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New Evidence on the Monetary Transmission Mechanism

THE QUESTION of how monetary policy affects the real economy is a perennial one in macroeconomics. Over the past several decades, however, the focus of the debate has changed. Today it is taken for granted that monetary policy affects aggregate demand; what is debated is why prices do not adjust fully to compensate for shifts in demand. Thirty years ago, in contrast, sluggish price adjustment was taken for granted; what was debated was the magnitude of the effect of monetary policy on aggregate demand and the channels through which that effect occurred.

This paper returns to the subject of that older literature. A fresh look at the way monetary policy affects aggregate demand is particularly timely in light of recent developments in theoretical analyses of credit markets. Work over the past 15 years has suggested that imperfections are a central feature of capital markets, and that these imperfections can cause credit allocation to be made largely on the basis of quantity rationing rather than price adjustment and can create a special role for lending by financial intermediaries. This work has also shown that credit market imperfections can have important consequences for macroeconomic fluctuations in general and for the way monetary policy is transmitted to aggregate demand in particular.

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Our central goal in this paper is to assess certain recent theories of the transmission mechanism based on credit market imperfections. Specifically, our focus is on theories that emphasize the effects of monetary policy as it operates through bank lending rather than through banks' transactions balances. To understand the issue, it is helpful to consider two polar views of the initial impact of monetary policy on financial markets. In both views, a decline in the stock of reserves coupled with less than full price adjustment leads to a rise in interest rates to clear the market for reserves; in both, the higher interest rates then depress aggregate demand. The two accounts differ, however, in explaining the source of the demand for reserves, and hence in explaining the initial rise in interest rates.

The first view is a traditional textbook description in which reserves are valued because they are held against transactions deposits that can only be issued by banks. According to this view, a reduction in reserves raises interest rates because it implies a fall in transactions deposits. Thus the initial impact of monetary policy on interest rates arises from the special characteristics of the liability side of banks' balance sheets; the asset side plays no role. For simplicity, we refer to this account of the transmission mechanism as the "money" view.

In the second polar view, it is banks' lending activities that cause reserves to be valuable. Information asymmetries are potentially extremely important in credit markets.[1] Because of this, the information that banks have about their customers may be critical to the customers' ability to obtain loans; if banks are for some reason unable to lend, other potential lenders, not possessing the same information about the customers, cannot make the loans instead. In this situation, even if bank liabilities have no distinctive features, a reduction in the stock of reserves will necessarily reduce the quantity of such loans. Competition among banks for the scarce reserves needed to make these loans will then bid up interest rates paid by banks to depositors, and this in turn will raise interest rates throughout the economy. Here the initial impact of monetary policy on interest rates hinges on the features of the asset

1. For analyses of the microeconomic consequences of asymmetric information in credit markets, see, for example, Jaffee and Russell (1976); Townsend (1979); Stiglitz and Weiss (1981); and Gale and Hellwig (1985).

side of banks' balance sheets. We refer to this account as the "lending" view.[2]

Determining which of these views better describes the initial steps of the transmission mechanism would further our understanding both of monetary policy and of the macroeconomy. Understanding the channels of monetary transmission would help monetary policymakers decide which financial market disturbances warrant changes in monetary policy and which do not. It would also assist them in the choice of intermediate targets for policy. Distinguishing between these competing views would also improve our understanding of how monetary and other financial disturbances affect the real economy. Most important, it could provide insight into whether asymmetric information in credit markets has significant macroeconomic consequences; this is useful because, despite the theoretical progress in modeling the effects of credit market imperfections, we still know relatively little about whether such imperfections are important to the macroeconomy.

In reality, a change in the stock of reserves requires simultaneous adjustments in the prices and quantities of the full array of assets in the economy, and those adjustments depend on the institutional and regulatory structure of the economy.[3] Nonetheless, we make no attempt to provide a complete account of the transmission mechanism. First, we focus on the initial impact of monetary policy on safe interest rates (or on credit market conditions more generally), and not on how those changes in turn are translated into changes in aggregate demand. For example, we do not attempt to determine the general importance of credit rationing in the transmission mechanism. Under *either* the money or the lending view, the channels through which higher interest rates are translated into lower aggregate demand are likely to involve reduced demand for loans of all types, and they may involve credit rationing as well. Second, although the two polar views set out above are clearly not mutually exclusive, we ask which of the two provides a better approximation to actual channels of monetary transmission; in our view, there is simply not enough information available to attempt the subtler task of

2. Farmer (1984); Blinder (1987); Bernanke and Gertler (1989, 1990); and Greenwald and Stiglitz (1988a, 1988b), among others, present models of the macroeconomic implications of credit market asymmetries. See Gertler (1988) for a survey.

3. Tobin and Brainard (1963); Brainard (1964).

estimating the relative roles of money and lending in the impact of monetary policy. And third, our analysis of bank loans focuses on the question of whether they are important in the transmission mechanism, and not on the issue of whether they have distinctive characteristics that are important in other macroeconomic contexts.[4]

Empirical work investigating the money and lending views of the transmission mechanism has for the most part examined simple correlations of growth rates of money and output and of lending and output and regressions of output on money and lending.[5] These studies are a useful first step. But because they make no effort to address issues of endogeneity, they provide little evidence concerning the nature of the transmission mechanism. Money and lending are affected by economic activity. Thus correlations of various money and lending measures with aggregate output may capture the effects of output on money and lending rather than effects operating in the opposite direction. The difficulty remains even when one focuses on prediction equations: the fact that a monetary or lending measure moves before real output does not imply that the former change causes the latter.

4. In addition, we are especially interested in the effects of monetary policy operating through the assets of financial intermediaries because of asymmetric information rather than because of specific regulations. An obvious example of an effect tied to a particular institutional structure rather than informational asymmetries is the impact of monetary policy on aggregate demand through mortgage lending by thrifts. The fact that mortgages are easily repackaged and resold today suggests that lender-customer relationships do not provide original lenders with important informational advantages in evaluating the quality of their mortgages. Yet the structure of financial markets through the 1970s gave thrifts a special role in the mortgage market, and this fact, coupled with interest rate ceilings, caused monetary policy to have a sharp impact on mortgage lending. Because this type of effect is not our primary interest, in our empirical work we focus on lending by commercial banks and do not address lending by thrifts.

5. King (1986), for example, investigates the predictive power of measures of money, lending, and interest rates for real economic activity. Similarly, Bernanke (1983) tests whether measures of bankruptcies and bank failure are useful in forecasting real output during the Depression. An important exception to the focus on correlations is Bernanke and Blinder (1989). We discuss the relationship between Bernanke and Blinder's approach and our own below. In addition, Wojnilower (1980) and Eckstein and Sinai (1986) provide largely descriptive analyses emphasizing the role of lending in cyclical fluctuations. And there are important studies of the microeconomics of credit market imperfections; see, for example, Fazzari, Hubbard, and Petersen (1988) and Hoshi, Kashyap, and Scharfstein (1988). Finally, note that investigations of the cyclical behavior of general measures of "credit"—for example, Friedman (1982, 1983, 1986) and Blinder (1985)—do not address the question of whether bank lending in particular plays an important role in macroeconomic fluctuations.

The basic strategy in this paper is to examine the behavior of financial variables and the real economy during episodes in which the Federal Reserve undertook large shifts in monetary policy that were essentially independent of real economic developments. In an earlier paper, we investigated an alternative to purely statistical approaches to the question of whether monetary policy affects real economic activity.[6] The central difficulty in answering that question (as with identifying the transmission mechanism) is determining the direction of causation: monetary policy and various financial variables both affect and are affected by real economic developments. We argued that there is abundant nonstatistical evidence that could be extremely useful in addressing this difficulty, and that economists in fact often rely on such evidence in making informal judgments about the effects of monetary policy. The "Volcker disinflation" of 1979–82 is a simple and well-known example. That the Federal Reserve publicly announced that it was undertaking a dramatic shift in monetary policy to reduce the rate of inflation strongly suggests that there was an independent shock to monetary policy. That the announced shift was followed by a major recession suggests that monetary shocks have large real effects.

The goal of our earlier paper was to investigate such nonstatistical evidence as formally and carefully as possible. The central part of the paper was a study of postwar U.S. monetary history. Through a study of Federal Reserve records, we identified six times since World War II when the Federal Reserve appears to have in effect decided to create a recession in order to reduce the rate of inflation. Because the decisions were motivated mainly by concern about inflation, they were relatively independent of contemporaneous real developments. The Federal Reserve's shift to tighter policy in late 1968, for example, was largely a response to the gradual increase in inflation over the previous decade. We found that such shifts were consistently followed by sharp declines in real economic activity; 33 months after a shift to anti-inflationary policy, for example, industrial production was typically 12 percent lower than would have been predicted on the basis of real economic developments up to the time of the shock.

In that paper we deliberately avoided any attempt to examine the monetary transmission mechanism. Our purpose was to investigate

6. Romer and Romer (1989).

whether monetary policy has real effects (and if so, what those effects are), not *how* those effects come about. But the identification of shocks in monetary policy that are largely independent of real economic developments is also extremely useful for studying the transmission mechanism. Because the episodes represent independent shifts in monetary policy, they can serve as experiments for isolating the channels through which monetary shocks affect the real economy. This paper therefore uses information provided by those episodes both to describe the financial effects of shifts in monetary policy and to provide some evidence concerning the validity of the money and lending views of the transmission mechanism.

We conclude that the evidence appears to favor the traditional money view over more recent theories that emphasize banks' lending activities. Two types of evidence particularly support the traditional view. The first concerns the structure of financial markets and banks' ability to raise funds. Because reserve requirements on certificates of deposit are low, banks can obtain funds with little cost in terms of reserve holdings. It follows that even if bank loans are special, restrictive monetary policy will have only a small direct impact on banks' ability to lend. By contrast, because reserve requirements on transactions balances are much higher, monetary policy has a much stronger effect on the stock of transactions balances. Thus the impact of monetary policy on interest rates is likely to operate largely through bank liabilities (transactions balances) rather than bank assets (bank lending).

The second kind of evidence concerns the timing of the money-output and lending-output relationships. With regard to money, we show that the money-output link, particularly the link between output and lagged money, is largely a phenomenon limited to anti-inflationary episodes. That money leads output in times of monetary disturbances and not at other times suggests an independent causal role for money. With regard to lending, we find virtually no lag between movements in lending and movements in output either within or outside of our focal episodes. We also find little difference in the lending-output link during the focal episodes and at other times. Moreover, the same findings hold when we employ the available data on loan commitments rather than data on actual loans. In light of the lags in the investment process and the differences between the focal episodes and other times, we find this evidence difficult to reconcile with a significant role for lending in the

transmission mechanism. Rather, it is consistent with the view that movements in lending are largely determined by movements in output. As we discuss when we present the results, however, there are other, more complex (and in our view less plausible) interpretations of our results that preserve an independent role for lending in the transmission mechanism.

The remainder of the paper is divided into five sections. The first discusses banks' sources of funds and the structure of reserve requirements. The second section describes the behavior of money, lending, and interest rates in the focal episodes. In the third section we turn to a comparison of the strength and timing of the money-output and lending-output relationships in response to independent shifts in monetary policy with those relationships at other times. The fourth section asks what can be learned by considering differences among the episodes and banks' responses to the tightening of policy during the individual episodes. The final section offers concluding remarks.

The Structure of Reserve Requirements and the Impact of Monetary Policy

Eugene Fama has observed that at the margin banks obtain funds using instruments that are highly substitutable for securities issued outside the banking system.[7] Specifically, Fama compares negotiable certificates of deposit (particularly large-denomination ones), which are issued by banks and are subject to reserve requirements, with commercial paper and bankers' acceptances, which are issued outside the banking system and are not subject to reserve requirements. Fama notes the similar risk and liquidity characteristics of the two types of assets and shows that their average yields over the period 1967–83 are virtually identical. Closer examination of the yield spreads shows that they are indeed much smaller and less variable than other interest rate differentials. Monthly data for the period April 1971–May 1989 show that the yield spreads of three-month CDs with three-month commercial paper and three-month bankers' acceptances have standard deviations of 18 and 16 basis points, respectively (with means of 19 and 21 basis points).

7. Fama (1985).

In contrast, the standard deviations of the yield differentials of both commercial paper and bankers' acceptances with three-month Treasury bills are 63 basis points.[8] In short, negotiable CDs, while not identical to commercial paper and bankers' acceptances, are quite similar.

The apparent high degree of substitutability between securities issued inside and outside the banking system has important implications for the transmission of monetary policy. In their extension of the *IS- LM* model to include a role for bank lending, Ben Bernanke and Alan Blinder show that if bank liabilities are subject to a uniform reserve requirement and if, at the margin, they are a perfect substitute for securities issued outside the banking system, monetary policy matters only because of its impact on the asset side of banks' balance sheets.[9] A specific instance of this arises if transactions balances and CDs are subject to the same reserve requirements and if CDs are perfect substitutes for commercial paper. In this situation, a decline in reserves requires a decline in bank liabilities. But because the perfect substitutability of CDs and nonbank securities causes interest rates to be unaffected by the proportion of bank funds obtained using CDs, the response of the quantity of transactions balances to the decline in reserves is irrelevant to the response of interest rates. Thus transactions balances play no role in the transmission mechanism. Bank assets, in contrast, are central to the transmission mechanism in this situation: there are certain loans that can be made only by banks, and a reduction in the quantity of reserves reduces the quantity of these loans that can be made.

The case polar to that of equal reserve requirements over all classes of liabilities is positive reserve requirements on transactions deposits and zero reserve requirements on CDs. In this case, any special features of bank loans would play no role in the transmission mechanism. Reductions in the stock of reserves caused by restrictive monetary policy would reduce the quantity of transactions balances. But this would have no direct impact on banks' ability to lend: banks could simply issue more CDs. Ultimately, bank lending would be affected through exactly the same channel as other credit flows: higher safe interest rates would be needed to clear the market for transactions balances, and these higher interest rates would in turn lead to reduced borrowing and investment.

8. The data used in these computations are from Citibase.
9. Bernanke and Blinder (1988).

The actual structure of reserve requirements is much closer to the second case than to the first. Currently the required reserve ratio is 12 percent for transactions (demand) deposits, 3 percent for short-term (less than one and a half years) time deposits (CDs), and zero for long-term CDs. This pattern is representative of the structure of postwar reserve requirements; typically the reserve requirement on demand deposits has been between 10 percent and 20 percent while that on large-denomination CDs of fairly short maturity has ranged from 3 percent to 6 percent.[10] Thus banks can greatly mitigate any direct impact of tight monetary policy on their lending by issuing CDs subject to low reserve requirements in response to a decline in the quantity of transactions balances caused by a reduction in reserves.

This discussion assumes that CDs are available as an alternative source of funds. But CDs did not exist before the 1960s, and even in the 1960s they were subject to interest rate ceilings that were at times binding. When CDs are not available, monetary policy will have a direct impact on the quantities both of transactions deposits and of lending. Thus in this case the characteristics of both the liability and asset sides of banks' balance sheets are relevant to the transmission mechanism.

The importance of banks' ability to obtain funds with little cost in terms of reserves can be demonstrated in a simple model in the spirit of Bernanke and Blinder's. We focus on the financial side of the economy, taking aggregate output as given, and analyze the impact of monetary policy on interest rates. Thus we effectively compute the size of the vertical movement in the economy's *LM* curve caused by changes in monetary policy and ignore the determinants of the slopes of the *IS* and *LM* curves. In addition, for expositional simplicity we neglect holdings of excess reserves by banks and of currency by the public. We begin with the case in which CDs are available as an alternative source of funds and then discuss the case in which they are not.

