserve accumulation after controlling for deposit growth. A 2.5 percentage point increase in average reserve requirements during 1936 and 1941 is estimated to have decreased total excess reserves by 20 percent and the ratio of excess reserves to deposits by over 100 percent. The larger effect on excess reserves to deposits is the result of deposits being relatively unaffected by reserve requirement changes.

6. The Flow of Gold and Excess Reserves

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

³⁰ In fact, because of reserve requirements, the maximum multiplier for the entire system should be under one.

previously discussed, the majority of gold came into New York City and was immediately converted to reserves at New York City banks. The major drain on these excess reserves was new government debt issues. When the U.S. Treasury auctioned new debt, New York City banks purchased the debt with their excess reserves balances. The Treasury, as a result of the debt sale, would then have high powered money that would be spent all over the United States. This expenditure would raise incomes across the United States, which would be deposited (and create reserves) at banks across the United States. Banks would then use these new reserves to fulfill reserve requirements, to keep as excess reserves, or to purchase loans or securities purchases. At the same time, NYC banks sold a large portion of the debt issues bringing back reserves from the rest of the country (Federal Reserve Bank of New York, 1934, 1935). Thus to be sure that gold flows were driving excess reserves we can test whether excess reserves were disproportionately concentrated in New York City and gold flows had their largest effect on banks in the city.

The Federal Reserve's *Banking and Monetary Statistics* show stocks of each balance sheet asset at a specific date but does not list flows of variables across the period, so disentangling these flows is not easy. However, the Federal Reserve Bank of New York shows the flows between NYC and the rest of the country in their *Annual Reports* for 1934 and 1935. Listed in Table 2, 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 NYC banks still surged. Thus 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 were chosen by banks in general equilibrium based on the value of excess reserves relative to other alternative assets that banks could hold.³¹

Looking at Figure 11 total reserves and excess reserves in New York City banks were nearly as large as the totals of all other banks combined. Indeed, the large rise in excess reserves after 1938 was even more disproportionately 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

³¹ 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.

reduced their excess reserves to almost zero by mid-1943, while banks elsewhere kept some. The data thus suggest that a great deal of reserve behavior was driven by New York City banks.

We can further check the gold mechanism by estimating the reserve regression equations separately for New York City Banks, Reserve City Banks, and Country Banks.³² As Treasury distributions were most likely to be made in large cities than in agricultural areas, we would expect to find gold inflows influence excess reserves behavior at New York City the most followed by Reserve City banks and finally by country banks. The pattern of coefficients in Table 4 shows just that. The coefficient on gold is multiple times larger for New York City than Reserve Cities which in turn is larger than Country Banks. A 10 percent rise in gold would lead to a 7 percent increase in total reserves in New York City, but only 2.7 and 2.5 percent increases in Reserve Cities and Country banks respectively. Gold has an even stronger effect on excess reserve growth. A 10 percent increase in gold would increase the excess reserves by 28 percent for New York City banks, 6 percent for Reserve Cities, and an insignificant 3 percent for Country banks. Interestingly, the effect of reserve requirements is also larger in New York City than Reserve Cities and Country banks. Again, the effect of reserve requirements is insignificant for country banks. In this case, some of the other variables are statistically significant, but like before, they are not consistently significant.

7. Conclusion

The experience of excess reserves in the period between the beginning of recovery from the Great Depression and the start of the WWII yields several lessons. One is that banks largely responded to developments outside of the banking system after 1933. While we cannot show causality, it appears that lending responded to developments elsewhere in the economy, rather than lending causing economic growth. This is why our simple residual model based on factors exogeneous to the banking system predicted actual reserve changes well. At no point did excess reserves cause an explosion of lending or a burst of excessive inflation. The Federal Reserve has indicated how it intends to “normalize” policy once the federal funds rate rises above its current target near zero. 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

³² We combined Chicago with the Reserve City Banks as it was not a center for gold inflows like New York City.

and allow for expanded excess reserve balances despite positive lending rates. It will also allow for the assets on the Federal Reserve's expanded balance sheet to shrink gradually as those assets come due over time. This implies that the Fed's balance sheet can shrink without massive open-market sales, because the rapid shrinking of the money base and such a severe monetary policy tightening could cause a recession (Ihrig et al. 2015).

The experience of the 1930s is supportive of the Federal Reserve's plans, as no tightening was required to unwind these excess reserve balances. Interest on reserves was not paid by the Fed prior to 2008 and yet excess inflation did not result even as unemployment began to reach normal levels in 1941. The Fed during the 1930s also did not try to return the money supply back to normal through asset sales but rather allowed economic growth to absorb the additional money supply. The Federal Reserve plans for an unwinding without tightening also finds support in the experience of the 1930s, as excess reserves declined even in periods when neither the Federal Reserve (nor the Treasury) was tightening. At the same time, the period suggests that lowering the interest on reserves to near zero might not fully eliminate the buildup of excess reserves.

Indeed, this episode even provides a cautionary tale. A coordinated policy tightening meant to reduce excess reserves and insure against a rise in inflation, including increases in reserve requirements, the sterilization of gold inflows from 1936-1937, and fiscal austerity were immediately followed by the recession of 1937-1938. While it does not appear that banks wished to rebuild their excess reserve balances after reserve requirements were increased, the recession reduced nominal income and deposits so much that excess reserves started rising. Thus a Federal Reserve program to tighten policy to increase interest rates could backfire and not only cause a recession, but even increase excess reserves due to the shrinkage of deposits during the recession.

This episode presents several avenues for future research. The geographic focus of gold inflows into New York City allows for an analysis of the monetary policy at the subnational level. As all new money creation took place in New York City, the expanded money supply had to pass from New York City banks to the rest of the country. Interbank networks, as well as Treasury operations, must have been important to transmit the increased New York City reserves into economic expansion across America. The sizes of gold inflows during this period were determined by international factors and not by a central bank. This means that monetary shocks were largely exogenous and thus present a promising opportunity to identify monetary shock

empirically. Moreover, there are clear spikes during major European events which provide additional variation in gold flows, which makes this an ideal monetary experiment.

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Table 1: Reserve Requirements: 1917-1942

Effective Date		Demand Deposits				Time Deposits
Year	Month	Central Reserve	Reserve	Country		
1917	June	13	10	7		3
1936	August	19.5	15	10.5		4.5
1937	March	22.75	17.5	12.25		5.25
1937	May	26	20	14		6
1938	April	22.75	17.5	12		5
1941	November	26	20	14		6
1942	August	24	20	14		6
1942	September	22	20	14		6
1942	October	20	20	14		6

Source: Carlson and Wheelock(2014).

