Monetary Policy and Credit Conditions: Evidence from the Composition of External Finance

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In this paper, we use the relative moments in bank loans and commercial paper to provide evidence on the existence of a loan-supply channel of monetary-policy transmission. We find that tighter monetary policy leads to a shift in firms' mix of external financing: commercial paper issuance rises while bank loans fall. This suggests that contractionary policy can indeed reduce loan supply. Furthermore, such shifts in loan supply seem to affect investment, even controlling for interest rates and output. (*JEL* E44, E52, G32)

How does monetary policy affect the economy? The textbook *IS-LM* model holds that monetary policy operates through the liability side of banks' balance sheets: when the Fed tightens policy by draining reserves from the banking system, the noteworthy consequence is a fall in the stock of money. An alternative view is that independent effects come from the asset side of banks' balance sheets (i.e., from bank loans). According to this view, there are some borrowers for whom nonbank sources of credit do not represent a perfect substitute for bank loans. Therefore, when tight monetary policy shrinks the size of the banking sector, it reduces the overall supply of loans to these "bank-dependent" borrowers. As a result, investment and aggregate demand fall by more than can be accounted for by the conventional money channel.[1]

A substantial body of empirical work seeks to distinguish between the "money" and "lending" theories of the transmission mechanism. Much of this work focuses on comparing the correlation between output and money to the correlation between output and loans.[2] This approach has its limitations, though, since it does not explicitly deal with the issue of endogeneity.[3] For example, a finding that output is more closely correlated with money than with loans does not necessarily mean that money is more important in a causal sense. It could instead be that money itself is endogenous and responds more strongly than do loans to exogenous output shocks.

Two recent papers revisit this issue. Bernanke and Blinder (1992) and Christina Romer and David Romer (1990) both identify what are arguably good indicators of exogenous shifts in Federal Reserve policy.

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[1]The idea that there may be an important lending channel has a long history. Early work on the subject includes James Tobin and William Brainard (1963) and Brainard (1964). For a recent exposition of the distinction between the money and lending channels of policy transmission, see Ben Bernanke and Alan Blinder (1988).

[2]For example, see Stephen King (1986), who examines whether money is a better forecaster of future economic activity than lending.

[3]Benjamin Friedman (1982, 1983, 1986) is an exception in that he does a number of tests aimed at establishing the exogeneity of his credit proxies.

The papers then go on to examine the impulse responses of money, loans, and various measures of economic activity to these indicators. Although different indicators are used (Bernanke and Blinder look at the federal funds rate and its spreads to Treasuries, while Romer and Romer rely on their reading of the minutes of Federal Open Market Committee [FOMC] meetings to identify shifts to tighter policy), many of the qualitative conclusions are similar. When the Fed tightens, the money stock falls almost immediately. Bank loans fall also, but with a significant lag: the decline does not begin to show up for 6–9 months. Output falls with a lag also and indeed seems to move roughly contemporaneously with loans.

However, even if the indicators used in these papers are indeed good proxies for exogenous impulses to monetary policy, an identification problem still remains in terms of deciding whether a distinct lending channel is at work. Just because a fall in output coincides with a fall in loans does not establish that the former was caused by the latter. It is possible that the entire output response to the policy tightening was due to the conventional money channel and that the fall in the quantity of loans simply reflects a decrease in loan demand (due to reduced output) and not a reduction in loan supply.

In this paper, we bring new evidence to bear that allows for a clearer econometric identification of the lending channel of monetary-policy transmission. Rather than just looking at how bank assets and liabilities respond to policy impulses, we also focus on the behavior of an important substitute for bank finance, namely commercial paper. The intuition for why such data can aid in achieving identification is simple. Suppose that monetary policy operated solely through a money channel, and that the fall in bank loans seen when the Fed tightens is due only to an output-induced effect on credit demand. Then one should expect the demand for nonbank sources of credit to decline as well, leading to a reduction in, say, the volume of commercial paper issues. If, on the other hand, Fed tightening reduces the supply of bank credit, one might expect an increase in commercial paper issuance, to the extent that businesses have some ability to substitute between the two sources of finance.

In the next section of the paper, we formalize the links between the stance of monetary policy and the composition of external finance with the aid of a simple model. The model highlights two basic conditions that are required for the existence of a lending channel and illustrates how data on nonbank sources of finance can be used to test each condition. Section II contains the first set of tests, and Section III contains the second set.

In addition to being informative about the transmission of monetary policy, our results also shed new light on a statistical finding that has attracted a great deal of attention in macroeconomics recently, namely, that the spread between prime commercial paper (CP) rates and Treasury bill rates forecasts economic activity surprisingly well. As noted by Friedman and Kenneth Kuttner (1992) and James Stock and Mark Watson (1989), the CP–bills spread has been a very powerful leading indicator.

While the spread's forecasting power appears to be well established, the economics of why it has forecast so well are less clear. One common interpretation is that the spread simply reflects default risk and that this forward-looking property is what makes it a good predictor. In Section IV, we argue against this interpretation. We suggest instead that the CP–bills spread is a proxy for the stance of monetary policy: tight monetary policy leads to an increase in commercial paper issuance, which exerts upward pressure on paper rates.[4] If tight money eventually has an output effect, this effect will have been forecast by the movement in the CP–bills spread.

As we explain in Section IV, the distinction between these two hypotheses is a potentially important one. Our theory leads one to be skeptical about the extent to

[4]Bernanke (1990) also argues that the spread reflects monetary policy; he notes but does not stress the role of commercial paper issuance as we do here.

which the historical correlation between the spread and economic activity can be expected to hold up: as the commercial paper market deepens, the price pressure generated by a given Fed tightening should decline. At the same time, our theory suggests that data on the volume of commercial paper issuance may continue to be a useful leading indicator. We provide some simple forecasting comparisons between interest rate spreads and the financing mix which are consistent with this view.

I. The Model

The model we present below is highly stylized. Its aim is not to be either particularly realistic or rigorous, but rather to illustrate simply the logic behind our empirical tests. The model is very similar to the one in Bernanke and Blinder (1988), with the one key difference being our more explicit focus on firms' capital structure choices. The model highlights the conditions under which all distinctions between bank loans and securities can be ignored, as is done in the standard *IS-LM* model where there are only two financial assets: "money" and "bonds." When these conditions are not satisfied, there are three assets—money, "bank loans," and "securities"—which must be accounted for separately.[5]

We begin by describing the investment and financing behavior of a representative firm. The firm invests an amount I and can choose between two sources of finance in raising the funds for the investment. A fraction α of the financing comes from bank loans at an interest rate r_ℓ, and the remaining fraction $(1-\alpha)$ comes from commercial paper at rate r_{p}. In order to keep the model simple, we assume that all markets clear by price. However, when we turn to the empirical work, it will be important to recognize that the "true" price of bank loans is imperfectly observable; because of the widespread use of nonprice terms of credit (e.g., covenants, collateral, or the type of quantity rationing discussed in Joseph Stiglitz and Andrew Weiss [1981]), variables such as the prime rate may be a very noisy measure of r_ℓ.

In addition to the direct interest cost, we assume that there is a "relationship" benefit R to bank borrowing that depends on the total amount borrowed from the bank:

$$R = If(\alpha) \tag{1}$$

where $f(\cdot)$ is an increasing concave function.

We do not explicitly model the sources of this relationship benefit here. However, there are several theories that can explain why firms with an option to do so might choose to finance themselves at least partially with higher-rate bank loans. For one, a banking relationship is likely to involve more monitoring and hence a lesser degree of informational asymmetry between borrowers and lenders. In this sense, a banking relationship can function like an extended internal capital market, allowing firms to finance investments even when adverse-selection problems make it difficult to raise funds from the public markets.[6] A banking relationship may also help to reduce the costs of financial distress: the free-rider problems associated with continued funding of a distressed firm are likely to be less severe than in the case when creditors are all dispersed security-holders.[7]

Given our assumptions, the firm's optimal financing mix, which we denote by α^*, is given by

$$\alpha^* = F(r_\ell - r_{\mathrm{p}}) \tag{2}$$

[5]Embedded in this simple version of the model is the (unrealistic) assumption that publicly traded corporate and government securities are perfect substitutes. This is an assumption that we will implicitly be relaxing when we discuss the determinants of the spread between commercial paper and Treasury bills in Section IV.