Banks have two types of assets, reserves (R) and loans (L), and two types of liabilities, demand deposits (M) and CDs (C). Certificates of deposit are assumed to be perfect substitutes for "bonds" (securities issued outside the banking system); we then suppress the CD-bond market by Walras's Law. Reserve requirements are τ on demand deposits and

10. See, for example, *Annual Report of the Board of Governors of the Federal Reserve System, 1983,* table 12, pp. 236–37.

τ' on CDs; thus $R = \tau M + \tau' C$ and $L = (1 - \tau)M + (1 - \tau')C$. Let i and ρ denote the rates of return on CDs-bonds and on loans, respectively. We assume that ρ depends on i, with $\rho'(i) > 0$: the loan interest rate increases with increases in banks' cost of obtaining funds. The demand for transactions deposits and loans is given by $M = M(i)$ and $L = L(i,\rho)$. We assume, using subscripts to denote partial derivatives, $L_\rho < 0$, $L_i > 0$—loan demand is decreasing in the loan interest rate and increasing in the cost of alternative funds—and $M_i < 0$. We also assume $L_\rho \rho_i + L_i < 0$; that is, a general increase in interest rates reduces the demand for loans.

The model implies that the impact of a change in the Federal Reserve's supply of reserves on the bond interest rate is given by

$$\frac{di}{dR} = \frac{1 - \tau'}{\tau' [L_\rho \rho_i + L_i] + (\tau - \tau')M_i} < 0. \tag{1}$$

There are several special cases of interest. If $\tau = \tau'$, di/dR is determined entirely by the properties of $L(\cdot)$. That is, if reserve requirements on transactions balances and CDs are equal and if CDs and bonds are perfect substitutes, transactions balances are irrelevant to the transmission mechanism. If $\tau' = 0$, on the other hand, di/dR depends entirely on the properties of $M(\cdot)$. Equation 1 also shows that monetary policy has no effects if money and bonds are perfect substitutes ($M_i = -\infty$) *or* if loans and bonds are perfect substitutes ($L_\rho \rho_i + L_i = -\infty$).[11]

In the general case, expression 1 suggests that the properties of the demand for transactions deposits are likely to be considerably more important than the properties of loan demand for the impact of monetary policy. Most obviously, $\tau - \tau'$ is much larger than τ'. Thus di/dR is much more affected by changes in the responsiveness of the demand for transactions deposits to interest rates than by changes in the responsiveness of loan demand. In addition, if interest rates on transactions balances are largely fixed (by government regulation, for example), a change in i will cause substitution between money and other assets; loan interest

11. Because of positive reserve requirements, it is reasonable to suppose that ρ rises more than one-for-one with i; this is the basis for our statement that perfect substitutability implies $L_\rho \rho_i + L_i = -\infty$. The reason that policy is powerless when loans and bonds are perfect substitutes is that the quantities of CDs and bank lending can adjust to the change in reserves with a compensating change in the funds that firms obtain in the bond market rather than by borrowing from banks.

rates (ρ), on the other hand, respond to movements in market rates, and so the impact of i on lending operates only through the impact of general interest rate movements on loan demand. If this difference in the responsiveness of interest rates causes M_i to be larger than $L_\rho \rho_i + L_i$, this too will make money more important to the transmission mechanism. Finally, introducing excess reserves to the model would further increase the importance of money in the transmission mechanism: excess reserves are almost surely held much more against transactions deposits than against CDs, and so the behavior of this component of the demand for reserves would be tied much more to money than to loans.

This analysis does not imply that bank loans do not have distinctive characteristics, or that those characteristics are not important for other macroeconomic issues. Indeed, as Fama shows, the fact that banks profitably make loans using funds obtained by issuing securities that are virtually perfect substitutes for securities issued outside the banking system and not subject to reserve requirements implies that banks must have some compensating advantage in making those loans. Nor does the analysis suggest that credit market imperfections are unimportant at all stages of the transmission mechanism. What it does suggest, however, is that it may be the case that to a first approximation restrictive monetary policy affects aggregate demand by first raising safe interest rates to reduce the demand for transactions balances and hence clear the market for reserves, and then affecting markets for loans of all types. Only then would credit market imperfections come into play. In the following sections we investigate whether the data support this view.

If CDs are unavailable, the situation is different. The condition for reserve market equilibrium is simply $R = \phi M(i)$, and the quantity of loans is given by $L = (1 - \phi)M(i)$. Banks are now constrained in their lending by the availability of transactions deposits, and so the behavior of bank lending is not determined simply by i.[12] The impact of monetary policy on aggregate demand now has two components. The first is the effect through its impact on interest rates outside the banking system. The effect on i is given by $di/dR = 1/\phi M'(i)$, and so here only the properties of $M(\cdot)$ are relevant. The second component is the effect through the quantity of bank lending. The impact on L is given by

12. We are assuming, realistically, that prohibition on interest payments on deposits prevents competition among banks for funds, at least in the short run.

$dL/dR = (1-\phi)/\phi$; this is unaffected by the properties of the demand for transactions deposits. The effect of this independent change in L on aggregate demand depends on the degree of substitutability between bank and nonbank loans. If they are highly substitutable, the behavior of L will be irrelevant; if they are poorly substitutable, the effect of monetary policy will occur in part through its effect on L. Thus for the case of no CDs it is not possible to establish any presumption on theoretical grounds concerning whether the asset or liability side of the balance sheet is likely to be more important in the transmission mechanism; it is an issue that can only be addressed empirically.

The Behavior of Money, Lending, and Interest Rates

As described in the introduction, our basic approach is to examine economic developments in a series of episodes in which the Federal Reserve appears to have deliberately shifted to tighter monetary policy in an attempt to induce a recession—or at least a "growth recession"—to lower the rate of inflation. By focusing on times when the Federal Reserve appears to have been willing to accept output sacrifices to reduce inflation rather than times when it merely expressed a general desire for lower inflation or price stability, we restrict our attention to times when the Federal Reserve had a serious intention of pursuing tighter policy. And by considering only episodes in which the Federal Reserve sought to lower inflation rather than times when it acted to prevent increases in inflation that it believed would have otherwise occurred, or times when it responded to other economic developments, we hope to ensure that there is no systematic factor at work other than monetary policy that might be affecting the behavior of financial variables and real output.

Our methods for identifying shifts in policy and our grounds for selecting the specific dates that we do are described in detail in our earlier paper. The identification is based on contemporaneous statements of the Federal Reserve's intent as revealed by the System's *Record of Policy Actions* and the *Minutes* of the Federal Open Market Committee. The large body of evidence provided by these records allows us to distinguish with a reasonable degree of confidence between shifts in policy undertaken to offset prospective increases in aggregate demand

and shifts undertaken to change aggregate demand. Simply examining the behavior of such policy instruments as high-powered money, reserve requirements, and the discount rate would not allow us to make this distinction. And considering the behavior of variables further removed from direct Federal Reserve control, such as the money stock and interest rates, would introduce the additional difficulty that we could not separate changes caused by Federal Reserve decisions from ones caused by outside developments.

The dates of shifts to anti-inflationary policy that we identified are October 1947, September 1955, December 1968, April 1974, August 1978, and October 1979. In some instances the identification of a single month for the policy shift is a convenient simplification; in others (October 1979, for example) it is entirely appropriate. Because our data often do not begin until the late 1940s, the October 1947 episode is sometimes excluded from the analysis that follows.[13]

In our examination of economic developments in these episodes, we use monthly postwar data. Our measure of bank lending is loans by commercial banks. This series is available since 1948 from the Federal Reserve Board's *Banking and Monetary Statistics, 1941–1970* and *Annual Statistical Digest*; slight adjustments are needed in December 1972 and January 1984 to account for definitional changes.[14] Our money stock measure is M-1. The Federal Reserve money stock data begin in 1959; we ratio splice the Federal Reserve series in January 1959 to the

13. As we document in our earlier paper, the 1966 "credit crunch" does not satisfy our criteria for an episode of anti-inflationary monetary policy: there is no evidence from contemporaneous Federal Reserve records that the goal of the policy was anything more than to prevent further increases in inflation caused by what it perceived to be runaway increases in aggregate demand. Nonetheless, the episode is widely viewed as one of strongly contractionary monetary policy, and it is very possible that it was: perhaps the Federal Reserve's motives are not revealed by the records, or more likely, perhaps it tightened much more than it intended; see, for example, the account in Maisel (1973). As we proceed, we therefore investigate the impact on our results of adding the credit crunch to our list of episodes. When we do this, we date the shift to tighter policy as occurring with the discount rate increase of December 1965.

14. Specifically, definitional changes cause moderate discontinuities in the series in these months. Lending in December 1972 is $387.3 billion using the initial definition and $393.7 billion using the revised; the corresponding figures for January 1984 are $1,133.2 billion and $1,167.2 billion. We therefore multiply all observations before January 1984 by 1,167.2/1,133.2, and all observations before December 1972 by an additional 393.7/387.3. Bernanke and Blinder (1989) use essentially the same series in their analysis of the transmission mechanism, stopping in December 1978.

M-1 series constructed by Milton Friedman and Anna Schwartz.[15] Finally, we measure real output by industrial production in manufacturing. Where they are available, we use seasonally unadjusted data and include monthly dummy variables in our regressions. Because Friedman and Schwartz present their data only in seasonally adjusted form, we employ adjusted money stock data.

The next part of this section sets the stage for the remainder of our analysis by documenting the behavior of money, lending, interest rates, and interest rate spreads in the focal episodes. Of course, a finding that money or lending fell in the focal episodes might simply reflect the variable's usual response to cyclical fluctuations.[16] The final part of this section therefore examines whether money and loans are unusually low in times of tight monetary policy *given their normal cyclical behavior.* In the following section we turn to a more systematic attempt to determine the roles of money and lending in the transmission mechanism.

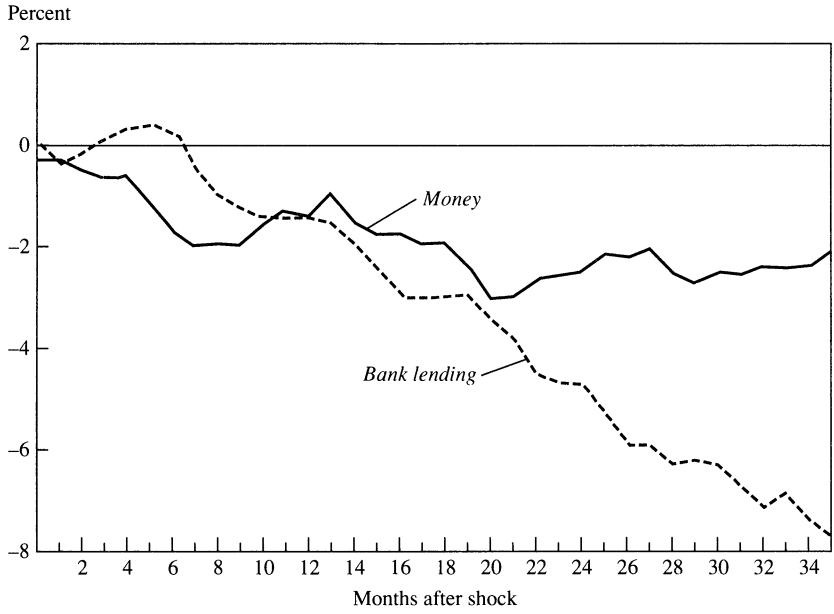
Behavior in the Focal Episodes

Figure 1 summarizes the behavior of the money stock and bank lending in five episodes of anti-inflationary monetary policy. The plot for money shows, for the three years following the policy shifts, the average departure of the actual path of M-1 from a dynamic forecast made using a simple univariate forecasting equation. The forecast is obtained from a regression of the monthly change in log money on a constant, trend, and 24 own lags. For each shock, we use the actual path of money up to the month before the shock and the estimated coefficients from the forecasting equation to construct a dynamic forecast of the changes in log money over the next 36 months. We then cumulate the forecasted changes to obtain forecasts for the level of log money and find the resulting forecast errors. For example, the observation for month nine in the figure shows that on average over the five episodes, nine

15. Friedman and Schwartz (1970).

16. This difficulty arises in Bernanke and Blinder's (1989) investigation of the transmission mechanism. Using the federal funds rate as their measure of changes in monetary policy, Bernanke and Blinder examine the responses of money and lending to changes in monetary policy, and compare those responses with the responses of real output. As they note, their approach, although suggestive, cannot disentangle independent roles in the transmission mechanism from endogenous cyclical responses.

Figure 1. Average Forecast Errors for Money and Bank Lending after Shifts to Anti-Inflationary Policy[a]



Sources: The money stock measure is M-1 taken from the Federal Reserve money stock data beginning in 1959 and spliced to the Friedman and Schwartz (1970) M-1 series. The measure of bank lending is loans made by commercial banks as reported in Federal Reserve Board, *Banking and Monetary Statistics, 1941–1970* and *Annual Statistical Digest*.

a. Forecast errors in table 1 are converted to percent by multiplying figures by 100 and then averaged. October 1947 episode excluded.

months after the policy shift the money stock was 1.9 percent lower than would have been predicted at the time of the shock using the forecasting equation. The plot for lending shows the analogous forecast errors for bank lending.[17] Table 1 presents the forecast errors for the individual episodes.

Figure 1 and table 1 show that money falls below the paths one would have predicted on the basis of the simple forecasting equation soon after the shifts to anti-inflationary policy. Just two months after the shocks, the forecast errors for money are negative in four of the five episodes.

17. Because the lending data are not seasonally adjusted, in this case the forecasting equation includes monthly dummies. The sample periods are February 1946–May 1989 for the money regression and February 1950–December 1986 for the lending regression; the precise starting and ending dates are determined by the availability of the data.

Table 1. Behavior of Money and Bank Lending in Episodes of Anti-Inflationary Monetary Policy[a]

Month after shock	*Date of shock*				
	September 1955	*December 1968*	*April 1974*	*August 1978*	*October 1979*
	Forecast error (cumulative) for log M-1				
0	0.002	0.000	−0.002	0.001	−0.012
1	−0.000	0.000	−0.004	0.006	−0.014
2	−0.004	−0.003	−0.004	0.003	−0.016
3	−0.004	−0.004	−0.006	0.004	−0.022
4	−0.005	−0.005	−0.008	0.005	−0.016
5	−0.007	−0.009	−0.009	0.000	−0.031
6	−0.008	−0.011	−0.008	−0.001	−0.058
9	−0.013	−0.023	−0.016	−0.004	−0.042
12	−0.019	−0.029	−0.022	0.016	−0.016
15	−0.020	−0.034	−0.010	0.011	−0.033
18	−0.027	−0.040	−0.017	0.012	−0.024
21	−0.035	−0.033	−0.018	−0.029	−0.035
24	−0.044	−0.033	−0.014	0.008	−0.042
30	−0.061	−0.018	−0.013	0.010	−0.044
35	−0.056	−0.020	−0.002	0.007	−0.033
	Forecast error (cumulative) for log loans				
0	0.003	−0.001	0.019	−0.003	−0.008
1	−0.002	−0.015	0.026	0.000	−0.026
2	−0.001	−0.006	0.030	0.004	−0.032
3	−0.004	−0.010	0.041	0.008	−0.028
4	−0.008	−0.003	0.045	0.009	−0.024
5	−0.013	−0.001	0.046	0.017	−0.028
6	−0.004	−0.001	0.044	0.019	−0.041
9	−0.008	−0.033	0.032	0.027	−0.080
12	−0.012	−0.032	−0.005	0.048	−0.068
15	−0.018	−0.062	−0.033	0.047	−0.053
18	−0.022	−0.067	−0.053	0.059	−0.064
21	−0.016	−0.066	−0.073	0.030	−0.065
24	−0.028	−0.073	−0.091	0.018	−0.061
30	−0.076	−0.080	−0.098	0.029	−0.091
35	−0.113	−0.081	−0.099	0.010	−0.103

Sources: The money stock measure is M-1 taken from the Federal Reserve money stock data beginning in 1959 and spliced to the Friedman and Schwartz (1970) M-1 series. The measure of bank lending is loans made by commercial banks as reported in Federal Reserve Board, *Banking and Monetary Statistics, 1941–1970* and *Annual Statistical Digest*.

a. The forecasts are made using a regression of the monthly change in log money or log loans on a constant, trend, and 24 own lags.