Table 2: Money market flows through New York City:1934-1935

Year	Gain through gold receipts	Loss through government withdrawals	Gain through commercial and banking transfers	Net loss through all other transactions	Net gain through all transactions
1934	1019	-1093	1018	-231	713
1935	1692	-1848	1238	-84	998

Source: Federal Reserve Bank of New York Annual Reports (1934, p.11; 1935, p. 7).

Table 3: 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)	-3.358 [5.366]	111.001 [120.299]	47.707* [27.531]	168.906 [131.936]
D.ln(US PI)	-0.034 [0.144]	-7.712** [2.879]	-0.122 [0.516]	-3.689 [2.973]
D.ln(Total Gold)	0.420*** [0.118]	6.404*** [1.969]	0.912** [0.336]	5.649*** [1.798]
D.AAA Rate	0.059 [0.067]	2.346 [1.643]	0.007 [0.212]	1.210 [1.496]
D. Reserve Requirement for Demand Deposits	0.799 [1.184]	12.521 [21.337]	-8.947*** [3.161]	-52.024*** [18.906]
L. Dependent Variable	-0.031 [0.024]	-0.057* [0.029]	-0.125* [0.070]	-0.078 [0.061]
Observations	42	42	42	42
R-Squared	0.311	0.292	0.387	0.302

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 10%; ** at 5% level and *** at 1% level.

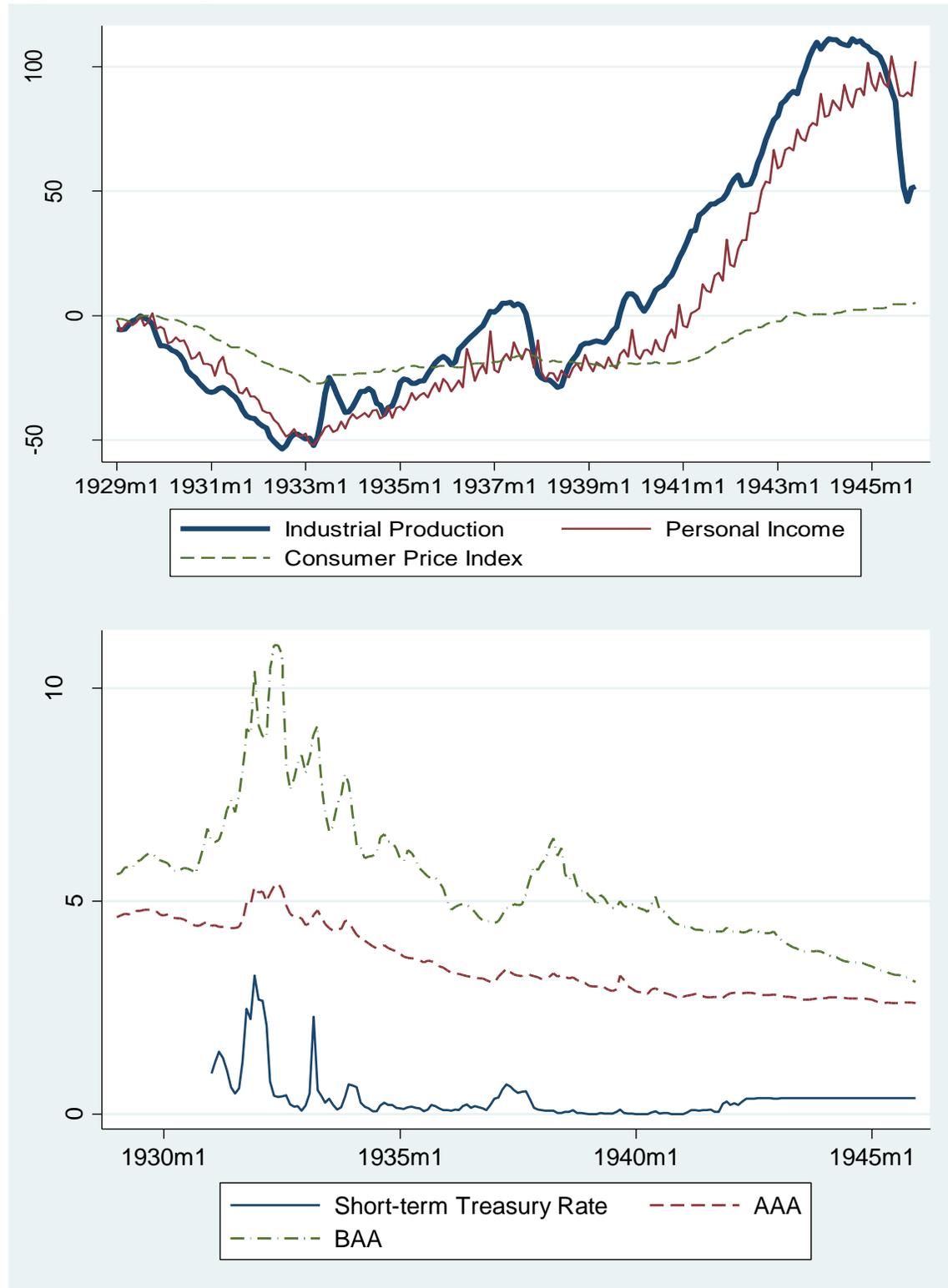
Table 4: Linear Determinants of Reserves By Bank Type (1933-1945)

	D.Total Reserves			D.Total Reserves/Individual Deposits		
	NYC	RC	Country	NYC	RC	Country
D.ln(Pop)	-2.828 [8.630]	-2.170 [5.274]	-7.751 [6.074]	7.362 [250.088]	183.448 [121.051]	-4.828 [61.235]
D.ln(US PI)	-0.452** [0.171]	0.360*** [0.131]	0.063 [0.144]	-22.109*** [6.260]	-1.402 [1.717]	-2.133* [1.168]
D.ln(Total Gold)	0.706*** [0.205]	0.270*** [0.099]	0.253*** [0.060]	15.712*** [5.169]	4.999*** [1.567]	1.465*** [0.498]
D.AAA Rate	-0.040 [0.099]	0.152** [0.062]	0.078 [0.054]	2.676 [3.521]	3.598** [1.580]	0.996** [0.469]
D.Reserve Requirement for Demand Deposits	0.221 [1.046]	0.051 [0.928]	2.889** [1.300]	-0.712 [35.328]	-1.033 [15.469]	23.946** [8.996]
L. Dependent Variable	-0.018 [0.026]	-0.054* [0.030]	-0.013 [0.025]	-0.037 [0.036]	-0.095** [0.035]	-0.072* [0.041]
Observations	42	42	42	42	42	42
R-Squared	0.386	0.239	0.284	0.267	0.231	0.335

