"Unconventional" Monetary Policy as Conventional Monetary Policy:

A Perspective from the U.S. in the 1920s

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To implement monetary policy in the 1920s, the Federal Reserve utilized administered interest rates and conducted open market operations in both government securities and private money market securities, sometimes in fairly considerable amounts. We show how the Federal Reserve was able to effectively use these tools to influence conditions in money markets, even those in which it was not an active participant. Moreover, our results suggest that the transmission of monetary policy to money markets occurred not just through changing the supply of reserves but importantly through financial market arbitrage and the rebalancing of investor portfolios. The tools used in the 1920s by the Federal Reserve resemble the extraordinary monetary policy tools used by central banks recently and provide further evidence on their effectiveness even in ordinary times.

Key words: monetary policy, unconventional monetary policy, central banking, administered rates, money markets, quantitative easing

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1. Introduction

In recent years, the Federal Reserve (Fed), like many other central banks, has introduced new tools to implement monetary policy, including large scale asset purchases and use of administered rates. Several of these tools were introduced as unconventional and temporary policy tools, but some have argued that the Fed may have to rely on them more frequently going forward. That might be the case, for example, if there has been a decline in the long-run neutral real rate of interest—that is, the inflation-adjusted short-term interest rate consistent with keeping output at its potential on average over time—as suggested by Clarida (2014), Holston, Laubach, and Williams (2016), and Kiley (2018). Indeed, scholars and policy makers have increasingly engaged in a broader debate about how central bank policy should be implemented, including whether the central bank should use administered rates or target market rates, and whether the size and composition of the balance sheet should be used as policy tools (Stein 2012, Goodfriend 2014, Reis 2016, and Yellen 2016). An important part of the debate about which tools might be part of the toolkit is whether these tools are effective and a growing literature has sought to evaluate their effectiveness, particularly of the asset purchases (Krishnamurthy, Vissing-Jorgensen, Gilchrist, and Philippon 2011; D'Amico, English, López-Salido, and Nelson 2012; Altavilla, Carboni, and Motto 2015; and Haldane, Roberts-Sklar, Wieladek, and Young 2016). However, such assessments are challenging given the limited number of actions and the fact that several asset purchase programs were announced following the financial crisis when market responsiveness may have been different than in normal times.

This paper provides a historical perspective on the tools available to the Fed by reviewing the U.S. monetary policy toolkit and analyzing the transmission of monetary policy to private money markets in the 1920s. The tools used during this period as part of normal policy

operations have important similarities to the tools introduced recently. Understanding their effectiveness as conventional policy tools during the 1920s might then provide additional insight on the potential effectiveness of such tools today for use in ordinary times, not just in crisis times. In particular, the Fed implemented policy by adjusting administered interest rates and by purchasing both private and government securities.[1] While the asset purchases of Treasuries used by the Fed in the 1920s were of a smaller scale than the recent ones, the operations during two easing cycles in the earlier period did more than triple the Fed's Treasury portfolio.

Moreover, the interactions of the Fed with respect to one of the principle money markets of the time, the Bankers' Acceptance market, offers useful insights into the channels by which monetary policy was transmitted to private financial markets. Traditionally, most work on monetary policy transmission in the 1920s has focused on the reserves channel—that is how the Fed's actions affected the supply and cost of reserves. We test the reserves channel, but we also investigate whether other channels that have been of interest in modern times, such as the portfolio balancing channel often associated with large scale asset purchases, may have mattered as well. In doing so, this paper also adds to the literature on understanding the channels through which monetary policy is transmitted to financial markets.[2]

We start with a review of the tools available to the Fed in the 1920s to implement monetary policy and a discussion of how they functioned.[3] The monetary policy toolkit at this

[1] For ease of exposition, we typically refer to the Fed as a single entity when it comes to setting monetary policy. The reader should keep in mind that this is a simplification. The regional Reserve Banks had considerable autonomy regarding open market operations, although there was a committee of Reserve Bank officials that tried to coordinate purchases and sales. The Reserve Banks had authority to set their discount rates independently and were not always in sync with each other regarding changes in these administered policy rates; there were also times when discount rate changes sought by the Reserve Banks were not approved by the Federal Reserve Board. In this paper, we focus on policy rates prevailing at the Federal Reserve Bank of New York and the system-wide holdings of securities.

[2] See, for instance, Hamilton 1997; Demiralp, Preslopsky, and Whitesell 2006; Carpenter, Demiralp, and Senyuz 2016; Duffie and Krishnamurthy 2016.

[3] As we discuss in more detail below, we use the term monetary policy to refer to actions taken by the Fed and the consequences of those action. We touch only lightly on the intent behind such actions.

time is particularly interesting because the Fed had three policy instruments at its disposal, each of which worked in a slightly different fashion. The first tool was the rate the Fed charged for discount window loans (or rediscounts) where banks could choose to borrow from the Fed to obtain reserves. The second tool was the rate at which the Fed would purchase bankers' acceptances; this tool directly impacted the value of a particular money market instrument and affected the cost (and incentive) for banks to obtain reserves by selling the acceptances to the Fed. The third tool was open market operations in government securities in which the Fed would add or subtract reserves through purchase or sale of Treasury securities at the going market rate.

After describing the three policy instruments and how they worked, we examine their effectiveness in influencing conditions in money markets during the 1920s. The connection between changes in the policy tools and changes in conditions in private money markets is a key link in the transmission of monetary policy. We focus on the years from 1923 until 1929—after distortions from war finance needs had diminished and before the onset of the financial distress of the Great Depression. In particular, we test whether private money market rates in New York City, where the major money markets in the U.S. were located, responded to changes in the discount window rate of the Federal Reserve Bank of New York (New York Fed), changes in the discount at which the New York Fed purchased acceptances, and changes in the System's holding of government bonds.

We find that the policy instruments were effective in influencing private money market rates, where higher administrative rates tended to raise private interest rates while purchases of Treasury securities reduced private interest rates. Indeed, we find that the impact of large-scale asset purchases on money markets was fairly substantial and larger than those that have been

found for the recent asset purchase programs. Such results are in line with those of Bordo and Sinha (2016).

To gain more insight into the channels through which monetary policy was operating, and particularly whether there were channels operating in addition to the reserves channel, we focus on the bankers' acceptance market and the Fed's rate for purchasing these instruments. We test whether the bankers' acceptance market was sufficiently developed such that it enabled the Fed to use changes in its acceptance rate to influence conditions in money markets through channels in addition to the reserves channel. Certainly changes in the rate at which the Fed purchased these securities affected the incentives of banks to sell the acceptances to the Fed and thus the availability of bank reserves and financial conditions. However, it is possible that there were additional effects. In the 1920s, the Fed supported the growth of the acceptance market with the intent that banks and other financial institutions use these instruments as part of their liquid investments. To the extent that other institutions adjusted holdings and prices of other instruments as the rates on acceptances changed, then arbitrage and portfolio rebalancing may have meant that changes in the rate at which the Fed bought these securities had sizable impacts on the prices of other money market securities. Balabanis (1935) suggests that such behavior occurred to some extent. Alternatively, it may be that the price of acceptances would not necessarily have mattered for any other market prices because the Fed was intervening strongly in this market, holding over 40 percent of the outstanding amount of acceptances at times.

We test the channels of transmission by looking at whether the changes in reserves appears to account for most of the change in money market rates. While we find that the effect of purchases of Treasury securities and bankers' acceptances were of similar magnitudes, consistent with the reserves channel, we also show that, for acceptances, the change in the rate at

which the Fed purchased these securities had much larger effects than could be explained by just the reserves channel. Instead our evidence is consistent with additional transmission channels, such as portfolio balancing, being important during the 1920s.

In addition, we find that banks' holdings of acceptances responded to changes in the acceptance rate and that the commercial paper rate responded to changes in outstanding amounts of acceptances. These findings are suggestive of a portfolio balance channel and are consistent with arbitrage between the acceptance market and the commercial paper market being a channel through which monetary policy operated. They also support the idea that the acceptance market, while strongly influenced by the Fed, was integrated with other money markets.

The paper is organized as follows. Section 2 describes the Fed's monetary policy toolkit, discusses the implications of the use of these tools for the Fed's balance sheet, and the channels through which they influenced money markets. In Section 3, we provide estimates of the size of the effects of the different monetary policy tools on money market interest rates in the 1920s. Section 4 explores the potential transmission channels, and particularly whether the changes in the acceptance rate operated through a portfolio balance channel in addition to its impact on reserves. Section 5 concludes.

2. Monetary Policy Toolkit and Transmission

In this section, we review the three main tools the Fed used to implement monetary policy in the 1920s—the discount window, purchases of bankers' acceptances, and open market operations in government securities—and how they shaped the Fed's balance sheet.[4] We also discuss several mechanisms through which changes in these tools may have been transmitted to private money markets.

[4] A more detailed description of the tools may be found in Carlson and Duygan-Bump (2016).

Note that in this paper, our focus is the Fed's toolkit and how the monetary actions taken by the Fed affected money market conditions. We are neither focused on the reasons for the policy actions nor whether the policy makers had the correct intentions behind their actions. Friedman and Schwartz (1963), Wicker (1966), Wheelock (1991), and Meltzer (2003) provide a detailed review of the factors driving monetary policy in this period.

Nevertheless, it is worth remembering that the Fed in this period was generally operating a countercyclical monetary policy with a stated goal of accommodating commerce and business, without allowing speculative excesses to create instability. The Federal Reserve would tighten policy when they viewed credit growth as excessive, and ease when industry and trade were in need of support. Conditions in financial markets were viewed as signals about the demand and supply of credit growth. Wheelock (1991) notes these signals required careful interpretation; for instance, low money market rates could signal low loan demand as well as excessive supply of reserves, but the appropriate monetary policy response differs depending on the underlying reason. Consistent with Friedman and Schwartz (1963)'s view of the 1920s as the "High Tide of Reserve System," Wheelock also suggests that the Fed interpreted the signals correctly in the 1920s given the correlation between monetary policy and industrial production in this period.

2.1 The discount window

In the 1920s, one of the primary tools for implementing policy was the discount window, where the Fed could (re)discount paper for banks or provide advances (loans) against eligible collateral. [5] Indeed, member banks, as a group, appear to have needed to borrow regularly from the Fed in order to meet their reserve requirements. The rates that were charged for providing

[5] Eligible collateral in the 1920s consisted of only government securities and short-term commercial, agricultural or industrial paper that was used on produce, purchase, carry, or market goods. The Fed could not discount private promissory notes, such as corporate bonds or longer-maturity commercial and industrial loans. Thus, there was a much narrower range of eligible collateral than is the case today. For details of rediscounting see Hackley (1961).

credit through the discount window could be increased or decreased in order to affect credit conditions.