By seven months after the shock the average forecast error is 2 percent; thereafter they typically become only slightly larger. The standard error of the estimate in the forecasting equation is 0.4 percent; thus a forecast error of 2 percent over seven months is substantial.[18]

The departures of lending from its forecasted paths are less rapid but larger than the movements in money. Lending typically shows little change (and in fact remains on average above the forecasted paths) in the first six months after the shifts in policy but then falls sharply below the predicted paths. The average forecast error is 1.4 percent 12 months after the policy shifts, 2.9 percent at 18 months, and 6.3 percent at 30 months. For comparison, the standard error of the forecasting equation is 0.6 percent.[19]

Figure 2 plots the average value of the three-month Treasury bill rate around the dates for which we identify shifts to anti-inflationary monetary policy. The data point for month 12, for example, is the average across the episodes of the Treasury bill rate 12 months after the shift in policy. Table 2 reports the data for the individual episodes.[20] The figure and table show that interest rates rise sharply and consistently around the times of the policy shifts. For example, the Treasury bill rate rises from an average of 6.00 percent three months before a policy shift to 7.73 percent six months after. Typically the difference between the lowest monthly figure in the several months before a shock and the highest in the several months after exceeds 50 percent.[21] The fact that interest rates

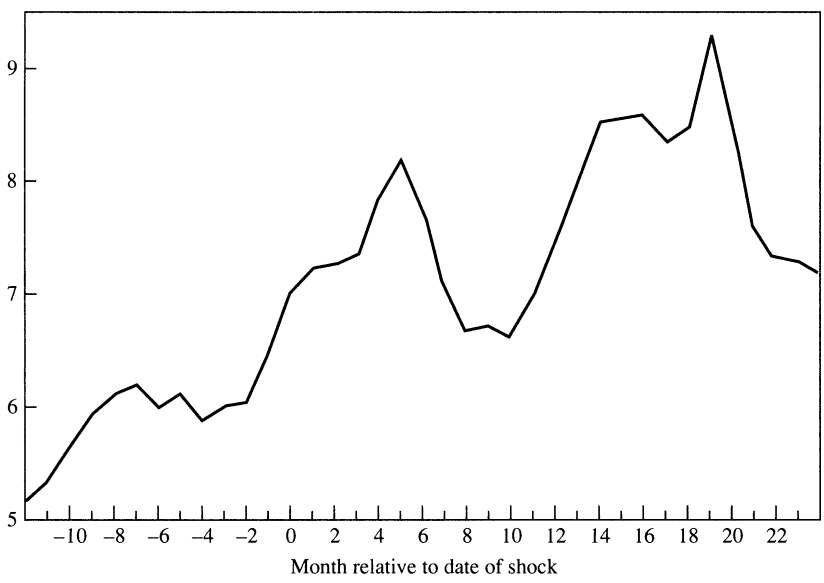
18. If the log money stock followed a random walk, the standard error of the average forecast error for the five episodes after seven months would be $(\sqrt{7} / \sqrt{5})$ 0.4 percent $\simeq$ 0.5 percent. Because there is some persistence to changes in money, the true standard error is slightly larger.

19. Simply examining the behavior of the growth rates of money and lending rather than the forecast errors yields a similar picture. The growth rate of money averages 6.3 percent in the 12 months before the shocks, 4.6 percent in the 12 months after the shocks, and 4.4 percent in the following 12 months. For lending, the corresponding figures are 14.4 percent, 9.1 percent, and 5.2 percent.

20. Because many interest rate series do not begin until after 1947, the averages shown in the figures and reported in the text (like those for money and lending) exclude the 1947 episode. When the relevant interest rate series are available for this episode, they are reported in the tables.

21. That portions of the rate increases occur before the specific months in which we identify the policy shifts is not surprising. The decisions to attempt to sacrifice output to reduce inflation were typically preceded by periods in which growing concern about inflation led the Federal Reserve to act gradually to raise interest rates in an effort to damp output expansion and prevent any further increases in inflation. In addition, despite our assignment of exact dates to the policy changes, the shifts in fact often occurred gradually.

Figure 2. Average Treasury Bill Rate in Episodes of Anti-Inflationary Policy[a]



Source: Citibase. See table 2.
a. October 1947 episode excluded.

rise sharply and consistently, together with our earlier finding that money and lending fall relative to their usual behavior, shows that the times of independent shifts in monetary policy that we identified solely on the basis of the Federal Reserve's statements of intent are indeed times of monetary upheaval.

Table 3 and figures 3 and 4 depict the behavior of a variety of interest rate spreads in the focal episodes. The movements in interest rate spreads generally confirm conventional views about the impact of tight monetary policy on relative interest rates: the federal funds–Treasury bill spread rises sharply and briefly around the times of the shocks; the yield differential between long- and short-term bonds typically falls considerably and is consistently quite low for several months after the shifts; and the yield spread between low- and high-grade corporate bonds rises consistently.

The most notable finding shown by the table and figures is the remarkably rapid change in the spread between commercial paper and

Table 2. Three-Month Treasury Bill Rate in Episodes of Anti-Inflationary Monetary Policy

Percentage points

Month relative to date of shock	*Date of shock*					
	October 1947	*September 1955*	*December 1968*	*April 1974*	*August 1978*	*October 1979*
−6	0.38	1.28	5.52	7.22	6.45	9.46
−3	0.66	1.41	5.19	7.77	6.41	9.24
−2	0.75	1.60	5.35	7.12	6.73	9.52
−1	0.80	1.90	5.45	7.96	7.01	10.26
0	0.85	2.07	5.96	8.33	7.08	11.70
+1	0.92	2.23	6.14	8.23	7.85	11.79
+2	0.95	2.25	6.12	7.90	7.99	12.04
+3	0.97	2.54	6.02	7.55	8.64	12.00
+4	1.00	2.41	6.11	8.96	9.08	12.86
+5	1.00	2.32	6.04	8.06	9.35	15.20
+6	1.00	2.25	6.44	7.46	9.32	13.20
+9	1.00	2.49	7.09	6.26	9.61	8.06
+12	1.12	2.84	7.82	5.61	9.52	11.62
+15	1.17	3.21	6.63	6.13	11.79	15.02
+18	1.17	3.08	6.68	5.96	12.86	13.69
+21	1.02	3.29	6.13	4.87	8.58	14.95
+24	1.05	3.53	4.87	4.86	9.13	13.54

Source: Citibase.

Treasury bill yields in the focal episodes. The yield differential between six-month commercial paper and three-month Treasury bills averages 72 basis points one month before the policy shifts and 153 basis points three months after. In all six episodes (including the October 1947 one), the spread rises sharply within the first six months after the shock, although in the 1974 episode—which is the one in which policy appears to have been reversed most rapidly—the spread peaks after just three months and then falls sharply. In the 1947 and 1955 episodes, which occurred in an era of relatively stable interest rates, the shift in the spread is only 20 to 30 basis points; in the later episodes it is 100 basis points or more.

While these findings concerning the behavior of interest rates provide a check on standard views about the effects of monetary policy, they do not allow us to distinguish between the money and lending views of the transmission mechanism. Both views are consistent with a rise in the general level of interest rates. And because quantities—either of money

Table 3. Interest Rate Spreads in Episodes of Anti-Inflationary Monetary Policy
Percentage points

Month relative to date of shock	*Date of shock*					
	October 1947	*September 1955*	*December 1968*	*April 1974*	*August 1978*	*October 1979*
	Federal funds rate minus three-month Treasury bill rate					
−6	n.a.	0.07	0.55	2.79	0.33	0.55
−3	n.a.	0.21	0.59	1.88	0.95	1.23
0	n.a.	0.11	0.06	2.18	0.96	2.07
+3	n.a.	−0.06	0.77	5.37	1.12	1.82
+6	n.a.	0.25	2.46	2.60	0.74	4.41
+9	n.a.	0.22	2.06	0.87	0.63	0.97
+12	n.a.	0.11	1.15	−0.12	1.42	1.19
+18	n.a.	−0.12	0.92	−0.14	1.27	2.03
+24	n.a.	−0.03	0.03	−0.04	0.48	1.54
	Ten-year Treasury bond rate minus three-month Treasury bill rate					
−6	n.a.	1.40	0.20	−0.43	1.58	−0.28
−3	n.a.	1.37	0.27	−0.78	1.94	−0.29
0	n.a.	0.90	0.07	−0.82	1.33	−1.40
+3	n.a.	0.42	0.28	0.26	0.17	−1.20
+6	n.a.	0.71	0.13	0.44	−0.22	−1.73
+9	n.a.	0.51	0.07	1.24	−0.36	2.19
+12	n.a.	0.54	−0.17	2.62	−0.49	0.13
+18	n.a.	0.33	1.16	2.18	−0.45	−0.01
+24	n.a.	0.39	1.52	2.70	1.97	1.61
	Six-month commercial paper rate minus three-month Treasury bill rate					
−6	0.62	0.41	0.73	1.70	0.35	0.41
−3	0.34	0.59	0.63	0.89	0.70	0.58
0	0.21	0.47	0.21	1.46	0.82	1.53
+3	0.33	0.45	0.80	4.17	1.59	0.66
+6	0.38	0.75	1.79	1.90	0.69	1.73
+9	0.38	0.89	1.39	1.04	0.37	0.23
+12	0.44	0.66	1.02	0.54	0.87	0.70
+18	0.39	0.55	1.53	0.52	0.74	0.48
+24	0.33	0.47	0.86	0.37	0.48	1.18
	Moody's BAA corporate bond rate minus AAA rate					
−6	0.63	0.46	0.79	0.81	0.73	0.95
−3	0.63	0.46	0.82	0.65	0.80	1.09
0	0.65	0.46	0.78	0.62	0.75	1.27
+3	0.66	0.47	0.66	0.76	0.80	1.33
+6	0.69	0.50	0.72	1.21	0.82	2.15
+9	0.56	0.50	0.91	1.98	0.97	1.58
+12	0.66	0.51	0.93	1.63	1.12	1.92
+18	0.75	0.77	0.77	1.76	1.19	1.68
+24	0.75	0.81	1.48	1.54	1.51	1.71

Source: Citibase.
n.a. Not available.

Figure 3. Average Values of the Federal Funds–Treasury Bill and Treasury Bond–Treasury Bill Yield Differentials in Episodes of Anti-Inflationary Monetary Policy[a]

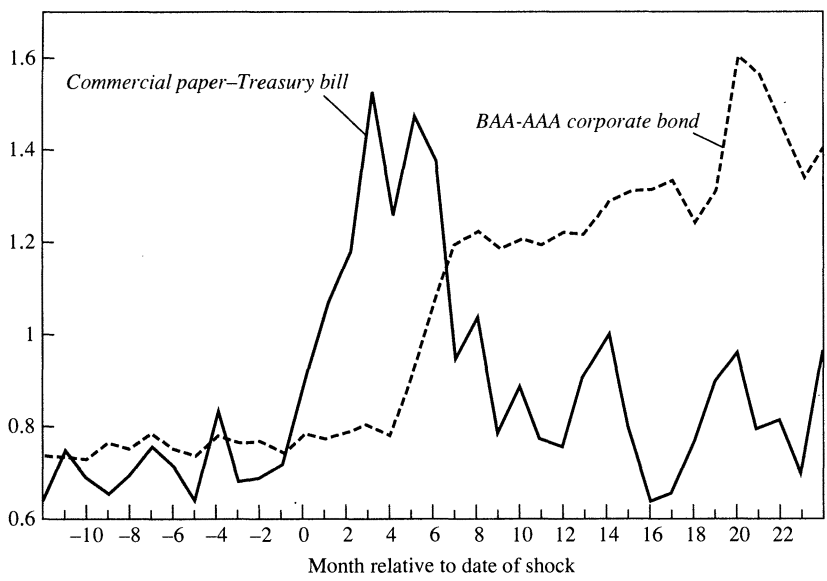
Source: Citibase. See table 3.
a. October 1947 episode excluded.

or of loans—can be adjusted only slowly, both views are consistent with the finding that interest rate movements generally precede movements in financial aggregates. In addition, the rise in the spread between risky and safe rates appears simply to reflect the increased likelihood of a recession, and the fall in the spread between long and short rates is most likely due to the fact that tight policy is not expected to be permanent. Thus the behavior of these spreads does not appear to be tied to a particular view of the transmission mechanism.

Comparison of Behavior in the Focal Episodes with Usual Cyclical Behavior

To compare the movements of money and lending in the focal episodes with the usual money-output and lending-output relationships, we estimate the normal cyclical behavior of money and lending and then ask

Figure 4. Average Values of the Commercial Paper–Treasury Bill and BAA-AAA Corporate Bond Yield Differentials in Episodes of Anti-Inflationary Monetary Policy[a]



Source: Citibase. See table 3.
a. October 1947 episode excluded.

whether the levels of these variables in the focal episodes are lower than one would expect given this estimated behavior and the actual movements in real output. A finding that, for example, lending fell by more than one would expect given the declines in output would suggest that monetary policy had an effect on lending beyond its impact on real output and thus, potentially, that lending played an important role in the transmission mechanism. A finding that the falls in lending were no more than one would expect given the behavior of output, on the other hand, would suggest that we were observing merely the endogenous response of lending to the declines in output.

To carry out this procedure, we do the following. We first regress, for the full sample period, the monthly change in log money (or in another equation, log loans) on 24 own lags, the contemporaneous value and twelve lags and twelve leads of the change in log industrial production, and a constant, a trend, and monthly dummies:

$$(2)\quad \Delta \ln M_t = a + bt + \sum_{i=1}^{24} c_i \Delta \ln M_{t-i} + \sum_{i=-12}^{12} d_i \Delta \ln Y_{t-i} + \sum_{i=1}^{11} k_i D_{it},$$

where Y is industrial production, M is money, and the D's are monthly dummies. The leads of industrial production are included because theories that account for the money-output correlation as an endogenous response of money to output allow for the possibility that money will move in advance of output. Robert King and Charles Plosser, for example, argue that firms planning to increase their output may first increase their holdings of transactions balances.[22] Given these equations, we then construct (as before) dynamic forecasts of the paths of money and lending, now using not only the behavior of money and lending up to the times of the shocks but also the behavior of industrial production before and after the shocks. We then find the resulting forecast errors.[23]

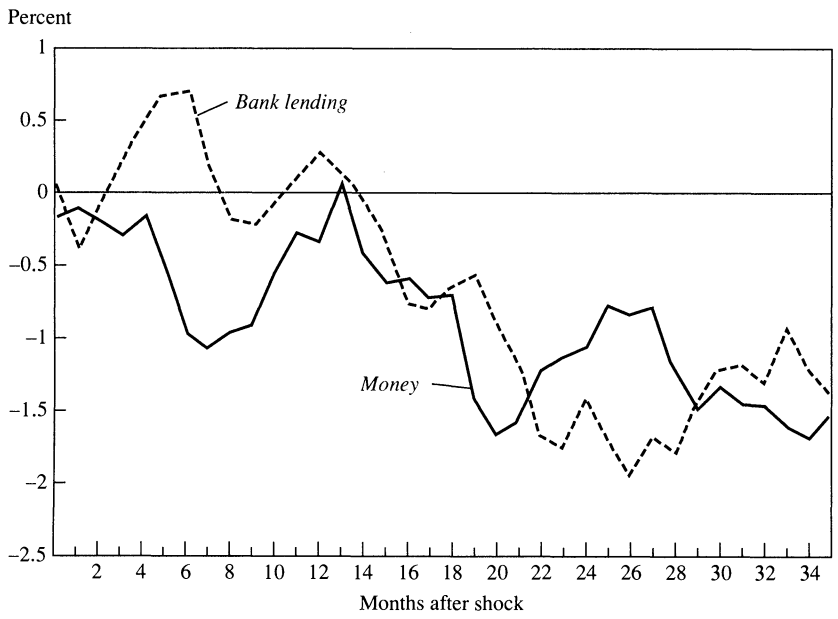
The results are presented in figure 5 and table 4. Considerable parts of the movement in both money and lending in the focal episodes appear to reflect just usual cyclical behavior. At 18 months, the average forecast errors for lending and money given the realized path of industrial production are just 0.6 percent and 0.7 percent, respectively; in contrast, the average errors not conditioning on output are 2.9 percent for lending and 1.9 percent for money (see table 1).