[6]For an example of theoretical work on the benefits of bank monitoring, see Douglas Diamond (1984, 1991). Takeo Hoshi et al. (1991) find empirical support for the idea that banking relationships can be valuable, because they help to make firms' investment less dependent on their internal cash flow. See also Eugene Fama (1985).

[7]Hoshi et al. (1990) and Stuart Gilson et al. (1990) present evidence consistent with this view.

where $F(\cdot)=f'^{-1}(\cdot)$ is a decreasing function. Equation (2) contains our first important insight. It establishes that any shock (e.g., monetary policy) that disturbs the relative costs of loans and paper will be reflected in shifts in firms' financing mix.[8] Thus, even if the "true" r_ℓ is difficult to observe accurately in practice, we can use data on firms' financing choices to infer something about the state of loan supply.[9]

We now close the model in the simplest possible fashion. Given the firm's choice of capital structure, its net cost of capital (inclusive of the relationship benefit of bank loans), k, is

$$k=r_\mathrm{p}+\alpha^*(r_\ell-r_\mathrm{p})-f(\alpha^*). \tag{3}$$

Investment demand is assumed to depend on both k and aggregate output Y:[10]

$$I=I^\mathrm{d}(Y,k). \tag{4}$$

Aggregate output, in turn, is the sum of investment and other autonomous demand:[11]

$$Y=I+G. \tag{5}$$

Interest rates on both paper and bank loans are determined by monetary policy. To keep things as simple as possible, we assume that banks are financed completely with demand deposits, hold cash to satisfy reserve requirements, and hold no excess reserves. Thus the quantity of money, M, is a sufficient statistic for the stance of monetary policy.[12] Money affects the interest rate on nonbank paper through the usual *LM*-type relationship:

$$r_\mathrm{p}=H(Y,M). \tag{6}$$

Money can also affect the interest rate on bank loans if banks have nondegenerate portfolio preferences across loans and paper as assets on their balance sheets. We assume that banks wish to hold a fraction of their assets in loans and that this fraction depends on the spread between the rate on loans and the rate on paper. Thus, loan supply L^s is given by

$$L^s=J(r_\ell-r_\mathrm{p})M \tag{7}$$

where $J(\cdot)$ is an increasing function. Note that since we allow banks to cushion the impact of monetary policy on loans by carrying out portfolio adjustments on the asset side of their balance sheets, there is no real loss of generality in assuming that they are inflexible with respect to the structure of their liabilities.

Equating loan supply to loan demand yields

$$\alpha^*I=J(r_\ell-r_\mathrm{p})M. \tag{8}$$

[8]In our formulation, a change in the relative cost of loans and paper is the *only* thing that alters the mix. Diamond (1991) presents a model in which the mix can be changed due to movements in the relative *demand* schedules for loans and paper. Diamond's model has the feature that R is effectively higher when real interest rates are higher, implying that the mix will *rise* in the wake of a monetary contraction. Therefore, the considerations in Diamond's basic model suggest that our tests will be excessively conservative; it will be harder for us to find the loan-supply effects we are looking for.

[9]There is another reason why looking at quantity financing variables can add value relative to using interest rate spreads as a proxy for $(r_\ell-r_\mathrm{p})$: the observed rate spread may be affected by other factors outside our model, such as changing default probabilities. For example, it may be that in a recession the likelihood of default rises more for the small companies who are bank borrowers than for the large companies who are commercial paper borrowers. If this is the case, the *observed* rate spread will widen even in the absence of any change in the "true" (net of default) costs of loans and paper. This sort of measurement error could be particularly problematic, as it is likely to be correlated with many of the business-cycle variables that we will be studying.

[10]The model is atemporal so investment and the capital stock coincide. Using standard adjustment-costs arguments, we could introduce dynamics and transform the demand for capital into a model for investment.

[11]For simplicity, we do not model consumption behavior.

[12]This is an obviously unrealistic assumption, and it is made for expository purposes only. Indeed, in the empirical work that follows, we use indicators other than the quantity of money to gauge the stance of monetary policy.

The six equations, (2)–(6) and (8), determine the six endogenous variables Y, I, k, r_ℓ, r_p, and α^* in terms of the exogenous parameters G and M. It is clear from these equations that there are two necessary conditions that must both be satisfied if monetary policy is to impact aggregate demand in part through a distinct lending channel:

(i) Loans and paper must be imperfect substitutes as bank assets. That is, banks must not react to a contraction in size simply by reducing their holdings of paper and leaving loan supply unchanged.
(ii) Loans and paper must also be imperfect substitutes as corporate liabilities. Firms must not be able to offset costlessly a reduction in bank loan supply by issuing more paper.

The next two sections of the paper are devoted to testing each of these necessary conditions in turn. In both cases, the model helps us to see how data on either the volume of nonbank paper or the ratio of bank loans to total financing can help in creating unambiguous tests.

To test condition (i), we investigate how paper volume and the ratio of loans to total financing respond to a monetary-policy impulse. That this provides a sharper test of condition (i) than simply looking at the response of loan volume to a monetary impulse can be seen by computing the following three derivatives:

$$(9)\quad d(\text{loans})/dM = \alpha^*\, dI/dM + I\, d\alpha^*/dM$$

$$(10)\quad d(\text{paper})/dM = (1-\alpha^*)\, dI/dM - I\, d\alpha^*/dM$$

$$(11)\quad d\alpha^*/dM = F' d(r_\ell - r_p)/dM.$$

According to equation (11), the financing ratio can vary with money only if condition (i) holds. If condition (i) does not hold, and loans and paper are perfect substitutes as bank assets, then the rates on both will be equalized, and α^* will not be affected by monetary policy. Thus, looking at how α^* moves with M can be informative about whether condition (i) holds.[13] The same cannot be said for loans. Equation (9) makes it clear that even if there is perfect substitutability (so that $d\alpha^*/dM = 0$), loans will be positively correlated with money due to their positive correlation with the level of investment. This is the source of the identification problem noted in the Introduction.

The responsiveness of paper volume to a monetary impulse provides an even stricter test of condition (i) than looking at α^*. As can be seen from equation (10), a monetary tightening has two opposing effects on paper volume. On the one hand, it leads to a decline in investment that reduces the demand for all types of financing. On the other hand, it may lead to a substitution away from loans and toward paper, thereby increasing paper volume. Thus the correlation between paper and money will be negative only if the effect of M on α^* is strong enough to overwhelm the positive effect of money on output and investment.

Our tests of condition (ii) are motivated by the observation that, in a Modigliani-Miller world where firms can costlessly substitute between bank and nonbank sources of finance, their financing choices (as measured by α^*) should be uninformative about investment activity. Thus, we can test condition (ii) by examining the relationship between α^* and various measures of investment.

The rationale for our tests of condition (ii) can be seen more formally by considering the total derivative of investment:

$$(12)\quad dI = I_y dy + I_k dr_p + I_k \alpha^* (dr_\ell - dr_p).$$

In a world where bank loans and paper are

[13] We also check directly to see how an interest-rate-based proxy for $r_\ell - r_p$ (the spread between the prime rate and the CP rate) responds to a monetary policy shock. To the extent that this proxy is an accurate one, we would expect to obtain similar results using both it and the financing ratio. However, as emphasized above, there are various potential measurement-error problems associated with using an observed rate spread as a proxy for the "true" cost differential between loans and paper.

perfect substitutes, the third term on the right-hand side of (12) drops out, and investment depends only on output and the security-market interest rate. However, with imperfect substitutability, the spread between loan and paper costs also affects investment. In testing condition (ii), we estimate investment equations similar in form to (12), making use of changes in α^* to capture changes in the spread between loan and paper costs.[14]

Before proceeding, we ought to comment on the homogeneity assumption implicit in our model, wherein a single representative firm faces a meaningful trade-off between bank loans and commercial paper. More realistically, there will be some heterogeneity: some larger firms may already be financing themselves solely from nonbank sources, and some small firms may be unable ever to access the securities markets. This leaves only some firms in the middle facing a meaningful trade-off.

