Is There a Bank Lending Channel for Monetary Policy?

Stephen D. Oliner and
Glenn D. Rudebusch

Chief, Capital Markets Section, Board of Governors of the Federal Reserve System; Research Officer, Federal Reserve Bank of San Francisco. We thank Ben Bernanke, Lee Crabbe, Mark Gertler, Simon Gilchrist, Anil Kashyap, David Romer, and David Wilcox for helpful comments and Tom Brennan for excellent research assistance.

Using data for the U.S. manufacturing sector, we investigate the existence of a credit channel for monetary policy that operates through bank lending. Our test is based on the behavior of the mix of bank and nonbank debt after a shift in monetary policy. We allow for a differential response to monetary policy of the debt mix for small firms and large firms, and we account for movements in all *major types of nonbank debt (including trade credit and long-term debt). In contrast to earlier work, we find no support for a bank lending channel.*

The nature of the monetary transmission mechanism—that is, the means by which monetary policy affects the economy—has long been debated. The most widely accepted channel for monetary policy depends on the interest rate sensitivity of spending. In essence, the actions of the monetary authority affect consumption and investment through changes in interest rates.[1] In contrast to (or at times in conjunction with) this interest rate transmission mechanism, many authors have focused on a *bank lending channel* for monetary policy. This lending channel operates when central bank actions affect the supply of loans from depository institutions ("banks") and, in turn, the real spending of bank borrowers.

Two conditions must be satisfied for a bank lending channel to operate: (1) banks do not fully insulate their supply of loans from changes in reserves induced by the monetary authority, and (2) borrowers cannot fully insulate their real spending from changes in the availability of bank loans. When the first condition holds, a tightening of monetary policy directly constrains bank lending. That is, after a fall in reserves, banks do not leave their stock of outstanding loans unchanged by simply rearranging their portfolio of other assets and liabilities; instead, the volume of bank loans declines as part of the adjustment. The second condition implies that bank loans are an imperfect substitute for other sources of finance for businesses. When this condition holds, firms cannot costlessly replace losses of bank loans with other types of finance, such as commercial paper, trade debt, or loans from finance companies. Simply put, these two conditions embody the notion that bank loans are special, reflecting their limited substitutability with other items on the balance sheets of both banks and nonfinancial firms.

Empirical work on the existence of a bank lending channel generally has focused on the correlations among aggregate output, bank debt, and indicators of monetary policy.[2] This work, however, is plagued by the problem of identifying shifts in loan demand from shifts in loan supply. Evidence that both output and bank loans fall after a

1. For a recent empirical study that solidly supports this channel, see Duguay (1994).

2. See, for example, King (1986), Romer and Romer (1990), Bernanke and Blinder (1988, 1992), and Ramey (1993).

monetary tightening does not identify whether the decline in loan volume reflects a constriction of loan supply or a dampening of loan demand through the traditional interest rate mechanism.

Kashyap, Stein, and Wilcox (1993), henceforth KSW, cut through this identification problem by examining *relative* movements in bank loans and commercial paper after monetary shocks. The intuition is straightforward: A monetary shock that operates through the usual interest rate channel lowers the demand for *all* types of finance, while a monetary shock that operates through a bank lending channel affects *only* the supply of bank debt. KSW find that bank loans outstanding decline relative to commercial paper after a monetary contraction, which they take as evidence for a bank lending channel.

We examine in more detail the evidence from the relative movements of bank and nonbank debt. First, we analyze the mix of bank and nonbank debt separately for small and large firms. As is well known, financing patterns differ sharply across these two groups. Only the very largest corporations issue significant amounts of commercial paper; conversely, small firms issue essentially no commercial paper, depending instead on banks as their primary source of finance. With heterogeneous firms, a given movement in the aggregate debt mix can reflect any number of developments at the firm level. We show that a full understanding of the mix can be obtained only by accounting explicitly for heterogeneity.

Second, our analysis accounts for movements in all types of debt finance. A limitation of KSW's analysis—which the authors themselves recognized—was the use of commercial paper as the only form of nonbank debt. In fact, firms obtain nonbank finance from many sources, including the issuance of longer-term securities, loans from finance and insurance companies, and trade credit. A narrow focus on commercial paper may exclude important shifts in financing patterns after a change in monetary policy. If, for example, firms substitute between commercial paper and another source of nonbank finance, a narrow measure of the finance mix will change even though the actual mix of bank and nonbank debt has not been altered.

Our results provide no support for a bank lending channel. Using data for the U.S. manufacturing sector, we find almost no evidence that a monetary shock changes the composition of bank and nonbank debt for either small firms or large firms. Rather, the main effect of a monetary contraction is to redirect *all types* of credit from small firms to large firms. This shift produces the decline in the aggregate bank-loan share observed by KSW, because large firms rely less heavily on bank debt than do small firms. Thus, given the absence of substitutions away from bank debt at the firm level, movements in the aggregate debt mix do not signal the existence of a bank lending channel.

