Is There a Broad Credit Channel for Monetary Policy?

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Using data for the U.S. manufacturing sector, we test for the existence of a broad credit channel for monetary policy, which operates through the total supply of loans. Our test focuses on the relationship between internal funds and business investment. After a monetary tightening, we find that this relationship becomes much closer for small firms but not for large firms. In contrast, after a monetary easing, the relationship is little changed for all firms. This evidence supports the existence of a broad credit channel.

In recent theoretical and empirical research, interest has been rekindled in a credit channel for the transmission of monetary shocks to real output. This line of research stresses that central bank actions affect output, in part, by causing shifts in the supply of loans. In contrast, the traditional Keynesian analysis of the transmission mechanism makes no mention of loan supply.

Two versions of the credit channel have been described in the literature. One version is a *bank lending channel*, which relies on the dual nature of banks as holders of reserve-backed deposits and as originators of loans.[1] For the bank lending channel to exist, a reduction in reserves engineered by the monetary authority must cause the volume of bank lending to decline; that is, banks must not insulate their loan supply after a shock to reserves by simply rearranging their portfolio of other assets and liabilities. Furthermore, a bank lending channel requires that some firms cannot costlessly replace losses of bank credit with other types of finance, but rather must curtail their investment spending. As highlighted by Kashyap, Stein, and Wilcox (1993), the bank lending channel makes a key prediction: After a monetary tightening, the supply of bank loans should decline *by more* than the supply of other types of debt (such as commercial paper and finance company loans). In Oliner and Rudebusch (1995, 1996), we found no evidence of this predicted differential response. Instead, after accounting for differences in the financing patterns of large and small firms, we found that the mix of bank and nonbank debt changed little after a monetary shock.

Although our earlier work found no support for a bank lending channel, we did observe a reallocation of all types of debt from small firms to large firms after monetary tightenings, which appeared consistent with what we call the *broad credit channel* for monetary policy.[2] This second version of the credit channel focuses on the supply of funds from all financial intermediaries and markets and has no special role for banks. The broad credit channel stresses

1. Descriptions of what we call the bank credit channel can be found in Blinder and Stiglitz (1983), Romer and Romer (1990), Bernanke and Blinder (1988, 1992), and Oliner and Rudebusch (1995, 1996).

2. See Gertler and Gilchrist (1993) for a discussion of similar evidence and for a survey of the bank and broad credit channels.

that all forms of external finance are imperfect substitutes for internal funds. Information asymmetries induce a cost premium for external funds as compensation to lenders for the expected costs of monitoring and evaluation. Importantly, the size of this premium depends on the stance of monetary policy. In particular, a tightening of policy can boost the premium for all types of external funds, which depresses the volume of spending. This rise in the premium occurs because the tighter policy causes the borrower's balance sheet to deteriorate, reducing the collateral that could be offered to a potential lender.

In this paper, we provide new evidence on the existence of a broad credit channel. We do so by investigating changes in the investment behavior of small and large firms after changes in monetary policy. Under a broad credit channel, investment spending will be tied more closely to internal finance after a monetary tightening than at other times. The closer link reflects the higher premium for external funds after a monetary contraction. In contrast, in the absence of a broad credit channel, we would expect the link between internal funds and capital spending to be stable over time. Thus, our test looks for shifts in the relationship between internal finance and capital spending after a monetary shock.

To enhance the power of our test, we conduct separate analyses for small and large firms. The information asymmetries that underlie a broad credit channel should be more severe for small firms than for large firms. Thus, if the broad credit channel exists, we should see its effects more strongly for small firms. Indeed, our results do indicate that the link between internal funds and investment becomes closer after a monetary contraction for small firms but not for large firms, which supports the existence of a broad credit channel.

Conversely, during episodes of monetary easing, we find no significant change in the link between liquidity and investment from that prevailing at other times. This asymmetry in the results obtained for periods of tight money and easy money is consistent with recent theoretical work on the broad credit channel (see, for example, Gertler and Hubbard (1988), Bernanke and Gertler (1989), and Stiglitz (1992)). This work indicates that the condition of a firm's balance sheet should affect its ability to borrow mainly when net worth is low; at all other times, balance sheet considerations move to the background when firms seek funding for investment projects.

How does our work fit into the rapidly growing empirical literature on the role of capital market imperfections in the transmission of monetary policy? Our test is most closely related to the one undertaken by Gertler and Hubbard (1988). For firms believed to face credit market imperfections, they showed that cash flow had a stronger effect on fixed investment during the 1974–1975 and 1981–1982 recessions than at other times. Similar evidence was provided by Kashyap, Lamont, and Stein (1994) for inventory investment. However, these results, though consistent with a broad credit channel, do not specifically tie *monetary policy* to the observed spending behavior. Moreover, the evidence is drawn from only a few episodes, and the data used are at an annual frequency. In contrast, our study examines the link between liquidity and real spending after all major shifts in monetary policy from the early 1960s through the early 1990s using quarterly data, which permits a richer dynamic structure and a more precise dating of policy changes. One other study that provides support for the broad credit channel over a long sample period is Gertler and Gilchrist (1994), who examined movements in sales, inventories, and short-term debt for small and large manufacturing firms. After a monetary contraction, they found that all three series declined more for small firms than for large firms. In addition, the sharp declines for small firms occurred when the aggregate economy was performing poorly, which suggests that liquidity problems were to blame.