The operations of the discount window were overseen by the 12 Federal Reserve Banks, and the rates that were charged at the window were set by these banks subject to approval by the Federal Reserve Board. As interbank markets were not as integrated in this period as they are today, the Federal Reserve Banks had some scope to set discount window rates that differed across districts.[6] As our analysis focuses on the money market rates in New York, we focus on the discount window rate at the New York Fed.[7]

The rates that the New York Fed charged on its discount window loans were often close to, but below, the interest rates on private money market rates in New York. These were markets in which banks were typically lenders. The discount window rate was often above the rates the money center banks in New York paid on their deposits, including their interbank deposits. As described by the New York Clearing House Association (1920), the maximum rates that member banks were allowed to pay on interbank deposits and certificates of deposit issued to banks in the early 1920s, were both below, and a function of, the discount rate of the New York Fed.[8] The relative expensiveness of the discount window is consistent with Burgess's report that the New York banks would often repay their discount window loans quickly when they received additional funds due to gold flows or Fed asset purchases (Burgess 1936, p. 235-236).

[6] Efforts by banks to arbitrage differences in discount window rates promoted the early development of the federal funds market and the subsequent integration of interbank markets (Turner 1931).
[7] The reserve banks could, and did, have multiple discount window rates that varied with the collateral being used. During World War I, all the reserve banks offered a preferential rate for loans backed by government securities to bolster demand for such securities. By the early 1920s, the New York Fed had a single discount window rate.
[8] Specifically, the rules stated that the maximum rate that member banks could pay on such deposits was set at one percent when the 90-day discount rate for commercial paper at the New York Fed was two percent. For each half-percentage point increase in the discount rate above two percent, the maximum rate that member banks could pay was increased by one-quarter of a percentage point (New York Clearing House Association, 1920, page 16). While the strict relationship between rates and the New York Fed's discount window rate was relaxed in the mid-1920s, it appears that rates the money center banks paid on many of their deposits remained below the discount window rate.

2.2 Open market purchases of bankers' acceptances

The Fed could purchase bankers' acceptances in the open market as part of its open market authority.[9] The primary use of bankers' acceptances in the 1920s was as a money market instrument to finance trade, especially international trade (Beckhart 1932). When an exporter shipped goods abroad, they typically had to wait to be paid until the goods reached the market and were sold. Rather than wait, the exporter could have brought a bill indicating the shipment to his bank and received a loan against that bill. Banks financed such loans by endorsing the bills and bringing them to larger banks, usually in a money center. The money center banks would then "accept" the bill and provide money to the exporter's bank. The money center bank could hold that bill or sell it into the market as a bankers' acceptance. The acceptance was guaranteed by the payment the exporter expected to receive, the promise of the exporter's bank to make good on the paper if the exporter failed, and the promise of the money center bank to make good on the paper if the exporter's bank failed. This type of instrument was little used in the United States prior to the creation of the Fed. Indeed, banks with national charters were forbidden to issue such securities. As many prominent European money markets, such as London, had large bankers' acceptance markets and the fact that these securities backed "real transactions," the founders of the Fed were keen to develop this market in the U.S., which would also help promote the U.S. dollar as an international currency (Ferderer 2003, Eichengreen and Flandreau 2012). These efforts were generally successful and by the mid-1920s, this market was comparable in size to other important money markets.[10]

[9] While the Fed could purchase a slightly broader set of securities than just bankers' acceptances, acceptances constituted nearly all the paper bought by the Fed so we use the term bankers' acceptances to refer to all such paper. The Fed still has the authority to purchases bankers' acceptances, however, it has not used this authority in some time. Open markets operations in bankers' acceptances and the use of repurchase agreements on bankers' acceptances to manage reserves were ceased in 1977 and 1984, respectively. See Small and Clouse (2005).

[10] In 1926 the average monthly outstanding volumes of the different money market instruments were Bankers' acceptances: $691 million; commercial paper: $627 million, brokers' loans on call $2,288 million, and brokers'

The Fed had a passive role in the open market operations in bankers' acceptances. Instead of directly buying a certain amount of acceptances directly from the market, the Federal Reserve Banks would set the rates at which they would buy acceptances of particular maturities, where this rate was the discount relative to the face value of the acceptance; we refer to this discount as the acceptance rate. The Federal Reserve Banks would then take all eligible acceptances that were delivered to them. [11] Given the desire of the Fed to promote this market, the rates at which the Federal Reserve Banks would buy acceptances tended to be set favorably relative to the rate at the discount window. As with rates at the discount window, the 12 reserve banks could each set their own rates for purchasing these securities. Again, given our focus on the New York markets, we use the rates offered by the New York Fed. (The acceptance market in New York was the largest market for these securities.)

The Fed's holdings of acceptances represented a significant share of the market, at times the Fed held nearly 40 percent of outstanding acceptances. Consistent with its large share of the market, the rate at which the New York Fed was willing to buy acceptances heavily influenced the market price. As shown in Figure 1, the market rate in New York and the rate at which New York Fed offered to purchase the securities were almost identical.

2.3 Open market operations in government securities

The Fed also has the authority to purchase or sell government obligations in the open market. Efforts to coordinate operations across the System eventually resulted in the creation of the Open Market Investment Committee in 1923.

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loans on time $825 million. There was an emerging federal funds market, but that was very small. There was also a repo market involving a variety of collateral, including bankers' acceptances, but the size of this market is unknown. For additional details on these markets, see Beckhart (1932).

[11] It is not clear what the maturity structure of these instruments at origination was, but at particular points in time, roughly 40 percent of the holdings of the Fed had maturities of less than 15 days, 20 percent had a remaining maturity of between 16 and 30 days, 25 percent had a remaining maturity of 31 to 60 days. The rest had a maturity of more than 60 days.

Around this time, large-scale open market operations in government securities began to be seen as a tool that could be used to manage the aggregate quantity of credit, and support the discount window policy. Some shifts in policy were associated with large swings in the holdings of government securities. For instance, in 1924, the Fed took steps to ease monetary policy and increased its holdings of Treasury securities from $100 million in January to $600 million by October. Purchases were not announced, but were observable from the Fed's weekly publication of its balance sheet. The Fed's holdings of Treasury securities consisted of the full range of Treasury securities: certificates of indebtedness (with maturities of a year or less), notes (with maturities of between one and ten years), and bonds (with maturities of more than ten years).[12] The maturity of the securities that were purchased or sold by the Fed when it engaged in substantial operations in Treasury securities appears to have varied over the 1920s as shown in Figure 2. (This is in contrast to the large scale purchases by the Fed following the Great Recession which focused on purchases of longer-term securities.)

With the Open Market Investment Committee, most purchases were conducted by the New York Fed and allocated to the accounts of the other Reserve Banks.

2.4 Balance sheet of the Federal Reserve

The balance sheet of the Fed for the year-end of 1926 is shown in Table 1. From this table, it is clear that the major asset of the Federal Reserve System was gold, which is consistent with the U.S. being on the gold standard. It is also apparent that, during this period, the direct exposure of the Fed to the condition of the commercial banking sector was fairly substantial. Private credit, consisting of bills of acceptance purchased in the open market, paper rediscounted, or advances to member banks on acceptable collateral (often government

[12] During this period, the Fed occasionally purchased cash-management securities directly from the Treasury. Such purchases were rare and short-term, but were large when they occurred. See Garbade (2014) for details.

securities), constituted about 20 percent of the Fed's assets. Advances, which were mostly secured by US government securities, were typically more substantial than discounts, which were typically of commercial and agricultural paper. Purchases of bankers' acceptances securities represented seven percent of the Fed's assets. Most of the acceptances held by the Fed were associated with imports or exports, though some were associated with domestic trade or inventory finance. Holdings of government securities were a smaller share of the Fed's balance sheet in this period, averaging about seven percent of total assets.[13]

2.5 Channels by which monetary policy was transmitted to financial markets

In this section, we describe some of the channels through which monetary policy could have been transmitted to financial markets. While there are many channels through which monetary policy operates, such as the bank lending or the exchange rate channel, we focus especially on two channels: the reserves channel, which was emphasized by contemporaries, and the portfolio balance channel—which have been associated with the more recent large scale asset purchases employed by several central banks. We also briefly touch on the signaling channel.

2.5.1 The reserves channel

The transmission channel described by contemporaries (especially Reifler 1930 and Burgess 1936) is the reserves channel, where the Fed affected the money market by changing the supply and cost of obtaining reserves.[14] Banks demanded reserves in order to comply with reserve requirements and to facilitate their conduct of the business of banking; for instance, reserves are useful for processing payment system transactions. The supply of reserves was determined importantly by the Fed through its open markets operations. Purchases (or

[13] At $315 million, the Fed's holdings of Treasury securities represented about 1.7 percent of outstanding interest-bearing Treasury securities.

[14] This channel is also quite similar to discussions about the market for reserves and implementation of monetary policy in the late 1990s/early 2000s (see Koeger, McGowan, and Sarkar 2017).

sales/maturing) of Treasury securities would expand (contract) the supply of reserves. Open markets operations in acceptances required that the banks decide to sell such securities to the Federal Reserve Bank, but the Federal Reserve Bank could influence commercial banks' incentives by changing the discount at which it purchased them. As these securities were short-term and naturally "self-liquidating," they would mature over time and tighten policy unless they were replaced.[15] Commercial banks could also obtain reserves by borrowing from the Fed through the discount window. Changes in the rate charged on discount window loans would have affected the willingness of banks to borrow from the Fed (supply of reserves) and the cost of obtaining them (price of reserves).

Typically, the Fed used its tools in a complimentary fashion during a shift in policy, as seen in Figure 3 and discussed in (Burgess 1936). For instance, when tightening policy, it would conduct open market sales of Treasury securities to decrease the supply of reserves. This would make banks more reliant on obtaining reserves through the discount window. The Fed could then increase the discount window rate to raise the cost of using the window. Moreover, the Fed could also increase the discount on acceptance purchases so that banks received fewer reserves when they sold acceptances to the Fed which would further tighten the market for reserves.

As the reserves market tightened, these pressures would have been passed on to other money markets. While there was not yet a liquid market in which banks could directly trade reserves—the federal funds market was still developing—banks could trade reserves indirectly through trading securities and through their mutual participation in other overnight money markets and thereby transmit monetary policy to these other markets

[15] Changes in monetary gold should have had similar effects as open market operations and we typically include such changes as a control variable. See Friedman and Schwartz (1963) for a discussion of the amount of gold on the Fed's balance sheet.