This result, however, does not rule out other forms of the credit channel. In particular, much recent work has posited a propagation mechanism for monetary policy that operates through total credit, with no special role for loans from depository institutions. This *broad* credit channel emphasizes that information asymmetries between borrowers and lenders may restrict the supply of debt from *all* sources after a monetary shock. Given the relative severity of information problems for small firms, any constriction of loan supply likely would hit these firms the hardest. Our main finding—that monetary contractions induce a widespread shift in lending away from small firms—appears consistent with the operation of a broad credit channel. However, a full investigation of such a credit channel is beyond the scope of this paper.[3] Here, we tackle a narrower question—namely, is there evidence for a credit channel that operates primarily through the supply of bank loans? We find no such evidence.

This paper is part of a rich literature concerning the differential effects of monetary policy on small and large borrowers. Early research on this topic includes Meltzer (1960), Bach and Huizenga (1961), Siber and Polakoff (1970), and Ou (1979). Among more recent work, our paper is most closely related to Gertler and Gilchrist (1993, 1994). Both their work and ours uses the *Quarterly Financial Report for Manufacturing Corporations (QFR)* as the basic data source, and we both examine movements in debt stocks, among other variables. Our paper contributes to the literature by exploring in depth the information conveyed by policy-induced changes in the debt mix, an inquiry not found in the related work.

The paper proceeds as follows. The next section briefly reviews the bank lending channel for monetary policy. Then, Section II describes the data set we constructed from the *QFR*. Section III presents the various measures of the mix of bank and nonbank debt that we employ. Section IV analyzes the response of the mix of short-term debt, including trade credit, to monetary shocks. We conduct a similar analysis in Section V for the mix of total debt. Section VI summarizes the results.

I. OVERVIEW OF THE BANK LENDING CHANNEL

Because the bank lending channel depends crucially on the behavior of banks, an analysis of this channel should

3. For assessments of the broad credit channel based on the differential behavior of small and large firms, see Gertler and Gilchrist (1993, 1994) and Oliner and Rudebusch (1994).

begin by examining movements in bank assets and liabilities after a shift in monetary policy. KSW supplement this analysis by characterizing movements in the mix of bank and nonbank debt on the balance sheets of nonfinancial firms. In this section, we outline the operation of the bank lending channel and describe the information provided by both sets of balance sheets.

Changes in Bank Balance Sheets

To understand the bank lending channel, consider the simplified bank balance sheet shown below. The assets in this balance sheet consist of reserves, loans, and market securities, while the liabilities consist of demand deposits and time deposits. A fraction τ of demand deposits must be held in reserves, but there is no reserve requirement on time deposits.[4]

A SIMPLIFIED BANK BALANCE SHEET

ASSETS	LIABILITIES
Reserves	Time Deposits
Loans	Demand Deposits
Securities	

One necessary condition for the bank lending channel to operate is that the supply of bank loans must decline after a reduction in reserves engineered by the monetary authority. That is, banks must not fully insulate their supply of loans by simply rearranging their portfolio of other assets and liabilities. The bank's range of possible reactions to a monetary shock can be seen by reference to the simplified balance sheet. Consider a monetary contraction undertaken as an open market sale of securities by the central bank to the banking system, which raises bank holdings of securities by one dollar and lowers bank reserves by the same amount. Assuming no excess reserves, the fractional reserve requirement mandates that demand deposits fall by $1/\tau$ dollars. Then, to enforce the balance sheet identity, time deposits must rise by $1/\tau$ dollars or, on the asset side, loans and securities together must fall by the same amount. The bank lending channel requires that loans bear a substantial portion of this balance sheet adjustment.[5]

This analysis of the bank's balance sheet highlights two reasons why a bank lending channel for monetary policy could fail to operate. First, as stressed by Romer and Romer (1990), during a period of monetary stringency, banks could offset the shrinkage of demand deposits by obtaining more time deposits, especially by issuing more certificates of deposit (CDs). If banks can use zero-reserve liabilities, such as CDs, to adjust their balance sheets, then loan supply need not be affected by a decline in reserves. Second, banks may be able to reduce their holdings of government and private securities to insulate loans from the impact of tight money. Some degree of insulation is likely because banks hold securities, in part, for their liquidity.

The actual response of bank balance sheets to monetary shocks has been documented with aggregate data by Bernanke and Blinder (1992). They find that six months after a monetary contraction, holdings of securities and deposits have fallen sharply, while the amount of outstanding bank loans has changed little. In contrast, two years after the shock, loans have moved down almost one-for-one with the reduction in deposits, while securities have been rebuilt nearly to their original level. The eventual decline in loans following a monetary tightening may represent a restriction on loan supply via a bank lending channel. However, the pattern uncovered by Bernanke and Blinder also can be explained by the effects of the traditional interest rate channel, which induces a drop in loan demand and thus in the observed volume of bank loans. Accordingly, in assessing whether a bank lending channel exists, the evidence from bank balance sheets—while suggestive—is ultimately inconclusive.[6]

Changes in Firm Balance Sheets

KSW argued that the identification problem plaguing the evidence from bank balance sheets could be solved by comparing the movements of bank loans and commercial paper on firms' balance sheets after a monetary shock. As noted in the introduction, KSW's key assumption is that the usual interest rate channel would reduce firms' demand for bank loans and other debt to an equal degree. Thus, a decline in bank loans relative to other debt outstanding could be taken as evidence of a constriction in the supply of bank loans.