The rest of our paper proceeds as follows. The next section provides an overview of the broad credit channel and the motivation for our empirical test. Section II describes the data set with which we carry out the test. Section III presents our results, and Section IV concludes with directions for future research.

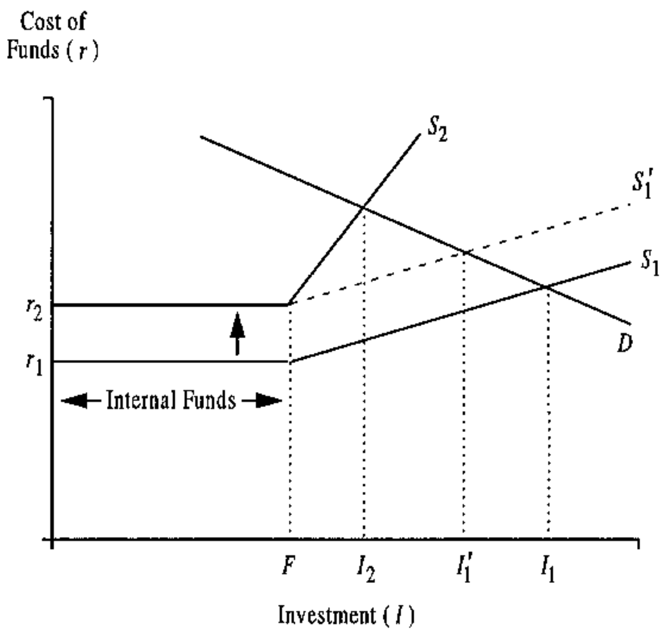
I. The Broad Credit Channel and the Cost of Funds

The broad credit channel arises from an asymmetry of information between borrowers and lenders, which induces a premium in the cost of all forms of external finance over the cost of internal funds.[3] This premium compensates lenders for the costs incurred in evaluating proposed investment projects, monitoring borrowers, and enforcing outcomes. The resulting cost of funds schedule is shown by S_1 in Figure 1, where F is the amount of internal funds that the firm has on hand. The cost of these internal funds, $\bar{r}_1$, can be decomposed into $r_1^f + \theta$, where r_1^f is the risk-free interest rate, which we take as the instrument of monetary policy, and θ is the risk adjustment appropriate for the firm. With perfect capital markets, external funds—which are the marginal source of finance when investment exceeds F —also would be available at a rate of $\bar{r}_1$. However, the asymmetry of information between borrowers and lenders produces a moral hazard, as a firm is more likely to default

3. Gertler (1988) surveys the literature on information asymmetries and their macroeconomic effects.

FIGURE 1

THE BROAD CREDIT CHANNEL:
MAGNIFICATION OF AN INTEREST RATE INCREASE



on its debt to outsiders than on its (implicit) debt to itself. This moral hazard raises the cost of external funds above $\bar{r}_1$ by a premium that we denote by Ω.[4]

The size of Ω depends on two factors. First, Ω increases with the level of borrowing, as greater debt intensifies the moral hazard problem, all else equal. This link between Ω and borrowing produces the upward slope shown for S_1. We denote the total amount of external borrowing by B, which is simply investment minus internal funds ($I - F$). Second, as demonstrated by Farmer (1984) and Gertler and Hubbard (1988), Ω also increases with the level of the risk-free rate, in part because increases in the rate lower the discounted value of borrowers' collateral, thereby increasing moral hazard. These two factors are captured in the equation $\Omega = \Omega(B,r^f)$, where both $\partial\Omega/\partial B$ and $\partial\Omega/\partial r^f$ are positive.

The dependence of Ω on the risk-free rate implies that credit market imperfections can act to magnify monetary shocks—the essence of a broad credit channel.[5] In terms of Figure 1, a rise in the risk-free rate boosts the cost of external funds by $\partial\bar{r}/\partial r^f + \partial\Omega/\partial r^f$, where the second term is the magnification effect. The increase in the risk-free rate pushes the cost of funds schedule from S_1 to S_2, and investment falls from I_1 to I_2. The fall in investment is magnified by the increase in the premium for external funds, which causes the new supply schedule to be S_2 rather than S_1'. Thus, by widening the spread between the rates on bank loans and other external debt over the risk-free rate, the broad credit channel intensifies the effect of a change in r^f induced by the monetary authority.

The motivation for our empirical analysis also is evident from Figure 1. Under a broad credit channel, the cost of external finance *relative* to internal finance rises after a monetary contraction. As we demonstrate more formally below, this shift in relative finance costs causes investment to be more sensitive to fluctuations in internal funds after a monetary contraction. As a result, under the broad credit channel, the correlation between investment and internal funds for firms facing significant capital market imperfections should be closer after a monetary tightening than during normal times.