Normal cyclical fluctuations in lending are much larger than those in money. For example, the sum of the coefficients on the output variable is 0.50 in the forecasting equation for lending and 0.08 in the equation for money. As a result, the movements in lending in the focal episodes simply reflect usual cyclical behavior to a greater extent than do the movements in money. At most horizons, about three-quarters of the average forecast errors for lending shown in figure 1 reflect usual cyclical patterns; for money the corresponding figure is about a half. In addition, the conditional forecast errors are slightly more consistently negative for money than for lending. The conditional forecast errors for money are negative at nearly all horizons in three of the five episodes and negative in months 7–20 in a fourth. For lending, the errors are consistently negative in two episodes, generally negative for most of a third,

22. King and Plosser (1984); see also Tobin (1970) and Sims (1983).

23. We experimented with also conditioning on the actual path of inflation; this had little effect on the results. Excluding the leads of industrial production increased the magnitude of the forecast errors for money and had little impact on the errors for lending.

Figure 5. Average Forecast Errors for Money and Bank Lending Given the Actual Path of Industrial Production after Shifts to Anti-Inflationary Policy[a]



Source: See source note to figure 1.

a. Forecast errors in table 4 are converted to percent by multiplying figures by 100 and then averaged. October 1947 episode excluded.

and largely positive in the remaining two.[24] Thus, although the results are not sharply different for money and loans, they are slightly more suggestive of independent movements in money in the focal episodes than of independent movements in loans.

24. The behavior of money, lending, and interest rates in the 1966 credit crunch (see footnote 13) is similar to their behavior in the times of tight monetary policy that we focus on in this section. The unconditional and conditional forecast errors for both money and lending are consistently negative following the discount rate increase in December 1965. The three-month Treasury bill rate rises from 3.92 percent in September 1965 to 5.37 percent a year later. From December 1965 to June 1966, the federal funds–Treasury bill spread rises by 56 basis points, the commercial paper–Treasury bill spread by 74 points, and the BAA-AAA spread by 17 points. The yield differential between ten-year Treasury bonds and three-month Treasury bills is very low throughout the period and becomes negative in the last four months of 1966.

In addition, because the money stock data extend back before 1948, we can find forecast errors for money following the October 1947 policy shift. Both the conditional and unconditional errors are strongly negative.

Table 4. Conditional Behavior of Money and Bank Lending in Episodes of Anti-Inflationary Monetary Policy

Month after shock	*Date of shock*				
	September 1955	*December 1968*	*April 1974*	*August 1978*	*October 1979*
	Forecast error (cumulative) for log M-1, given path of industrial production[a]				
0	0.002	0.000	−0.001	0.000	−0.010
1	0.001	0.002	−0.000	0.005	−0.011
2	−0.002	0.002	−0.000	0.004	−0.013
3	−0.002	0.003	−0.001	0.003	−0.017
4	−0.002	0.004	−0.002	0.004	−0.012
5	−0.002	0.002	−0.001	0.001	−0.024
6	−0.002	0.000	0.001	0.001	−0.049
9	−0.003	−0.008	−0.001	−0.000	−0.033
12	−0.009	−0.007	−0.009	0.020	−0.012
15	−0.009	−0.007	−0.005	0.018	−0.028
18	−0.008	−0.009	−0.018	0.018	−0.017
21	−0.011	0.001	−0.025	−0.020	−0.024
24	−0.015	0.001	−0.024	0.011	−0.027
30	−0.026	0.013	−0.035	0.008	−0.028
35	−0.028	0.002	−0.029	0.003	−0.024
	Forecast error (cumulative) for log loans, given path of industrial production[b]				
0	−0.003	0.002	0.013	−0.002	−0.005
1	−0.003	−0.011	0.013	−0.000	−0.019
2	−0.003	−0.002	0.017	0.003	−0.019
3	−0.005	−0.006	0.031	0.006	−0.014
4	−0.005	−0.001	0.036	0.005	−0.008
5	−0.005	0.000	0.038	0.010	−0.009
6	0.005	0.004	0.038	0.008	−0.020
9	0.006	−0.027	0.045	0.013	−0.048
12	0.003	−0.018	0.033	0.028	−0.032
15	−0.009	−0.040	0.026	0.023	−0.016
18	−0.017	−0.032	0.014	0.037	−0.034
21	−0.012	−0.022	−0.001	0.014	−0.039
24	−0.018	−0.013	−0.022	0.013	−0.031
30	−0.018	−0.006	−0.039	0.031	−0.028
35	−0.018	−0.009	−0.053	0.019	−0.011

Source: See source note to table 1.

a. Forecast errors derived from equation 2 in text.

b. Forecast errors derived from

$$\Delta \ln L_t = a + bt + \sum_{i=1}^{24} c_i \Delta \ln L_{t-i} + \sum_{i=-12}^{12} d_i \Delta \ln Y_{t-i} + \sum_{i=1}^{11} k_i D_{it}.$$

Timing

We now turn to a more detailed examination of the relationships among money, lending, and output. We focus especially on the question of whether the strength and timing of the money-output and lending-output relationships are different in response to independent shifts in monetary policy than they are at other times.

Approach

To describe our basic approach, it is useful to consider regressions of output on money and on lending in the spirit of the "St. Louis equation":[25]

$$(3) \quad \Delta \ln Y_t = a + bt + \sum_{i=1}^{24} c_i \Delta \ln Y_{t-i} + \sum_{i=0}^{24} d_i \Delta \ln M_{t-i} + \sum_{i=1}^{11} k_i D_{it},$$

$$(4) \quad \Delta \ln Y_t = a + bt + \sum_{i=1}^{24} c_i \Delta \ln Y_{t-i} + \sum_{i=0}^{24} d_i \Delta \ln L_{t-i} + \sum_{i=1}^{11} k_i D_{it},$$

where L is lending and the other variables are the same as in equation 2. As is well known, estimating an equation like equation 3 or 4 by ordinary least squares is not appropriate: because movements in money and lending are in considerable part endogenous, the estimated d_i's will be biased estimates of the impacts of money and lending on output.

Our episodes of anti-inflationary policy represent periods in which shifts in monetary policy occurred primarily in response to the level of inflation and largely independently of other economic developments. Thus, loosely speaking, shifts in monetary policy are the only systematic force in the focal episodes acting to change the money supply and lending. It is therefore natural to estimate equations 3 and 4 not by OLS but by two-stage least squares, instrumenting for the financial variables with a dummy variable for shifts in policy. Our instruments (in addition to the other right-hand-side variables in the equations) are the current and 36 lagged values of a dummy that is equal to one on each of the six dates on which we identify shifts to anti-inflationary policy. The lags are included because the dates represent the beginnings of episodes of anti-

25. Andersen and Jordan (1968).

inflationary policy; thus the shifts in policy are likely to affect money and lending over considerable periods.

To interpret this instrumental variables procedure, it is easiest to consider the case in which the lagged output variables are omitted from the equation. Because the constant, trend, and monthly dummies are included both in the instrument list and on the right-hand side of the equation, this procedure is equivalent to first demeaning, detrending, and seasonally adjusting the output, money (or lending), and dummy variables, and then regressing the resulting adjusted output series on the adjusted money or lending series by two-stage least squares, instrumenting with the adjusted dummy. The fitted values of the first-stage regression thus represent the average movements in the (adjusted) money or lending series relative to normal in the focal episodes. Thus, the two-stage least squares estimates summarize the relationship between output movements in the focal episodes and the average departures of money or lending from its usual behavior in the episodes.[26]

Under certain conditions, the two-stage least squares estimates from equation 3 provide consistent estimates of the impact of money on output. Specifically, this will be the case if we have been successful in identifying shifts in monetary policy prompted by concern about the level of inflation rather than current economic developments, if inflation does not directly affect the path of real output, *and* if monetary policy is transmitted to the real economy entirely through the money stock. Under these conditions, the movements in money in the focal episodes would be exogenous, and the movements in money would be the only source of systematic movements in output in these periods. However, although we are willing to assume that the first two of the needed conditions are (at least approximately) satisfied, we do not wish to assume the third: we wish to allow for the possibility that monetary policy affects output not only through money but also through lending. The two-stage least squares estimates of the d_i's therefore do not necessarily provide consistent estimates of the impact of independent movements in money on output. For example, in the extreme case in which monetary policy

26. When the lagged output variables are included in the regression (and the instrument list), another variable is being partialled out, and the interpretation of the regression is therefore more complex. The inclusion of the lagged output variables, however, is not important to our results: when the equations reported below are reestimated excluding the lagged output variables, the results are little changed.

affected output only through lending (and in which output had some effect on money), both output and money would fall in the episodes, and thus the two-stage least squares estimates of the d_i's would be positive even though monetary policy did not operate through its impact on the money stock. Similar comments apply to using instrumental variables estimates of equation 4 to estimate the impact of lending on output.

In light of this difficulty, we focus on *comparisons* of OLS and IV estimates of equations 3 and 4. The OLS estimates summarize the usual money-output and lending-output associations. And, as just described, the IV estimates summarize the relationship between the movements in output and the average movements of money and lending relative to usual in the episodes. We concentrate on two aspects of the differences between the OLS and IV estimates. The first is the relative strength of the estimated relationship between money (or lending) and output. Monetary policy is almost surely a relatively more important source of output fluctuations in the focal episodes than at other times. If this is the case and if the money-output association primarily reflects an effect operating from money to output—that is, if money plays an important independent role in the transmission mechanism—the additional independent movements in money in the focal episodes would cause the IV estimates to imply a stronger effect of money on output than the OLS estimates. If, on the other hand, monetary policy affects output through channels other than the money stock, and if the money-output relationship simply reflects an effect of output on money both in and out of the focal episodes, there is no reason to expect the IV estimates of the relationship to be any stronger than the OLS estimates. Again, a similar discussion applies to the relative strength of the OLS and IV estimates of the lending-output relationship.

The second feature of the OLS versus IV results that we focus on involves the time pattern of the estimated links. Both the money view and lending view of the transmission mechanism plausibly imply that the relevant financial aggregate will lead real activity. Because much borrowing is done to finance investment projects that are not completed instantaneously, if contractionary monetary policy reduces aggregate demand by restricting the availability of bank loans, one would expect declines in bank lending to precede declines in real output. Similarly, traditional monetary views of the transmission mechanism suggest that, because consumers and investors respond with a lag to changes in

interest rates and producers respond with a lag to changes in spending, changes in money will lead changes in output. Thus, for example, a finding that the IV estimates implied a lagged relationship between the relevant financial aggregate and real output would be supportive of a view of the transmission mechanism that assigned an important role to that aggregate. This support would be strengthened if the OLS estimates implied a weaker lagged relationship: the failure of the OLS estimates to detect the same relationship would mean that the aggregate did not lead output (or led it less strongly) in times not dominated by independent shifts in monetary policy, and would thus cast doubt on theories that explained the timing of the relationship as arising from a general pattern of the aggregate responding to anticipated output movements rather than from an independent causal role for the aggregate.

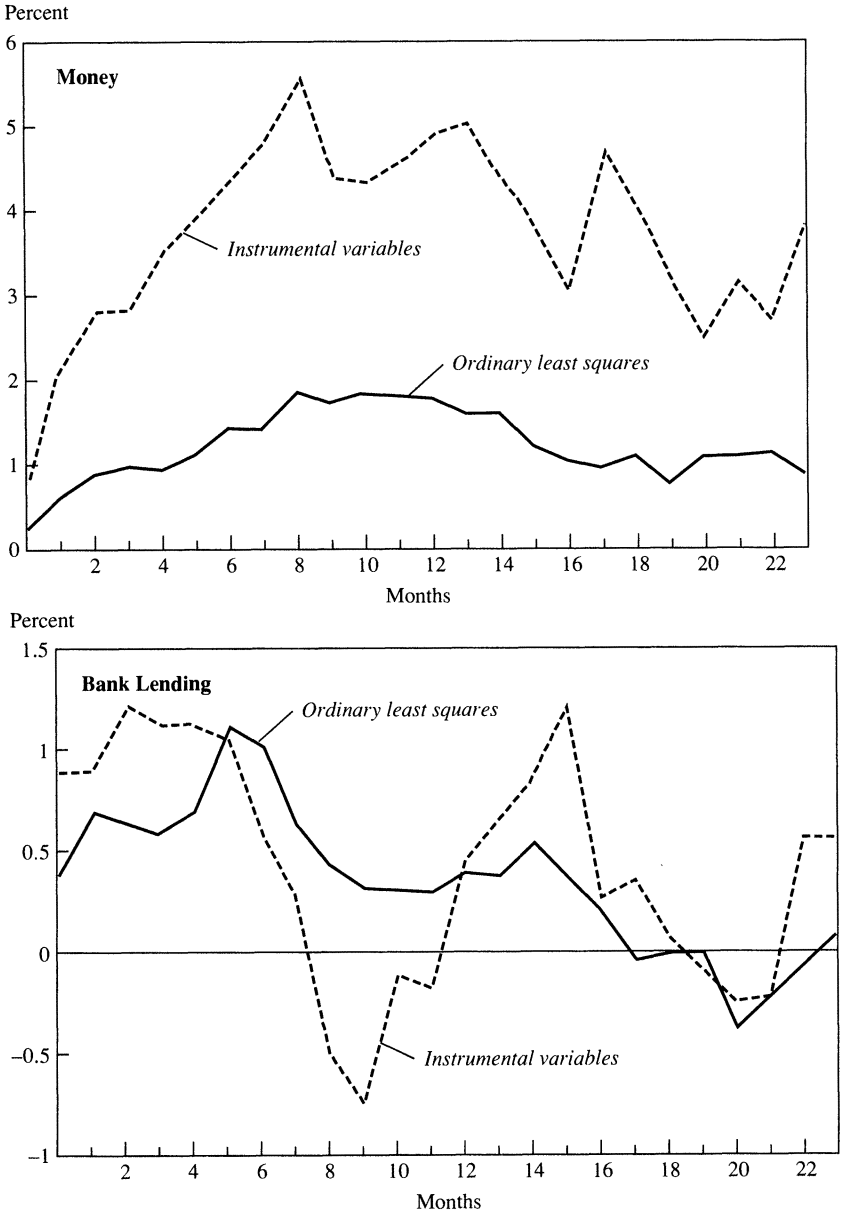
As should be clear from this discussion, the interpretation of the results cannot be airtight: the identification of independent shifts in monetary policy is not enough to provide a definitive identification of the transmission mechanism. The best that one can do is establish that the data appear supportive of some commonly held views of the transmission mechanism and not supportive of others, and ask whether there are plausible modifications of the views that are not supported that can make them consistent with the evidence. For this reason, after presenting our results and our preferred interpretation of them, we consider some alternative candidate explanations.