4. Before 1991, banks were required to hold reserves on some time deposits, but the associated reserve requirements always were lower than those on demand deposits.

5. Our discussion and analysis are focused only on this one necessary condition for a bank lending channel. As noted in the introduction, the other necessary condition is that bank loans and other sources of finance must not be perfect substitutes for all borrowers.

6. Bernanke and Blinder's evidence actually suffers from a second identification problem. Because bank loans are the only form of debt examined in their study, they cannot determine whether the response of bank loans to monetary policy differs from the response of other forms of debt. Thus, the evidence they present cannot distinguish the bank lending channel from what we have called the broad credit channel. Also, see Morris and Sellon (1995) for a very different and negative assessment of the bank balance sheet evidence for a bank lending channel.

KSW formalized this idea in a simple model in which a firm selects the optimal mix of bank and nonbank debt to minimize its cost of debt finance. This cost has two components. The first is the direct interest payment on the firm's stock of bank debt (B) and nonbank debt (N), which equals $r_B B + r_N N$, where r_B and r_N are the respective interest rates.[7] The second component, which partly offsets these interest costs, is the "relationship" benefit (R) that the firm derives from bank borrowing.[8] KSW specify that

$$(1) \qquad R = f(B/D)^*D \,,$$

where D represents total debt ($D = B + N$) and $f(\bullet)$ is an increasing concave function ($f' > 0$ and $f'' < 0$). That is, for a given amount of total debt, the relationship benefit rises with the bank loan share, subject to diminishing returns. Using (1), the firm's choice problem is

$$\min_{B,N} \; C = r_B B + r_N N - f(B/D)D \quad \text{s.t. } B + N = D.$$

The first-order conditions for B and N imply:

$$(2) \qquad r_B - r_N = f'(B/D).$$

Because f' is positive, the interest rate spread $r_B - r_N$ must be greater than zero for (2) to hold. Now, let MP denote the stance of monetary policy and differentiate (2) with respect to MP, yielding

$$(3) \qquad \frac{d(B/D)}{dMP} = \frac{1}{f''(B/D)} \frac{d(r_B - r_N)}{dMP}.$$

Equation (3), the main result from KSW's model, shows that the optimal debt mix, B/D, moves inversely with the spread between the interest rates on bank loans and nonbank debt (because $f'' < 0$). Thus, if a tightening of monetary policy reduces the supply of bank loans relative to nonbank loans, the spread of r_B over r_N would widen, causing the optimal debt mix B/D to fall. Conversely, if a monetary contraction had no effect on relative loan supplies, both the spread $r_B - r_N$ and the debt mix B/D would be unchanged.[9] This linkage between $r_B - r_N$ and B/D is what makes the latter an informative signal about constraints on the supply of bank loans.

In their empirical work, KSW find that a tightening of monetary policy induces a drop in the debt mix of nonfinancial firms, measured as the ratio of bank debt outstanding to the sum of bank debt plus commercial paper. Guided by equation (3), KSW interpret this drop in the debt mix as indicating a restriction of bank loan supply, consistent with the existence of a bank lending channel.[10] In the analysis below, we reconsider KSW's interpretation of this evidence.

II. DATA DESCRIPTION

We assembled our data set, which spans the period 1973.Q4 to 1991.Q2, from various issues of the *Quarterly Financial Report for Manufacturing, Mining and Trade Corporations (QFR)*.[11] The *QFR* has been published since 1982 by the Census Bureau and before then was published by the Federal Trade Commission and the Securities and Exchange Commission. The *QFR* provides a quarterly balance sheet and income statement for the manufacturing sector as a whole and for eight size classes based on a sample of more than 7,000 manufacturing companies.[12] The reported size classes consist of corporations 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.

We condensed the eight asset size classes into one aggregate of "small" firms and another of "large" firms. Because the size classes reported in the *QFR* are defined in terms of fixed nominal cutoffs, these classes have no consistent meaning over a span of twenty-odd years. We created more meaningful aggregates of small and large firms through the following procedure. 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.[13] For example, $C_t(\gamma)$

7. KSW's model specified commercial paper to be the only form of nonbank debt; however, their model applies as well to a broader measure of nonbank debt.

8. One aspect of this relationship benefit is the monitoring done by the bank, which has value because it signals the firm's creditworthiness to all lenders.