To bring the key relationship into focus, consider the equations behind the simple supply and demand schedules in Figure 1:

(demand) $\quad r = -\kappa I + \nu$

(supply) $\quad r = \bar{r} + \Omega(B,r^f) = r^f + \theta + (\lambda r^f)(I - F),$

where $\Omega(B,r^f) = \lambda r^f B$, $B = I - F$, and the parameters κ, λ, and ν are greater than zero. With $\lambda > 0$, Ω depends positively on r^f and B. Equating supply and demand, the sensitivity of equilibrium investment (I^e) to changes in internal funds is

$$\Phi \equiv \frac{\partial I^e}{\partial F} = \frac{\lambda r^f}{\kappa + \lambda r^f}. \tag{1}$$

Furthermore, and this is crucial for our empirical analysis, the correlation Φ varies directly with r^f because

$$\frac{\partial \Phi}{\partial r^f} = \frac{\lambda\kappa}{(\kappa + \lambda r^f)^2} > 0. \tag{2}$$

The linkage between Φ and r^f reflects the steepening of the supply schedule with a rise in r^f, depicted in Figure 1 as the rotation from S_1' to S_2.

Our empirical test for the broad credit channel is straightforward: We regress investment on cash flow—the usual proxy for internal liquidity—and a set of control variables.

4. Thus, the total risk premium embedded in the cost of external funds is $\theta + \Omega$.

5. More generally, credit market imperfections magnify any macroeconomic shock that affects borrowers' moral hazard. See, for example, Greenwald and Stiglitz (1988), Bernanke and Gertler (1989, 1990), Calomiris and Hubbard (1990), and Stiglitz (1992). In this work, the magnification effect has been termed the "financial accelerator" or the "collateral effect." Our focus on the monetary transmission mechanism leads us to describe this effect as the "broad credit channel."

Equation (2) suggests that the coefficient on cash flow, Φ, should be relatively high during the period of high risk-free rates after a monetary tightening. As r^f increases, the cost premium for external funds rises, and internal funds take on special importance as a source of finance. A significant increase in Φ after a monetary contraction would provide evidence of a broad credit channel.

The power of our test is enhanced by comparing the behavior of Φ after a monetary contraction for small and large firms. Much recent research suggests that small, relatively young firms face a significant premium for external funds.[6] This premium reflects the relatively severe asymmetry of information between small firms and their suppliers of credit; indeed, small firms are almost completely closed out of securities markets and must rely on credit from banks, finance companies, and other intermediaries. In contrast, large firms generally present outsiders with a substantial track record for the purpose of assessing credit risks. Potential investors also benefit from economies in gathering information on a single large firm rather than on many small ones. These factors work to reduce the information asymmetry between large firms and outsiders, so large firms enjoy relatively free access to organized credit markets and to intermediated debt. In terms of equation (2), we expect the value of λ to be close to zero for large firms but to be significantly greater than zero for small firms. Because of this difference, we anticipate that after a monetary contraction, the cash flow coefficient will increase only for small firms.

In our empirical analysis, we also test for shifts in the importance of liquidity for investment after a monetary *easing.* As noted in the introduction, models of information problems in capital markets suggest an asymmetric effect of monetary policy. In these models, a credit constraint arises endogenously when the net worth of a potential borrower falls relative to its desired investment spending. A tightening of monetary policy, with its attendant adverse effects on net worth, can cause the credit constraint to bind. However, with a sufficient easing of policy, the constraint is relaxed, and the link between liquidity and investment returns to that normally prevailing. Once the constraint has stopped binding, a further monetary easing would be represented in Figure 1 as a downward parallel shift of S_1. Such shifts of S_1 would not change the sensitivity of investment to internal funds; thus, we anticipate no change in the cash flow coefficient after a substantial monetary easing.

6. The classic modern study is Fazzari, Hubbard, and Petersen (1988); also see Oliner and Rudebusch (1992) and Gilchrist and Zakrajšek (1996) and the references therein. For a forceful dissenting view, see Kaplan and Zingales (1995).

II. DATA DESCRIPTION

Our data set, which spans the period 1958.Q4 to 1992.Q4, was assembled from various issues of the *Quarterly Financial Report for Manufacturing, Mining and Trade Corporations (QFR),* currently produced by the Census Bureau. Based on a sample of more than 7,000 manufacturing companies, the *QFR* provides a quarterly balance sheet and income statement for the U.S. manufacturing sector as a whole and for eight size classes.[7] Arrayed from smallest to largest, the reported size classes consist of companies with total assets (at book value) of less than \$5 million, \$5 to \$10 million, \$10 to \$25 million, \$25 to \$50 million, \$50 to \$100 million, \$100 to \$250 million, \$250 million to \$1 billion, and more than \$1 billion.

The *QFR* has some advantages over other sources of firm-level data, such as Compustat, which was used by both Gertler and Hubbard (1988) and Kashyap, Lamont, and Stein (1994). First, the *QFR* permits the construction of quarterly time series over the bulk of the postwar period, rather than annual time series over a much shorter period. In addition, the *QFR* includes firms at the bottom of the size distribution,which are largely omitted from Compustat and other commercial databases.