Such heterogeneity will probably make it *harder* for us to find the evidence we are looking for. To see why, consider the polar case in which all firms are either completely in or completely out of the paper market, so that there are no firms facing a trade-off at the margin. In such a case, monetary policy will indeed have lending-channel effects—it will lead to a credit crunch for bank-dependent firms—but commercial paper issuance will not increase, because the bank-dependent firms cannot move into the paper market.[15] Thus, heterogeneity cannot "explain away" a finding that paper issuance rises in the wake of a monetary tightening. If anything, it makes such a finding all the more striking.

II. Monetary Policy and the Composition of External Finance

In this section, we look at how the volume of bank loans and commercial paper outstanding respond to changes in the stance of monetary policy. Unfortunately, measuring the stance of monetary policy is in itself not a straightforward task. Given that any single measure is imperfect and subject to criticism, we use several different monetary-policy indicators which have been suggested in the literature.

In our first set of tests, we follow the technique of Romer and Romer (1990), who read the minutes of the FOMC and identify six dates since World War II when the Fed appears to have opted for a clear shift to tighter policy. These "Romer dates" are: October 1947, September 1955, December 1968, April 1974, August 1978, and October 1979. Thus, one simple experiment is to compare the behavior of commercial paper and bank loan volume before and after Romer dates.[16] An increase in commercial paper volume subsequent to a Romer date would constitute evidence of a constriction in bank loan supply.

Although intuitively appealing, the Romer-date approach, by focusing on only a handful of extreme episodes, may sacrifice valuable information. To recapture some of that information, we also use data from the federal funds market. Bernanke and Blinder (1992) argue persuasively that the federal funds rate, as well as the spread between federal funds and Treasury bonds, are good indicators of monetary policy. Our second set of tests thus examines the corre-

[14]Again, we also use the prime–CP spread as a proxy for $r_\ell - r_p$ in our investment equations. The same caveats discussed above apply.

[15]This polar version of the model seems to be what Bernanke and Blinder (1988) have in mind.

[16]A couple of questions have been raised concerning the use of Romer dates as proxies for monetary policy. First, it is difficult to make an airtight case for their exogeneity; the Fed may be endogenously responding to changes in activity when it opts to tighten policy. However, we believe that this presents less of a problem for our use of the Romer dates than it might in other applications. For example, the endogeneity issue might be problematic if one were trying to argue that monetary policy has a causal effect on output. If a Romer date endogenously tends to follow temporarily elevated GNP, it might be incorrect then to infer that the tightening causes any subsequent decline in GNP. However, we think it is much less likely that Fed policy responds endogenously to fluctuations in variables such as the financing mix.

A second issue is the Romer dating criterion's potential omission of other significant episodes of policy tightening, such as the 1966 "credit crunch." We shall discuss this issue shortly.

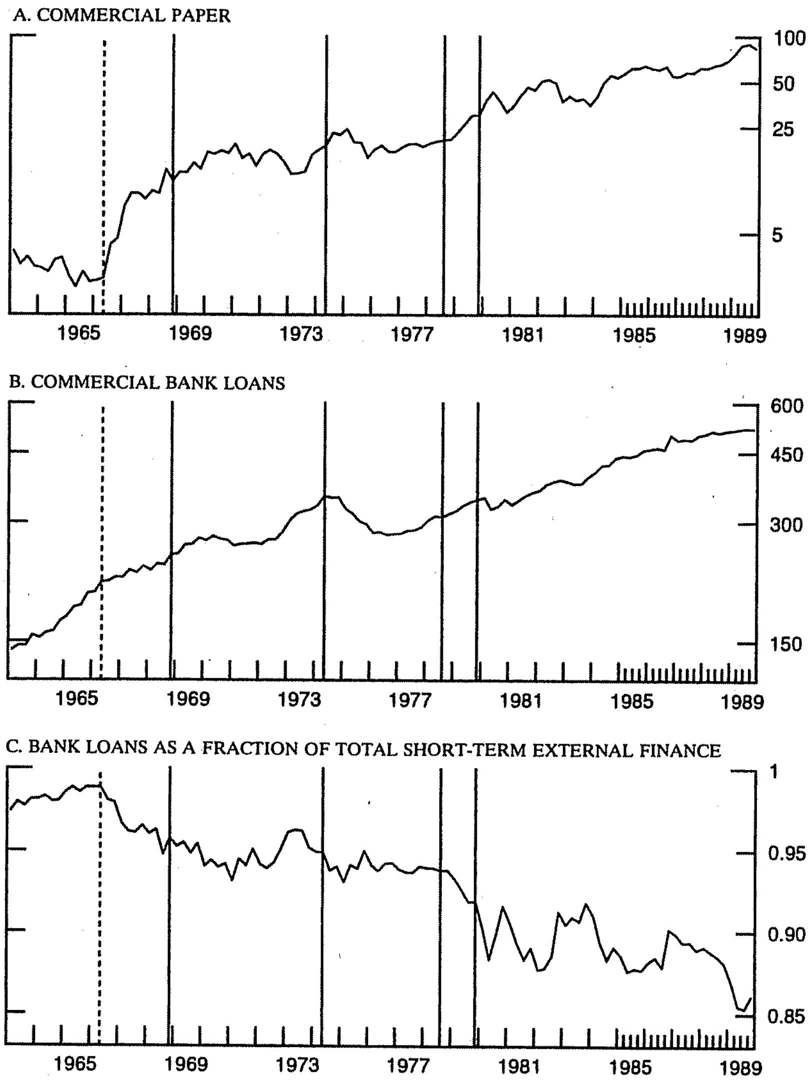

FIGURE 1. THE COMPOSITION OF SHORT-TERM EXTERNAL FINANCE (FLOW-OF-FUNDS DATA, QUARTERLY, 1963–1989)

Notes: Solid vertical lines mark Romer dates; the dotted line represents the 1966 credit crunch. Nominal values are deflated using the GNP implicit deflator. Commercial paper and bank loan values are in billions of 1982 dollars.

lation between both of these interest rate indicators and the financing variables.

Figure 1 presents the basic financing data that will be analyzed in this section: the log of the real amount of commercial paper issued by nonfinancial domestic corporations ("commercial paper" hereafter); the log of the real amount of commercial bank loans made to businesses ("bank loans" hereafter); and the ratio of the bank loans to the sum of bank loans and commercial paper ("mix" hereafter). These data, along with all the other data used in the paper, are described in the Data Appendix. The mix variable is an empirical proxy for the quantity α. The solid vertical lines in the chart denote the dates identified by the Romers as the onset of monetary tightening.

The dashed vertical line marks the beginning of the 1966 "credit crunch." Although this episode was not singled out by the Romers, it is widely regarded as one of the most significant periods of tight credit in the post-World War II period. For example, Philip Cagan (1972) notes that monetary growth was flat over the last three quarters of 1966. Moreover, he argues that the decision made by the FOMC on May 10 of that year, to restrict reserve growth until deposit growth slowed, represented a significant tightening of policy. In light of this ambiguity, the formal statistical tests that we will present shortly are done two ways: both with and without the 1966 credit crunch included in our list of tightening episodes.

The figure illustrates the phenomenal growth of the commercial paper market over the last 25 years. As the mix variable shows, commercial paper moved from being a trivial fraction of financing (less than 2 percent) to becoming a large source of financing.

Figure 2 focuses on the movements in commercial paper, bank loans, and the mix in the year before and three years following each of the Romer dates (and the 1966 credit crunch). For comparability across episodes, each series is normalized to equal zero as of the date of the monetary tightening. For reference, the straight line in each graph shows the sample average trend in each series. The average across the Romer episodes (not including the 1966 episode) is given by the bold line in each panel.