2.5.2 Portfolio rebalancing

Another channel through which monetary policy might be transmitted to financial markets is the portfolio balance channel (see, for example, the discussion in Haldane, Roberts-Sklar, Wieladek, and Young 2016). Underlying this mechanism is the idea that investors have particular preferences regarding the assets they hold. If the central bank were to purchase a particular type of asset, then the investors who had held that asset would purchase other assets with somewhat similar characteristics in ways that would change the relative prices of these assets. For instance, if certain investors have preferences for assets with a particular duration profile, then when the Fed purchases large amount of longer-term Treasury securities those investors might purchase large amounts long-term corporate debt and compress the yield spreads between these asset classes. This compression in yield spreads might consequently promote issuance of corporate bonds.

In our period, the Fed purchased two types of assets – Treasury securities and bankers' acceptances. Under the portfolio balance channel, we might expect that the effect on money market prices from purchases of bankers' acceptances to be different, and possibly stronger, than the effects from purchases of Treasury securities as the former are a more similar instrument. Specifically, the acceptance rate in particular may have been able to influence financial market conditions in an additional, and more direct way. Certain investors held both acceptances and other money market securities, such as commercial paper, as part of their portfolios. If the Fed changed the rate at which it bought acceptances, and thus changed the prevailing market rate, then we would expect the investors holding both assets to demand a different rate on other assets in their portfolios. Some contemporary observers mention such a dynamic (see Balabanis 1935). In this case, money market conditions should respond to changes in the acceptance rate to a

greater degree than would be expected just from the changes in the Fed's holdings of acceptances and the associated change in the supply of reserves.[16]

However, this mechanism crucially depends on bankers' acceptances being treated as an active part of the portfolio. The Fed was heavily involved in this market and regularly held a considerable fraction of outstanding acceptances on its balance sheet. Moreover, the market price of acceptances seldom differed from the rate at which the Fed was willing to purchase them. Given this intervention, it is not certain that market participants would have used the rate on acceptances to price other assets and the actions by the Fed may not have had any impact other than by changing the supply of reserves.

2.5.3 Signaling/forward guidance

One last mechanism by which policy might be transmitted is through signaling; by shaping expectations about whether monetary policy might be tighter or easier in the future, the Fed would be able to affect the prices of assets that would mature after the change in policy was expected to occur. Newspaper stories clearly indicate that market participants had expectations about actions the Fed might take. Additionally, newspaper stories and analysis of changes in the Fed's balance sheet and in the discount and acceptance rates make it clear that financial market participants were paying close attention to actions taken by the Fed. However the Fed did not provide much forward guidance. [17] Further, there is little discussion in the newspapers regarding

[16] Our analysis of the portfolio rebalancing effect in the 1920s focuses on the effects of purchases of acceptances on other money market instruments where the effects are likely to be strongest. Studies of the more recent period have looked at the effects on longer-term assets, such as corporate bonds, which are more similar to the Treasury securities purchased by the Fed during the recent LSAPs. Thus, the mechanism being considered is the same, but the type of security that is the most natural comparison instrument is somewhat different.

[17] As policy tools were used in combination, it is possible that a sustained change in Treasury holdings might foreshadow a change in the discount rate or acceptance rate. To gauge this potential signaling effect of balance sheet movements, we looked to see whether there was indeed any relationship between a switch from accumulating/shedding Treasury holdings and the first decrease/increase in the discount rate by the New York Fed. We found that the first change in the discount rate occurred any time between 5 weeks and 24 weeks after the peak or trough in Treasury holdings. Given the wide range of time that could elapse between Treasury operations and

how any actions taken by the Fed were reshaping the expectations of market participants about longer term monetary policy.[18]

3. Impact of monetary policy tools on market rates

In this section, we test whether changes in the monetary policy tools impacted rates in markets, especially money markets. As part of this first pass, we are agnostic about which channel the tools are operating. Before testing the transmission, we briefly review the important money markets of this period.

3.1 Review of major private money markets

There are two major private money markets that we use in our analysis. The prime commercial paper market was a money market in which moderately sized firms could borrow on an unsecured basis (larger firms would typically issue long-term bonds). The firms would issue short-term notes that would be purchased by a commercial paper house, which would arrange to distribute the paper around the country. While the houses would not guarantee the paper they sold, there were reputational consequences to selling paper that subsequently went bad. [19] As such, commercial paper was the most similar money market instrument to bankers' acceptances. The most common buyers of commercial paper were banks, which would use this as a place to put funds on a short-term basis. This market was fairly deep for much of the 1920s, but started to fade by the end of that period.

interest rate operations, the role of any signaling effect on changes in market interest rates in any given week was likely pretty small.

[18] By contrast, Bordo and Sinha (2016) report notably discussion in newspapers of shifts in market expectations in response to changes in the Federal Reserve's balance sheet. They find that these shifts in expectations mattered for longer-term Treasury yields during 1932 when the Fed engaged in substantial purchases of Treasury securities.

[19] Interest rates on this paper in the secondary market were determined by the quality of the firm issuing the paper. "Prime" commercial paper reflected the paper considered by the National Credit Office (a private firm affiliated with the R. G. Dun credit rating agency) to be of the highest quality and the interest rates on that paper trading in the secondary market were used to construct the prime commercial paper rate.

The second money market is the market for broker's loans, which were loans extended to New York City stock brokers and brokerage houses and backed by equity securities traded on the New York Stock Exchange. This was the largest money market in the 1920s (see footnote 10). The New York City money center banks were prominent lenders, but other domestic banks foreign banks, corporations, and investment trusts all provided funds. Broker loans were typically short-term demand loans and could be called by the lender at any time which resulted in the market being referred to as the "call loan market." However, a meaningful share (30 percent) of these loans were made on a time basis (90 days). In this paper, we focus on the time portion of the market.

3.2 Setup of the analysis

To get a general sense of the relationship between the policy tools and market rates, we plot two policy rates and two private money market rates at a weekly frequency in Figure 4.[20] The two policy rates are the New York Fed's discount window rate and rate for purchases of acceptances with a maturity of 16-30 days. The private rates are the interest rate on four-to-six month commercial paper and the rate on time call loans (90 days). The figure suggests that, in general, policy rates seem to have moved in the same direction though they were not adjusted at exactly the same time. From Figure 3, we know that holdings of Treasury securities tended to move inversely with these rates. Figure 4 also indicates that the private market rates moved broadly at the same times as movements in the policy rates and the changes in holdings of Treasury securities. It is also clear from Figure 4 that money market spreads during this time

[20] As noted by Wheelock (1991), the Fed was reportedly attentive to whether its policy rates were out of alignment with market rates. Thus, there is some possibility of reverse causality in that changes in market rates could have caused the Fed to adjust its policies. However, it seems likely that any policy response would have been in reaction to more sustained changes in market rates rather than the week to week fluctuations analyzed here. Moreover, the results in Section 3.4 below using a dynamic framework should further alleviate concerns about reverse causality.

were positive and tended to move around over time, which is different than is the case now where these spreads tend to be fairly tight and steady over time.

To more formally test whether private rates move in response to changes in policy instruments, we regress changes in private money market rates on the changes in the policy tools. Using changes is a better test than using levels because of reduced likelihood of spurious correlation and of issues associated with autocorrelation.[21] Specifically, we estimate the following equation:

$$r^{mm} = \alpha_0 + r^{ac\prime}\alpha_1 + r^{dw\prime}\alpha_2 + Treas'\alpha_3 + Gold'\alpha_4 + \alpha_m + \alpha_y + \varepsilon \qquad (1)$$

The vector r^{mm}denotes the changes in private market rates–the interest rate on four-to-six month commercial paper, time call loans (90 days), and the interest rate on overnight, renewed call loans, and the interest rate on a long-term Treasury bond.[22] The matrices r^{ac}, r^{dw}, and $Treas$ capture the contemporaneous change and two lags of changes in the policy tools—the acceptance rate, the discount rate, and the Fed's holding of Treasury securities, respectively. The rate at which the Fed discounted acceptances varied by remaining maturity of the acceptance; we use the rate on acceptances with 16-30 days remaining maturity. For Treasury operations, we scale the changes in the Fed's holdings to be in units of $100,000. Measuring changes in holdings of Treasury securities in dollar units facilitates estimating the size of the impact of Treasury purchases/sales; alternative scaling of the size of operations in Treasury securities produce qualitatively similar results. As indicated above, increases in the administered

[21] We also estimated the effects of the level of policy instruments on the level of market rates using autoregressive distributed lag model; the long-run effects estimated using that approach are similar to those reported here using the first difference specification.

[22] For most of the sample period these are bonds issued as part of the Fourth Liberty Loan program, which matured in 1938 (but were callable starting in 1933).

rates should raise private interest rates while increased holdings of Treasury securities should reduce them.

Changes in the Fed's holdings of gold should also affect money rates in a manner similar to Treasury purchases. (Hanes (2006) finds that gold flows affected monetary conditions in the 1930s; gold inflows increased the supply of reserves and lowered longer term treasury yields.) To control for the impact of gold on financial conditions, we include contemporaneous and two lags changes in the monetary gold (also measured in units of $100,000), denoted by the matrix $Gold$. Seasonal factors may also be important and we include monthly dummies in the regressions. We also include year effects.

All variables are measured at a weekly frequency. Our sample period is from June 1923 to August 1929, although for the overnight call loan market, we end the sample at the start of 1929 as this market appears to change in character during that year (see White (1990) for a detailed discussion).[23] We also omit a couple of months for the long-term bond near the end of the sample in which there was a change in the reference rate. Summary statistics of the variables used in the analysis are reported in Table 2. Our regressions control for first order serial correlation (although since we are looking at changes at a weekly frequency, the effects of serial correlation seem fairly minimal).