Before undertaking our analysis, we condensed the eight *QFR* size classes into one aggregate of small firms and another of large firms. The simplest method for doing this would have been to allocate a fixed number of size classes to the small-firm group and the remainder to the large-firm group. For example, the four size classes covering companies with assets of \$50 million or less could have been combined to create the small-firm group. However, because the cutoff of \$50 million is fixed in nominal terms, this procedure would have yielded an aggregate with no stable meaning over our long sample period.

Instead, we used the following procedure, which is described in more detail in Oliner and Rudebusch (1995). Let $C_t(\gamma)$ denote the cumulation of those size classes, starting from the bottom of the size distribution, that make up γ percent of the manufacturing capital stock at time t. To construct a time series for any variable for the small-firm group, we first computed the growth rate of the variable between quarters $t-1$ and t using the data for the aggregate $C_t(\gamma)$, and then repeated this process quarter by quarter.[8] We linked the resulting growth rates to the initial level

7. As indicated by its title, the *QFR* also provides data for the mining and trade sectors; however, the absence of breakdowns by size class makes these data useless for this paper.

8. The raw QFR data, it should be noted, are riddled with breaks caused by changes in accounting conventions and sampling methods. Fortu-

of the variable to obtain the desired quarterly series (in levels) for the small-firm group. The series for the large-firm group were computed simply as the difference between the levels for total manufacturing and the small-firm group.[9]

For our analysis, we used the 15th percentile of the capital stock distribution ($\gamma = 15$) as the boundary between the two size groups. With this value of γ, the largest size class used to calculate growth rates for our small-firm group in 1970 was the \$25 to \$50 million asset class; by 1990, the marginal asset class had risen to \$100 to \$250 million. This boundary was chosen as the maximum proportion of the manufacturing capital stock that could be included in the small-firm group without stretching the definition of a "small" firm. Merely raising the cutoff to the 20th percentile would have placed companies with assets of \$250 million to \$1 billion in the small-firm group in 1990.

With one exception, the *QFR* provided every series needed to estimate our investment equations. Specifically, we used *QFR* data to construct the following variables for both small and large firms: fixed investment spending, the gross stock of fixed capital, net sales, and cash flow. Although the *QFR* does not explicitly report investment spending, we were able to impute this variable as the sum of two series that are reported in the *QFR*—namely, depreciation and the change in net capital stock. Every variable was converted to 1987 dollars using deflators from the U.S. National Income and Product Accounts (NIPAs). We then seasonally adjusted each of these constant-dollar series. The only variable we constructed from non-*QFR* data was the user cost of capital.The *QFR* does not provide the necessary information on financing costs and tax parameters; therefore, our measure of the cost of capital was taken from the Federal Reserve Board's Quarterly Econometric model. The Data Appendix provides further documentation for each series and describes the method of seasonal adjustment.

III. EVIDENCE FOR A BROAD CREDIT CHANNEL

In this section, we test for a broad credit channel by looking for changes, after a monetary shock, in the importance of internal funds for explaining investment. Our baseline investment equation takes the form

$$IK_t = \alpha' X_t + \beta CFK_{t-1} + u_t , \tag{3}$$

where IK_t denotes gross investment in period t scaled by the capital stock at the end of period $t-1$, X_t is a vector of control variables, and CFK_{t-1} denotes cash flow in period $t-1$, scaled by the capital stock at the end of the previous period. In a strictly neoclassical model with perfect capital markets, investment spending is determined by the discounted value of expected future returns to capital (e.g., Abel and Blanchard (1986)). Empirical studies have shown that the most important empirical proxy for this unobserved variable is the historical growth of sales (the so-called accelerator effect), with a smaller role for the change in the cost of capital (see, e.g., Clark (1979) and Oliner, Rudebusch, and Sichel (1995)). Thus, X_t was specified to include eight quarterly lags of the change in net sales scaled by the capital stock at the end of the prior period (ΔYK), as well as eight quarterly lags of the change in the cost of capital (ΔCOC). To capture more fully the quarterly dynamics of investment, X_t also included four lags of the dependent variable, IK. Along with the usual neoclassical determinants of investment, we included cash flow in equation (3) to capture the effects of internal liquidity on investment. The lagged value of CFK is used to reduce problems of simultaneity.

Table 1 provides the estimates of equation (3) for our aggregates of small and large firms. For large firms, the traditional determinants of investment have the expected effects on IK and explain a large fraction of its total variation. The sum of the coefficients on the lagged output terms (ΔYK) is positive and significant, and the sum of the coefficients on the lagged cost of capital (ΔCOC) is negative, although insignificant. In contrast, these two traditional determinants of capital spending explain little of the movement in small-firm investment—the coefficients are both small and insignificant. Most interestingly, the coefficient on lagged cash flow is large, positive, and highly significant for small firms but not for large firms. This pattern is consistent with the results of Fazzari, Hubbard, and Petersen (1988) and many subsequent studies, which have found a significant cash flow coefficient in panel data for firms believed a priori to have limited access to capital markets.