Panel A of Figure 2 confirms that across all of the episodes, paper grows at or above trend over the first year following the focal dates. The 1966 experience is particularly noteworthy, as paper volume soared over the last half of 1966 and the beginning of 1967. Interestingly, many analysts studying this period explain the boom in commercial paper issuance using exactly the sort of logic discussed above: they argue that the paper market took off when high-quality borrowers seeking loans were turned away by their bankers. For instance, Timothy Rowe (1986, p. 119) reports that during the 1966 credit crunch, "many potential borrowers who formerly relied on bank short-term credit were forced to turn to the commercial paper market. Consequently, the annual growth rate of commercial paper outstanding rose from 7.8 percent in 1965 to 46.6 percent in 1966."

Returning to the other episodes, the rapid growth in paper tends to abate over the second and third years following the focal date. Panel B of Figure 2 shows that there is relatively little action in bank loans immediately following the Romer dates: as documented by Romer and Romer (1990), bank loans grow at about trend rates for the first few quarters after a monetary contraction. Subsequently, loan growth begins to slow. Bernanke and Blinder (1992) argue that this pattern should be expected since loan commitments and other implicit arrangements prevent banks from quickly shifting their portfolios in response to a shock. By two full years after each of the Romer dates, loan volume is typically below trend.[17]

The behavior of the mix is as would be expected from the behavior of its individual components. This can be seen in panel C of Figure 2. The mix declines noticeably within the first year after a Romer date, and by the third year it is still below the trend line. Notice again that the 1966 episode stands out as a period of dramatic shifting away from bank financing and toward commercial paper financing.

In panel A of Table 1, we attempt to quantify the statistical significance of these effects. We begin by creating two dummy variables. The first, labeled the "Romer dates" dummy, equals 1 on a Romer date, and 0 otherwise. The second, labeled the "Romer dates plus 1966" dummy, also equals 1 at the onset of the 1966 credit crunch. We then do Granger causality tests to see if movements in either of these variables help forecast movements in firms' financing choices. We do the tests in two

[17]The average decline in bank loans is largely attributable to the 1974 episode, as can be seen from Figure 2.

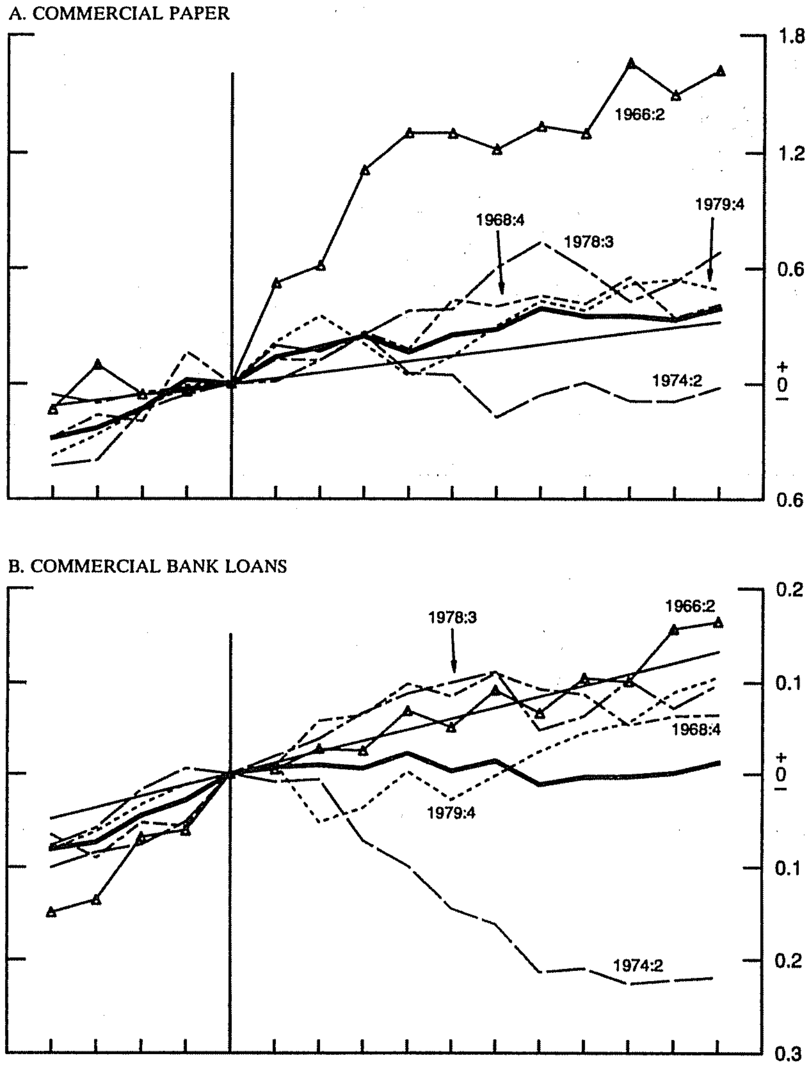

Figure 2. Changes in Short-Term External Finance Around Romer Dates

Notes: All series are shown as log deviations from their values as of the Romer dates. Ticks along the x-axis mark quarters. Averages across Romer dates, excluding the 1966 episode, are shown by the bold lines in each panel. Average growth over 1963–1989 is shown as the straight line.

basic ways. In the "bivariate" version of the tests, we regress the change in the financing variable (e.g., the mix) on eight lags of itself and on eight lags of the dummy variable. In the "multivariate" version, we add eight lags of GNP growth to the equation, in an effort to control for cyclical factors other than monetary policy which might conceivably affect the financing variables. Thus for each financing variable (mix, paper, and loans) we conduct four separate tests.

The results in panel A of Table 1 indicate that many of the patterns displayed in Figure 2 are indeed statistically significant, in

C. BANK LOANS AS A FRACTION OF TOTAL SHORT-TERM EXTERNAL FINANCE

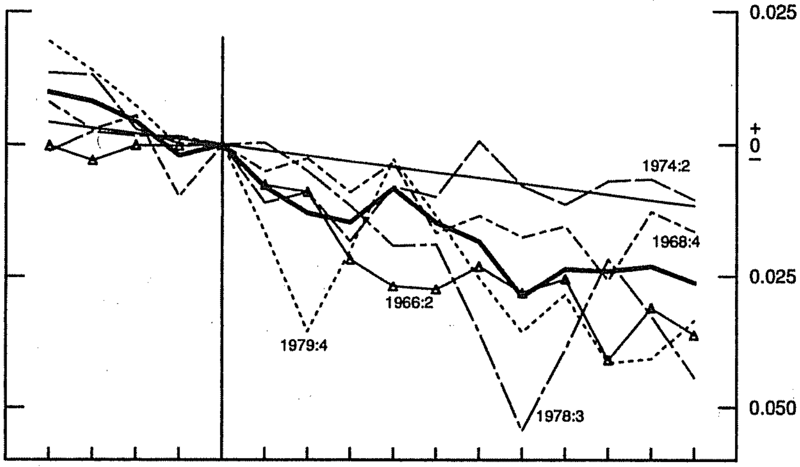

FIGURE 2. (*Continued*)

TABLE 1—CAUSALITY TESTS BETWEEN FINANCING VARIABLES AND INDICATORS OF THE STANCE OF MONETARY POLICY

Indicator	Mix		Log real paper		Log real loans		Prime–CP spread	
	Exclusion	Summation	Exclusion	Summation	Exclusion	Summation	Exclusion	Summation
A. *Romer Date Indicators:*								
Romer dates (bivariate)	0.09	−2.10	0.84	0.61	0.17	−2.16	0.0002	2.17
Romer dates plus 1966 (bivariate)	0.08	−2.55	0.13	1.99	0.07	−1.99	0.002	2.27
Romer dates (multivariate)	0.02	−2.91	0.57	1.63	0.45	−1.02	0.0009	2.35
Romer dates plus 1966 (multivariate)	0.05	−3.02	0.07	2.96	0.12	−1.18	0.02	1.98
B. *Interest Rate Indicators:*								
Funds rate (bivariate)	0.003	−3.06	0.06	2.23	0.24	−1.46	0.001	4.10
Spread: 10-year government bond–funds (bivariate)	0.03	1.92	0.14	−1.10	0.55	1.61	0.003	−1.48
Funds rate (multivariate)	0.007	−1.92	0.20	1.35	0.58	−0.15	0.002	2.44
Spread: 10-year government bond–funds (multivariate)	0.04	2.36	0.10	−2.73	0.99	−0.48	0.028	−1.10

Notes: In each case, the variable at the top of the column is regressed against eight lags of itself and eight lags of the variable in the row. In the multivariate cases, eight lags of GNP growth are added to the regression. The following variables have been differenced so that they enter the regressions in stationary form: mix, log real paper, log real loans, prime–CP spread, and funds rate. Entries in the "exclusion" columns report the marginal significance levels on tests that variables shown in rows do not help forecast the variable at the top of the column. Entries in the "summation" columns report the t statistic for the test that the sum of the coefficients on the eight lags of the variable shown in the row is zero.

spite of the small number of observations. The sum of the coefficients on the dummy variable is significantly negative in all four of the mix regressions. Thus, even without including the 1966 episode, we find that the mix falls significantly after a Romer date.