	D.Excess Reserves			D.Excess Reserves/Individual Deposits		
	NYC	RC	Country	NYC	RC	Country
D.ln(Pop)	77.849 [93.770]	98.615*** [28.427]	2.686 [18.687]	16.471 [250.453]	375.334** [162.217]	93.812 [62.070]
D.ln(US PI)	-1.533* [0.780]	0.965* [0.548]	0.592 [0.562]	-15.452** [6.012]	1.634 [3.109]	-1.236 [1.604]
D.ln(Total Gold)	2.785*** [0.973]	0.636** [0.248]	0.328 [0.293]	12.719*** [3.850]	4.621*** [1.593]	1.608*** [0.437]
D.AAA Rate	-0.248 [0.410]	0.457** [0.225]	0.389 [0.277]	0.503 [3.115]	2.270 [1.482]	0.726 [0.632]
D.Reserve Requirement for Demand Deposits	-15.058** [7.067]	-8.841*** [2.725]	-2.266 [2.257]	-54.677*** [19.481]	-51.876*** [15.307]	-7.380 [9.142]
L. Dependent Variable	-0.082 [0.091]	-0.215*** [0.070]	-0.172** [0.083]	-0.040 [0.056]	-0.170** [0.075]	-0.135* [0.071]
Observations	42	42	42	42	42	42
R-Squared	0.350	0.411	0.271	0.282	0.286	0.194

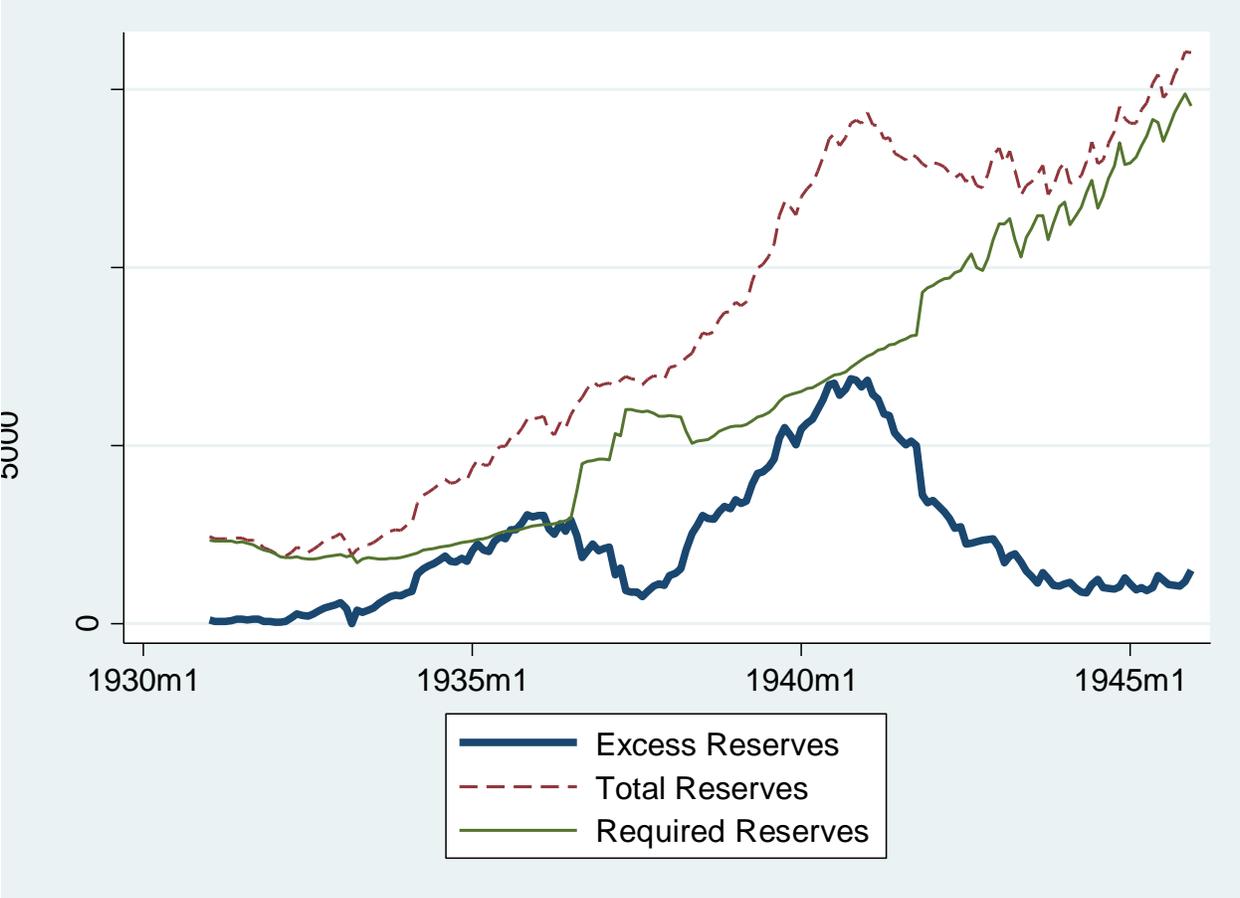
Notes: Table presents the results of an OLS regression. The dependent variable is provided in the column heading. Each observation is a specific call report. Robust standard errors are provided in brackets. * denotes significance at 10%; ** at 5% level and *** at 1% level.