As described in Section I, our main test of the broad credit channel concerns differences in the coefficient on cash flow between normal periods and those of tight money. An uncontroversial measure of the stance of monetary policy is not available. Therefore, to ensure the robustness of the results, we employ three different definitions of a significant monetary tightening.

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nately, these breaks can be eliminated, as each issue of the *QFR* provides restated data for the previous four quarters. Before aggregating the individual size classes to form $C_t(\gamma)$, we level-adjusted the *QFR* data for each size class on a year-by-year basis by the ratio of the restated value to the original value of the series for the fourth quarter of that year.

9. This description is somewhat simplified in one respect. Combining the individual size classes never yielded an aggregate with exactly γ percent of the manufacturing capital stock. See Appendix A to Oliner and Rudebusch (1995) for our method of dealing with this issue.

TABLE 1

BASELINE INVESTMENT EQUATIONS

	SMALL FIRMS	LARGE FIRMS
CONSTANT	.003 (.24)	.009 (1.33)
SUM OF LAGGED *IK*	.261* (1.80)	.726** (9.63)
SUM OF LAGGED ΔYK	.013 (.18)	.219** (2.14)
SUM OF LAGGED ΔCOC	–.171 (.20)	–.357 (1.12)
CFK_{t-1}	.487** (3.02)	.095 (1.04)
$\bar{R}^2$	.285	.696
DW	1.988	2.039

NOTES: Results derived from OLS regressions over 1962.Q1 to 1992.Q4 of *IK* on a constant, four lags of *IK*, eight lags of ΔYK and ΔCOC, and one lag of *CFK*. The table entries show the estimated coefficients, with *t*-statistics (in absolute value) in parentheses.

** Significantly different from zero at the 5 percent level.

* Significantly different from zero at the 10 percent level.

The first definition is that of Romer and Romer (1989, 1994), which is based on their reading of the narrative history of the Federal Reserve. Our sample period contains five "Romer dates" of significant monetary contraction: December 1968, April 1974, August 1978, October 1979, and December 1988.

The second definition is based on large increases in the nominal federal funds rate, which is arguably the policy variable most closely targeted by the Federal Reserve over our sample (see Bernanke and Blinder (1992) and Goodfriend (1991)). Specifically, we consider a quarter in which the federal funds rate rose at least 75 basis points (on a quarterly average basis) to be the date of a monetary tightening. By this definition, there were 20 such quarters of monetary tightening during our sample period of 124 quarters. Only about half of these 20 quarters either were contemporaneous with a Romer date or occurred within 4 quarters thereafter. Thus, the dating of monetary contractions based on changes in the federal funds rate is somewhat different from that based on the Romer dates.

Although the level of the nominal funds rate reflects the stance of monetary policy, it also depends on the prevailing rate of inflation.To accommodate variations in inflation, several authors (e.g., Laurent (1988) and Goodfriend (1991)) have proposed the funds rate minus a long-term interest rate as an alternative measure of monetary policy. Thus, for our final definition, we date monetary tightenings as those quarters with increases in the term spread (defined as the funds rate minus the rate on the 10-year Treasury note) of at least 65 basis points. During our sample, there were 21 quarters during which the term spread changed by this amount (on a quarterly average basis); only thirteen of these quarters were contemporaneous with the large increases in the funds rate alone.

We consider the four quarters following the date of a monetary contraction to be a period of tight money. Let DMT_t denote a dummy variable that equals unity in the four quarters after a monetary tightening and equals zero otherwise. Then, the investment equation we estimate for each group of firms is

$$(4) \quad IK_t = \alpha' X_t + \beta CFK_{t-1} + \delta(DMT_t * CFK_{t-1}) + u_t \, .$$

Under a broad credit channel, δ should be positive for small firms, indicating that investment is more closely tied to internal liquidity during periods of monetary stringency. Furthermore, given the difference in the severity of capital market imperfections across the two size groups, we would expect δ to be essentially zero for large firms.

Table 2 displays the results of estimating equation (4) for small and large firms under each of the three definitions of tight money. The first column reports the coefficient on the cash flow variable (β), and the second column reports the coefficient on the tight-money dummy times this variable (δ). For small firms, there is always a significant increase in the cash flow coefficient after a monetary contraction, as shown in the second column. For the three different definitions of tight money, the average increase in the effect of lagged cash flow on investment (measured by $(\delta/\beta) - 1$) is about 17 percent. In contrast, for large firms, the interactions of lagged cash flow with the tight money dummies are always small and negative, and generally are insignificant. This evidence suggests that small firms perceive a rise in the relative cost of external funds after a monetary contraction, leading to greater reliance on retained earnings to fund investment projects. Large manufacturing firms, in contrast, apparently experience no increase in their relative cost of external funds after a monetary contraction. These