Basic Results

Figure 6 presents the results of the OLS and IV estimation of equations 3 and 4. The top panel shows the dynamic responses of output to money implied by the OLS and IV estimates of the money-output regressions. The bottom panel shows the analogous estimates of the responses of output to lending.[27] For money, both the OLS and IV regressions imply considerable lags in the money-output relationship. In both, the coefficients on the contemporaneous and first eight lags of the money variable are all either positive or trivially negative, and the sums of these

27. The period zero response of Y to M is just d_0, the contemporaneous effect of $\triangle M$ on $\triangle Y$ from equation 3. The period 1 response is $(c_1 d_0 + d_1) + d_0$, the period 1 effect on $\triangle Y$ plus the period zero effect. And so on. The sample period for both regressions is January 1950–December 1986.

Figure 6. Ordinary Least Squares and Instrumental Variables Estimates of the Impacts of Money and Bank Lending on Industrial Production



Source: Authors' calculations using the money and lending data described in the source note to figure 1.

coefficients are highly statistically significant. For both sets of estimates, the implied impacts of money on output peak after eight months and then decline slowly. Even two years after the shock, only about half of the maximum effect on real output has been undone. Perhaps more important, the effects implied by the IV regression are much larger than those implied by the OLS equation; at most horizons the response function computed using the IV estimates is about four times as large as that obtained using the OLS estimates.

These results are generally supportive of an independent role for money in the transmission mechanism: money leads output, and the money-output link is stronger than usual in response to independent shifts in monetary policy. One minor difficulty is that the implied lag in the money-output relationship is no longer using the IV estimates that it is under OLS. As described below, however, our finding of any discernible relationship between output and lagged money for the full sample is due almost entirely to the portion of movements in money associated with the policy shifts. An additional limitation of the results is that although the point estimates of the impact of money on output are larger under instrumental variables, the IV estimates are quite imprecise. As a result, it is difficult to reject the hypothesis that the OLS and IV estimates are equal. Focusing on sums of coefficients on the monetary variables, the null that the two estimates are equal is marginally rejected when one considers horizons of approximately six months (that is, when one examines the sums of the contemporaneous and first six or so lag coefficients on the money variable), but cannot be rejected at other horizons.[28]

For lending, the OLS estimates imply relatively rapid responses of output to bank lending. The estimated impact of loans on industrial production essentially reaches its peak after five months and returns to zero after seventeen. In the IV regression, the estimated effect of lending on output is virtually instantaneous. The contemporaneous effect of lending on output is three quarters of the maximum effect; the maximum itself comes after just two months. After eight months the estimated impact of lending on output fluctuates irregularly around zero. The size

28. Under the null that the OLS and IV estimates are equal, the OLS estimates are efficient. Thus the variance of the difference between the two estimates is just the difference of the variances. (That is, the standard error of the difference is the square root of the difference of the squares of the standard errors.) See Hausman (1978).

of the estimated effect of lending on output is no larger under IV than under OLS. The absence of any significant lags in the lending-output link and of any important differences in the strength and timing of the relationships estimated by IV and by OLS is not supportive of an important independent role for lending in the transmission mechanism. Again, however, the IV estimates are very imprecise; no null hypothesis of interest about the coefficients themselves or the differences between the IV and OLS coefficients can be rejected.

Table 5 presents some simple regressions that reveal the essential source of the results shown in figure 6. We regress the change in log output on current and lagged values of the change in log money (or log lending) separately within and outside of our focal episodes. To simplify the presentation, the regressions are estimated using quarterly data (where the figure for the final month of the quarter is used as the value for the quarter). In addition, so that the R^2's can be interpreted as the explanatory power of money (or lending) for output, we first regress the change in the log of each of industrial production, money, and bank lending on a constant, trend, and seasonal dummies, and then estimate the money-output and lending-output relationships using the resulting residuals.

The regressions estimated inside and outside the focal episodes correspond roughly to the IV and OLS regressions estimated above. The within-episode regressions differ from the IV regressions underlying figure 6 by treating all of the movements in money and lending in the focal episodes, rather than just the average movements, as independent, and by not relying on the average difference between money's (and lending's) behavior in and out of the focal episodes to estimate the money-output (and the lending-output) link. And the regressions estimated outside the episodes differ from the full-sample OLS regressions simply by placing no weight on the behavior of money, lending, and output in the periods of large independent shifts in policy.

The results of this comparison are very similar to those of the IV versus OLS comparison. First, both in and out of the focal episodes there is no lag at all in the link between lending and output. In fact, the coefficients on the lagged lending variables are consistently negative. Second, while the lending-output relationship is little different in times of large independent shifts in monetary policy than it is at other times, the money-output relationship changes dramatically. The results show

Table 5. Regressions of Industrial Production on Money and Lending[a]

Quarterly lag of money or lending	*Full sample*	*Anti-inflationary episodes, 1–12 quarters after shocks*	*Outside focal episodes*	*Anti-inflationary episodes, 3–10 quarters after shocks*	*Outside focal episodes*
			Money		
0	0.72	1.48	0.50	1.49	0.33
	(0.30)	(0.46)	(0.44)	(0.51)	(0.42)
1	0.71	1.39	0.23	1.28	0.61
	(0.33)	(0.44)	(0.50)	(0.54)	(0.48)
2	0.52	1.39	−0.12	1.24	0.31
	(0.33)	(0.46)	(0.50)	(0.60)	(0.46)
3	0.33	0.74	0.45	0.77	0.34
	(0.33)	(0.48)	(0.46)	(0.58)	(0.45)
Summary statistic					
R^2	0.13	0.32	0.04	0.25	0.07
Durbin-Watson	1.60	1.64	1.75	1.69	1.82
Standard error of estimate	0.030	0.030	0.028	0.030	0.031
			Lending		
0	1.01	1.04	0.85	0.76	1.02
	(0.14)	(0.21)	(0.21)	(0.30)	(0.17)
1	−0.06	−0.06	−0.08	−0.12	−0.10
	(0.14)	(0.21)	(0.20)	(0.27)	(0.18)
2	−0.51	−0.55	−0.48	−0.36	−0.64
	(0.14)	(0.22)	(0.18)	(0.26)	(0.17)
3	−0.22	−0.28	−0.24	−0.33	−0.19
	(0.14)	(0.23)	(0.19)	(0.26)	(0.17)
Summary statistic					
R^2	0.31	0.36	0.24	0.26	0.32
Durbin-Watson	1.91	1.72	2.04	2.01	2.09
Standard error of estimate	0.027	0.029	0.025	0.030	0.026

Source: See source note to table 1.

a. Regressions are estimated using quarterly data equal to the figure for the final month of the quarter and using seasonally adjusted and detrended changes in logs of the series. The change in log output is regressed on current and lagged values of the change in log money or log lending separately within and outside the focal episodes. Figures in parentheses are standard errors. Coefficients and standard errors for constant terms not reported.

that the relationship between money and output, particularly the link between lagged money and output, is to a large extent a phenomenon solely of the episodes of anti-inflationary policy. Defining the episodes as consisting of the first twelve quarters after the policy shifts, the R^2 of the regression of the change in log industrial production on the current and three lagged values of the change in log money estimated in the

episodes is 0.32. The coefficients on the lagged money variables are all large, and the *F*-statistic for the null hypothesis that the lags do not enter is 6.61, which is significant at better than the 0.1 percent level. Outside the episodes, in contrast, the R^2 of the regression is 0.04, and the *F*-statistic for a test of the hypothesis that the coefficients on the three lagged money variables are zero is just 0.44, which is highly insignificant. Thus the fact that we detect some lagged impact of money on output in the full sample OLS estimates summarized in figure 6 appears to rest entirely on the large estimated effect from that component of movements in money associated with the independent shifts in policy. Finally, the table shows that when the episodes are defined more narrowly as ranging from three to ten quarters after the shifts—which is the time period over which we found in our previous paper that output fell in response to the shifts—the results, though less dramatic, are qualitatively similar to those obtained with the broader definition.[29]

Robustness

We examine the robustness of our results in three ways. The first concerns the selection of shocks and the sample period. Focusing on only six episodes raises the possibility that a single highly unusual episode could be driving our results. To address this possibility, we examine the impact on the IV estimates of the money-output and lending-output relationships of dropping each of the shocks in turn. That is, we first reestimate the two-stage least squares regressions using the current and lagged values of a dummy equal to one on the date of each of the policy shifts except October 1947; we then reestimate the regressions employing a dummy equal to one on each of the dates except September 1955; and so on. We find that the results are quite robust to dropping individual episodes. For example, when October 1979—which is prob-

29. Our results concerning the timing patterns of the money-output and lending-output relationships are consistent with what other researchers, using entirely different approaches, have found. King (1986), using Granger causality tests and vector autoregressions, finds that bank lending has little predictive power for real activity. And Bernanke and Blinder (1989) find that money responds more rapidly than lending to shifts in the federal funds rate, which they use as an indicator of shifts in monetary policy. Bernanke and Blinder also find that the declines in lending occur contemporaneously with falls in output in response to changes in the federal funds rate, while the falls in money occur earlier.

ably the most dramatic policy shift—is excluded from the construction of the dummy, the estimated maximum effect on industrial production of a 1 percent change in money falls from 5.6 percent to 4.7 percent, which is still well above the maximum effect of 1.9 percent obtained using OLS, and the estimated maximum impact of a 1 percent change in lending is unchanged at 1.2 percent.

Similarly, because traditional money-output and credit-output relationships broke down after the Federal Reserve's changes in operating procedures in October 1979, the fact that our sample extends past 1979 appears to have the potential to cloud the results.[30] We therefore consider the effects of stopping the sample in September 1979. Again we find that the results are little changed.

The second way in which we investigate the robustness of the results focuses on the coverage of the lending data. Theories of credit market imperfections arising from asymmetric information apply most plausibly to loans to businesses. It is for these loans that banks' informational ties to their customers are strongest. The apparent ease with which lenders resell other types of loans (notably mortgages) suggests that lender-customer relationships do not always provide large informational advantages. Thus one possible objection to our results is that our measure of lending is excessively broad.

To investigate this issue, we examine the behavior of bank loans *to businesses* in and out of our focal episodes. Data on commercial and industrial lending by commercial banks are available since 1959. The behavior of this series is in fact very similar to that of total loans; thus it does not appear that noncommercial loans are masking clear differences between times of tight money and other times in the link between business loans and real output. Regressions like those in table 5 estimated using commercial and industrial loans rather than total loans yield results very similar to the lending regressions reported there: there is a contemporaneous link between growth of business lending and growth of real output, but the lagged association is negative, and the relationship is essentially the same in times of restrictive monetary policy as it is at other times. Thus there is no evidence that our use of a broad measure of bank lending is important to our results.

The final way in which we examine the robustness of our results

30. For an account of the breakdown of the traditional relationships, see Friedman (1988).

focuses on loan commitments. In many cases, banks provide lending commitments before actually providing the loans themselves. Thus one possible explanation of our finding of essentially only a contemporaneous correlation between output and lending is that loan commitments precede output movements (either in general or in times of independent shifts in monetary policy) but that the borrowers only take down the loans as they produce.

From January 1975 through June 1987 the Federal Reserve kept data on unused loan commitments by large commercial banks to commercial and industrial firms, and on loans made under those commitments.[31] For this period it is therefore possible to investigate the relationships between commitments and lending and between commitments and output. Table 6 shows some regressions investigating this issue. The first column shows that for the full sample, controlling for the past behavior of loans, unused commitments have virtually no predictive power for loans made under commitments. Indeed, the point estimates suggest a slight negative relationship. Because the quantity of unused commitments can rise either because of an increase in new commitments or a fall in the quantity of loans taken out under existing commitments, this result may not be surprising. But the second and third columns show that this result obtains even in our focal episodes. Thus the absence of any lag in the relationship between lending and output in times of independent shifts in monetary policy does not reflect simply a delayed response of actual lending to loan commitments.

The remaining columns of table 6 examine the relationship between unused commitments and subsequent movements in real output. Consistent with our findings about the commitment-lending relationship and the lending-output relationship, we find that both in general and in times of restrictive monetary policy, changes in commitments do not lead changes in output.[32]

31. The data are from the Board of Governors' monthly G.21 release. The data were often revised and there were several changes in the coverage of the series, and the Federal Reserve did not revise the historical data. To construct reasonably consistent series we therefore splice together the series presented in various G.21 releases, adjusting for any inconsistencies noted on the releases. A detailed description of how we constructed the series, together with the series themselves, is available on request.

32. In addition, in our earlier paper we investigate whether our finding that the shifts in policy lead to sharp declines in output relative to usual is robust to the inclusion of various measures of fiscal policy and supply shocks. We find no systematic patterns in the behavior of these variables in the episodes.

Table 6. Regressions Using Loan Commitment Data[a]

Monthly lag of loan commitments	*Regressions of lending on loan commitments*[b]			*Regressions of industrial production on loan commitments*[c]		
	Full sample	*1–36 months after shocks*	*7–30 months after shocks*	*Full sample*	*1–36 months after shocks*	*7–30 months after shocks*
0	−0.145	−0.186	−0.022	−0.133	−0.044	0.061
	(0.116)	(0.148)	(0.176)	(0.185)	(0.250)	(0.303)
1	−0.069	0.048	−0.104	0.081	0.162	0.059
	(0.118)	(0.147)	(0.178)	(0.192)	(0.252)	(0.321)
2	−0.036	−0.171	−0.271	−0.071	−0.160	−0.207
	(0.118)	(0.147)	(0.184)	(0.191)	(0.245)	(0.323)
3	−0.028	−0.046	−0.075	−0.144	−0.049	−0.029
	(0.117)	(0.145)	(0.191)	(0.191)	(0.249)	(0.334)
4	0.266	0.292	0.290	−0.344	−0.488	−0.566
	(0.116)	(0.145)	(0.199)	(0.190)	(0.262)	(0.351)
5	0.009	−0.126	−0.100	0.152	0.013	0.118
	(0.118)	(0.154)	(0.203)	(0.190)	(0.271)	(0.347)
6	0.064	0.164	0.117	−0.010	0.070	−0.004
	(0.114)	(0.140)	(0.184)	(0.183)	(0.237)	(0.323)
Summary statistic						
R^2	0.20	0.30	0.31	0.05	0.08	0.09
Durbin-Watson	1.91	1.95	2.00	2.51	2.35	2.32
Standard error of estimate	0.015	0.014	0.015	0.026	0.027	0.029

Source: Loan commitment data are from Federal Reserve Board of Governors' monthly G.21 release. Data are available from January 1975 through June 1987. Also see footnote 31 for details.

a. Figures in parentheses are standard errors. Coefficients and standard errors for constant terms not reported. Regressions are estimated using seasonally adjusted and detrended changes in logs of the series. The lending regressions also include six lags of the dependent variable.

b. Sample period is January 1975–December 1986.

c. Sample period is January 1975–June 1987.

Candidate Interpretations

The simplest interpretation of our results is that money plays an independent role in the transmission mechanism but lending does not. That money leads output in response to independent shifts in monetary policy but not at other times is consistent with an independent role of money in the transmission mechanism and does not support theories that explain the money-output correlation as the result of an impact of output on money. More generally, that it is sometimes difficult to find a clear relationship between money and output suggests that a combination of the impact of output on money and endogenous shifts in monetary policy causes there to be no simple link between money and output in

periods not dominated by independent shifts in money supply. Our findings also suggest that simply regressing output on money leads to a large underestimate of money's real effects.[33]

With regard to lending, the findings that there is no noticeable lag in the lending-output link, that the relationship is essentially the same in response to independent shifts in monetary policy as it is in general, and that lending commitments have no important predictive power for lending or output are all consistent with the view that lending is driven primarily by output. At the same time, given the obvious lags in the investment process and the obvious differences between the focal episodes and other periods, these findings appear difficult to reconcile with a central role of lending in the transmission mechanism.