Figure 1: The Depression Years: Macroeconomic Indicators and Interest Rates



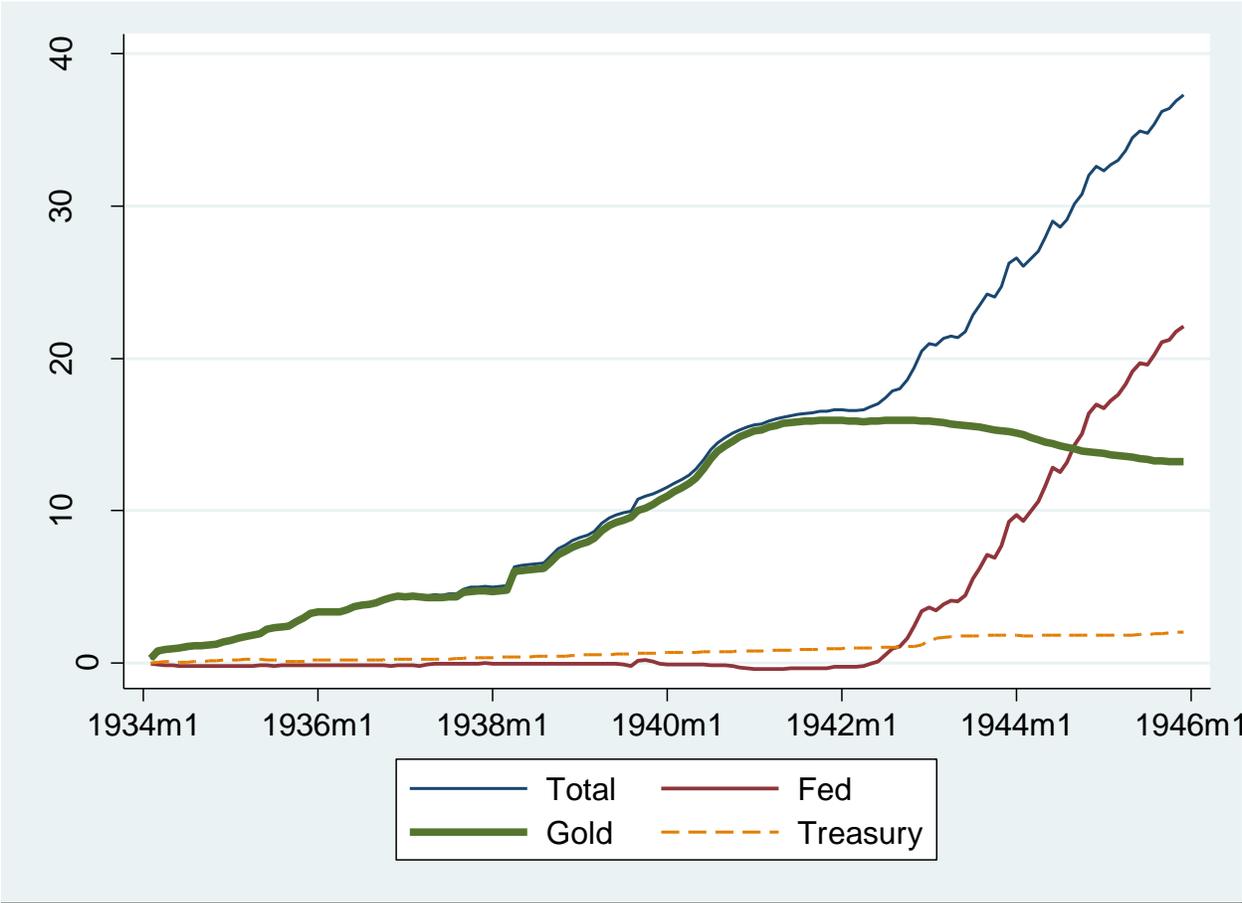
Source: BLS/BEA/Department of Commerce/Moody's.

Figure 2: Reserves 1931-1945



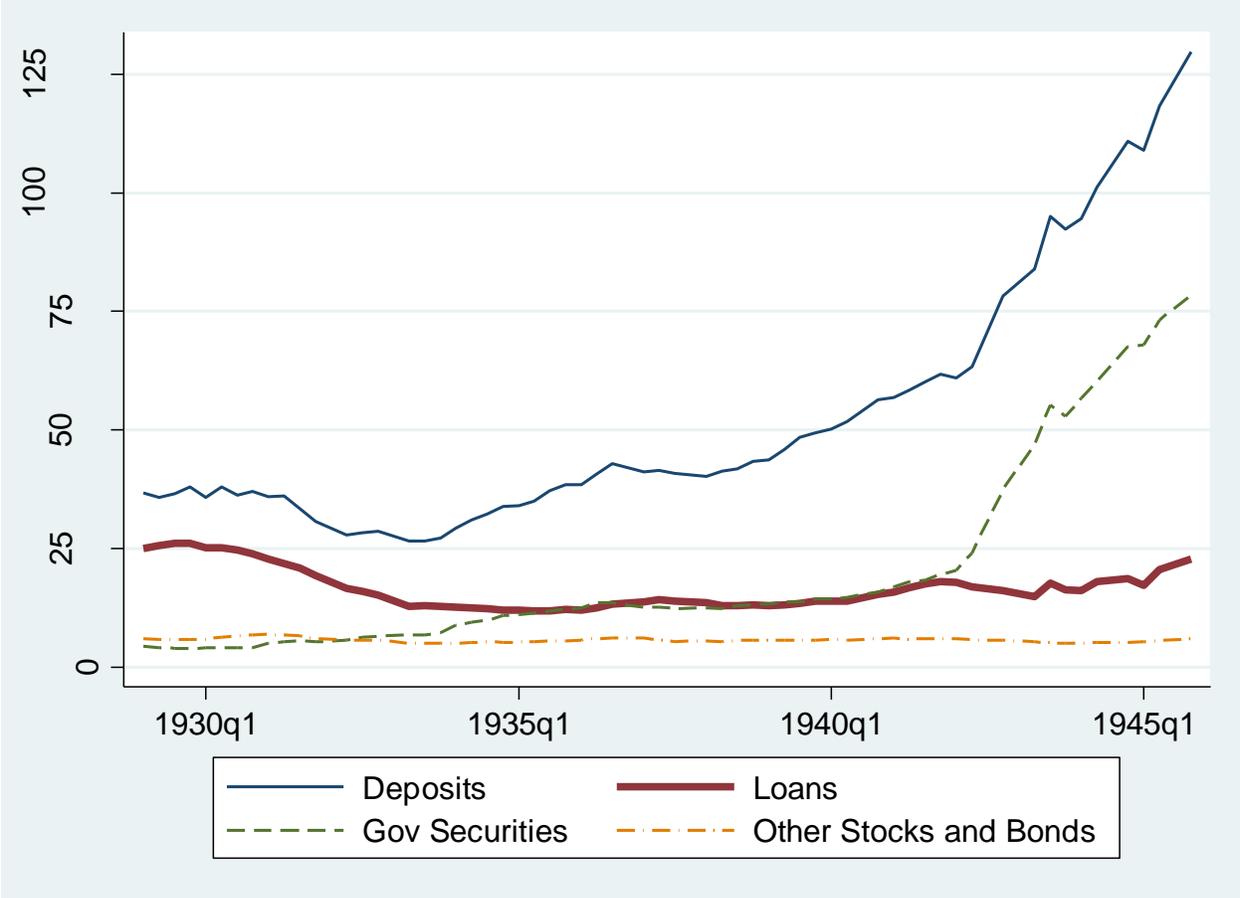
Source: Federal Reserve *Banking and Monetary Statistics*, 1914-1941.