TABLE 2

IMPORTANCE OF CASH FLOW FOR INVESTMENT AFTER MONETARY TIGHTENING

	CFK_{t-1}	$DMT*CFK_{t-1}$	$\bar{R}^2$
AFTER ROMER DATES			
Small firms	.468**	.112**	.316
	(2.96)	(2.38)	
Large firms	.093	–.009	.693
	(1.01)	(.37)	
AFTER A LARGE INCREASE IN FUNDS RATE			
Small firms	.480**	.073**	.309
	(3.03)	(2.11)	
Large firms	.095	–.008	.693
	(1.03)	(.46)	
AFTER A LARGE INCREASE IN TERM SPREAD			
Small firms	.542**	.061*	.297
	(3.33)	(1.75)	
Large firms	.079	–.028*	.702
	(.87)	(1.74)	

NOTES: Results derived from OLS regressions over 1962.Q1 to 1992.Q4 of *IK* on a constant, four lags of *IK*, eight lags of ΔYK and ΔCOC, one lag of *CFK*, and the lag of *CFK* interacted with a dummy variable that equals one for the four quarters after a monetary tightening. There are three different definitions of a monetary tightening: a Romer date, a 75 basis point increase in the federal funds rate, and a 65 basis point increase in the spread between the funds rate and the rate on the 10-year Treasury note. The table entries show the coefficients of the cash flow terms, with *t*-statistics (in absolute value) in parentheses.

** Significantly different from zero at the 5 percent level.

* Significantly different from zero at the 10 percent level.

results provide support for the existence of a broad credit channel.

We tested the sensitivity of the results for δ in two ways. First, to see whether the estimate obtained using Romer dates hinged on just one of these dates, we reestimated equation (4) after dropping each Romer date one at a time. The estimate of δ for large firms remained insignificant in all cases. For small firms, the estimate of δ ranged from 0.087 to 0.138 and was always significant at the 10 percent level. Evidently, the results in the top part of Table 2 are not driven by a single Romer date. Our other sensitivity test used a more stringent threshold for increases in the funds rate or the term spread to define a monetary tightening. Specifically, for either variable, we dated tightenings as occurring in those quarters with at least a 100 basis point rise from the prior quarter. This alternative definition eliminated about half of the quarters of monetary tightening for both variables. For large firms, the estimates of δ were little different from those shown in Table 2. For small firms, the estimates of δ remained positive (at 0.057 for increases in the funds rate and 0.054 for increases in the term spread), but the associated *t*-statistics declined to about 1.5. Thus, the results obtained with interest rates as the signal of monetary tightening are somewhat less crisp than those obtained with Romer dates. Still, even our weakest findings are largely in line with the predictions of the broad credit channel.

One final point should be made concerning the results in Table 2. Strictly interpreted, δ should be positive only when the monetary tightening causes credit constraints to bind. A tightening that occurs from a position of loose monetary policy might leave balance sheets strong enough to prevent a rise in the premium for external funds; in this case, δ would be zero. Because our definition of a monetary tightening does not explicitly account for the initial stance of policy, the results in Table 2 could, in theory, understate the true value of δ.

However, as a practical matter, any such bias in our results probably is minor. We reach this conclusion by combining our analysis with the characterization of monetary policy in Boschen and Mills (1995). Based on their reading of historical Federal Reserve documents, Boschen and Mills constructed a monthly index of the stance of policy beginning in 1953. A value of –2 indicates the tightest stance of policy, while +2 indicates the loosest stance; zero signals neutral policy. The five Romer dates in our sample occur during quarters for which the value of the Boschen-Mills index (averaged over the three months of the quarter) is negative. In addition, the twenty quarters of tightening defined by increases in the federal funds rate all occur when the index is either zero or negative. Thus, none of these significant tightenings took place against a backdrop of initially loose policy. When the term spread is used to date tightenings, three of the tightenings do occur during quarters with a positive value for the Boschen-Mills index. However, when we constructed the *DMT* dummy variable without these three quarters, the estimate of δ for small firms was little changed from that shown in Table 2. For large firms, the estimate of δ remained negative, though it was no longer significant.

Table 3 displays the results of our tests that involved monetary easings. We estimated equation (4) for large firms and small firms, replacing the tight money dummy *DMT* with an easy money dummy (*DME*), which equals unity in

TABLE 3

IMPORTANCE OF CASH FLOW
FOR INVESTMENT AFTER MONETARY EASING

	CFK_{t-1}	$DME*CFK_{t-1}$	$\bar{R}^2$
AFTER A LARGE DECLINE IN FUNDS RATE			
Small firms	.498**	.013	.279
	(2.99)	(.26)	
Large firms	.095	–.020	.695
	(1.04)	(.83)	
AFTER A LARGE DECLINE IN TERM SPREAD			
Small firms	.484**	–.006	.278
	(2.95)	(.14)	
Large firms	.083	–.019	.696
	(.90)	(1.01)	

NOTES: Results derived from OLS regressions over 1962.Q1 to 1992.Q4 of *IK* on a constant, four lags of *IK*, eight lags of ΔYK and ΔCOC, one lag of *CFK*, and the lag of *CFK* interacted with a dummy variable that equals one for the four quarters after a monetary easing. There are two different definitions of a monetary easing: a 75 basis point decline in the federal funds rate, and a 65 basis point decline in the spread between the funds rate and the rate on the 10-year Treasury note. The table entries show the coefficients of the cash flow terms, with *t*-statistics (in absolute value) in parentheses.