3.3 Results

The results of the regression analysis are reported in Table 3. They are, for the most part, in line with our expectations. We find that increases in both the acceptance rate and the discount

[23] This is also the time period when the Fed was using moral suasion to deter banks from using discount window loans from being used to support "speculative excesses" in the stock market. Consequently, we would expect that changes in the discount rate would have less impact on call loan rates.

window rate generally raised market interest rates (with the exception that overnight call loan rates are less responsive to the policy rates). The effects are strongest for commercial paper rates. The coefficients imply that an increase of 25 basis points in the acceptance rate would have increased the commercial paper rate by 9 basis points; a similarly sized increase in the discount window rate would have increased the commercial paper rate by 4 basis points. While these effects are economically meaningful, the pass-through from changes in policy rates to changes in market rates is notably less than the close to one-for-one pass-through observed in modern times. Increases in the discount window rate and the acceptance rate also appear to have lifted long-term rates. While the coefficient indicates that a 25 basis point increase in the acceptance rate or the discount window rate is associated with only a 1 basis point increase in the long-term Treasury rate in that week, the standard deviation of weekly changes in the long-term rate is only 2.5 basis points. Thus, while the effect is small, it is meaningful.[24]

Also as expected, increased holdings of Treasury securities are associated with reductions in private money market rates. We estimate that an increase of $500 million in the Fed's holding of Treasury securities (about the size of the increase in holdings of Treasury securities in 1924 when the Fed was easing policy and an amount equivalent to 3 percent of Treasury securities outstanding at the time) would have decreased the commercial paper rate by 300 basis points. Similarly, we estimate that such purchases would have resulted in a 90 basis point decline in the long-term Treasury rate.

[24] We investigated alternative lag lengths. For most monetary policy variables, we are unable to reject that coefficients beyond a two week lag are equal to zero. For changes in the acceptance rate, there is some evidence that lags up to four weeks may matter for the commercial paper rate, in which case the economic effects reported in Table 3 would be somewhat larger, but lags beyond two weeks are not significant for other market rates. In the VAR specification below, we also investigated whether alternative lag lengths might matter. Different criteria suggest different things: Schwarz's Bayesian information criterion suggests 1 lag is optimal; the Hannan and Quinn information criterion suggests that 2 lags is optimal, while Akaike's information criterion is suggests 4 lags. Using different lag lengths however, does not meaningfully change the economic magnitudes of the cumulative responsiveness of the variables to shocks. Thus, for consistency with the OLS results, we continue to use 2 lags.

We can compare this effect to the effect of purchases associated with the Fed's large scale asset purchases in the wake of the financial crisis. Recent estimates (e.g., Li and Wei 2013, D'Amico and King 2013) suggest that the Fed's first round of quantitative easing (QE1)—which resulted in $300 billion in asset purchases (also about 3 percent of outstanding Treasury securities) resulted in a decline in Treasury yields of about 8-30 basis points. Thus, our evidence suggests that Treasury purchases had large effects in the 1920s than they do today.[25] This result is similar to Bordo and Sinha (2016) who also find larger effects of Treasury purchases in the 1930s than in modern times.

We also find that, again as expected, increases in monetary gold tended to reduce market interest rates. We find modest seasonal effects, with interest rates tending to rise a bit more, on average, during August, September, and October than other months. However the size of the seasonal effects are small (4 to 5 basis points), consistent with the Fed having successfully damped seasonal pressures (See Miron 1986, Carlson and Wheelock 2016).

3.4 Effects of changes in monetary policy in a dynamic system

In the approach used above, we have assumed not only that the policy variables do not respond to week-to-week changes in market interest rates, but also that gold flows similarly do not respond to such fluctuations. However, it is possible, and indeed likely, that gold flows responded to changes in interest rates. In this case, an increase in the acceptance rate as the Fed tightened policy would raise the commercial paper rate or call market rate. The high rates would result in gold inflows. Gold inflows would add to monetary gold on the Fed's balance sheet, generate an increase in reserves, and partly reverse the increase in policy rate.

[25] The larger impacts are consistent with the Treasury market being notably less liquid in the 1920s than today.

In this subsection, we explore this interaction and allow the changes in our variables to respond to each other using a Structural Vector-Auto-Regression (SVAR) consisting of five vectors in the following order: (1) changes in the holdings of Fed's Treasuries, (2) changes in the acceptance rate, (3) changes in the discount rate, (4) changes in Fed's holdings of gold, and (5) changes in the private commercial paper rate. Specifically, we estimate the following model:

$$\beta x_t = \Gamma_0 + \Gamma_1 x_{t-1} + \Gamma_2 x_{t-2} + \varepsilon_t \qquad (2)$$

where x_t is a matrix in which the columns are our five variables. To identify this model, we assume that changes in the policy interest rates and Treasury purchases are able to influence gold flows and market rates contemporaneously but market rates and gold flows do not have contemporaneous effects on the policy variables. We also allow gold flows and market rates to affect each other contemporaneously. In addition, all variables are allowed to affect each other with a one- and two-week lag. Accordingly, we impose the following structure on the matrix β:

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ b_{g,t} & b_{g,r^{dw}} & b_{g,r^{ac}} & 1 & b_{g,r^{cp}} \\ b_{r^{cp},t} & b_{r^{cp},r^{dw}} & b_{r^{cp},r^{ac}} & b_{r^{cp},\mathrm{g}} & 1 \end{bmatrix}$$

Results of the SVAR involving the commercial paper rate as the market rate are shown in Figure 5. We show the cumulative impacts of one-time, one standard-deviation shocks to the different variables. (The size of the shocks thus matches the standard deviations of the variables as reported in Table 2.) Results using other market rates instead of the commercial paper rate are similar.

We do observe some of the dynamics that motivated us to consider this framework. As shown in the next-to-the-last column, we find that gold inflows tended to reduce the commercial

paper rate. Further, as shown in the last column, an increase in the commercial paper rate resulted in some gold inflows.

However, accounting for these dynamics does not diminish the impact of changes in policy rates on the commercial paper rate. As shown in the first three columns, the commercial paper rate continues to respond to the monetary policy variables of Treasury holdings, the acceptance rate and the discount rate. If anything, the effects of a shock to the policy interest rates are even a little stronger than in the previous section. Here an 8 basis point increase in the acceptance rate is estimated to eventually result in a 6 basis point rise in the commercial paper rate and a 10 basis point increase in the discount rate increases the commercial paper rate by about 4 basis points.

The SVAR shown in Figure 5 assumes that gold responds to policy contemporaneously, but that policy does not respond to gold contemporaneously (policy may respond with a one week lag). Some discussion of the 1920s argues that offsetting gold flows was an important part of the Fed's policy in the 1920s (Friedman and Schwarz 1963). In this case, a one week lag may not sufficiently capture how policy was operating.

To more directly account for the possibility that monetary policy was sterilizing gold flows, we reorder the variables and adjust the restrictions in the SVAR to allow gold to affect the policy variables (and commercial paper rates) contemporaneously. The policy variables continue to affect the commercial paper rates contemporaneously. Commercial paper rates only affect other variables with a lag.

The results of this alternative SVAR are shown in Figure 6. As before, we focus on cumulative responses. Here we observe that, while interest rate policy does not appear to have

responded to gold flows, an increase in gold does seem to have been associated with a decrease in Treasury holdings. This finding is consistent with at least partial sterilization.

In terms of our main object of interest, the response of the commercial paper rate to changes in the discount rate and the acceptance rate appear to be of about the same magnitude in this specification as in the one used to generate Figure 5. We do find that the response of the commercial paper rate to a change in Treasury holdings is reduced slightly when we account for gold sterilization, but it is still economically and statistically meaningful.

4. Some evidence regarding transmission channels

Our analysis of the relationship between changes in the monetary policy tools and changes in the money rates was silent on the channels through which monetary policy mattered. In this section, we provide some evidence on which channels might be particularly relevant. We are especially interested in whether the monetary policy tools might have affected financial conditions beyond their effect on just the supply of reserves in the system. To test this, we focus on the acceptance market and the unique role that the rate at which the Fed purchased acceptances and the acceptance market might have played.

4.1 Acceptances and the channel of transmission

The Fed strongly supported the market for acceptances as we discussed earlier. One way it did so was by encouraging banks to include acceptances in their portfolio of liquid assets, in addition to commercial paper and call loans. And perhaps more importantly, the Fed acted as a major buyer in the market (as noted above, the Fed at times held over 40 percent of outstanding acceptances). If the Fed was successful in convincing banks to hold acceptances in their portfolio of liquid assets (as was suggested by Balabanis 1935), then changes in the acceptance rate ought to have caused institutions holding acceptances to reprice other assets in their portfolio

and changing the acceptance rate should lead to larger effects than would be suggested just by the reserve channel. But, if the Fed distorted that market by being such a significant purchaser of these instruments such that it became disconnected from other money markets, then we would expect that the reserve channel would account for nearly all the effect of this policy tool. To state this argument slightly more formally, if the reserves channel accounts for the entire transmission of the acceptance rate to market rates, then the estimated size of the effect on market rates from changing acceptance rate directly, as measured in equation (1), should be the same as estimating the effect of the change in the acceptance rate on changes in the Fed's holdings of acceptances (q^{ac}) and then looking at the effect of the changes in the Fed's holdings of acceptances on changes in money market rates, as measured in equations (3) and (4).[26]

$$q^{ac} = \alpha_0 + r^{ac\prime}\alpha_1 + r^{dw\prime}\alpha_2 + Treas'\alpha_3 + Gold'\alpha_4 + \alpha_m + \alpha_y + \varepsilon \qquad (3)$$

$$r^{mm} = \alpha_0 + q^{ac\prime}\alpha_1 + r^{dw\prime}\alpha_2 + Treas'\alpha_3 + Gold'\alpha_4 + \alpha_m + \alpha_y + \varepsilon \qquad (4)$$

(As above, the matrices r^{ac}, r^{dw}, and $Treas$ capture the contemporaneous change and two lags of changes in the policy tools—the acceptance rate, the discount rate, and the Fed's holding of Treasury securities, respectively.) If there are other channels at work besides the reserve channel, then the effect estimated in equation (1) should exceed the effect estimated in equations (3) and (4).

In addition, regardless of whether changes in the acceptance rate operated only through reserves or through additional channels, the impact of additional holdings of acceptances, Treasury securities, or gold should, dollar for dollar, have the same impact on money rates. This

[26] In fact, the effect of this two-step procedure should be slightly larger as banks would presumably offset some of the change in reserves due to changes in sales of acceptances to the Fed with changes in the discount window borrowing so that the overall changes in reserves is less than the change in acceptances. That offsetting effect is captured in (1) but not in (3) + (4).

result is because changes in all of these instruments should have an equal effect on the supply of reserves.

We show the results of estimating equation (1) in Table 3. Table 4 shows the results of estimating equation (3) and Table 5 shows the results of estimating equation (4).[27] From Table 3, we find that the impact of a 25 basis point increase in the acceptance rate would be expected to raise the commercial paper rate by 9 basis points. Based on Table 4, we estimate that a 25 basis point increase in the acceptance rate would, over the course of three weeks, have reduced the amount of acceptances on the Fed's balance sheet by about $13,200. Based on the results reported in Table 5, we estimate that these reductions in the Fed's holdings would have increased the commercial paper rate by 0.8 basis points. Thus, we find much stronger effects from the reduction in the acceptance rate than can be accounted for by the changes in reserves.