Figure 3: Changes in High Powered Money Sources, 1934-1943



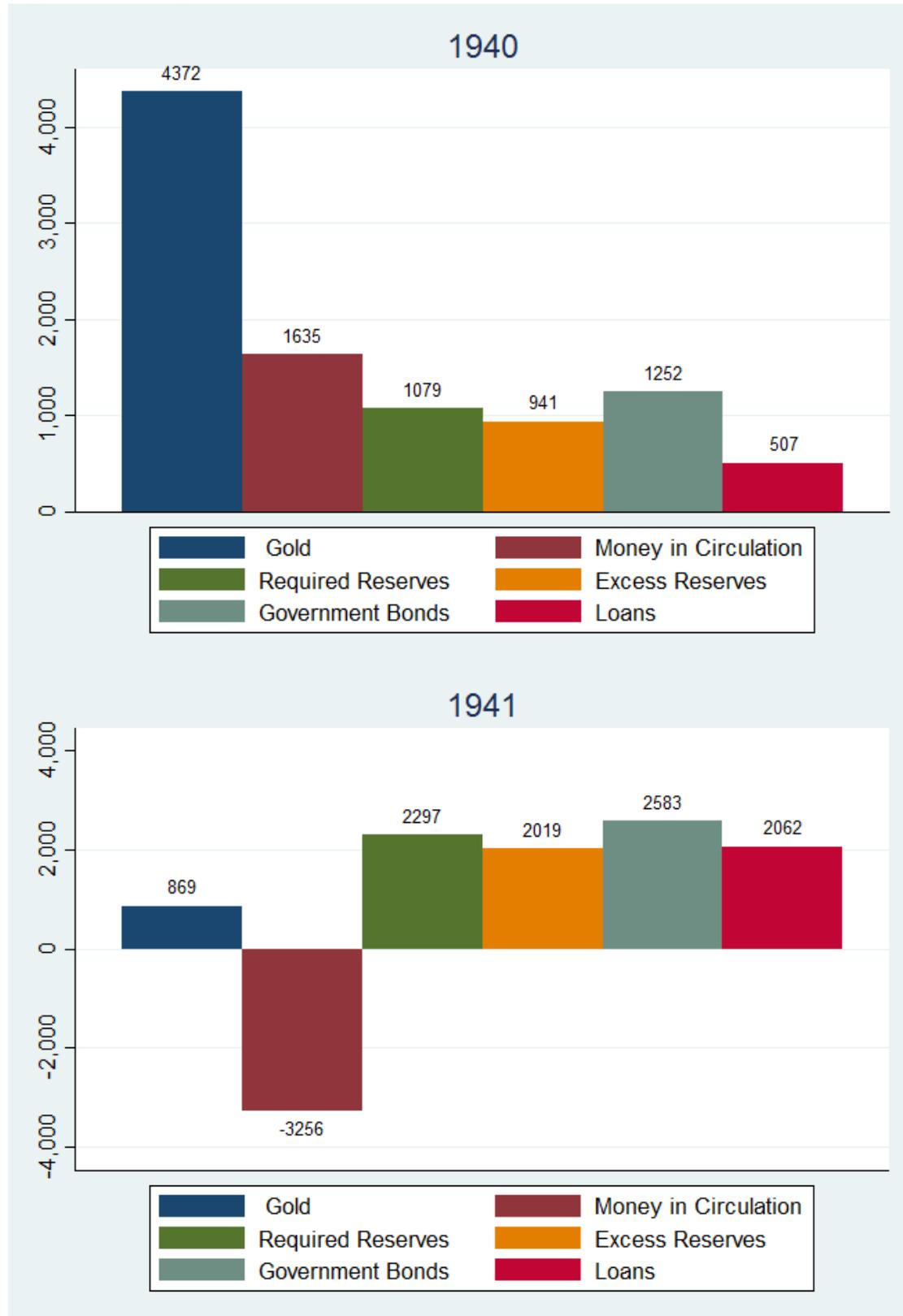
Source: Federal Reserve *Banking and Monetary Statistics*, 1914-1941.

Figure 4: Bank Balance Sheet Categories, 1929-1945



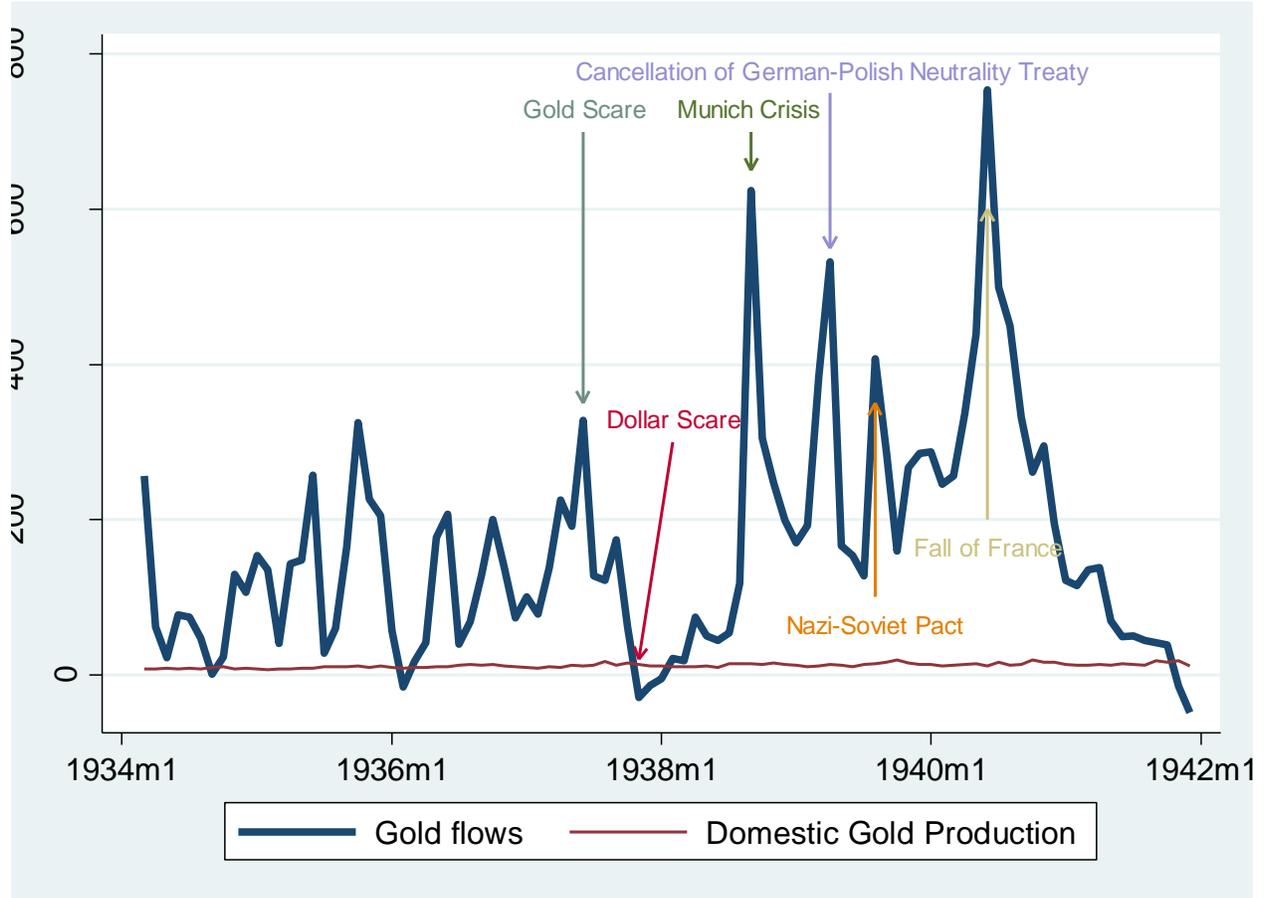
Source: Federal Reserve *Banking and Monetary Statistics*, 1914-1941 and 1941-1970.