There are three important caveats to this interpretation of the results. First, our estimates are imprecise: in a volatile economy, six episodes are not enough to pin down the effects of monetary policy with a high degree of confidence. Thus, although we find the point estimates supportive of the money view of the transmission mechanism and not supportive of the lending view, it is possible that sampling error has an important impact on the results.

Second, although the results tend not to support a natural version of the lending hypothesis, one can construct more extreme versions of the theory that are consistent with our results. One could argue, for example, that monetary policy affects the money stock but that money does not in turn affect output, and that lending is a critical and proximate determinant of output at all times. In this case one would not expect the lending-output relationship to involve lags or to be different in and out of the focal episodes. While no statistical procedure can definitively untangle channels of causation, our view is that this interpretation is simply not plausible. In our theoretical model, the condition for money to play no role in the transmission mechanism is that it be a close substitute for other assets. This would lead one to expect the behavior of money to be highly unstable in response to shifts in monetary policy, not that money would move in a way that was strongly associated with subsequent movements in real output. The suggestion that lending is

33. Our finding for the postwar period that there is a clear and strong relationship between money and output in times of large monetary disturbances and no simple relationship at other times is precisely the conclusion that Friedman and Schwartz (1963) reach concerning the period before World War II.

central to all output fluctuations is difficult to maintain seriously given the prominence of fiscal policy and supply shocks in various parts of our sample period. And some further modification of the theory would be needed to account for our results concerning loan commitments. Thus, although it is possible to reconcile our results with a view of the transmission mechanism that assigns a central place to lending, it appears difficult to do so plausibly.

Third, the scope of our results is limited. As emphasized at the outset, we are addressing not the general question of whether credit market imperfections are important in the impact of monetary policy, but the narrower question of whether a direct impact of monetary policy on bank lending is important in the transmission mechanism. Nor are we testing whether bank loans are special; one view that is entirely consistent with the results reported thus far is that banks have an advantage in making certain types of loans, but that the availability of alternative sources of funds with low cost in terms of reserves causes monetary policy to have little direct impact on bank lending. If this view is correct, then direct shocks to banks' ability to lend—such as the financial collapse that Bernanke argues was important in the Great Depression—would have important real consequences.[34] For the transmission of changes in monetary policy, however, the general effect of the quantity of reserves on economywide interest rates would be more important.

Indeed, there is a view of the transmission mechanism that is consistent with our results—particularly our finding of no lag between changes in banks' lending activities and changes in real output—in which credit market imperfections, in addition to money, play a central role. Albert Wojnilower and Otto Eckstein and Allen Sinai argue that "credit crunches"—sudden interruptions of credit flows—are a central feature of postwar downturns.[35] And these authors assign an important role to high interest rates in triggering the crunches; Eckstein and Sinai, for example, emphasize the strains on firms' balance sheets and liquidity positions caused by high interest rates. Thus, one possible view of the transmission mechanism is that tight monetary policy first causes the general level of interest rates to rise to clear the market for transactions balances, and that the higher rates then lead, with some lag, to a credit

34. Bernanke (1983).
35. Wojnilower (1980); Eckstein and Sinai (1986).

crunch. When the crunch occurs, the impact on firms' financial positions is so dramatic that it causes a sharp and immediate decline in loan commitments, loans, and spending. Whether the crunch falls particularly on bank lending rather than other credit flows would depend on whether the imperfections that gave rise to the crunch (rather than simply to higher interest rates) were more important for bank loans than for other sources of credit. In any event, the initial impact of monetary policy on interest rates, according to this view, would stem from its effect on the quantity of transactions balances.

Interest Rate Differentials

We conclude this section by briefly investigating the timing and strength of the links between various interest rate spreads and real output within and outside the focal episodes. As in the previous section, our purpose in examining spreads is not to shed light on the money and lending views of the transmission mechanism but simply to investigate "stylized facts" about the impact of monetary policy. We are especially interested in the questions of whether conventional views about the impact of monetary policy on yield differentials are confirmed by the behavior of the differentials in our focal episodes and of whether general associations between rate spreads and real activity reflect the influence of monetary policy.

Table 7 presents regressions of changes in log industrial production on various interest rate differentials analogous to table 5's regressions with money and bank lending.[36] The table shows that there are indeed systematic connections between movements in yield spreads and changes in real output in times of restrictive monetary policy. Increases in the federal funds–Treasury bill and the commercial paper–Treasury bill differentials and decreases in the spread between long-term and short-term bond rates are associated with declines in output after one to two quarters. The spread between BAA and AAA bonds also moves with real output, though in this case the association is largely contemporaneous.

36. We include four lags of the right-hand-side variable in the regressions in table 7 rather than the three included in table 5 simply because the movements in interest rate differentials appear more rapid than the movements in the quantity variables. Inclusion of the additional lag has little impact on the results.

The results also show that the associations between rate spreads and real output are present in weaker forms outside the focal episodes. The lagged associations between the federal funds–Treasury bill and commercial paper–Treasury bill differentials are briefer and less pronounced; the link between the yield curve and output is essentially nonexistent; and the correlation of output movements with the spreads between low- and high-grade corporate bond yields is considerably weaker.

These results largely confirm conventional views about the impact of monetary policy on yield differentials. In addition, they suggest that previous findings that interest rate spreads have predictive power for real activity occur at least in part because the spreads reflect shifts in monetary policy. James Stock and Mark Watson, for example, find that the commercial paper–Treasury bill spread is the single most important variable in their index of leading indicators.[37] In light of the results in table 7 and our earlier finding that this spread appears to respond extremely rapidly to shifts in monetary policy, Stock and Watson's finding is not surprising. Similarly, Stock and Watson find that the yield spread between ten-year and one-year U.S. government bonds also serves as a leading indicator, and Bernanke and Blinder find that the federal funds rate outperforms a variety of other interest rates as a predictor of real economic activity. Our results show that both variables reflect shifts in monetary policy.[38]

The Individual Episodes

Our analysis thus far has summarized the average patterns in our focal episodes with little attention to differences across the episodes. In this section we examine some of the evidence provided by the individual episodes. We do this in two ways. First, we compare the statistical evidence about the relationships between money and output and between lending and output from the earlier and later episodes in light of the differences in the structure of financial markets in the two sets of

37. Stock and Watson (1989). See also Friedman and Kuttner (1989).

38. Stock and Watson (1989); Bernanke and Blinder (1989). Bernanke and Blinder provide indirect evidence that the superior predictive power of the federal funds rate stems from its responsiveness to monetary policy. And Cook and Hahn (1989), using daily data, show that the immediate effect of shifts in monetary policy on the federal funds rate is larger than their impact on Treasury bill and Treasury bond rates.

Table 7. Regressions of Industrial Production on Interest Rate Differentials[a]

Quarterly lag of interest rate differential	*Full sample*	*Anti-inflationary episodes, 1–12 quarters after shocks*	*Outside focal episodes*	*Anti-inflationary episodes, 3–10 quarters after shocks*	*Outside focal episodes*
	Federal funds rate minus three-month Treasury bill rate				
0	0.0011	0.0049	−0.0035	0.0051	0.0005
	(0.0036)	(0.0050)	(0.0054)	(0.0064)	(0.0047)
1	−0.0126	−0.0101	−0.0150	−0.0051	−0.0210
	(0.0040)	(0.0050)	(0.0077)	(0.0061)	(0.0058)
2	−0.0113	−0.0173	0.0038	−0.0152	−0.0064
	(0.0041)	(0.0052)	(0.0074)	(0.0065)	(0.0059)
3	0.0037	0.0038	0.0023	0.0019	0.0088
	(0.0040)	(0.0050)	(0.0072)	(0.0056)	(0.0067)
4	0.0012	0.0011	0.0141	0.0055	0.0042
	(0.0036)	(0.0046)	(0.0067)	(0.0053)	(0.0061)
Summary statistic					
R^2	0.24	0.36	0.19	0.21	0.27
Durbin-Watson	1.80	1.55	2.01	1.42	2.00
Standard error of estimate	0.025	0.026	0.022	0.027	0.023
	Ten-year Treasury bond rate minus three-month Treasury bill rate				
0	−0.0082	−0.0104	−0.0012	−0.0103	−0.0029
	(0.0029)	(0.0037)	(0.0056)	(0.0036)	(0.0049)
1	0.0086	0.0107	0.0018	0.0117	−0.0001
	(0.0035)	(0.0043)	(0.0077)	(0.0041)	(0.0065)
2	0.0038	0.0027	0.0057	0.0005	0.0105
	(0.0033)	(0.0042)	(0.0063)	(0.0040)	(0.0060)
3	0.0040	0.0072	−0.0012	0.0055	−0.0005
	(0.0035)	(0.0046)	(0.0059)	(0.0045)	(0.0056)
4	0.0010	−0.0002	−0.0010	−0.0007	0.0012
	(0.0029)	(0.0040)	(0.0048)	(0.0040)	(0.0045)
Summary statistic					
R^2	0.20	0.31	0.04	0.34	0.10
Durbin-Watson	1.76	1.57	1.78	1.41	1.70
Standard error of estimate	0.026	0.028	0.024	0.025	0.026
	Six-month commercial paper rate minus three-month Treasury bill rate				
0	−0.0098	−0.0137	−0.0086	−0.0227	−0.0092
	(0.0053)	(0.0087)	(0.0068)	(0.0146)	(0.0054)
1	−0.0284	−0.0193	−0.0319	−0.0276	−0.0288
	(0.0059)	(0.0093)	(0.0086)	(0.0158)	(0.0061)
2	−0.0018	−0.0137	0.0080	0.0134	−0.0027
	(0.0059)	(0.0098)	(0.0075)	(0.0145)	(0.0063)

Table 7 ***(continued)***

Quarterly lag of interest rate differential	*Full sample*	*Anti-inflationary episodes, 1–12 quarters after shocks*	*Outside focal episodes*	*Anti-inflationary episodes, 3–10 quarters after shocks*	*Outside focal episodes*
3	0.0047	0.0063	0.0075	−0.0120	0.0142
	(0.0059)	(0.0097)	(0.0075)	(0.0123)	(0.0071)
4	0.0077	0.0042	0.0126	0.0148	0.0083
	(0.0053)	(0.0083)	(0.0072)	(0.0091)	(0.0068)
Summary statistic					
R^2	0.26	0.32	0.24	0.30	0.31
Durbin-Watson	1.72	1.54	1.93	1.49	1.89
Standard error of estimate	0.027	0.030	0.024	0.029	0.025
	Moody's BAA corporate bond rate minus AAA rate				
0	−0.0644	−0.0755	−0.0405	−0.0549	−0.0639
	(0.0122)	(0.0161)	(0.0238)	(0.0201)	(0.0173)
1	0.0145	0.0193	0.0092	0.0200	0.0092
	(0.0160)	(0.0199)	(0.0317)	(0.0230)	(0.0249)
2	0.0182	0.0360	−0.0119	0.0317	0.0057
	(0.0159)	(0.0209)	(0.0280)	(0.0228)	(0.0244)
3	0.0250	0.0265	0.0238	0.0231	0.0334
	(0.0160)	(0.0216)	(0.0255)	(0.0248)	(0.0229)
4	0.0014	−0.0132	0.0201	−0.0172	0.0103
	(0.0012)	(0.0175)	(0.0186)	(0.0212)	(0.0160)
Summary statistic					
R^2	0.22	0.34	0.11	0.24	0.20
Durbin-Watson	1.80	1.60	1.82	1.62	1.83
Standard error of estimate	0.028	0.029	0.026	0.030	0.027

Source: Author's calculations using interest rate data from Citibase.

a. Figures in parentheses are standard errors. Coefficients and standard errors for constant terms not reported. Regressions are estimated using seasonally adjusted and detrended data; the industrial production variable is the change in the log of the series.

episodes. Second, we briefly describe some qualitative evidence about banks' behavior in the focal episodes and the implications of that evidence for the issue of whether bank loans are special.

Early and Late Episodes

Because broad deregulation of interest payments on transactions deposits did not occur until the 1980s, after the last of our focal episodes,

the most important institutional differences among our episodes involve banks' ability to turn to alternative sources of funds. Certificates of deposit did not exist before the 1960s. Thus in the episodes beginning in October 1947 and September 1955, banks had no ready alternative source of funds to transactions deposits. By the time of the December 1968 policy shift, the market for CDs was well established. But CDs were subject to interest rate ceilings, and the ceilings were binding during much of 1969. Banks' attempts to turn to alternative sources of funds, such as the Eurodollar market, were limited by the Federal Reserve. Thus the first two of our episodes, and to some extent the third, are best described as ones in which banks did not have access to alternative sources of funds. In light of the simple theoretical analysis presented earlier in the paper, one might therefore expect the lending-output and money-output relationships in these episodes to be different from those in the later ones. Specifically, because banks could not mitigate any direct impact of tighter policy on lending by turning to sources of funds with low cost in terms of reserves, one might expect lending to be linked more clearly to output movements in the early episodes than to those in the later ones.

With only six episodes altogether (one of which begins before the lending data become available), one should not expect to distinguish differences in the time patterns and correlations of the movements in money, lending, and output with any precision. Nonetheless, tables 1 and 4 provide some modest evidence of differences in the behavior of lending between the earlier and later episodes.[39] Table 1 shows that in the two early episodes for which lending data are available, the falls in lending relative to its forecasted path occur essentially immediately after the policy shift rather than with a lag, a pattern that occurs only in one of the three later episodes. In the early but not the late episodes, in other words, lending leads output. Similarly, table 4 shows that in the two early episodes lending is below the path one would have expected given the actual behavior of output; again this is not the case in two of the three later episodes. Thus the data from the individual episodes are at

39. Note that despite the fact that in our simple theoretical model, movements in money and in lending are perfectly tied together when CDs are not available, in practice, because of excess reserves, security holdings, and so on, money and lending need not move precisely together in the early episodes. Thus there is scope for attempting to distinguish between the lending-output and money-output relationships in these episodes.

least consistent with the view that when alternative sources of funds are easily available, movements in lending are driven by movements in output, while when alternative sources of funds are unavailable, there are independent movements in lending in times of restrictive monetary policy.