** Significantly different from zero at the 5 percent level.

* Significantly different from zero at the 10 percent level.

the four quarters after a monetary easing and zero otherwise. We employ two definitions of a monetary easing: (1) a 75 basis point decrease in the funds rate and (2) a 65 basis point decrease in the term spread. By these definitions, monetary easings occur about as often as the monetary tightenings defined by the nominal funds rate or the term spread. As shown in the second column of Table 3, the coefficient on DME_t*CFK_{t-1} is never significant. That is, after a sizable monetary easing, the link between investment and cash flow remains about the same as that prevailing at other times. We interpret this result as consistent with recent theoretical work that points to the broad credit channel primarily as a factor that magnifies the impact of tight monetary policy.

As with our test based on monetary tightenings, the estimates of δ in Table 3 may depend on the initial stance of policy. Loosenings that occur from a position of tight monetary policy might not remove a binding credit constraint. The estimated value of δ then would be biased up relative to the case in which the constraint fails to bind initially. Thus, in principle, Table 3 might show δ to be zero after a monetary easing when its true value is negative. We tested for this potential bias in a manner parallel to that used for monetary tightenings. That is, we omitted the instances of monetary easing that occurred when the value of the Boschen-Mills index was negative (which indicates a tight stance of policy). The resulting estimate of δ for small firms continued to be essentially zero. In contrast, for large firms, δ became more negative and was significant at the 10 percent level. Taken literally, this result could be viewed as evidence that the broad channel operates during both monetary easings and monetary tightenings, contradicting our expectation that it comes into play only when policy is tightened. We would be inclined toward this view if the negative coefficient had been found for *small* firms, for whom there is reason to believe that a credit channel exists. However, one is hard-pressed to interpret a negative value of δ only for large firms as evidence of a reduced premium for external funds.

IV. CONCLUSION

At the heart of the broad credit channel is the proposition that internal and external funds are not perfect substitutes because of the information asymmetries that hamper the functioning of securities markets. Such information asymmetries are likely to be far more severe for small firms than for large firms. Thus, to examine the existence of the broad credit channel, we explore whether small firms respond to a monetary shock differently from large firms. Our results suggest that a broad credit channel does exist for the transmission of monetary policy and that it operates through small firms. Specifically, for these firms, we found that the association between internal funds and investment tightens significantly after a monetary contraction, indicating a scarcity of external finance. In contrast, for large firms, there was no change in the linkage between internal funds and investment after a tightening of monetary policy.

Looking ahead, we see several fruitful avenues for future research on monetary transmission. As stressed in Oliner (1996), the natural next step is to assess the importance of the broad credit channel. To our knowledge, no research has yet established that a broad credit channel accounts for much of the real effect of monetary policy actions. Equally important, our understanding of the nature and incidence of the broad credit channel is still seriously incomplete. Much further research, including detailed case studies, is needed to pin down the types of firms most affected by policy-induced changes in the supply of credit. In this regard, we see the potential for a high payoff from studies that explore (1) the lending behavior of nonbank financial institutions, principally finance and insurance companies,

(2) the effect of banking relationships on loan supply, and (3) the potential for trade credit to offset a contraction of lending by financial intermediaries.

DATA APPENDIX

This appendix documents the data series used in our empirical work and describes the method of seasonal adjustment. All series are quarterly, spanning the period 1958.Q4 to 1992.Q4.

Net sales (Y)

The *QFR* series "Net sales, receipts, and operating revenues," divided by the NIPA implicit price deflator for gross domestic product (GDP), was our measure of net sales in 1987 dollars.

Cash flow (CF)

Current-dollar cash flow equaled the sum of the following *QFR* series: "Net income retained in business" and "Depreciation, depletion, and amortization of property, plant, and equipment." This measure defines cash flow to be net of dividend payouts. We converted current-dollar cash flow to 1987 dollars with the GDP deflator.

Capital stock (K)

The *QFR* series "Property, plant, and equipment" provided the data on gross capital stock at book value through 1973. For later years, when this series was no longer published, we summed the two components of property, plant, and equipment: "Depreciable and amortizable fixed assets" and "Land and mineral rights." We converted the book value series to 1987 dollars with the use of capital stock series for the manufacturing sector published by the Bureau of Economic Analysis (BEA). Let KB_t denote BEA's series for the gross stock of equipment and nonresidential structures at book value, and let $K87_t$ denote the corresponding series in 1987 dollars. Both *KB* and *K87* are annual series, valued at year-end, and we used linear interpolation to fill in the missing quarters. We then multiplied the *QFR* capital stock series by the quarterly ratio $K87_t/KB_t$ to obtain gross capital stock in 1987 dollars.