To test our additional hypothesis, we calculate the impact of a reduction in $13,200 of Treasury securities and of gold. Based on the estimates in Table 3, we find that amount of Treasury sales would have increased the commercial paper by 0.8 basis points. Similarly, that dollar amount reduction to monetary gold would have raised the commercial paper rate by 0.9 basis points. Thus, we find evidence consistent with the idea that the same dollar amount change in all three balance sheet items had the same effect on the commercial paper rate, consistent with this specification capturing the impact of the reserves channel.

4.2 Robustness check

Here, we use a slightly different approach to confirm that the acceptance rate has effects beyond the reserves channel. We do this by regressing changes in money rates directly on

[27] We also used an SVAR to estimate this specification, similar to equation 2, but using acceptances on the balance sheet rather than the acceptance rate. The results regarding the impact of this balance sheet variable on the commercial paper rate are similar to the OLS specification in that an increases in holdings of acceptances has a small, negative effect on the commercial paper rate.

changes in reserves as well as changes in the acceptance rate and the discount rate. If the acceptance and discount rates continue to matter, then it ought to be because of a channel other than their impact on reserves. The regression is quite similar to the previous specifications and continues to use contemporaneous and two lags of each of the independent variables.

The results are shown in Table 6. We find a strong connection between changes in reserves and changes in the overnight call loan rate; but do not find much evidence that other rates were much affected by changes in reserves. (The weekly changes in reserves were also affected importantly by changes in check float and in the Treasury account at the Fed; to the extent that weekly changes in reserve balances from these factors were seen as temporary, then they might well have affected the overnight rate without affecting longer-term money market rates or the Treasury rates.) The effect of changes in the policy rates are similar to what we found above. The coefficients on changes in the acceptance rate and on the discount rate, for example, are quite close to those estimated in Table 3. Overall these results are strongly supportive of our earlier results.

4.3 Additional evidence involving quantities of acceptances

We are able to provide some additional evidence regarding the transmission of monetary policy and the interaction between the acceptance market and the commercial paper market using information on quantities. The portfolio balance channel of transmission suggests that, when the Fed changes the rate at which it would purchase acceptances and hence the relative attractiveness of these instruments, that should affect investors preferences for these instruments. We are able to test this using data on banks' holdings of acceptances. The portfolio balance channel also suggest that changes in the volume of these securities available to investors should impact the

prices of similar securities. We test this by looking at whether changes in the issuance of acceptances impacts the commercial paper rate.

In both cases the evidence is consistent with the portfolio balance channel. We only have a modest number of observations, as this data is only available monthly from 1925 onward, so the results should be treated with some caution. Nevertheless, it is useful to know that evidence that is available using this data is consistent with the portfolio balance channel.

4.3.1 Change in holdings of acceptances in response to a change in the acceptance rate

We first look at how banks' holdings of acceptances changed in response to a change in the rate at which the Fed would purchase acceptances. As shown in Figure 1, when the Fed increased the acceptance rate, the market rate would advance by about the same amount and the rate of return that investors would earn by holding acceptances would increase. (This would apply to new purchase or originations. Investors would experience a mark-to-market loss on their current holdings of acceptances.) The opposite would occur when the Fed decreased rates. When the rate of return on acceptances increased, we would expect that investors and acceptance originators would seek to add more of these assets to their portfolio and shift away from holdings of similar securities. The reduced demand for those similar securities would be expected to eventually reduce the price on those securities and raise the associated interest rates to be in line with those on acceptances.

In this section we test whether an increase (decrease) in the acceptance rate resulted in banks holding more (less) acceptances. As part of their monitoring of developments in the acceptance market, the Fed collected information on banks' holdings of acceptances on a monthly basis starting in 1925. We regress changes in this amount, measured in units of $1 million, on lagged changes in the acceptance rate as well as changes in other monetary policy

tools (the discount rate and holdings of Treasury securities) and holdings of monetary gold. We also control for changes in economic activity by including changes in the index of industrial production and seasonal factors using month dummies. Given the small sample, controlling for serial correlation can bias the coefficients, so we report results using ordinary least squares and including an auto-regressive term.

The results, reported in Table 7, are consistent with the portfolio balance channel. An increase in the Fed's acceptance rate resulted in banks holding more of these securities, though after a one month lag.[28] An increase in the acceptance rate of 25 basis points would have increased banks' holdings of acceptances by roughly $20 million, about one-half of standard deviation change.

Banks holdings of acceptances also appear to have been affected by other monetary policy tools as well as economic activity. For instance, when the Fed purchased more Treasury securities, which would have reduced interest rates, banks held fewer acceptances. We also find that banks tended to hold fewer acceptances on their balance sheets when industrial production was expanding more rapidly.

4.3.2 Impact of changes in the quantity of acceptances on commercial paper rates

The second supporting hypothesis we test is whether changes in the outstanding amounts of acceptances affected interest rates in the commercial paper market. If portfolio rebalancing and quantities of securities mattered, then we would also expect that changes in private market issuance of acceptances should also affect commercial paper rates. This effect is because increased issuance of acceptances creates additional supply of high quality liquid assets. Since

[28] There are variety of potential reasons for this lag. For instance, there may be issues associated with the mark-to-market accounting as the value of acceptances on balance sheet securities declined. Alternatively, it may have taken some time for the change in secondary market rates, the ones affected by the Fed, to change primary market rates in such a way that banks would find it valuable to increase their holdings of newly originated acceptances.

the Fed essentially pinned down the interest rates in the secondary market for acceptances, we should not expect that the price of these securities would change. However, we ought to see a change in the price of close substitutes, particularly commercial paper.

We test this hypothesis by regressing the change in the commercial paper rate on changes in the amount of acceptances outstanding and the monetary policy variables. We expect that increases in acceptances should push up the commercial paper rate. We estimate this regression using monthly data owing to the frequency with which information is available regarding acceptances outstanding. We also control for changes in economic activity using changes in industrial production and seasonal factors using month dummies. Again we report results using ordinary least squares and including an auto-regressive term.

The results, shown in Table 8, indicate that increases in acceptances outstanding did boost commercial paper rates, consistent with a portfolio balance channel. The effect occurs after two months, timing that is coincident with when banks increased their holdings of acceptances. The monetary variables matter as before—increases in the acceptance rate and the discount rate pushed up commercial paper rates while increases in Fed holdings of monetary gold lowered them.

5. Conclusion

In this paper, we provide an overview of the three primary tools used by the Fed as part of the normal implementation of monetary policy in the 1920s—the discount window, purchases of bankers' acceptances, and purchases of government securities in the open market. These tools are fairly similar to the more "novel" or "unconventional" tools that were introduced by the Fed during the past decade. The large scale asset purchases of Treasuries used by the Fed in the 1920s were of a smaller scale than the ones used by the Fed after the financial crisis, although

operations during two easing cycles in the earlier period did more than triple the Fed's Treasury portfolio.

In addition, we show that the Fed was able to influence the private money market rates effectively with each of these tools. Indeed, the impact of changes in holdings of Treasury securities were larger in the 1920s than today. We also provide evidence that the rate at which the Fed purchased bankers' acceptances had quite substantial effects on other interest rates beyond what would be expected only due to the impact on acceptances sold to the Fed and the level of reserves. We find evidence consistent with a portfolio balance channel as banks appear to have changed their preferences for holding acceptances after the changes in the Fed's policy rate. Finding evidence that, even in the 1920s, the portfolio balance channel appears to have mattered provides a deeper understanding of the importance of different channels in the transmission of monetary policy. Taken together, these results suggest that what is deemed as "unconventional" monetary policy during the recent decade can also be seen as fairly conventional policy used in ordinary times, and working through fairly conventional channels.

Appendix 1 - Data

The weekly Fed balance sheet is from the H.4.1 statistical release available from the Federal Reserve Bank of St. Louis FRASER website. The year-end 1926 balance sheet is from the Federal Reserve Board Annual Report for 1926.

Interest rates for commercial paper, new call loans, renewed call loans, time call loans and the Federal Reserve Bank of New York policy rates are from the Federal Reserve's *Banking and Monetary Statistics 1914-1941*. Weekly data on long-term Treasury yields are from the *Federal Reserve Bulletin*.

Outstanding amounts of commercial paper and acceptances are from the Federal Reserve's *Banking and Monetary Statistics 1914-1941*.

The index of industrial production is from the Board of Governors of the Federal Reserve.