The results for the individual components of the mix (i.e., loans and commercial paper) are somewhat less uniform, although they too always go in the predicted direction. The sum of the coefficients is positive in all four of the regressions involving commercial paper, but the results are statistically significant only when the 1966 credit crunch is included. In the loan regressions, the coefficients are always negative, but they are only significant in the bivariate specifications. Thus, while loans appear to decline in the eight quarters following a monetary contraction, this decline is not significantly greater than would be expected given the weakening of GNP that occurs in this period.

Finally, we also tested to see whether the spread between the prime rate and the commercial paper rate widens after the Fed tightens. If the sorts of measurement-error problems discussed above are not too severe, one would expect the behavior of this spread to be closely related to that of the mix. Interestingly, the last column of Table 1 suggests that this is indeed the case: in all four specifications, we observe a statistically significant increase in the prime–CP spread subsequent to a monetary contraction.

Next, we turn to the two interest-rate-based measures of monetary policy proposed by Bernanke and Blinder (1992): the federal funds rate (Bernanke and Blinder's preferred proxy for monetary policy) and the difference between the 10-year constant-maturity government bond rate and the funds rate. We use exactly the same format as above, simply replacing the two dummy-variable series in the regression tests with these two interest-rate series.[18] As before, we conduct both bivariate and multivariate tests, so that we again have four separate tests for each financing variable.

The results of these tests are reported in panel B of Table 1, and they parallel those in panel A quite closely. Most notably, the sum of the coefficients on the monetary-policy indicator is again statistically significant (and of the predicted sign) in all four of the specifications involving the mix variable: the mix falls significantly when either the funds rate rises or when the (bond–funds) spread shrinks.

Commercial paper issuance goes up when either of the interest rate indicators points to tighter monetary policy, although here (as in panel A) the statistical significance depends somewhat on the specification employed. The results for loans are the weakest: they are of marginal significance in the bivariate tests and are completely insignificant in the multivariate tests. Thus, as in panel A, the evidence suggests that the decline in loans in the first eight quarters after a monetary tightening is not much greater than would be expected given the weakening of GNP that occurs in this period.

Finally, as in panel A, the results in panel B also suggest that the (prime–CP) spread widens in the wake of a monetary contraction.

Thus far, we have looked only at the commercial paper market for evidence on the behavior of nonbank sources of finance. While commercial paper may be the closest substitute for bank loans, our narrow focus on this market nonetheless raises a question: what if the increases in commercial paper volume that we document do not represent substitutions away from bank loans, but rather substitutions away from other nonbank sources of finance? If this were the case, it would be inappropriate for us to interpret our results as evidence of a reduction in bank loan supply.

Ideally, we would tackle this issue by analyzing the movements in all major nonbank sources of finance. Commercial paper and trade credit stand out as the leading short-term substitutes for bank loans. Unfortunately, however, the standard aggregate data on gross trade credit is not appropriate for our purposes, since gross trade credit does not represent a *net* source of financing to the corporate sector.[19]

Data availability is less of a problem with respect to long-term financing instruments.

[18] We actually used the *change* in the federal funds rate in the regressions, as the funds rate itself is nonstationary. Thus, all the tests in panels A and B of Table 1 involve differencing every nonstationary variable. However, we have also rerun all the tests with an alternative specification in which the nonstationary variables enter in level form, but in which a time trend is added to the right-hand side of the equation. This alternative specification produces results very similar to those we report here.

[19] The lending view of monetary-policy transmission has implications for the pattern of *interfirm* trade credit flows, rather than for the aggregate quantity of gross trade credit. For example, if loan supply is constricted, we might expect to see larger firms with access to public debt markets extending more trade credit to smaller firms, an argument made by Allan Meltzer (1960). Pursuing this issue requires firm-level data and is beyond the scope of this paper.

We are not aware of any good theoretical reasons to believe that a substitution from bonds (or other long-term sources of financing) to commercial paper *should* follow a monetary contraction.[20] Nevertheless, it seems worth checking out this possibility empirically. To do so, we looked at new issues of high-grade industrial bonds and performed tests similar to those done above for the other financing variables. The results do not support the notion that a monetary contraction leads to a swap from bonds to paper. For example, we find a *positive* (albeit statistically insignificant) correlation between the federal funds rate and bond issuance. In other words, bonds typically move in the same direction as paper after the Fed tightens. This strengthens the case for believing that the movements seen in commercial paper volume are due to loan-supply effects rather than to relative shifts in the demand for alternative sources of nonbank finance.

III. The Composition of External Finance and Real Activity

We now turn to an investigation of whether condition (ii)—imperfect substitutability by corporations between loans and paper—is satisfied. Our tests are motivated by the observation that in a Modigliani-Miller world where businesses can costlessly substitute between bank and nonbank sources of finance, their financing choices should be uninformative about investment activity. In contrast, our model suggests that data on financing choices should have some predictive power for investment.

Our basic approach is to ask whether the financing mix adds significant explanatory power to investment equations that already include the usual interest rate variables. If we did not control for interest rates, our results would not be able to verify the existence of an independent lending channel of transmission. For example, an unconditional correlation between the mix and real activity could arise if monetary policy moved the mix around [i.e., condition (i) was satisfied] but influenced the real economy solely through its effect on security-market interest rates [i.e., condition (ii) failed to hold].[21]

Unfortunately, the empirical success of most investment and inventory models is open to question. Furthermore, simultaneity and feedback relationships tend to make the results from reduced-form models such as VAR's difficult to interpret. We proceed by examining several "off-the-shelf" structural models for inventories and investment. The advantage of this approach is that it makes the interpretation of the results much more straightforward. The cost is that one must be more concrete in specifying how the economy operates. To avoid being tied to one point of view on this question, we use a host of models.

In the case of fixed investment, there are several well-known empirical models. We examine three: the "accelerator," the "neoclassical," and the securities-value (or "Q") models. Our specifications follow directly from the work of Peter Clark (1979), who conducts a detailed comparison of these models as well as a couple of others. The first two models, the neoclassical and the accelerator, can be motivated from a partial-adjustment mechanism. If we denote the desired capital stock by K^*, the accelerator model is derived by assuming that this desired level is proportional to the current level of output, Y, and that some costs of adjustment impede firms from instantaneously equating their actual capital stock with their desired stock. Given the slow

[20]For example, a simple expectational model of the term structure provides no theoretical guidance as to how changes in monetary policy and the accompanying interest rate changes should affect firms' choice of debt maturity.