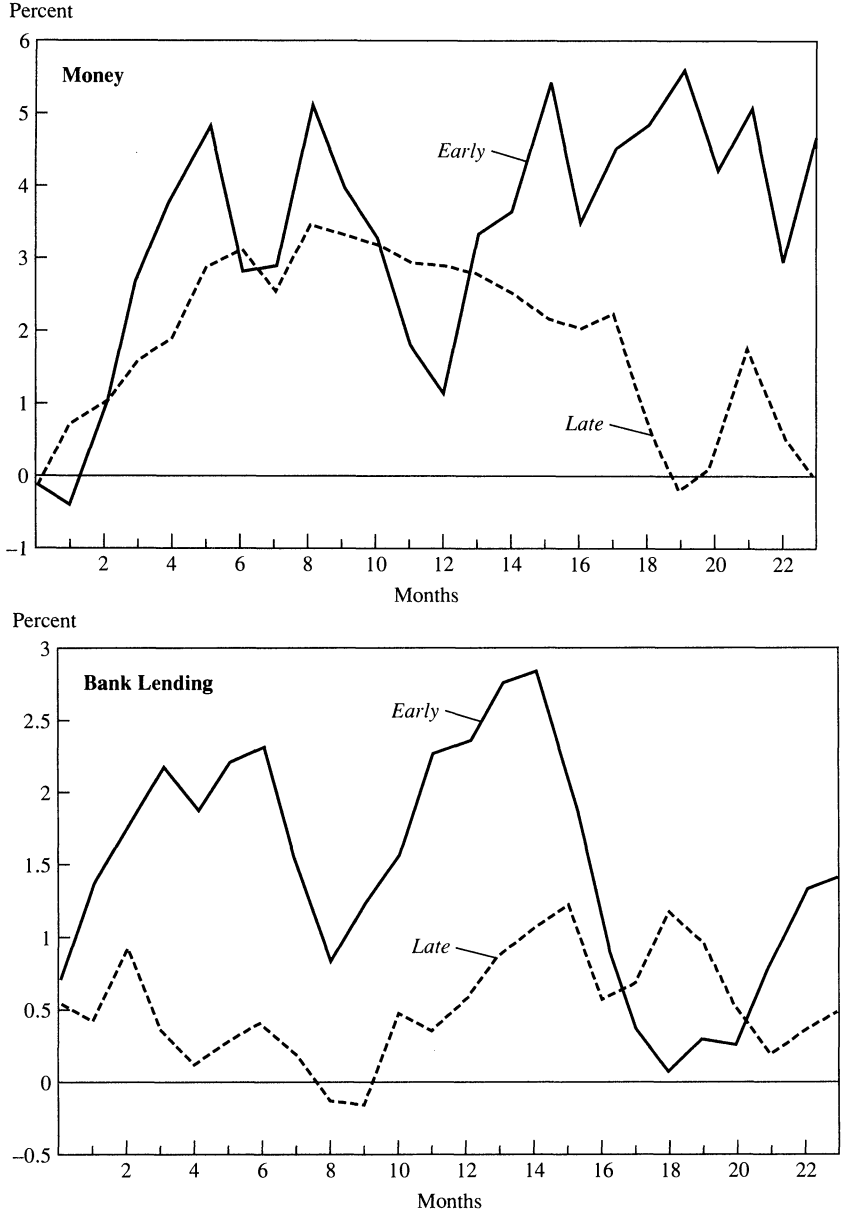
Figure 7 shows the results of a more systematic examination of the differences between the early and late episodes. The figure plots the response functions implied by two sets of instrumental variables estimates of both equations 3 and 4. Rather than using a single dummy variable equal to one on the dates of each of the policy shifts, and lags of this dummy, as the instruments (along with the other right-hand-side variables), we first use a dummy equal to one on the dates of the first three shifts and then a dummy equal to one on the three later dates.

The key results are in the bottom panel of the figure, which shows the response functions of output to lending implied by the two sets of IV estimates of equation 4, the regression of output on lending. When the dummy for the early episodes is used, the estimated real impact of a shift in lending is consistently positive, and there is a considerable lag in the relationship. In contrast, when the dummy for the final three episodes is used, the estimated impact of lending on output rises very quickly to a low peak and then fluctuates irregularly. Thus again the results suggest a greater role for lending in the transmission mechanism in the early episodes than in the later ones. For neither of the sets of IV estimates, however, is the estimated impact of lending on output sharply different from that implied by the OLS estimates shown in figure 6. Finally, the implied relationships between money and output are similar for the two sets of IV estimates.

Bank Behavior in the Individual Episodes

As we have discussed, there are two views of bank lending activities that are consistent with our failure to find any significant evidence of an independent role of bank lending in the transmission mechanism. The first view is that bank loans do not have important distinctive features—that is, that banks do not have any important advantages in making certain types of loans, and thus that any particular customer's ability to borrow is not tied to the ability of a specific bank to lend. The second view is that bank loans are indeed special, but that for much of our

Figure 7. Instrumental Variables Estimates of the Impacts of Money and Bank Lending on Industrial Production for the Early and Late Episodes of Shifts to Anti-Inflationary Policy[a]



Sources: Authors' calculations using the money and lending data described in the source note to figure 1.

a. Late episodes are the shifts of April 1974, August 1978, and October 1979. Early episodes are those of October 1947, September 1955, and December 1968.

sample banks can turn to sources of funds with low cost in terms of reserves when restrictive monetary policy leads to a reduction in the quantity of transactions deposits.

These two views make differing predictions about how banks will respond to tight policy. According to the first view, if restrictive policy leads to a fall in the stock of transactions balances, banks will simply let the size of their portfolios fall. In this view bank assets are of little importance—they are simply assets earning the prevailing rate of return—and banks' unique features, and their profits, stem from their transactions deposits. Thus there is no incentive for a bank to attempt to turn to sources of funds other than transactions deposits to maintain its assets holdings. According to the second view, in contrast, banks may have a strong incentive to attempt to turn to such alternative sources of funds. Here there is a group of potentially heterogeneous borrowers who, at least in the short run, are tied to a particular bank; as a result, restricting the quantity of loans the bank can make raises the quality of the marginal loan. Thus there are profits to be made by going to the general capital market for funds.

Descriptions of bank behavior and actions make it overwhelmingly clear that banks are not indifferent about the asset sides of their balance sheets. Certificates of deposit and other alternative sources of funds arose, in the standard view, precisely because banks desired alternatives to transactions deposits as means of obtaining funds to make loans. The development of CDs in the early 1960s, the growth of the Eurodollar market in the late 1960s, and banks' use in the same period of bank holding companies to obtain funds by issuing commercial paper were all responses to the limitations of transactions deposits as sources of funds.[40] Similarly, conventional accounts of banks' responses to times of tight money emphasize their efforts to maintain their lending activities in the face of declines in the quantity of transactions balances. Wojnilower, for example, describes "chief executives of leading banks reportedly . . . pleading with their counterparts in industry to renew their CDs" during the 1966 credit crunch. Indeed, a central theme of his account of postwar financial history is banks' preoccupation with their lending activity and their relative lack of concern with transactions deposits except as a source of funds for lending.[41] This is consistent with the view

40. See, for example, Wojnilower (1980).
41. Wojnilower (1980, p. 287).

that bank loans are special but that banks' ability to turn to alternative sources of funds causes restrictive monetary policy to affect the general level of interest rates and credit availability primarily through its impact on the stock of transactions balances.

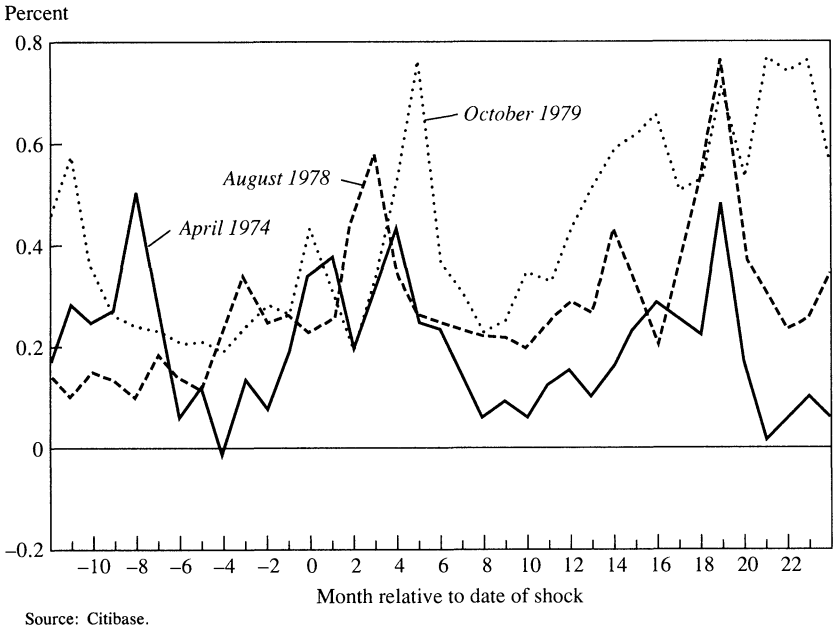
Some modest quantitative evidence that bank loans are special is provided by the behavior of the spread between CD and commercial paper interest rates in the later episodes of tight monetary policy. If bank loans were simply generic assets earning the going rate of return, banks would not be willing to pay a premium to obtain funds to maintain their lending activities in times of restrictive policy; if bank loans were special, on the other hand, banks might be willing pay such a premium.

Data on CD interest rates are available only since the early 1970s. Figure 8 plots the path of the rate spread between three-month CDs and three-month commercial paper in the three most recent episodes of anti-inflationary monetary policy. The figure shows a brief increase after all three shifts. In all three episodes, for example, the spread increases about 10 basis points in the four months after the shock and then falls to roughly its pre-shock level over the next several months. This pattern is consistent with the roles that we are attributing to bank lending and transactions balances in the transmission mechanism. That the spread consistently rises suggests that as the reduced quantity of reserves shrinks the funds available to banks from transactions deposits, banks are indeed willing to pay a premium to maintain their lending by shifting to alternative sources of funds with lower costs in terms of reserves. Because CDs and commercial paper are not exact substitutes, particularly in the short run, this process leads to a modest temporary widening of the CD-commercial paper yield differential. But that the widening is small suggests that the required premium is small—that is, it suggests that banks are able to obtain funds in the general credit market relatively easily when transactions balances fall. Thus again it appears that the impact of monetary policy on bank lending is for the most part not direct but takes place through an increase in the general level of interest rates.

Conclusion

A large body of recent theoretical work argues that the Federal Reserve's leverage over the economy may stem as much from the

Figure 8. Behavior of the Certificate of Deposit–Commercial Paper Yield Differential around the April 1974, August 1978, and October 1979 Shifts to Anti-Inflationary Monetary Policy



Source: Citibase.

distinctive properties of the loans that banks make as from the unique characteristics of the transactions deposits that they receive. According to this view, tight monetary policy has a direct impact on bank lending, and credit market imperfections cause many bank borrowers not to have easy access to alternative sources of funds. The effect of monetary policy on bank lending thus leads to a reduction in aggregate demand. Examining the behavior of financial variables and real output in a series of episodes of restrictive monetary policy, we are unable to find any support for this view. We find that the evidence is instead much more consistent with a conventional textbook account in which the Federal Reserve's influence over the economy stems from the impact of monetary policy on the stock of transactions balances.

It is difficult to know how broadly our results should be interpreted. While we have found no evidence for a narrow lending view of the transmission mechanism, our results do not imply that bank loans do

not have important distinguishing characteristics. Indeed, our reading of the evidence concerning banks' responses to tight monetary policy strongly suggests that bank loans are highly imperfect substitutes for other assets. Banks' access to alternative sources of funds, however, causes monetary policy to have little direct impact on bank lending. In addition, our focus has been on the issue of whether the transmission of monetary policy to the economy includes a direct effect on bank lending, not on the broader question of whether credit market imperfections in general play an important role in the transmission mechanism. The question of the role of general credit rationing remains open.

Finally, in a changing economy, the channels of monetary transmission are unlikely to be constant over time. Three of the six episodes that we examine (and three of the five that we examine in the most detail) occur between the mid-1970s and the early 1980s, a period in which, on the one hand, banks were relatively free to obtain funds from sources other than transactions deposits, and, on the other hand, interest rates on transactions deposits remained relatively tightly regulated. Deregulation of interest rates on transactions deposits in the 1980s has very likely made the demand for transactions balances less responsive to the general level of interest rates. As a result, in future episodes of tight monetary policy, bank loans are likely to bear a larger part of the burden of adjusting to decreases in the quantity of reserves. Thus although we have found no evidence that bank lending has played an important independent role in the transmission of monetary policy to the real economy in the major episodes of restrictive monetary policy since World War II, we can provide no guarantee that it will not be critical in the future.

Comments and Discussion

Stephen M. Goldfeld: It is a pleasure to discuss this paper by the Romers, which returns to what they characterize as an older literature on transmission mechanisms and monetary policy. I regard this topic with some nostalgia since it was one that many people of my generation encountered at a formative stage of their careers. Indeed, the question of whether bank loans are special and the role of banks in the transmission mechanism played a prominent part in my graduate education and early professional interests.

The present paper seeks to evaluate a modern version of this "lending" view and contrast it with the more conventional "money" view of the transmission process. The Romers compare these views by making creative use of their earlier work identifying anti-inflationary episodes. They regard these episodes as representing independent shifts in monetary policy, thus providing experiments for contrasting the money and lending views.

The Romers begin their empirical analysis with some comparisons of the behavior of money and lending during the focal episodes, using a regression for money or loans to correct for the usual cyclical behavior of these variables. The resulting equations are dynamically simulated through the focal periods to yield forecasting errors. An analysis of these errors provides some support for both the money and lending views in the sense that both money and lending fall more than one would expect, given the declines in output during the episodes. The Romers interpret the results as slightly favoring the money view, but overall do not place much weight on this evidence. Nevertheless, there are a few points worth making about this part of the analysis, especially since a number of them apply to the subsequent analyses as well.

First, there is a school of thought that says that static simulation residuals would be more appropriate for their analysis. I hasten to observe that this same criticism was made of my use of dynamic simulations in work on money demand. In the context of trying to judge the usefulness of a model for forecasting several periods into the future, it made sense to me, and it still makes sense, to look at residuals from dynamic simulations. In the context, however, of hypothesis testing, which is what is going on in the Romers' paper, the case for looking at static residuals is rather stronger, and I wish that they had done so.

Second, if the residuals are systematically one-sided during their focal episodes, they may be systematically on the other side during the nonfocal episodes. It would be nice to know the facts here and whether or not there were any differences between the static and dynamic residuals.

Third, the use of dynamic simulations creates a minor problem in interpreting the results, especially because the equations are estimated in difference form and must be cumulated to obtain the graphs that are provided in the paper. This unfortunately makes it rather difficult to calculate a proper standard error, something that is necessary to interpret whether big is big in their graphs.

Fourth, there is a sense in which the Romers may have biased the results against themselves. In particular, if one believes that the relevant relationship is different in focal and nonfocal episodes, then estimating one regression over the full sample will tend to force the regression through the extreme observations. But the extreme observations are the focal periods, so the residuals may end up downplaying the unusual behavior in the focal periods. This argues for separate estimation for the focal and nonfocal episodes, a technique the Romers subsequently use.

Finally, the results from this part of the paper gave me pause as to the dating of the episodes. Unless I am misreading it, the results suggest that the episode beginning in August 1978 is a red herring. This anemic episode seems additionally suspect because it is followed in quick order by another major episode, indeed by most measures the largest shift in policy in their sample. One would therefore think that there is a double reason for this episode to look good and the fact that nothing happens suggests to me that the episode may not qualify as a veritable anti-inflationary one.

I turn now to what, by the Romers' own characterization, is the more

serious evidence in favor of the money view over the lending view. The basic tool of analysis is a variant of the old-fashioned St. Louis equation, which in the present context would relate changes in output to changes in money or changes in loans. The Romers indeed estimate such equations, but they do so in two novel ways. First, using monthly data they estimate money and loan versions by ordinary least squares (OLS) and instrumental variable (IV) techniques. Second, in an approach they characterize as roughly equivalent, using quarterly data they estimate money and loan equations separately for their nonfocal and focal episodes. It is considerably easier to discuss these in reverse order, and I will do so.

With the split-sample approach, the Romers find that output is closely related to money in their focal periods but not outside. In contrast, the lending-output relationship is much less different and not necessarily stronger in focal periods. They also emphasize that there is no lag from lending to output, suggesting that the effect is from output to lending rather than the other way around. Overall, these results are interpreted as distinctly favoring the money view.

There is a little bit of Alice in Wonderland about this interpretation in the sense that the lending-output relationship is stronger and more stable while the preferred explanation is the weaker and unstable one. The Romers provide a plausible and almost convincing defense of this view. However, one could well imagine shifts to a more anti-inflationary but more stable monetary policy that made the money-output relationship weaker in focal periods. This suggests we need to think about these equations in a bit more detail.