Figure 5: Changes in Bank Balance Sheets: 1940 and 1941



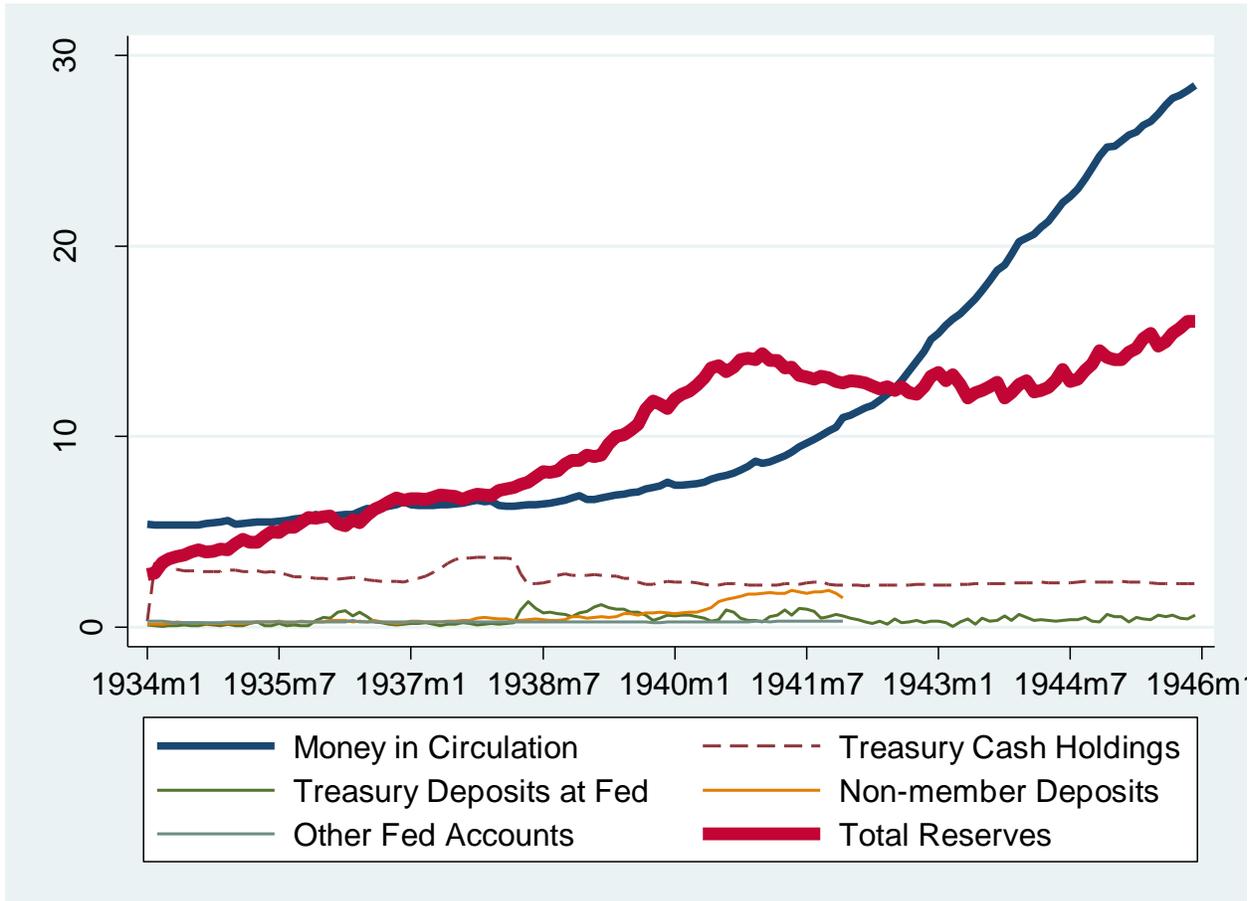
Source: *Banking and Monetary Statistics, 1914-1941*.

Figure 6: Gold Flows and Domestic Gold Production



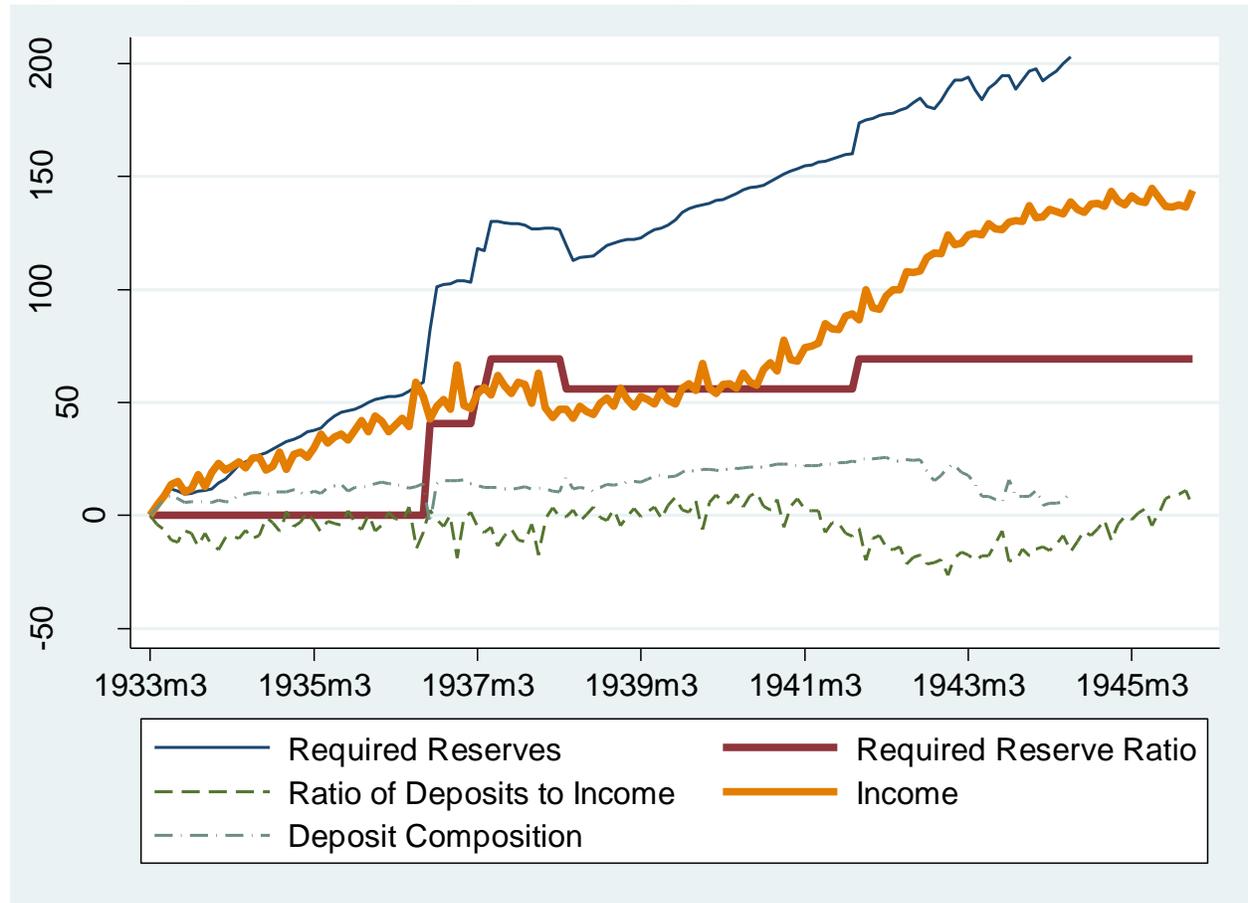
Source: Federal Reserve *Banking and Monetary Statistics*, 1914-1941