9. See Hall and Thomson (1992) for further analysis of the effect of a monetary tightening on the interest rate spread. They show that the spread unambiguously widens when the bank lending channel is at work—that is, when this channel deepens the contractionary effects of a monetary tightening.

10. KSW also find that movements in the aggregate debt mix help explain fluctuations in investment spending, which they interpret as supporting the second necessary condition for the bank lending channel (i.e., that some firms depend on bank credit to fund spending).

11. The details of our procedures are provided in Appendix A.

12. 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 the mining and trade data useless for this paper.

13. We define the capital stock to be the sum of plant, equipment, land, and mineral rights—the usual measure of fixed capital on financial statements.

might include all asset size classes up to and including the $25 to $50 million class. To construct a time series for any variable for the small-firm group, we first computed the growth rate of this variable between quarters t–1 and t using the data for the aggregate $C_t(\gamma)$. Repeating this process quarter by quarter yielded a time series of growth rates. We linked these growth rates to an initial level of the variable to obtain the desired quarterly series (in levels) for the small-firm group. The data series for the large-firm group were computed simply as the difference between the quarterly levels for total manufacturing and the small-firm group.[14]

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, this marginal size class had risen to the $100 to $250 million class, reflecting the upward shift of the nominal size distribution.[15] By allowing the marginal size class in $C_t(\gamma)$ to rise over time, we control for the inflation of nominal price levels.

Although the *QFR* is a rich source of information on the cyclical behavior of manufacturing, it was not designed to provide consistent series over time. Rather, the *QFR* is a sequence of cross-sectional snapshots of the manufacturing sector. If one naively links these quarterly snapshots, the resulting time series will be contaminated by frequent breaks. These discontinuities mainly reflect changes over time in the accounting conventions and sampling methods used by the *QFR*. Fortunately, these breaks can be eliminated: Each issue of the *QFR* provides restated estimates for the previous four quarters, which enables one to adjust the data prior to a level jump. We level-adjusted every series for a given year by the ratio of the restated to the original value of the series for the fourth quarter. We then aggregated these adjusted series across size classes by the method described above, converted the aggregated series to constant 1987 dollars, and seasonally adjusted the resulting constant-dollar series.

The *QFR* disaggregates debt into bank loans, commercial paper, and other nonbank debt. Bank debt and other nonbank debt, in turn, are each split by maturity into short-term debt (which has an original maturity of one year or less) and long-term debt. The *QFR* also provides data on trade credit—that is, accounts payable and accounts receivable. Although not classified as debt in the *QFR*, accounts payable are, in fact, an important form of short-term debt. Accordingly, some of our measures of the debt mix include accounts payable (which we denote hereafter by "trade debt").

All our debt series represent gross liabilities for a certain group of firms without regard to the identity of the lender. For example, our series for small-firm trade debt is the total trade debt owed by such firms to all suppliers, which may include other small manufacturing firms. As a result, an increase in this trade-debt series may not represent a net rise in funds provided to the small-firm group. Thus, debt mix variables that include trade debt potentially could give a distorted picture of relative credit supplies. In light of this potential problem, we examine whether our results are sensitive to the inclusion of trade debt.[16]

III. Measuring the Mix of Bank and Nonbank Debt

Before we examine the response of the mix of bank and nonbank debt to monetary shocks, it is useful to describe the range of nonbank financing options available to small and large firms and the relative importance of bank lending. Table 1 summarizes the composition of debt for our two groups of manufacturing firms in 1980, a representative year from our sample. The top part of the table shows the amount outstanding in billions of 1987 dollars for each type of debt, while the bottom part gives the definitions and the levels of the various mix variables that we examine below.

Focus first on short-term debt, which consists of trade debt (*TD*), commercial paper (*CP*), short-term bank loans (*B*) and short-term "other" debt (*O*). As can be seen, trade debt is the dominant form of short-term finance for both small and large firms, accounting for about two-thirds of total short-term debt for each group. However, apart from

14. This description is overly simplified in one respect. Combining the individual size classes reported in the *QFR* never yielded an aggregate with exactly γ percent of the manufacturing capital stock. See Appendix A for our method of dealing with this issue.

15. Although our small-firm group accounts for a relatively modest share of the total capital stock in manufacturing, increasing the value of γ would shift some rather large firms into the resulting aggregate. Indeed, raising γ just to the 20th percentile would yield a small-firm group that included companies with assets of $250 million to $1 billion in 1990.

16. The likelihood that intra-group lending relationships will exist is much greater for trade debt than for other types of debt simply because manufacturing firms serve as suppliers of inputs to one another. However, one cannot rule out intra-group holdings of commercial paper or other nonbank debt, a problem that would affect KSW's commercial paper series as well as ours. In contrast, our data on bank debt is free of this problem because the lender clearly is outside the manufacturing sector.