[21]This is not to imply that unconditional correlations between the mix and real activity are uninteresting. Indeed, we examine such correlations in the next section and compare them to the well-documented correlations between the CP–bills spread and real activity. Our only point here is that unconditional correlations are inappropriate for drawing a clear distinction between money and credit channels.

adjustment, net investment I^{N} will be given by

$$(13)\qquad I_t^{\mathrm{N}} = \mu + \sum_{s=0}^{N} \beta_s \Delta K_{t-s}^{*} = \mu + \sum_{s=0}^{N} \beta_s \Delta Y_{t-s}$$

where Δ represents the first-difference operator and N is the length of the distributed lag. To model gross investment, I, we assume that replacement demand is proportional to the lagged capital stock. Furthermore, we follow Clark (1979) in normalizing all variables by potential output, YP, to correct for heteroscedasticity, and in assuming that the stochastic disturbance in the equation exhibits first-order serial correlation.[22] Therefore the specification of the Clark accelerator equation is

$$(14)\qquad \left(\frac{I}{\mathrm{YP}}\right)_t = \frac{\mu}{\mathrm{YP}_t} + \sum_{s=0}^{N} \beta_s \left(\frac{\Delta Y_{t-s}}{\mathrm{YP}_{t-s}}\right) + \frac{\delta K_{t-1}}{\mathrm{YP}_t} + u_t$$

$$u_t = \rho u_{t-1} + \varepsilon_t.$$

The Jorgenson-style neoclassical model that we consider is obtained by postulating that the desired capital stock is the following linear function of output:

$$(15)\qquad K^{*} = \gamma \frac{pY}{C}$$

where p is the price of output and C is the rental price of capital services. This formula can be derived by assuming that output is produced competitively and that the production function is Cobb-Douglas. In this case, the parameter γ is the share of capital in output. On theoretical grounds, many prefer the neoclassical model over the accelerator model since it introduces a dependency between investment and the cost of capital. Given the earlier assumptions regarding replacement investment, heteroscedasticity, and serial correlation, the specification Clark (1979) analyzes is:

$$(16)\qquad \left(\frac{I}{\mathrm{YP}}\right)_t = \frac{\mu}{\mathrm{YP}_t} + \sum_{s=0}^{N} \beta_s \left[\frac{\Delta\left(\frac{pY}{C}\right)_{t-s}}{\mathrm{YP}_{t-s}}\right] + \frac{\delta K_{t-1}}{\mathrm{YP}_t} + u_t$$

$$u_t = \rho u_{t-1} + \varepsilon_t.$$

We also experimented with Clark's version of Bischoff's modified neoclassical model, which allows for different coefficients on output and the cost of capital. The results were very similar to the results from the simple neoclassical specification and thus are omitted.

Our final model, the Q model, is based on the assumption that if the market value of a firm exceeds the replacement cost of its assets, then it should seek to expand. Our specification, again taken from Clark (1979), is

$$(17)\qquad \frac{I_t}{K_{t-1}} = \mu + \sum_{s=0}^{N} \beta_s Q_{t-s} + u_t$$

$$u_t = \rho u_{t-1} + \varepsilon_t$$

where Q is the market value of the firm (corrected for the effect of taxes) divided by the replacement cost of the firm. Together these three models roughly encompass most of the structural equations that have been proposed for studying investment.

There is even less consensus on how to handle inventories. We follow Louis Maccini and Robert Rossana (1981) and embed the role of interest rates in a partial-adjustment model. As Blinder and Maccini (1991)

[22] Without scaling, the residuals from the equation seem to be quite heteroscedastic. In a large sample, the scaling should only help to correct the heteroscedasticity and not otherwise affect the equation. We find that the scaling not only helps to correct the heteroscedasticity, but also makes the impact of the mix more pronounced in our augmented equations.

note, although this strategy has been relatively unsuccessful in finding interest rate effects, it is virtually the only tractable alternative and therefore has been widely used. Letting H be the actual stock of inventories and H^* be the desired stock of inventories, Maccini and Rossana begin with

$$\Delta \log(H_t) = \lambda[\log(H_t^*) - \log(H_{t-1})] \tag{18}$$

$$\log(H_t^*) = \mu + \beta \log(S_t^e) + \gamma r_t^e \tag{19}$$

where S^e and r^e are expected sales and carrying costs, the factors that are typically assumed to be the key determinants of desired inventories.[23] Maccini and Rossana follow the standard practice of using distributed lags to proxy for the expected value of sales and carrying costs. Thus, after substituting to eliminate the desired target and allowing for serial correlation, the equation they consider is

$$\begin{aligned} (20)\quad \Delta \log(H_t) &= \mu + \sum_{s=1}^{N_1} \beta_s \log(S_{t-s}) \\ &\quad + \sum_{s=1}^{N_2} \gamma_s r_{t-s} + \delta \log(H_{t-1}) + u_t \\ u_t &= \rho u_{t-1} + \varepsilon_t \end{aligned}$$

where S and r are actual sales and interest costs. We use two variants of this equation. The first, which we label the "accelerator" model, contains only the terms pertaining to expected sales. The second, labeled "neoclassical" in what follows, includes both the sales and interest-expense proxies.

Before the equations can be estimated several other details must be finalized. First, we need to identify the lag lengths that will be used in the estimation. For the investment equations we follow Clark (1979) by using quarterly data and allowing for 20 lags on the output and cost-of-capital measures, but restricting the lag coefficients to lie on a sixth-order polynomial. In the inventory equations we follow Maccini and Rossana (1981) by allowing for 24 lags of sales and 20 lags for the inventory carrying costs and restricting these coefficients to lie on a third-order polynomial. (Limited experimentation suggested that the results were robust with respect to both of these choices.)

Second, we must specify which inventory and investment series will be used. For the investment series, we follow the standard convention in the literature and distinguish between investment in equipment and investment in nonresidential structures. For inventories, we follow the distinction made in the national income and product accounts and isolate inventories held by manufacturers, wholesalers, and retailers of nondurable goods and inventories of manufacturers and wholesalers of durable goods.[24] For convenience, we refer to these as nondurables and durables inventories, respectively.

Finally, to test whether the mix has any additional explanatory power, we added the mix to each equation with a specification symmetric to that for interest rates. For the investment equations this amounts to adding 20 lags of the mix with the coefficients constrained to lie on a sixth-order polynomial, while for inventories this strategy suggests allowing for 20 lags of the mix with the coefficients constrained to lie on a third-order polynomial. (We obtained fairly similar results when we instead added four lags of the mix to the equations and did not restrict the coefficients.) The equations are estimated over the 1964–1988 period.[25]

[23]Maccini and Rossana (1981) also experiment with allowing inventories to depend on other factors such as materials costs and wages. Those extensions had little effect on the importance of interest rate effects, so we suppress them.

[24]Thus we are ignoring retail durable-goods inventories. This category is mostly automobiles and is relatively small compared to the other two categories we consider.

[25]The sample period was chosen to correspond to the availability of the data for Q, which was available only through 1988.

TABLE 2—TESTS FOR EXPLANATORY POWER OF MIX AND PRIME–CP SPREAD IN STRUCTURAL INVENTORY AND INVESTMENT EQUATIONS

	Mix			Prime–CP spread		
Category	Accelerator	Neoclassical	Q	Accelerator	Neoclassical	Q
Nondurable inventories	0.173	0.009	—	0.022	0.001	—
Durable inventories	0.002	0.049	—	0.500	0.302	—
Producer's durable equipment	10^{-6}	0.003	0.026	10^{-7}	0.003	0.027
Nonresidential structures	0.460	0.391	0.175	0.537	0.011	0.037

Notes: The number in each cell is the significance level in an F test that tests whether a distributed lag of either the mix or the prime–CP spread enters the inventory and investment equations described in the text. "Nondurable inventories" are inventories held by manufacturers, wholesalers, and retailers of nondurable goods; "durable inventories" are inventories held by manufacturers and wholesalers of durable goods.

In Table 2 we report the significance levels for the F tests of whether all the coefficients on the mix are jointly equal to zero.[26] The results suggest that the mix is an important determinant of inventories; the mix shows up very strongly for the durables inventories and moderately strongly for the nondurables inventories. The shapes of the lag distributions imply that the mix has the expected effect, at least over the first couple of years: a declining loan share is associated with falling inventories. Given that the long-run output effects of monetary policy would be predicted to be small, it is also not surprising to find that the long-run impact of a shift in the mix is insignificantly different from zero.

These results—that inventories can be influenced by financial factors—are particularly interesting in light of two stylized facts. First, interest rate effects have been hard to find in standard inventory models. Second, there is a very tight positive correlation between bank loans and inventories (see e.g., Board of Governors of the Federal Reserve System, 1980 chart 1). By itself, of course, this correlation says nothing about any causality running from loans to inventories; it could just reflect fluctuations in inventory demand that are passively accommodated by bank loan supply. However, our results suggest that inventories could indeed be affected by the availability of bank credit. Thus financing costs may be important for inventories, but these costs may not be adequately captured by security-market interest rates alone.