Figure 7: Uses of High Powered Money: 1934-1951



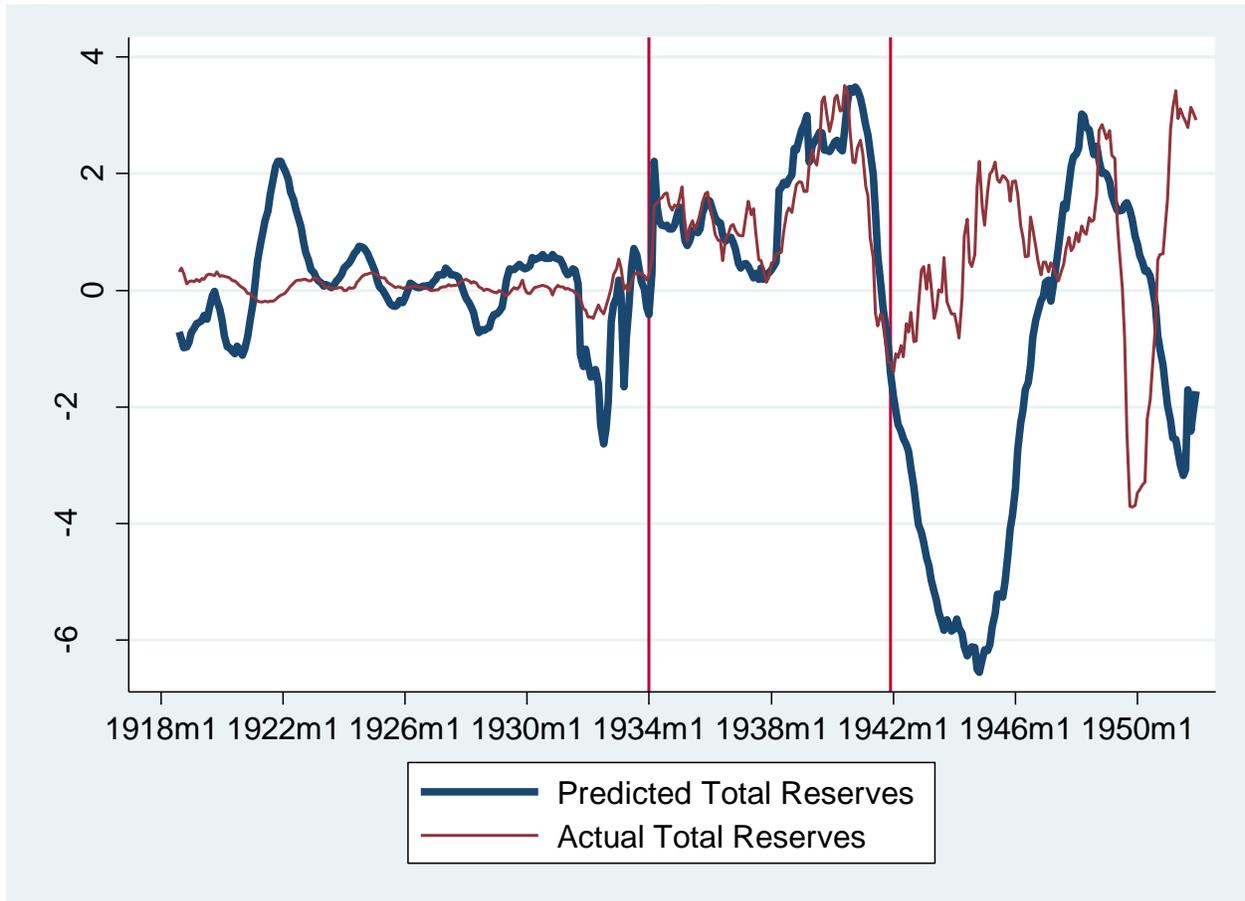
Source: Federal Reserve *Banking and Monetary Statistics*, 1914-1941 and 1941-1970.