TABLE 1

COMPOSITION OF TOTAL DEBT FOR MANUFACTURING COMPANIES IN 1980

	SMALL FIRMS	LARGE FIRMS
BILLIONS OF 1987 DOLLARS		
Total debt	139.2	635.9
Trade debt (*TD*)	44.0	138.3
Bank loans (*TB*)	55.1	100.2
Short-term (*B*)	19.5	24.7
Long-term	35.6	75.5
Commercial paper (*CP*)	.1	19.6
Other debt (*TO*)	40.0	377.8
Short-term (*O*)	3.8	12.9
Long-term	36.2	364.9
Total short-term debt	67.4	195.5
Total long-term debt	71.8	440.4
RATIO		
Measures of short-term debt mix		
$MIX_{KSW} = B/(B+CP)$	.99	.56
$MIX_O = B/(B+CP+O)$	.83	.43
$MIX_{TD} = B/(B+CP+O+TD)$	.29	.13
Measures of total debt mix		
$TMIX_O = TB/(TB+CP+TO)$	.58	.20
$TMIX_{TD} = TB/(TB+CP+TO+TD)$	.40	.16

NOTE: Authors' calculations using *Quarterly Financial Report*. Short-term debt is defined as debt with an original maturity of less than one year; long-term debt is debt with an original maturity of more than one year.

this common reliance on trade debt, the short-term financing patterns of the two groups differ substantially. In particular, small firms depend on bank loans for a much larger fraction of their total short-term credit than do large firms. Furthermore, small firms issue essentially no commercial paper, while large firms have almost as much commercial paper outstanding as they have short-term bank loans. Finally, both types of firms do have access to other sources of short-term nonbank debt (O),such as loans from finance and insurance companies.

Using these short-term instruments, we construct three measures of the mix of bank and nonbank debt. The first measure is simply the ratio of short-term bank debt to the sum of this debt plus commercial paper; we denote this measure by $MIX_{KSW} \equiv B/(B+CP)$ because it follows the definition used by KSW. However, as we just discussed, MIX_{KSW} omits several important nonbank sources of short-term debt. Accordingly, we employ broader measures of the mix to capture a wider range of potential substitutions between bank and nonbank finance. One such measure is the ratio of short-term bank debt to total short-term debt (excluding trade debt), which we denote by $MIX_O \equiv B/(B+CP+O)$. Finally, to allow for an even wider range of substitutions, our third short-term mix variable is defined to include trade debt: $MIX_{TD} \equiv B/(B+CP+O+TD)$. The inclusion of trade debt in the finance mix is justified both by its relative importance as a source of short-term credit and by the suggestion of many observers—including KSW—that trade debt functions as a leading substitute for short-term bank loans.[17]

We now shift our attention to long-term debt, defined as debt with an original maturity of more than one year. As noted above, the *QFR* reports the long-term component of both bank loans and "other" debt (commercial paper and trade debt are exclusively short term). The top part of Table 1 highlights the importance of long-term debt as a source of funding for manufacturers. Long-term instruments constitute the bulk of total bank debt (*TB*) and total "other" debt (*TO*) for both small and large firms. Indeed, long-term debt accounts for just over half of the total debt of these small firms and more than two-thirds of the total debt of the large firms.

Although KSW and others in this literature have focused on short-term debt, substitutions between bank and nonbank debt may well involve instruments with maturities longer than one year.[18] If such substitutions do occur, the mix of short-term debt alone may not fully characterize relative loan supplies. In fact, there is direct evidence that firms consider bank debt to be a substitute for nonbank

17. This view dates back at least to Meltzer (1960), who argued that the bank lending channel was limited in scope because trade debt extended by large firms could cushion any fall in bank lending to small firms.

18. Note that the use of a one-year original maturity to distinguish short-term debt from long-term debt is simply an accounting definition used on balance sheets; it has little economic significance.

debt with maturities greater than one year. Following SEC regulations, the prospectus for a public bond offering must disclose the intended use of the proceeds. Frequently, firms state that the funds will be used to refinance bank debt. For example, in a study of speculative-grade (junk) bonds issued from 1983 to 1991, Fridson and Weiss (1992) found that almost a quarter of all proceeds were earmarked for paying down bank debt.

Given the importance of long-term debt and the likelihood of substitutions across the maturity spectrum, we consider two measures of the mix of total debt, displayed in the bottom two rows of Table 1. These two measures are $TMIX_O \equiv TB/(TB+CP+TO)$, the ratio of total bank loans to total debt excluding trade debt, and $TMIX_{TD} \equiv TB/(TB+CP+TO+TD)$, the corresponding ratio that includes trade debt.

IV. Monetary Policy and the Mix of Short-Term Debt

This section examines movements in the mix of short-term debt stocks to assess whether monetary policy directly constrains the supply of bank lending. To preview our results, we find no evidence—for either small or large firms—that bank loans decline as a share of short-term debt after a monetary contraction. This finding casts doubt on the operation of an important bank lending channel. For aggregate manufacturing, we find that MIX_{KSW} and MIX_O do respond significantly to monetary shocks. However, these aggregate results are driven by a reallocation of both bank debt and nonbank debt toward large firms after a monetary shock, which reflects a tightening of all types of credit for small firms, not a constriction of bank lending alone.