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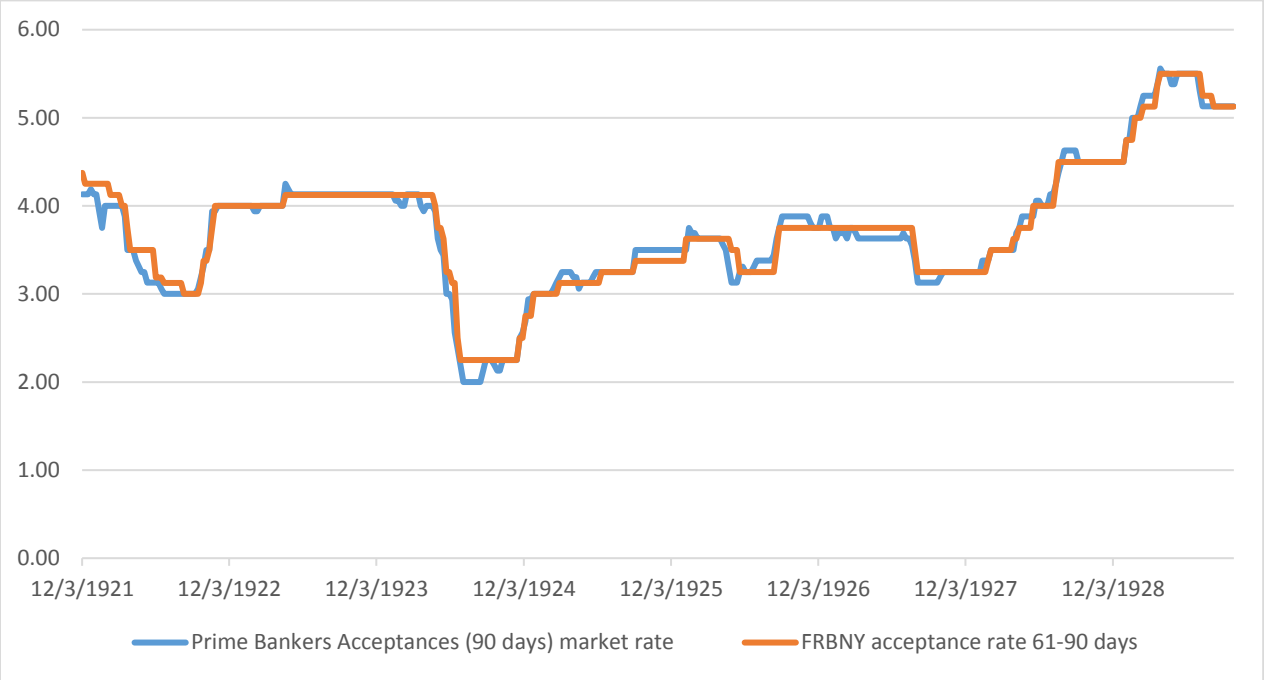
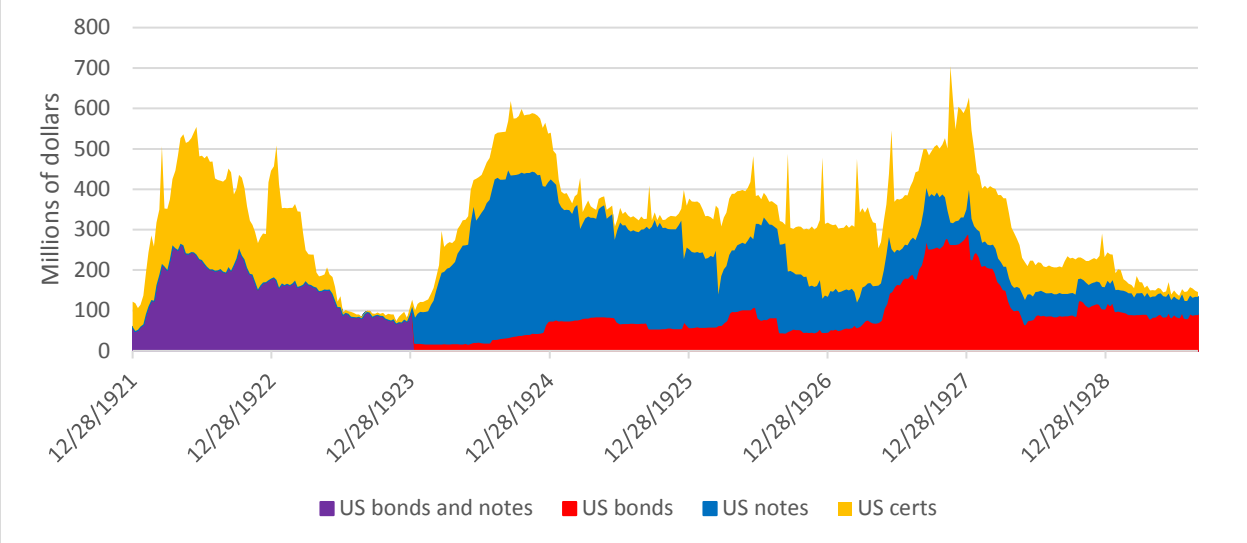
Figure 1
Market rate of interest and FRBNY buying rate on bankers' acceptances



Source: Federal Reserve, Banking and Monetary Statistics, 1943.
Note: FRBNY is the Federal Reserve Bank of New York

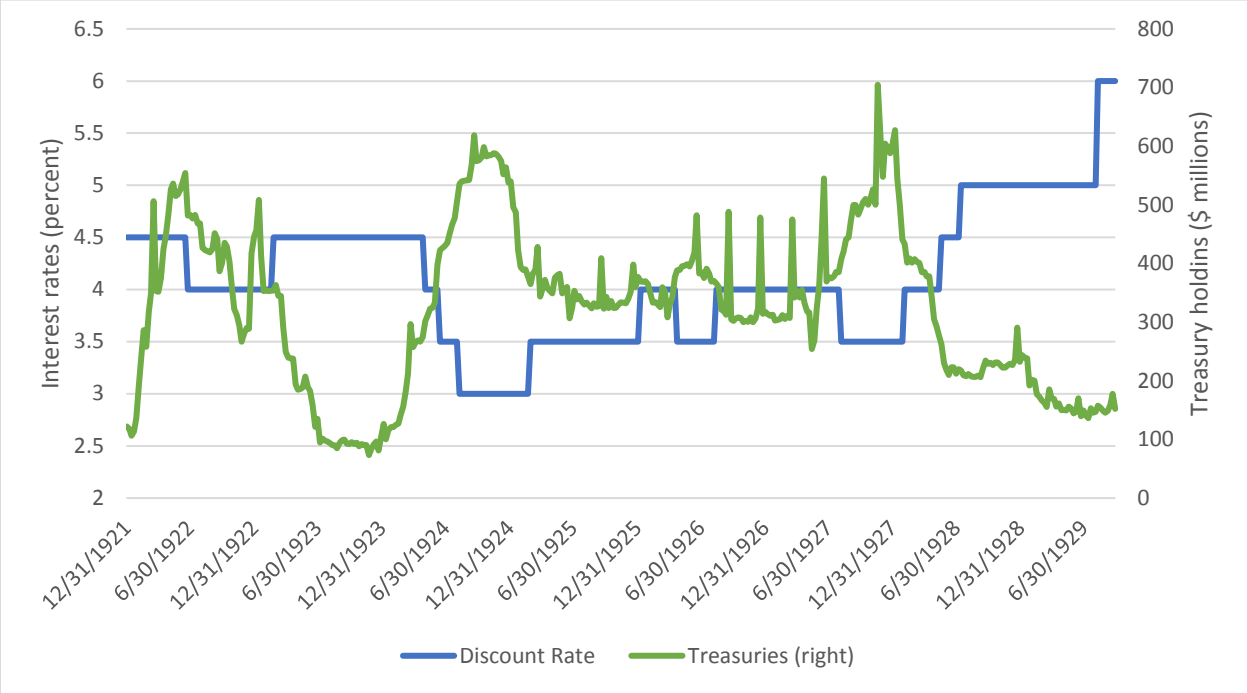
Figure 2

Federal Reserve holdings of Treasury securities by maturity



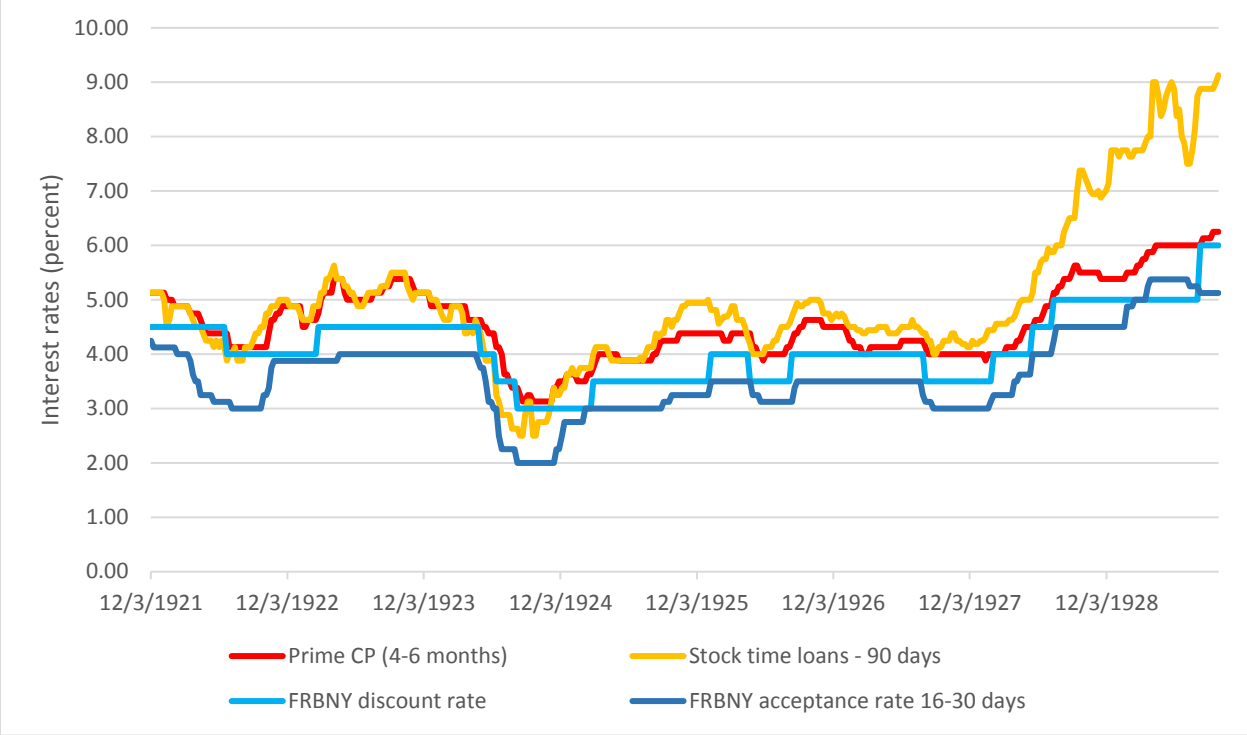
Source: Federal Reserve, Factors Affecting Bank Reserves and Condition Statement of Federal Reserve Banks (H.4.1 statistical release).