The results for investment are less uniform. For equipment investment, the mix again appears to be very important, regardless of the baseline model chosen. In contrast, the mix appears to be much less important for investment in nonresidential structures.[27] Nevertheless, in all cases, the impact of declines in intermediated financing is as expected: there is a negative short-run effect on investment, and this effect dies off at longer horizons.

Table 2 also contains a second set of tests, in which the prime–CP spread is substituted for the mix everywhere. As in the previous section of the paper, we find some evidence that the two variables contain similar information. Like the mix, the prime–CP spread has significant explanatory power both for nondurable inventories and for

[26]The tests are carried out in terms of the level of the mix. The arguments in Jeffrey Wooldridge (1990) suggest that standard asymptotics apply, provided that the mix, conditional on the other right-hand-side variables in the equations is stationary. This condition is easily satisfied in all of the specifications aside from the Q equations, where it is marginally satisfied. Nonetheless, to ensure that our small-sample results are not due to any leftover time trends in the investment series that are correlated with the trend in the mix, we reran all the tests, adding a time trend to the right-hand side of each equation. We obtained qualitatively similar results with this procedure.

[27]This finding accords with the common result in the literature that it is notoriously difficult to find important financing effects for structures (see e.g., Robert J. Gordon and John M. Veitch, 1986).

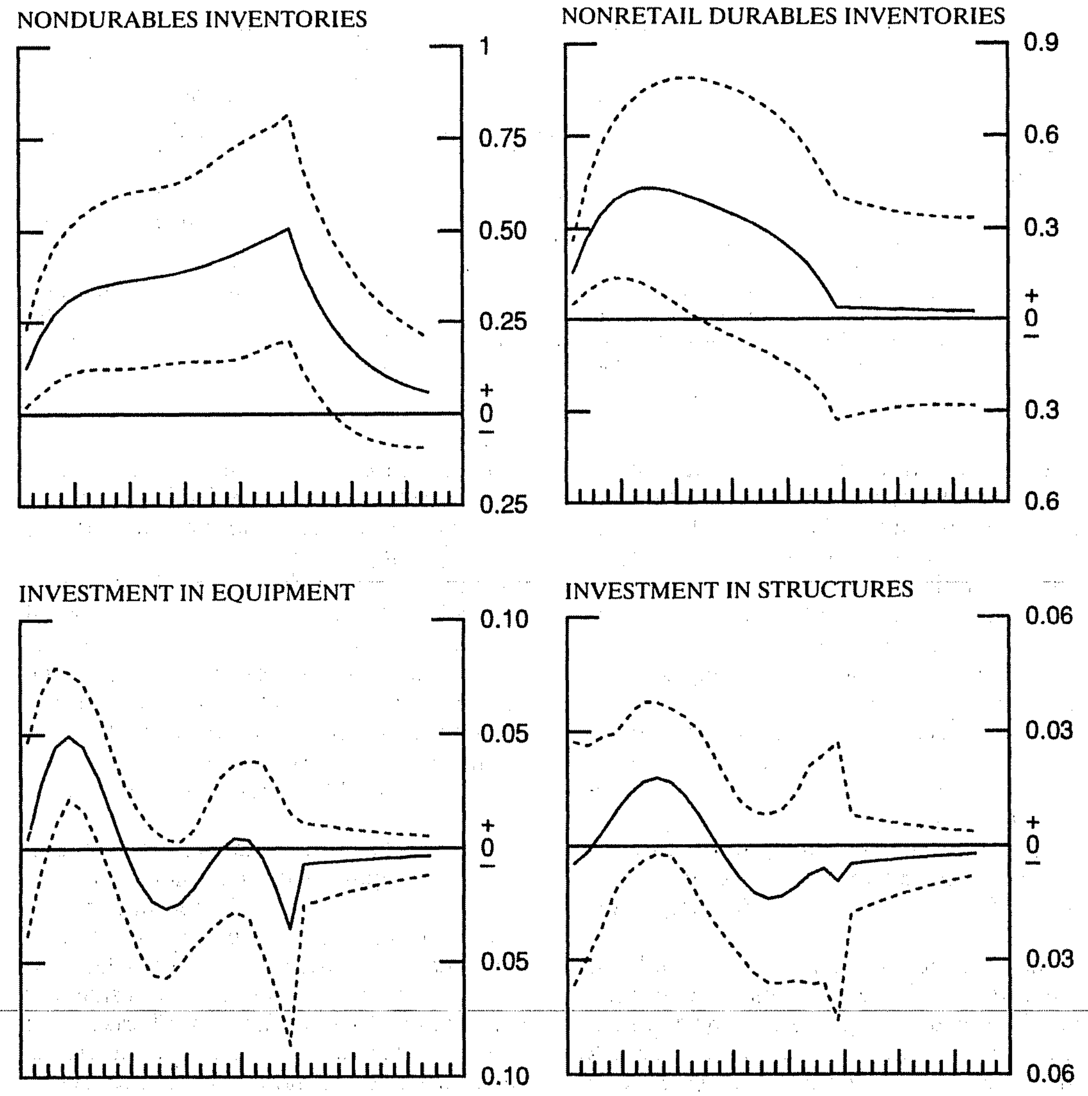

FIGURE 3. IMPULSE RESPONSES AND APPROXIMATE 95-PERCENT CONFIDENCE INTERVALS FOR SHOCKS TO THE MIX IN NEOCLASSICAL MODELS

Notes: Ticks along the *x*-axis mark quarters after the shock to the financing mix. Dotted lines show plus and minus two standard errors around the means, shown as solid lines. The means and confidence intervals were calculated from a Monte Carlo simulation using 500 replications.

equipment investment. Unlike the mix, however, it adds little to the equations for durable inventories. Also unlike the mix, it is significant in two of the three structures specifications.

While Table 2 demonstrates the statistical significance of our loan-supply variables, it does not provide any guidance on their quantitative importance. We now attempt a rough calibration of these magnitudes. To begin, we compute the responses of investment and inventories to shocks in the mix using the neoclassical specifications [equations (16) and (20) augmented to include lags of the mix]. We also compute confidence intervals using Monte Carlo simulations.[28] The mean responses for a one-unit increase in the mix, along with standard-error bands are shown in Figure 3. As is typical, the range associated with plus and minus two standard errors around the path is fairly wide in all four cases, but at least in the short run, there appear to be some meaningful patterns in the data.

Next, we calculate the impact of a one-time, 0.036 decline in the mix. This is a large decline, comparable to that seen in the two quarters after the Fed's October 1979 tightening. One year after such a shock, inventory investment would be reduced by about $36 billion (in 1982 dollars), equipment investment would be reduced by about $7.5 billion, and structures investment would be reduced by about $1.5 billion. Together this suggests a decline of roughly $45 billion, which is just over 1 percent of GNP. While the standard errors on these estimates are large, the overall magnitudes seem reasonable, and the sectoral incidence is plausible: inventories are most strongly affected, while equipment investment is slightly affected, and investment in structures is hardly affected.

IV. Financing Variables as Predictors of Economic Activity

In the previous section, we showed that financing variables such as our mix variable could help to predict certain components of economic activity, even after controlling for interest rates and other factors. These controls were necessary to address the specific hypothesis we were testing: whether condition (ii) was satisfied and there was thus evidence of a distinct lending channel of monetary transmission.

In this section, we shift our focus away from the issue of trying to differentiate carefully between the money and lending channels and address a less structured set of forecasting questions. In particular, we consider how our mix variable performs as a univariate "leading indicator" and contrast it with another variable that has received a great deal of attention in this regard: the spread between the rate on prime commercial paper and Treasury bills.

Our results thus far suggest a couple of reasons why the mix might be a good univariate leading indicator. First, the evidence in Section III tells us that the mix has some forecasting power even when many other variables are included in the model. Second, the evidence in Section II implies that the mix might also do well in univariate forecasting even if we had found no role for it in the multivariate setting. This is because even if condition (ii) fails to hold, and monetary policy thus works solely through a money channel, we know that the mix is correlated with changes in monetary policy.