The Response of the Debt Mix to Monetary Shocks

Our analysis of the effect of monetary policy on the debt mix follows the methodology in KSW.[19] We regressed the change in either MIX_{KSW}, MIX_O, or MIX_{TD} on four quarterly lags of itself, eight lags of a monetary policy indicator (denoted MP), and a constant:[20]

$$(4) \quad \Delta MIX_{j,t} = c + \sum_{i=1}^{4} \alpha_i \Delta MIX_{j,t-1} + \sum_{i=1}^{8} \beta_i MP_{t-1} + u_{j,t} \quad (j = KSW,\ O,\ TD).$$

Table 2 reports the sum of the β_i coefficients, as well as the t statistic for the test of the significance of this sum.[21] To ensure robustness, we employ two indicators of the stance of monetary policy: changes in the federal funds rate, the indicator recommended by Bernanke and Blinder (1992), and a dummy variable for the dates selected by Romer and Romer (1989, 1994) as marking the beginning of an anti-inflationary tightening of monetary policy by the Federal Reserve. The Romer dummy variable equals one in the quarter of the "Romer date" and zero otherwise. Our sample period contains four such Romer dates: April 1974, August 1978, October 1979, and December 1988.

Under a bank lending channel, we would expect the various measures of mix to decline in response to a monetary contraction. As shown in the upper block of Table 2, both MIX_{KSW} and the broader measure MIX_O decline for the aggregate manufacturing sector after a Romer date or a positive innovation in the federal funds rate. These declines in mix have marginal significance levels ranging from about 0.04 to 0.15 in a two-sided t test. These results are largely consistent with those obtained by KSW, who found—based on data for the nonfinancial business sector—that MIX_{KSW} declined significantly after a tightening of monetary policy.

Yet, when we apply this analysis of MIX_{KSW} and MIX_O to small and large firms, the result are far less supportive of a bank lending channel. For small firms, the only significant change in either mix variable is a *rise* in MIX_{KSW}, which suggests a shift *toward* bank finance. And for large firms, only the decline in MIX_{KSW} after a Romer date is close to statistical significance. These results for small and large firms cast doubt on KSW's story of a substitution at the firm level between bank debt and nonbank debt. Adding trade debt to the measure of mix further weakens the case for a bank lending channel. As shown in the final column of Table 2, MIX_{TD} never changes significantly after a monetary shock.

Table 3 examines the movements in the various types of short-term debt that underlie the results for the debt mix shown in Table 2. The results in Table 3 were derived by estimating equation (4), with the log difference of each

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19. This methodology has been criticized by some for failing to distinguish between endogenous and exogenous policy actions. We also conducted a similar analysis with a VAR in Oliner and Rudebusch (1995), which is not subject to this criticism, and we obtained similar results.

20. This specification is essentially the same as KSW's "bivariate" specification. Our results, however, were not materially different when we added lags of the growth of real GDP, as in KSW's "multivariate" specification.

21. We also performed exclusion tests, which test whether the β_i coefficients are jointly zero. These tests were no more favorable to the bank lending channel than the results we report.

TABLE 2

MIX OF SHORT-TERM DEBT STOCKS: RESPONSE TO MONETARY POLICY

	MIX_{KSW} $B/(B+CP)$	MIX_O $B/(B+CP+O)$	MIX_{TD} $B/(B+CP+O+TD)$
TOTAL MANUFACTURING			
Romer dates	–.072 (1.61)	–.068** (2.07)	–.001 (.06)
Federal funds rate	–.011* (1.68)	–.006 (1.43)	.002 (.99)
LARGE FIRMS			
Romer dates	–.070 (1.50)	–.011 (.35)	.003 (.18)
Federal funds rate	–.005 (.83)	.001 (.30)	.002 (.84)
SMALL FIRMS			
Romer dates	.004 (.98)	–.015 (.75)	–.014 (.94)
Federal funds rate	.002** (2.62)	–.002 (.64)	.003 (1.40)

NOTES: Results are derived from an OLS regression over 1975.Q2 to1991.Q2 of each mix variable on a constant, four quarterly lags of itself, and eight quarterly lags of the monetary policy indicator.All variables except the dummy for Romer dates were differenced. Each table entry shows the sum of the coefficients on the lags of the monetary policy indicator, with the t statistic (in absolute value) in parentheses.
** Significantly different from zero at the 5 percent level.
* Significantly different from zero at the 10 percent level.

debt variable replacing the change in the debt mix. As in Table 2, we report the sum of the coefficients on eight lags of each monetary policy indicator, as well as the associated t statistic. The left side of Table 3 reports the results for bank loans and the other components of short-term debt, while the right side reports analogous results for the debt aggregates serving as the denominator of MIX_{KSW}, MIX_O, and MIX_{TD}, respectively.