Figure 3
Holdings of Treasury Securities and the Discount Rate



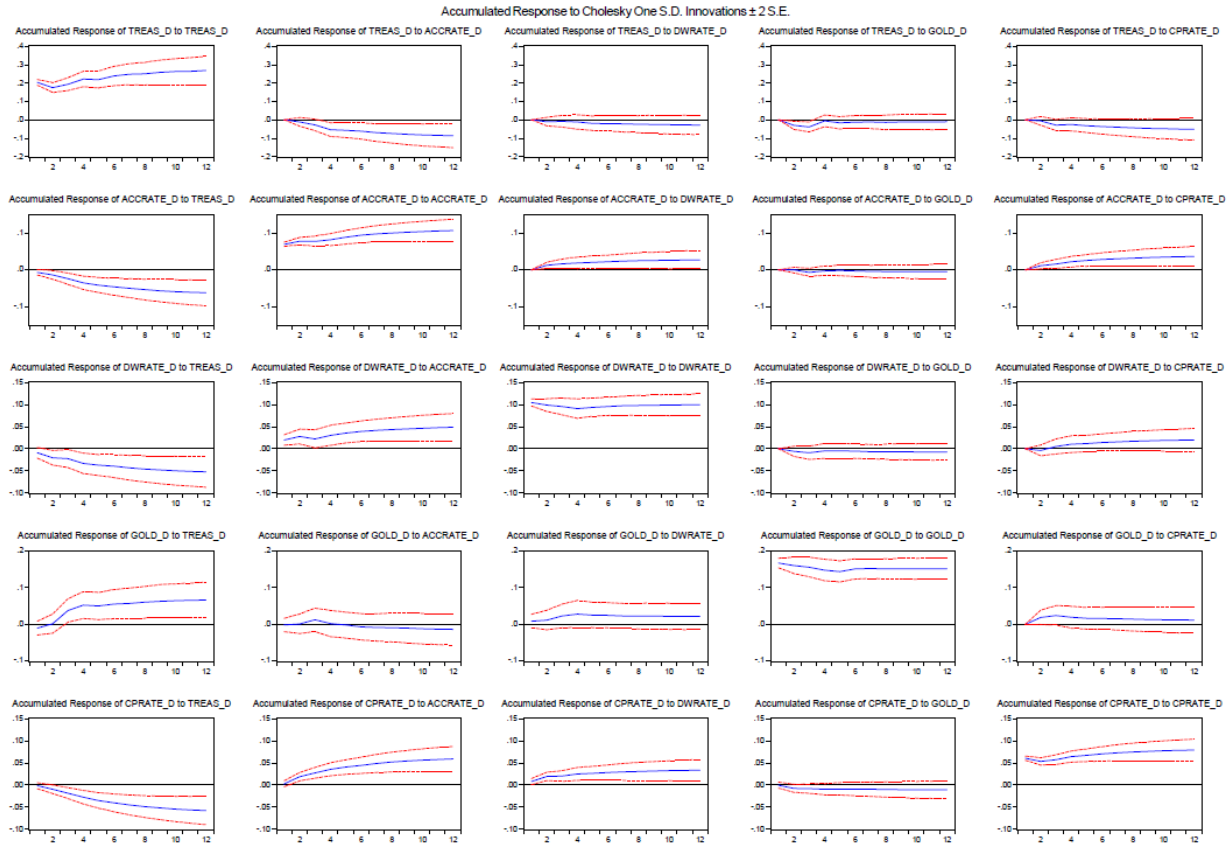
Source: Federal Reserve, Banking and Monetary Statistics, 1943.

Figure 4
Federal Reserve Policy Rates and Private Money Market Rates



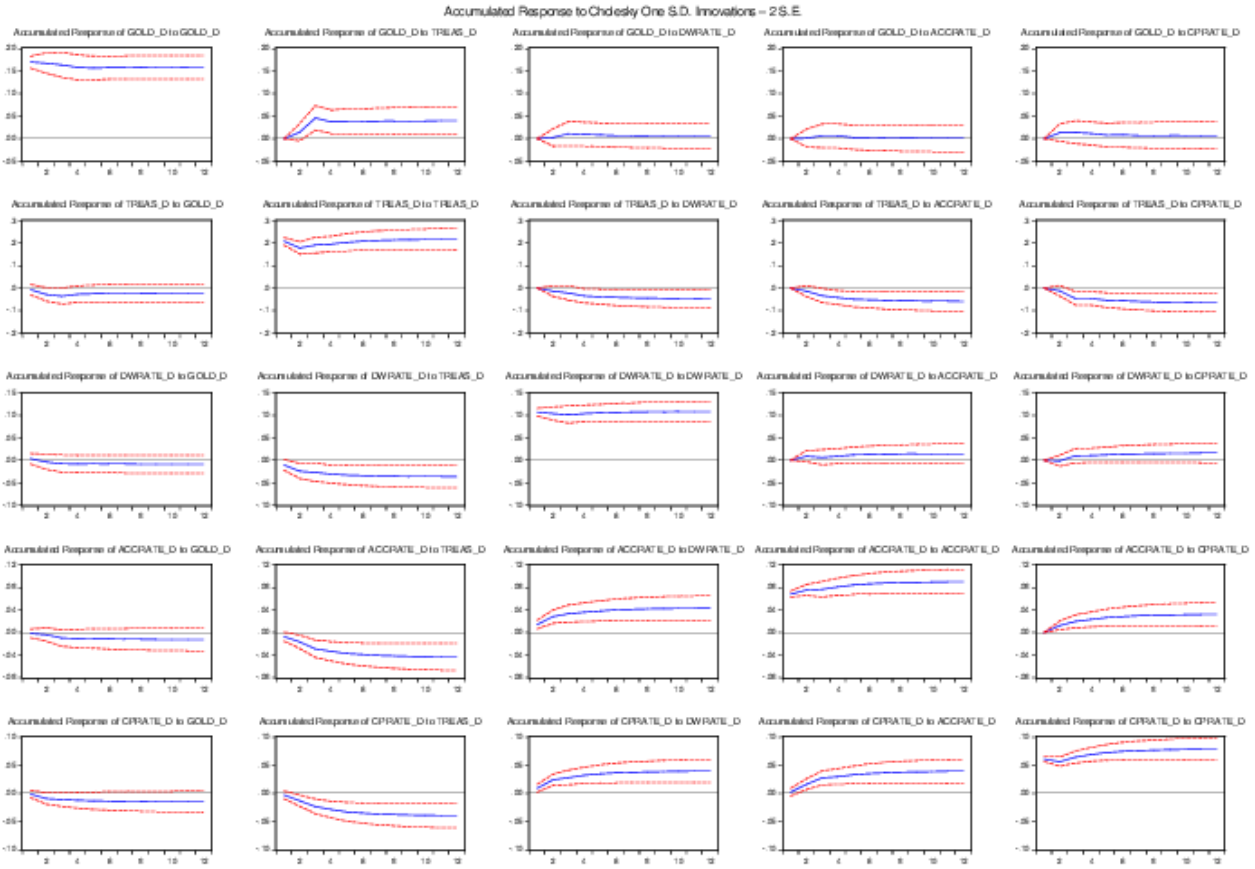
Source: Federal Reserve, Banking and Monetary Statistics, 1943.
Note: FRBNY is the Federal Reserve Bank of New York

Figure 5
Vector auto-regression results using commercial paper rate



Source: Federal Reserve, Factors Affecting Bank Reserves and Condition Statement of Federal Reserve Banks (H.4.1 statistical release), and Federal Reserve, Banking and Monetary Statistics, 1943.
Note: The individual panels show the cumulative response over 12 weeks of each variable to shocks to each variable. The columns are arranged by the variable that provides the shock impetus. The first column shows the response of all variables to a shock to the Fed's holdings of Treasury securities. The remaining columns show, respectively, the response to shocks to the acceptance rate, the discount rate, the Fed's holdings of gold, and the commercial paper rate. The rows are arranged by which variable is responding to the shock. The top row shows the response in the Fed's holdings of Treasury securities to the various shocks. The remaining rows show, respectively, the response of the acceptance rate, the discount rate, the Fed's holdings of gold, and the commercial paper rate.

Figure 6
Vector auto-regression results using commercial paper rate allowing for sterilization



Source: Federal Reserve, Factors Affecting Bank Reserves and Condition Statement of Federal Reserve Banks (H.4.1 statistical release), and Federal Reserve, Banking and Monetary Statistics, 1943.
Note: The individual panels show the cumulative response over 12 weeks of each variable to shocks to each variable. The columns are arranged by the variable that provides the shock impetus. The first column shows the response of all variables to a shock to the Fed's holdings of Treasury securities. The remaining columns show, respectively, the response to shocks to the acceptance rate, the discount rate, the Fed's holdings of gold, and the commercial paper rate. The rows are arranged by which variable is responding to the shock. The top row shows the response in the Fed's holdings of Treasury securities to the various shocks. The remaining rows show, respectively, the response of the acceptance rate, the discount rate, the Fed's holdings of gold, and the commercial paper rate.

Table 1

Balance sheet of the Federal Reserve
December 31, 1926

Assets		Equity and Liabilities	
Gold held against Federal Reserve notes	1,448.6	Federal Reserve Notes	1850.8
Other gold	1,369.9		
Bills rediscounted		Deposits	
Commercial and industrial paper	170.6	Member bank reserves	2194.1
U.S. Government	1.1	Other deposits	81.9
Other bills	3.1		
Advances		Other liabilities	669.7
Secured by U.S. Government	364.2		
Otherwise secured	97.6		
Bills bought in open market			
Acceptances for imports & exports	252.2		
Acceptances for domestic trade	77.7		
Other bills	51.0		
US Gov. securities bought in open market			
Certificates of indebtedness	179.5		
Notes	87.4		
Bonds	48.0		
Uncollected items	730.5	Capital	124.8
		Surplus	228.8
Other assets	268.7		
Total	5150.1	Total	5150.1

Source: Federal Reserve Board Annual Report for 1926.
Note: All values in millions of dollars.

Table 2
Summary statistics

Weekly variables

Variable	Obs.	Mean	Standard Deviation	Min	Max
Change in the commercial paper rate (basis points)	314	.31	6.9	-37	25
Change in the call loan time rate (basis points)	314	1.2	15.2	-63	100
Change in the call loan renewal rate (basis points)	314	.68	74	-390	435
Change in the long-term Treasury yield (basis points)	274	-.15	2.5	-9.0	12.0
Change in the New York Fed discount rate (basis points)	314	.47	10.9	-50	100
Change in the at which the New York Fed purchased acceptances with 16-30 days to maturity (basis points)	314	.36	7.7	-50	38
Change in holdings of Treasury securities ($100,000)	314	-.005	.25	-1.76	1.07
Change in holdings of acceptances ($100,000)	314	-.004	.20	-.65	.74
Change in holdings of gold ($100,000)	314	-.004	.19	-.67	.65

Monthly variables

Variable	Obs.	Mean	Standard Deviation	Min	Max
Change in the commercial paper rate (basis pts)	83	.49	19.9	-74.7	44.4
Change in the New York Fed discount rate (basis points)	83	.60	23.6	-130	80
Change in the at which the New York Fed purchased acceptances with 16-30 days to maturity (basis points)	83	.14	19.7	-76.5	58.8
Change in holdings of Treasury securities ($100,000)	83	.0001	.05	-.12	.17
Change in holdings of gold ($100,000)	83	-.002	.04	-.12	.08
Change in banks' holdings of acceptances ($1,000,000)	71	2.1	37.3	-121	115
Change in bankers acceptances outstanding ($100,000,000)	83	.11	.63	-1.3	2.7
Change in industrial production	81	1.1	.11	.90	1.42

Source: See Data Appendix.