Investment (I)

As noted in the text, we imputed a current-dollar series for investment spending from the following identity:

$$I_t \equiv (KNB_t - KNB_{t-1}) + DEP_t$$

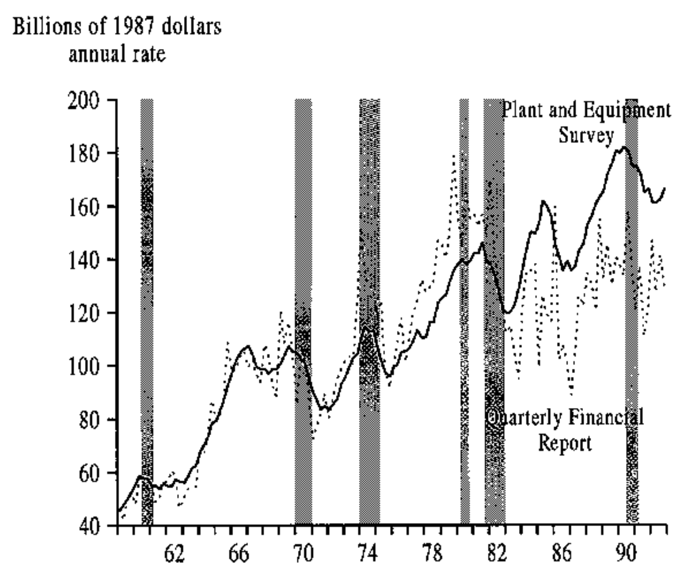
where DEP_t is the *QFR* series "Depreciation, depletion, and amortization of property, plant, and equipment," and KNB_t is the *QFR* series "Net property, plant, and equipment," which is measured at the end of period *t*. The resulting series for current-dollar investment was converted to 1987 dollars with the NIPA implicit price deflator for business fixed investment.

Figure A.1 compares the resulting investment series for total manufacturing to an independent measure of manufacturing investment from the Census Bureau's Survey of Plant and Equipment Expenditures. As shown, the two series display quite similar cyclical patterns. However, the *QFR* series is far more volatile on a quarterly basis, presumably because of inconsistencies between the measures of depreciation and net capital stock from which we imputed investment.

The *QFR* investment series for the small-firm group is even more volatile than that for total manufacturing. Moreover, the small-firm group displays a strong contemporaneous correlation between investment and the change in net sales (which is less evident either for large firms or for total manufacturing). To reduce the volatility in small-firm investment, we regressed I_t/K_{t-1} on a constant and $\Delta Y_t/K_{t-1}$,

FIGURE A.1

MEASURES OF REAL GROSS INVESTMENT IN MANUFACTURING*



* Shading shows periods of recession as dated by NBER. Current-dollar investment spending divided by implicit price deflator for business fixed investment.

and used the residuals from this regression as the dependent variable (*IK*) in our tests of the broad credit channel. For the sake of completeness, we smoothed the investment series for the large-firm group in the same way. (Note that the test results we report are very similar to those obtained when we use the unsmoothed I_t/K_{t-1} as the dependent variable in our empirical work and augment the regressors to include $\Delta Y_t/K_{t-1}$.)

Cost of capital (COC)

We relied on the cost of capital measures from the Federal Reserve Board's Quarterly Econometric Model. Specifically, we used a weighted average of the real cost of capital for equipment and for nonresidential structures:

$$COC_t = \omega_t\,(RTPD_t/PXB_t) + (1-\omega_t)(RTPS_t/PXB_t),$$

where *RTPD* is the current-dollar rental cost for producers' durable equipment; *RTPS* is the corresponding rental cost for nonresidential structures excluding petroleum drilling, mining, and public utility structures; and *PXB* is the implicit price deflator in the NIPAs for gross private domestic business product. *RTPD* and *RTPS* capture the effects of financing costs, depreciation, and corporate tax provisions. *RTPD*, *RTPS*, and *PXB* were taken directly from the Quarterly Model, and further description of these variables can be found in Brayton and Mauskopf (1985). The weight ω_t equals $IE_t/(IE_t+IS_t)$, where *IE* is investment in producers' durable equipment and *IS* is investment in nonresidential structures excluding petroleum drilling, mining, and public utility structures. *IE* and *IS*, measured in 1987 dollars, are from the NIPAs.

Seasonal adjustment

We seasonally adjusted the deflated series for investment, capital stock, net sales, and cash flow by regressing the natural log of each variable on a constant, a set of quarterly dummy variables, and a cubic time trend. The seasonally adjusted measure of each variable was calculated as the original series divided by the exponent of the estimated coefficients on the quarterly dummies. This regression was estimated over a rolling, centered 11-year window, which allows the seasonal factors to vary smoothly over time. For example, the seasonal factors for 1980 were based on estimates from a regression spanning 1975.Q1 to 1985.Q4, while the seasonals for 1981were generated from a regression spanning 1976.Q1 to 1986.Q4. For the first five years of the sample, we truncated the left-hand side of the window; similarly, for the final five years of the sample, we truncated the right-hand side of the window.

We did not seasonally adjust the series for the cost of capital, as the basic components of that series are either terms that have no seasonal variation or price data from the NIPAs that were seasonally adjusted by BEA.

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