Focusing first on total manufacturing, the movements in the individual debt components are generally insignificant. Nonetheless, the point estimates indicate a step-up in the stock of commercial paper (*CP*) and a smaller rise in other nonbank debt (*O*), combined with little change in bank loans outstanding. The sizable increase in commercial paper after a monetary contraction drives down both MIX_{KSW} and MIX_O for aggregate manufacturing, producing the results displayed in Table 2. These patterns for bank loans and commercial paper in aggregate manufacturing are broadly in line with those obtained by KSW for the total nonfinancial business sector. Given this similarity, we believe that the insights developed in the remainder of the paper can be generalized to the broader sector studied by KSW.

The results in Table 3 also reveal important differences in the behavior of small and large firms. For large manufacturers, short-term debt outstanding—both bank and nonbank—tends to expand after a monetary contraction, while these debt stocks generally decline for small manufacturers.[22] Although the changes in debt stocks for both

22. Importantly, this pattern also holds for trade debt. Thus, we find no evidence that small firms make greater use of trade debt to offset potential constraints on the supply of bank loans.

TABLE 3

SHORT-TERM DEBT STOCKS: RESPONSE TO MONETARY POLICY

	Individual Types of Debt				Total of Bank Loans Plus		
	Bank Loans (*B*)	Commercial Paper (*CP*)	Other Debt (*O*)	Trade Debt (*TD*)	*CP*	*CP+O*	*CP+O+TD*
TOTAL MANUFACTURING							
Romer dates	.008	.139	.048	.001	.013	.053	.010
	(.10)	(.65)	(.23)	(.02)	(.13)	(.59)	(.22)
Federal funds rate	.006	.076**	.023	–.014*	.013	.026	–.000
	(.47)	(2.15)	(.74)	(1.83)	(.82)	(1.67)	(.00)
LARGE FIRMS							
Romer dates	.073	.139	.071	.016	.051	.099	.039
	(.53)	(.64)	(.28)	(.34)	(.39)	(.83)	(.69)
Federal funds rate	.027	.079**	.019	–.013	.027	.046**	.012
	(1.20)	(2.17)	(.50)	(1.48)	(1.16)	(2.10)	(.97)
SMALL FIRMS							
Romer dates	–.105	–.948*	–.095	–.057	–.110	–.093	–.058
	(1.54)	(1.72)	(.67)	(1.41)	(1.62)	(1.55)	(1.58)
Federal funds rate	–.006	–.166**	.007	–.018**	–.006	–.006	–.016**
	(.63)	(2.22)	(.31)	(2.99)	(.67)	(.66)	(2.82)

NOTES: Results derived from an OLS regression over 1975.Q2 to 1991.Q2 of the log of each debt variable on a constant, four quarterly lags of itself, and eight quarterly lags of the monetary policy indicator. All variables except the dummy for Romer dates were differenced. Each table entry shows the sum of the coefficients on the lags of the monetary policy indicator, with the *t* statistic (in absolute value) in parentheses.
** Significantly different from zero at the 5 percent level.
* Significantly different from zero at the 10 percent level.

small firms and large firms are mostly insignificant, the *difference* between the two groups usually is significant. Thus, we observe a widespread reallocation of short-term credit from small firms to large firms in response to a tightening of monetary policy, a pattern also highlighted by Gertler and Gilchrist (1993, 1994).[23] In addition, our results are consistent with those presented in Morgan (1992) and Lang and Nakamura (1992). During periods of tight money, Morgan found an increase in the share of bank loans made under pre-existing loan commitments, while Lang and Nakamura found an increase in the share of bank loans carrying an interest rate less than prime plus 1 percent. Both characteristics are generally associated with loans to large firms.

To sum up, the *QFR* data provide strong evidence of a broadly based reallocation of lending toward large firms after a monetary contraction. In contrast, there is little sign of a substitution away from bank debt for either small or large firms. Hence, the results in Tables 2 and 3 cast doubt on the existence of a credit channel operating primarily through bank lending.

Interpreting the Aggregate Mix Results

How can we reconcile the finding of no significant decline in any mix variable for either small or large firms after a

23. In their analysis of the *QFR* data, Gertler and Gilchrist used net sales rather than capital stock as the yardstick for defining the small-firm group; they also employed a somewhat different procedure from ours for seasonal adjustment. Despite these differences, their results line up with ours, indicating that the observed reallocation of credit toward large firms after a monetary contraction is robust to alternative treatments of the *QFR* data.