Table 3
Impact of policy instruments on changes in private money rates
(weekly frequency)

Dependent variable: change in the private money market rates

	4-to-6 month Prime CP	Call loans on time (90-day)	Call loans Renewal (overnight)	Long-term Treasury
Change in the acceptance rate				
Contemporaneous	.03 (.05)	-.04 (.12)	.01 (.35)	.04** (.02)
Lagged one week	.19*** (.05)	.21* (.12)	-.19 (.38)	.02 (.02)
Lagged two weeks	.13** (.05)	.05 (.12)	.33 (.33)	.01 (.02)
Change in the discount rate				
Contemporaneous	.07** (.03)	.08 (.08)	.22 (.25)	.04*** (.02)
Lagged one week	.10*** (.03)	.13 (.08)	.04 (.25)	-.002 (.02)
Lagged two weeks	-.01 (.03)	.01 (.08)	-.07 (.26)	-.02 (.02)
Change in Treasury holdings				
Contemporaneous	-.01 (.02)	-.002 (.04)	.16 (.11)	-.01* (.007)
Lagged one week	-.03* (.02)	-.12*** (.04)	-.35*** (.11)	-.003 (.007)
Lagged two weeks	-.02 (.02)	-.02 (.04)	-.07 (.11)	-.003 (.007)
Change in monetary gold				
Contemporaneous	-.01 (.02)	-.02 (.05)	-.58*** (.14)	.009 (.009)
Lagged one week	-.05** (.02)	-.10** (.05)	-.39*** (.14)	-.005 (.008)
Lagged two weeks	-.01 (.02)	-.06 (.05)	.41*** (.13)	.004 (.008)
Month and year dummies	Yes	Yes	Yes	Yes
Intercept	-.03* (.02)	-.04 (.05)	-.17* (.09)	-.02* (.01)
AR1	-.11	.12	-.43	-.07
Observations	327	327	292	274
F-stat	4.6	1.7	5.5	2.0
Adjusted R^2	.24	.06	.30	.10

Source: Authors' calculations based on data described in the Data Appendix.
Note: The symbols *, **, and *** indicate statistical significance at the 10, 5, and 1 percent levels respectively. Standard errors in parentheses. Regressions adjust for first-order autocorrelation in the error terms (and we find no evidence of second order serial correlation).

Table 4
Impact of policy instruments on holdings of acceptances
(weekly frequency)

Dependent variable: change in holdings of acceptances

	Change in holdings of acceptances
Change in the acceptance rate	
Lagged one week	-.29** (.14)
Lagged two weeks	-.14 (.14)
Lagged three weeks	-.10 (.14)
Change in the discount rate	
Lagged one week	.19** (.09)
Lagged two weeks	.05 (.09)
Lagged three weeks	-.01 (.09)
Change in Treasury holdings	
Lagged one week	.11** (.05)
Lagged two weeks	-.11** (.05)
Lagged three weeks	-.04 (.05)
Change in monetary gold	
Lagged one week	-.87 (.60)
Lagged two weeks	-.64 (.56)
Lagged three weeks	-.58 (.54)
Month and year dummies	Yes
Intercept	-.13*** (.05)
AR1	-.09
Observations	327
F-stat	5.9
Adjusted R^2	.30

Source: Authors' calculations based on data described in the Data Appendix.
Note: The symbols *, **, and *** indicate statistical significance at the 10, 5, and 1 percent levels respectively. Standard errors in parentheses. Regressions adjust for first-order autocorrelation in the error terms (and we find no evidence of second order serial correlation).

Table 5
Impact of policy instruments on changes in private money rates
(weekly frequency)

Dependent variable: change in the private money market rates

	4-to-6 month Prime CP	Call loans on time (90-day)	Call loans Renewal (overnight)	Long-term Treasury
Change in holdings of acceptances				
Contemporaneous	-.04** (.02)	.03 (.05)	.76*** (.12)	.00 (.01)
Lagged one week	-.01 (.02)	.02 (.05)	-.23* (.12)	-.00 (.01)
Lagged two weeks	-.01 (.02)	-.12** (.05)	-.32*** (.12)	-.02* (.01)
Change in the discount rate				
Contemporaneous	.09*** (.03)	.08 (.08)	.14 (.22)	.05*** (.02)
Lagged one week	.15*** (.03)	.15** (.08)	-.01 (.22)	.01 (.02)
Lagged two weeks	.04 (.03)	.05 (.08)	.15 (.22)	-.003 (.02)
Change in Treasury holdings				
Contemporaneous	-.02 (.02)	-.02 (.04)	.04 (.10)	-.01** (.01)
Lagged one week	-.04** (.02)	-.13** (.04)	-.28** (.13)	-.01 (.01)
Lagged two weeks	-.03* (.02)	.002 (.04)	-.06 (.11)	-.003 (.01)
Change in monetary gold				
Contemporaneous	-.02 (.02)	-.005 (.50)	-.51*** (.13)	.01 (.01)
Lagged one week	-.05** (.02)	-.10** (.05)	-.29** (.13)	-.01 (.01)
Lagged two weeks	-.02 (.02)	-.07* (.05)	.25** (.12)	-.001 (.01)
Month and year dummies	Yes	Yes	Yes	Yes
Intercept	-.04* (.02)	-.05 (.05)	-.13 (.09)	-.02* (.01)
AR1	-.06	.13	-.36	-.03
Observations	327	327	292	274
F-stat	3.3	1.8	7.9	1.8
Adjusted R^2	.16	.07	.40	.08

Source: Authors' calculations based on data described in the Data Appendix.
Note: The symbols *, **, and *** indicate statistical significance at the 10, 5, and 1 percent levels respectively. Standard errors in parentheses. Regressions adjust for first-order autocorrelation in the error terms (and we find no evidence of second order serial correlation).

Table 6
Impact of policy instruments on private money rates
(controlling directly for reserves)

Dependent variable: change in private money market rates

	4-to-6 month Prime CP	Call loans on time (90-day)	Call loans renewal	Long-term Treasury
Change in reserves				
Contemporaneous	-.004 (.01)	-.03 (.02)	-.01 (.06)	-.0004 (.004)
Lagged one week	-.01 (.01)	-.04 (.03)	-.32*** (.07)	.002 (.004)
Lagged two weeks	.01 (.01)	.003 (.02)	.02 (.06)	.002 (.004)
Change in the acceptance rate				
Contemporaneous	.04 (.05)	.05 (.12)	.29 (.37)	.05** (.02)
Lagged one week	.20*** (.05)	.25** (.12)	-.32 (.39)	.02 (.02)
Lagged two weeks	.14*** (.05)	.11 (.12)	.40 (.35)	.01 (.02)
Change in discount rate				
Contemporaneous	.09** (.03)	.10 (.08)	.22 (.27)	.05*** (.02)
Lagged one week	.11*** (.03)	-.03 (.08)	.08 (.27)	-.003 (.02)
Lagged two weeks	-.01 (.03)	-.10 (.08)	-.15 (.27)	-.02 (.02)
Month and year dummies	Yes	Yes	Yes	Yes
Intercept	-.03** (.02)	-.06 (.04)	-.37*** (.09)	-.02 (.01)
AR1	-.10	.11	-.28	-.08
Observations	327	327	304	274
F-stat	4.6	1.5	3.5	2.1
Adjusted R^2	.22	.04	.18	.09

Source: Authors' calculations based on data described in the Data Appendix.
Note: The symbols *, **, and *** indicate statistical significance at the 10, 5, and 1 percent levels respectively. Standard errors in parentheses. Regressions adjust for first-order autocorrelation in the error terms (and we find no evidence of second order serial correlation).

Table 7
Impact of acceptance rate change on banks' holdings of acceptances

Dependent variable: change in banks' holdings of acceptances

	OLS	AR1
Change in acceptances rate		
Lagged one month	85.1* (43.1)	76.4* (39.4)
Lagged two months	-36.9 (34.6)	-21.8 (32.4)
Change in the discount rate		
Lagged one month	-6.5 (30.6)	-5.5 (29.5)
Lagged two months	11.0 (26.7)	8.6 (25.3)
Change in holdings of Treasury securities		
Lagged one month	-198.7* (108.7)	-191.2* (104.8)
Lagged two months	172.6 (108.9)	158.4 (106.9)
Change in holdings of gold		
Lagged one month	77.8 (151.1)	145.7 (136.6)
Lagged two months	118.8 (158.2)	64.2 (142.1)
Change in industrial production		
Contemporaneous	-24.6 (39.2)	-30.5 (37.0)
Lagged one month	-60.3 (39.4)	-62.7* (36.5)
Intercept	-14.2 (22.9)	-7.4 (22.4)
Includes month dummies	Yes	Yes
AR1		-.31
Observations	55	55
F-statistic	1.4	1.5
R^2	.14	.16

Source: Authors' calculations based on data described in the Data Appendix.
Note: The symbols *, **, and *** indicate statistical significance at the 10, 5, and 1 percent levels respectively. Standard errors in parentheses.

Table 8
Impact of issuance of acceptances on commercial paper rates

Dependent variable: change in the commercial paper rate

	OLS	AR1
Change in acceptances outstanding		
Lagged one month	-.02 (.04)	-.03 (.04)
Lagged two months	.09** (.04)	.09** (.04)
Change in the acceptance rate		
Contemporaneous	.51*** (.09)	.52*** (.09)
Lagged one month	.31*** (.11)	.29** (.11)
Change in the discount rate		
Contemporaneous	.16*** (.05)	.16*** (.05)
Lagged one month	-.08 (.07)	-.07 (.07)
Change in holdings of Treasury securities		
Lagged one month	-.08 (.26)	-.05 (.27)
Lagged two months	.02 (.27)	.02 (.26)
Change in holdings of gold		
Lagged one month	-.70* (.38)	-.74* (.38)
Lagged two months	.27 (.42)	.34 (.41)
Change in industrial production		
Contemporaneous	.09 (.09)	.10 (.09)
Lagged one month	.12 (.10)	.11 (.09)
Intercept	-.15*** (.05)	-.15** (.06)
Includes month dummies	Yes	Yes
AR1		-.10
Observations	54	54
F-statistic	15.8	17.7
R^2	.87	.88

Source: Authors' calculations based on data described in the Data Appendix.
Note: The symbols *, **, and *** indicate statistical significance at the 10, 5, and 1 percent levels respectively. Standard errors in parentheses.