Loosely speaking, the Romers' approach is premised on the notion that the focal episodes are brought about by exogenous regime changes that turn the Federal Reserve into a serious anti-inflationary fighter and that consequently there are no systematic factors at work on financial variables during focal episodes. This seems to suggest that they need not include any other variables in their version of the St. Louis equation. At times it also seems to suggest that money is "more exogenous" during focal episodes. There are a number of difficulties with these views, although few of these difficulties have easy solutions.

Even if it is true that other variables are not needed for focal periods, they do estimations over nonfocal periods and compare these with the focal period results. To the extent that additional variables are called for

in the nonfocal periods, the comparison does not seem to be a completely fair one. The Romers themselves suggest one variable that may be omitted from the money-output regressions, namely loans. Despite the recognition that the lending and money views are not mutually exclusive, the analysis is structured as a horse race between the two views. The suggestion is made that there is inadequate information available to estimate the joint role of money and lending. While this may be true, although no evidence is provided, if both variables are relevant, running a separate horse race involves a specification error. Even the original purveyors of the St. Louis equation, who did not believe in fiscal policy, used both fiscal and money measures.

Because the split-sample approach is estimated by OLS and because, with the possible exception of money during focal periods, both money and lending are properly regarded as endogenous variables, simultaneity is an issue. That is, the estimated equations reflect both supply and demand forces in some unholy fashion that is a bit difficult to disentangle.

In the case of money, for example, it would seem to matter whether the operating procedure of the Federal Reserve involves an interest rate policy or a money stock policy. Only in the latter case might one argue that money is exogenous. However, even in their focal periods, several types of policies were pursued over the sample period suggesting that not only is money endogeneity an issue but also there were structural changes, which are unaccounted for, in their sample. On the demand side, as one who had a misspent youth worrying about instabilities in the money demand function, I am somewhat curious as to where they are buried in this story. Overall, this suggests to me that the use of M-1 to characterize monetary policy may be somewhat clouded and the use of OLS may not be appropriate. Similar caveats apply to the lending equations.

When they use their full sample, the Romers explicitly note the endogeneity of both money and lending and use IV techniques. They note that if shifts to anti-inflationary policy are exogenous, then a dummy variable that is associated with the episodes provides a useful additional instrument. They then suggest that the IV estimator summarizes the money-output relationship in focal periods while the OLS estimator summarizes the usual money-output relation. Given this interpretation, a comparison of the OLS and IV estimates yields results that are analogous to the focal-nonfocal comparisons.

I must confess that this is one of those ideas that I do not fully understand but that nevertheless seems quite clever. My concerns are of two sorts. First, as the Romers state, even the IV approach is unlikely to provide consistent estimates. If this is the case, and for the reasons outlined above I believe it is, I am unsure what conclusions we are entitled to draw from the comparison they make. Second, to the extent that relevant variables are omitted from the analysis, the comparison is further clouded, just as it is in the split-sample approach.

The final set of issues I want to address concerns the interpretation of the lending view. The Romers state that their central goal is to provide evidence on credit market imperfections that stem from informational asymmetries. This raises the question of whether the loan measures they use—total bank loans, business loans, and loan commitments—are appropriate indicators for the phenomenon of interest. It is not clear to me that any of these measures necessarily captures the effect of credit market imperfections.

Total loans includes mortgages, which do not fit their story, whereas the latter two categories exclude consumer loans, which may be important. Even within the class of business customers, it is not clear that the measures used are up to the task. Loan commitments may pertain to high-quality customers, and it may be the borrowers who never make it into the loan commitment data who get rationed. Moreover, total business loans is a rather heterogeneous aggregate including borrowers with varying degrees of creditworthiness.

I was also puzzled by the various caveats in the paper concerning the lending view. On the one hand, the Romers suggest the evidence is against the lending view because it implies there is no lag between lending and output. On the other hand, they argue that the money view is quite consistent with credit crunches and with rationing being important, also suggesting that they are only focusing on the initial impact of monetary policy. While I understand the flavor of these distinctions, I am less sure that their empirical approach is capable of making these distinctions.

The other complicating factor in assessing the lending view is that for at least the first part of the sample period banks did not have a ready access to funds to make loans when reserves were curtailed, either because CDs did not exist or because of interest rate ceilings or reserve requirements. In such a world the lending view should be more important, and the Romers find some evidence of this in their analysis of individual

episodes. While this is reassuring, it does raise some doubts about the wisdom of estimating the same lending model over the entire sample.

Despite these reservations, the Romers have written a thought-provoking paper that forces us to think about a number of important issues. Moreover, they have done so in a way that makes intelligent use of their earlier work on identifying anti-inflationary episodes.

Benjamin M. Friedman: Christina Romer and David Romer have emerged as the leading academic proponents of the Watch-What-I-Say approach to central banking.

The fundamental methodological presumption underlying both this paper and its predecessor is that the best guide to whether monetary policy has changed is not the actions taken in the Federal Reserve's trading room but the words spoken in its boardroom.

This is, of course, greatly comforting to our central bankers, whose behavior clearly reflects their realization that although they inhabit a world in which talk about some subjects can be expensive and maybe even dangerous—ready examples are exchange rates and stock prices—when it comes to monetary policy, talk is cheap enough. Hence when the Romers write, "That the Federal Reserve publicly announced that it was undertaking a dramatic shift in monetary policy to reduce the rate of inflation strongly suggests that there was an independent shock to monetary policy," they no doubt provide substantial reassurance to our current Federal Reserve leaders, who have publicly announced that reducing the rate of inflation to zero is the chief goal of U.S. monetary policy but have yet to take any visible action that might render this announcement a reality.

Naturally, any notion that gives so much comfort to proponents of one school of thought must be distressing to at least some people who think otherwise. In this case, the methodological presumption underlying the Romers' work contradicts familiar thinking not only in arguing that it is more important to watch boardroom give and take than trading room buys and sells, but also in implicitly holding that there exists no simple quantitative measure of trading room activity to watch. For example, as the upper panel of table 4 suggests (and as the discussion in their previous paper makes explicit) they identify several of their episodes of monetary policy tightening entirely without reference to the quantity of money or its rate of change.

The chief question addressed in this paper, however, is not which variable—money or any other—is the best indicator of monetary policy, but rather the process by which central bank actions affect nonfinancial economic activity. To this end, the Romers identify two alternatives. Under what they call the "money view," reducing the quantity of bank reserves leads, through the standard mechanics of fractional reserve banking, to a smaller quantity of transactions balances, and hence, given conventionally specified money demand behavior, to higher market-clearing interest rates—which, in turn, depress the demand for real goods and services in any or all of a familiar variety of ways.

By contrast, under the "lending view," transactions deposits issued by banks are sufficiently substitutable for liabilities issued by other institutions that restricting banks' ability to create money need not cause interest rates to rise much, if at all. But because bank loans are not ready substitutes for credit extended by other institutions, the parallel restrictions on banks' ability to *lend* does lead to higher interest rates, as well as to now-familiar rationing effects—both of which, again, depress real aggregate demand. (Needless to say—except that a reader of the paper might easily get the opposite impression—these two mechanisms are not mutually exclusive, and so in reality both may be operative simultaneously.)

What is clearly at issue here is, first, the extent to which the central bank can actually limit banks' ability to create either liabilities or assets, and, second, a comparison of the substitutability of bank and nonbank liabilities against the substitutability of bank and nonbank assets.

These are not new issues, nor is there good reason to be confident that the answers describing how monetary policy worked in this regard at any particular time in the past are identical to those pertinent to today. For example, when the Federal Reserve first dropped the Regulation Q interest ceiling on large certificates of deposit, in June 1970, it was not long before economists pointed out that the monetary authority had thereby surrendered part of its ability to restrict bank lending. Similarly, economists' discussion of the development of NOW accounts and money market mutual funds at the outset of the 1980s amply emphasized the resulting increased substitutability of transactions balances issued by banks and nonbanks.

The Romers' principal contribution to this line of inquiry is to use their specification of episodes of tight monetary policy, derived from

their reading of Federal Open Market Committee minutes and policy statements, to identify those movements of either transactions balances or bank loans that may plausibly correspond to these respective views of the monetary policy process. Their use of what they call "nonstatistical evidence" as what amounts (in a statistical sense) to an identification device is most explicit in the section of their paper in which they report instrumental variable regressions in which zero-one dummy variables for their series of tight monetary policy episodes serve as the instruments for both money and bank loans. But at a broader conceptual level, their list of episodes is implicitly playing this identification role in the empirical analysis carried out throughout the paper.

In the end, the Romers interpret their results as favoring the money view over the lending view. While I do not necessarily disagree with this conclusion—in large part because of their narrow conception of what they call the lending view—I do have several reservations.

The first piece of quantitative evidence that the Romers offer in support of the money view over the lending view is that, as shown in figure 5, during the first year or so after the shift to tight monetary policy that they identify, money tends on average to grow more slowly, but bank loans more rapidly, than would be expected conditionally on the prior path of output and of either money or bank lending itself. As inspection of table 4 shows, however, these average patterns across all five tight money episodes are, in both cases, mostly driven by only one episode: the 1979 policy change in the case of money, and the 1974 policy change in the case of bank loans.

A further piece of evidence that the Romers introduce in support of the money view over the lending view rests on lead-lag relationships. (In this respect, their assertion that previous researchers' studies "make no effort to address issues of endogeneity" is uncharacteristically ungenerous. One can easily agree that the Romers' procedures, incorporating their nonstatistical evidence, potentially add value with respect to the standard Granger-Sims exogeneity tests, without claiming that the large literature applying those standard tests to systems including output, money, and credit measures did not even constitute an effort along these lines.) In table 5 they show that, although OLS regression of output on current and lagged bank loans always has a higher R^2 than the analogous OLS regression of output on current and lagged money, the lagged values of money do play a significant role while the relationship

between output and bank loans is mostly contemporaneous. The respective response patterns plotted in figure 6 suggest that the same is true, but even more so, for the corresponding IV regressions. (It is unfortunate that the paper does not show the actual IV regression results.) Given the patterns of money and bank loan movements in the individual tight money episodes as shown in table 4, however, I came away from both the OLS and the IV regression exercises wondering whether here too the money results reflect mostly the 1979 episode, and the bank loan results mostly the 1974 episode.

A further aspect of these regressions, which the Romers highlight (but stop short of directly citing as evidence favoring the money view over the lending view), is how the money-output relationship and the loan-output relationship differ depending on whether the economy is or is not in a tight money episode. As table 5 shows, the R^2 of the regression of output on bank loans is greater than that of the corresponding regression with money, for any sample period that they investigate. But as the Romers point out, "while the lending-output relationship is little different at times of large independent shifts in monetary policy than it is at other times . . . the relationship between money and output, particularly the link between lagged money and output, is to a large extent a phenomenon solely of the episodes of anti-inflationary policy." The basis for this argument is the sharply higher R^2 (and, correspondingly, coefficient values and t-statistics) when the regressions with money (but not loans) are estimated for the subsamples including the tight monetary policy episodes only, compared with the results for the subsamples consisting of all other observations.

The mere change in regression estimates, however, does not provide a firm basis for inferring that the evidence favors the money view over the lending view. Suppose, for example, that during the period before a decision to tighten monetary policy the central bank had permitted substantial variability of money growth, and that the immediate consequence of its tightening decision were smoother money growth (presumably at a slower rate than the previous average). Further suppose that what the Romers call the money view of the monetary policy transmission mechanism were precisely correct. In that case, the regression of output on money would exhibit not a higher but a lower R^2 during tight money episodes than at other times.

Questions like these bear important implications for the basic meth-

odological thrust of both this paper and its predecessor by highlighting the limited use that, in the end, the Romers have made of their nonstatistical evidence. Once they have used the FOMC minutes and policy records to identify a series of dates that they identify (rightly or not) with Federal Reserve decisions to tighten monetary policy for reasons other than responding to movements in real output, all the analysis that they carry out in these papers is purely statistical in nature. Although they appeal to Milton Friedman and Anna Schwartz as the inspiration for their use of nonstatistical evidence, there is actually nothing here to correspond to Friedman and Schwartz's narrative analysis of what was happening within each episode.

Finally, apart from criticisms of the specifics, what should one think about the Romers' conclusion that the money view is preferable to the lending view as a description of how monetary policy works? Here it is crucial to return to the issues that lie at the core of the distinction between the two views that they compare: first, the central bank's relative ability to limit banks' creation of money, as against their creation of credit; and, second, the respective substitutability between bank and nonbank liabilities and between bank and nonbank assets.

Especially for the historical period under study here—to recall, a period characterized, for the most part, by no Regulation Q ceiling, at least on large CDs, and by low or zero reserve requirements on at least some CDs—it is not difficult to believe that the Federal Reserve has had greater ability to limit creation of transactions balances than bank lending. Further, at least judging from my own empirical work on the relationship between credit and the determination of either nominal or real income, the evidence has always pointed in the direction of a role for *total* credit, inclusive of advances by all lenders, rather than for bank credit alone—as would be expected if bank loans and loans from nonbanks were close substitutes for many, if not most, borrowers.

The key point here is the focus of this paper on the banking system—a focus that is appropriate enough as a starting point for any discussion of monetary policy, to be sure, but that is fairly narrow compared with many familiar views of the institutions and behavioral mechanisms involved in the process by which monetary policy affects output, including views to which the Romers refer in this paper. After all, there is no necessary contradiction between the claim that, between *bank* liabilities and *bank* assets considered alone, the initial cutting edge of

tight monetary policy occurs on the liability side, and the view that shifts in the ability or willingness of lenders *in the aggregate* to supply credit is a major (or even the major) financial influence on nonfinancial economic activity.

General Discussion

Several panelists objected to studying the channels through which monetary policy works as if the exercise were a horserace between the paper's two alternatives, the "money" view and the "lending" view. William Brainard noted that the transmission mechanism presumably includes a multitude of channels. The traditional mechanisms include interest rate effects on expenditures for investment in plant, equipment, and inventories; wealth and rate effects on consumption; and rate and rationing effects on housing. The attempt to capture this variety of mechanisms in M-1 and bank loans artificially limits the investigation. Ben Bernanke suggested that the authors treat money as the policy instrument and treat interest rates and the quantity of loans as the channels in an attempt to gauge the relative importance of each. He observed that if bonds and loans are perfect substitutes, then what matters is the total of the two, and there is no reason for there to be a correlation between loans alone and output.

Several panelists found it hard to interpret the authors' results in the absence of a structural model. Franco Modigliani noted that, since a large part of commercial loans goes into inventories, it is not surprising that bank loans and economic activity move contemporaneously; therefore, he was not convinced that the lack of significance for lagged loans demonstrates that changes in credit do not cause changes in output. He added that the important question is which policy instruments better control the economy, not which have historically had a higher correlation with output. Bernanke described a mechanism that is compatible with the authors' empirical results, but in which loans are more important than money. Imagine that both money and loans have two-way causation with income, but that the relationship running from loans to income, although stronger than from money to income, does not vary in strength between ordinary times and periods of tight money. In this case, we would observe the correlation patterns the authors report. Bernanke

also felt that the authors mischaracterized banks' marginal cost of funds as the CD rate. Banks gain valuable information about the actions of their borrowers by monitoring their transaction accounts. Because there are important economies of scope between transactions deposits and CDs, the cost of funds is not simply the CD rate, but a weighted average of deposit and CD rates.

Brainard emphasized that it is important to examine how the transmission mechanism has changed over the period in question. He observed that although recent theoretical advances have drawn attention to credit rationing as an important part of the transmission mechanism, institutional changes in the financial system may have made rationing less important than it was in the 1950s and 1960s. In the same vein, Stephen Cecchetti warned against using the results as a basis for monetary policy because of the institutional changes that have occurred since the end of the sample period. William Branson defended the authors' use of the minutes of meetings of the Open Market Committee as a way to identify periods of exogenous money tightening, noting that the authors' periods lined up well with movements in the spread usually taken as evidence of tight money.

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