The insight that the mix may be a good proxy for the stance of monetary policy, no matter what the eventual channels of policy transmission, is also helpful in understanding the success of the CP–bills spread as a leading indicator. Several explanations for the spread's success have been offered. The first is that the spread reflects expected future default risk and that this forward-looking property is what makes it a good predictor. Friedman and Kuttner (1993), as well as Bernanke (1990), argue that this is at best a partial explanation. For example, Bernanke points out that it is hard to reconcile the 300-basis-point swings seen in the spread with changes in default expectations, given that defaults on prime commercial paper are extremely rare. Furthermore, both papers note that the CP–bills spread is not closely correlated with other more natural measures of default risk, such as the spread between BAA corporate bonds and Treasury bonds, or the spread between low-grade and high-grade commercial paper.

A second possible explanation, put forward by Friedman and Kuttner (1993), focuses on the changes in companies' demand for funds that occur around cyclical turning points. To the extent that the end of an expansion is characterized by a buildup in inventories, there will be an increased demand for such short-term sources of funds

[28] The results are based on 500 replications, assuming that the errors in each equation are normally distributed.

TABLE 3—CAUSALITY TESTS FOR MIX AND SIX-MONTH CP–BILLS SPREAD

	1964–1989		1964–1979:3		1979:4–1989	
Dependent variable	Spread	Mix	Spread	Mix	Spread	Mix
Capacity utilization	10^{-8}	0.048	10^{-8}	0.426	0.110	0.007
Log employment	10^{-8}	0.003	10^{-8}	0.063	0.005	0.078
Log housing starts	0.015	0.105	0.059	0.660	0.229	0.054
Log personal consumption	0.00002	0.314	0.001	0.127	0.049	0.460
Log personal income	0.005	0.572	0.021	0.438	0.423	0.359
Unemployment	10^{-8}	0.017	10^{-8}	0.266	0.012	0.006
Industrial production	10^{-8}	0.007	10^{-8}	0.221	0.017	0.004
Log durable goods orders	10^{-8}	0.067	10^{-6}	0.278	0.036	0.161
Log retail sales	0.0002	0.645	0.003	0.635	0.049	0.529

Notes: Entry in each cell is the significance level from a test that four lags of the mix or spread add explanatory power to a regression that already includes four lags of the dependent variable. All nonstationary variables have been differenced.

as commercial paper. If commercial paper and Treasury bills are imperfect substitutes, this demand-side effect should widen the spread between the two. Friedman and Kuttner (1993) find empirical support for this proposition.

A third explanation for the predictive prowess of the spread—discussed by both Friedman and Kuttner (1993) and Bernanke (1990)—is that the spread contains information about the stance of monetary policy. Our results in Section II support this hypothesis. Specifically, our results point to one clear reason why the CP–bills spread may be a good proxy for the stance of monetary policy: if tight money leads to an increase in commercial paper issuance, and if the commercial-paper market is less than perfectly "deep," then the end result will be an increase in paper rates relative to Treasury rates. In other words, the spread may be a good proxy for the stance of monetary policy for exactly the same reasons that the mix is.

However, this line of reasoning raises the following question: should one expect the spread to continue to be a good forecaster in the future? Bernanke (1990) also provides evidence on this point. He shows that the forecasting ability of the spread has deteriorated noticeably over the 1980's. According to the story above, this might be expected if the spread's variation is driven by fluctuations in paper issuance. Over time, as markets become deeper and more liquid, this "price-pressure" effect may be reduced. Even if monetary policy continues to have a significant impact on paper volume, the impact on paper rates may diminish. This would weaken the forecasting power of the spread, while leaving the forecasting power of the mix unaffected.[29]

To investigate this hypothesis, we compare the forecasting properties of the CP–bills spread and our mix variable for a host of indicators of economic activity over several sample periods. Specifically, we follow Bernanke and Blinder (1992) and study the following activity measures: industrial production, capacity utilization, employment, the unemployment rate, housing starts, personal income, retail sales, consumption, and durable-goods orders. We consider three sample periods: 1964–1989, 1964–1979:3 and 1979:4–1989. The sample break point was suggested by Bernanke's (1990) work on the changing forecasting ability of the CP–bills spread.[30]

In each regression, we run the activity variable on four lags of itself and four lags of either the mix or the spread.[31] These results are shown in Table 3. The results for

[29]Bernanke (1990) describes other reasons why market developments might lead to a reduction in the forecasting power of the spread.

[30]By starting in 1964 we capture the 1966 episode without using too much data from the period before the first major expansion in the paper market.

[31]All nonstationary variables have been differenced in these regressions.

the CP–bills spread confirm Bernanke's (1990) findings that the information content of the spread has fallen off noticeably in the 1980's; indeed, the spread's explanatory power declines in the later subsample for every activity variable we study. In most cases, the spread still seems to have some predictive power, but overall the results are much less impressive.

In contrast, the forecasting performance of the mix improves over the later subsample for seven of the nine activity variables. Moreover, in the later sample period, the mix actually outperforms the spread for five of the nine activity measures in these forecasting contests. This is in sharp contrast to the earlier sample period, where the spread uniformly dominated the mix. On balance, these results do suggest that the information content in the mix has held up better than that of the spread as the commercial paper market has deepened. Still, even over the 1980's, it does not appear that the mix is an unambiguously better leading indicator than the spread.

V. Conclusions

There are two necessary conditions that must be satisfied in order for monetary policy to affect the economy through a lending channel. First, banks must view loans and securities as imperfect substitutes on the asset side of their balance sheets, so that monetary tightening does indeed reduce the supply of bank loans. Second, loans and nonbank sources of finance must also be imperfect substitutes for firms on the liability side of their balance sheets, so that reduced loan supply has real effects. The data we have examined suggest that both conditions are satisfied: shifts in monetary policy seem to alter the mix of loans and commercial paper, and the induced shifts in this mix seem to affect investment (even controlling for interest rates).

In this paper, we have looked only at aggregate data. However, the lending view of monetary-policy transmission also has a number of important cross-sectional implications. To take just one example, the lending view suggests that the inventory and investment declines that follow a monetary contraction should be disproportionately concentrated among "bank-dependent" firms (i.e., firms with scarce cash reserves and without ready access to public bond and commercial paper markets). In current work (Kashyap et al., 1992) firm-level data are being used to investigate this hypothesis.

Data Appendix

The data used in the paper can be divided into four categories. Except where otherwise noted, all data come from the Federal Reserve data base.

Financing Measures.—The bank loan and commercial paper series used in our investigation are taken from the Federal Reserve Board's (1980) flow-of-funds publication. The bank loan series is the sum of two series. The first series is "Bank Loans, NEC," line 25, in the "Nonfarm Non-Corporate Business" sector. The second series is "Bank Loans, NEC," line 34, in the "Nonfinancial Corporate Business" sector, excluding farms. The commercial paper series is taken from line 36 of the "Nonfinancial Corporate Business" sector, excluding farms. Finally, the bond issuance series was constructed by splicing a Moody's series and one tracked by the Federal Reserve. The nominal quantity data were adjusted using the 1982-based GNP deflator.

Interest Rates.—We use a variety of interest rates in this study: the federal funds rate, the six-month Treasury bill rate, six-month high-quality commercial paper rate, the prime rate, and the 10-year constant-maturity government security. These are all standard series.

Inventory and Investment Data.—The variables needed to run the inventory equations come from the MPS quarterly-model data base and the National Income and Product Accounts. The MPS data are described at length in Flint Brayton and Eileen Mauskopf (1985) and are available upon request. The data on Q and investment were kindly provided by Glenn D. Rudebusch and are described in Stephen D. Oliner et al. (1992).

Business-Cycle Indicators.—The data for the indicators of economic activity used in Section IV are all available from a number of sources. We used the Federal Reserve Board data base; Bernanke and Blinder (1992) use the same data (obtained from Data Resources, Inc.) and provide the DRI mnemonics.

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