Figure 8: Required Reserve Component % Changes : 3/33-12/1945



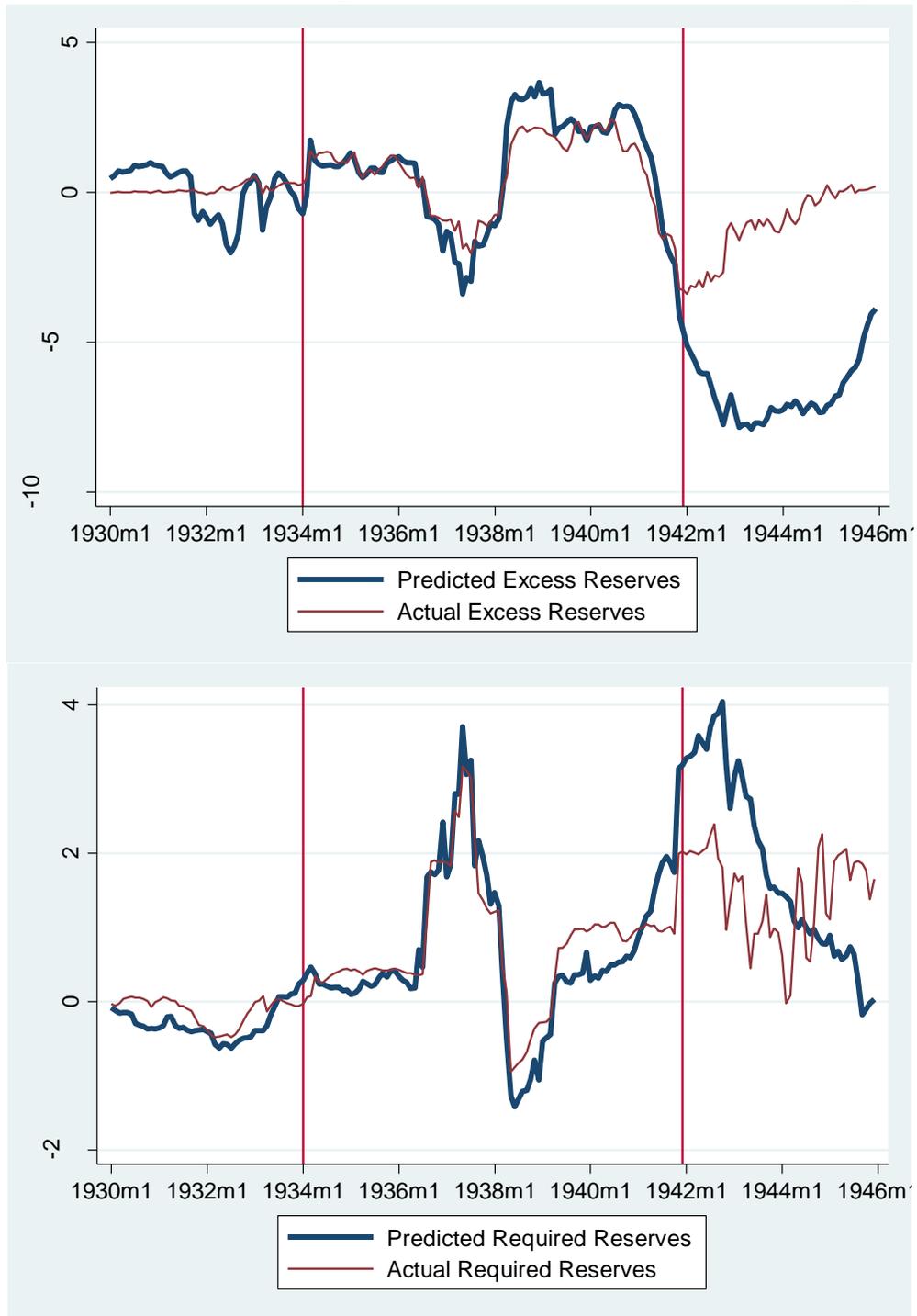
Source: Federal Reserve Banking and Monetary Statistics, 1914-1941 and 1941-1970. Y-axis is cumulative percent change since March 1933.

Figure 9: Actual and Predicted Total Reserve Changes



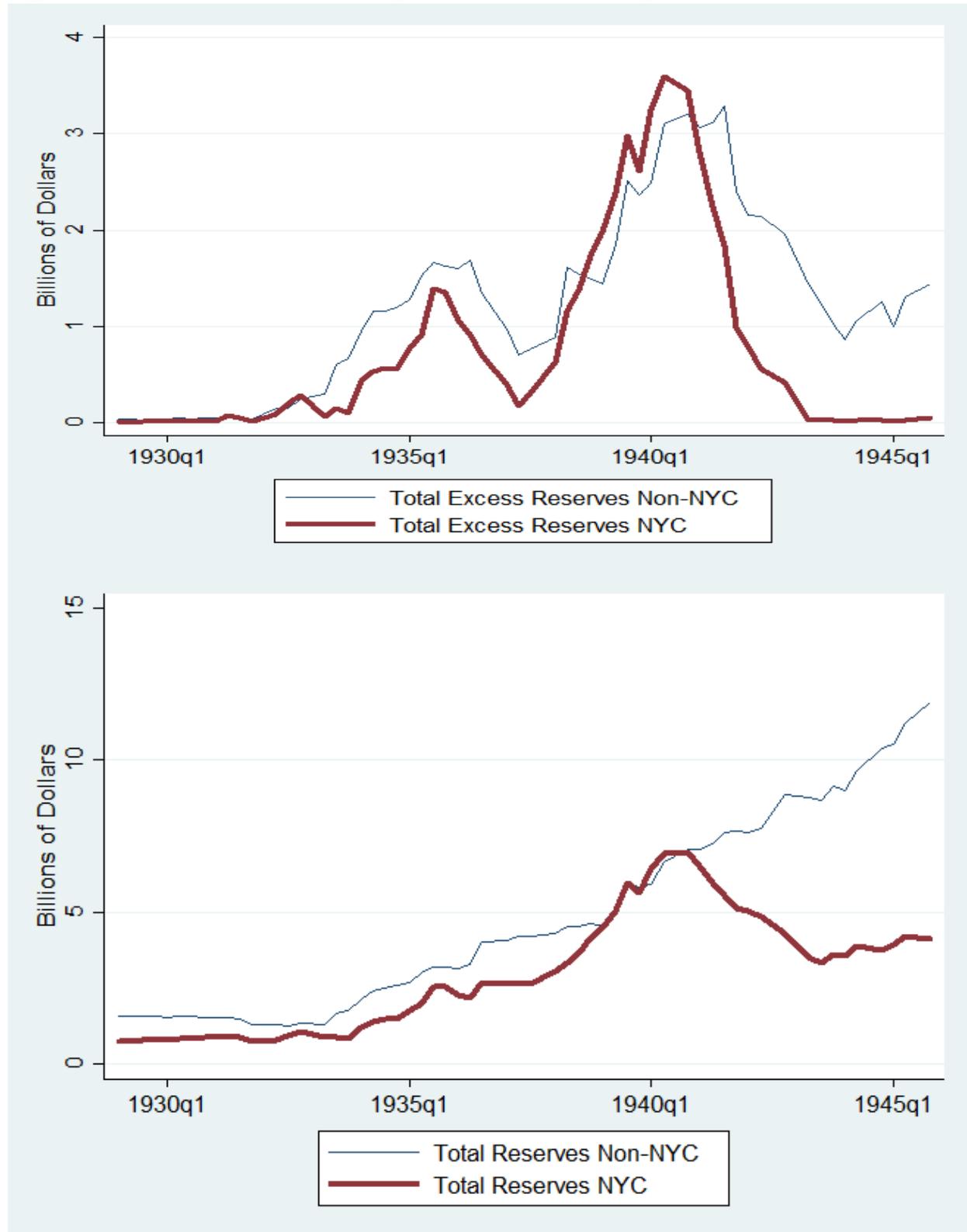
Source: Federal Reserve Banking and Monetary Statistics, 1914-1941 and 1941-1970 and authors' calculations. Predicted Total Reserves equals the change in Monetary Gold minus Money in Circulation. Predicted Required Reserves are equal to Required Reserves lagged one year times the annual percent change 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. Red lines denote the 1/34-12/41 period of interest.

Figure 10: Actual and Predicted Required Reserve and Excess Reserve Changes



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 Required Reserves are equal to Required Reserves lagged 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. Red lines denote the 1/34-12/41 period of interest.

Figure 11: Reserves in New York City vs. Rest of the Country



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