monetary tightening with the evidence that both MIX_{KSW} and MIX_O decline significantly at the aggregate level? To address this question, we express the debt mix for aggregate manufacturing (MIX^A) in terms of the mix for small firms (MIX^S) and large firms (MIX^L):

$$(5) \qquad MIX^A \equiv \frac{B^A}{D^A} = \left(\frac{D^S}{D^A}\right)\left(\frac{B^S}{D^S}\right) + \left(\frac{D^L}{D^A}\right)\left(\frac{B^L}{D^L}\right) = \theta^S MIX^S + \theta^L MIX^L$$

where the superscripts *A, S,* and *L* denote aggregate manufacturing, small firms, and large firms, respectively, D^i denotes total short-term debt for group i (i=A,S,L), and $\theta^S = D^S/D^A$ and $\theta^L = D^L/D^A$ are the shares of total short-term manufacturing debt held by small firms and large firms, respectively. By appropriately defining total debt, D, the MIX measures in equation (5) can represent either MIX_{KSW}, MIX_O, or MIX_{TD}; for example, equation (5) would be a decomposition of MIX_O if $D = B+CP+O$.

Equation (5) implies that

$$(6) \qquad \Delta MIX^A \approx \theta^S \Delta MIX^S + \theta^L \Delta MIX^L + \Delta\theta^S MIX^S + \Delta\theta^L MIX^L .$$

Now, because $\theta^S = D^S/D^A = D^S/(D^S+D^L)$, one can show that

$$(7) \qquad \Delta\theta^S = \theta^S\left(\frac{\Delta D^S}{D^S} - \frac{\Delta D^A}{D^A}\right) = \theta^S\theta^L\left(\frac{\Delta D^S}{D^S} - \frac{\Delta D^L}{D^L}\right).$$

Similarly,

$$(8) \qquad \Delta\theta^L = \theta^L\left(\frac{\Delta D^L}{D^L} - \frac{\Delta D^A}{D^A}\right) = \theta^S\theta^L\left(\frac{\Delta D^L}{D^L} - \frac{\Delta D^S}{D^S}\right).$$

Substituting equations (7) and (8) into (6), we obtain

$$(9) \qquad \Delta MIX^A = FIXED + SHIFT$$

where

$$(10) \qquad FIXED \equiv \theta^S \Delta MIX^S + \theta^L \Delta MIX^L$$

$$(11) \qquad SHIFT \equiv \theta^S\theta^L\left(MIX^S - MIX^L\right)\left(\frac{\Delta D^S}{D^S} - \frac{\Delta D^L}{D^L}\right).$$

Equation (9) shows that ΔMIX^A is the sum of two terms. The first, denoted *FIXED,* is the share-weighted average of ΔMIX^S and ΔMIX^L. This is the expression for ΔMIX^A that would result if the distribution of manufacturing sector debt between small and large firms were constant in the face of monetary shocks. However, when the debt shares θ^S and θ^L are altered by monetary policy, the *SHIFT* term comes into play. *SHIFT* captures the pure effect of shifts in the shares of total debt held by small and large firms, holding fixed the mix of debt for both groups. For *SHIFT* to be nonzero, not only must the debt growth of small firms differ from that of large firms, but the mix of debt also must differ between the two groups. In fact, both of these conditions hold. Table 1 showed that small firms depend far more heavily on short-term bank loans than do large firms, so that $MIX^S > MIX^L$. In addition, Table 3 showed that monetary contractions cause a reallocation of manufacturing-sector debt away from small firms—that is, $\Delta D^S/D^S < \Delta D^L/D^L$. Therefore, *SHIFT* will be negative, implying that MIX^A can fall significantly after a monetary contraction even though MIX^S and MIX^L do not. The aggregate debt mix declines because a monetary contraction induces a shift in the share of total short-term debt toward large firms, which rely much less on bank loans than do small firms.

Once we control for the influence of this shift in debt shares, does there remain any significant effect of monetary policy on MIX_{KSW} and MIX_O for aggregate manufacturing? This question boils down to the response of the *FIXED* component of each mix variable to a monetary policy shock. To answer this question, we used equations (10) and (11) to compute *FIXED* and *SHIFT* for both ΔMIX_{KSW} and ΔMIX_O (for the sake of completeness, we also computed this decomposition of ΔMIX_{TD}).[24] We then estimated equation (4) for the *FIXED* and *SHIFT* component of each mix variable—the same regression that we ran for the mix variables and the individual types of debt. Paralleling the presentation in Tables 2 and 3, Table 4 reports the sum of the coefficients on the lags of the monetary policy indicator from these regressions.

As shown in Table 4, *FIXED* never declines significantly after a tightening of monetary policy. In contrast, *SHIFT* moves down significantly in every instance except one. These results are quite damaging to the case for a bank lending channel. The lack of a significant decline in *FIXED* means that our earlier results for MIX_{KSW} and MIX_O for aggregate manufacturing cannot be viewed as evidence of a substitution away from bank loans toward nonbank debt. Rather, these measures of the debt mix are heavily influenced by a general redirection of short-term credit toward large firms, in which bank loans have no special role.

24. *FIXED* and *SHIFT* at time t represent contributions to the change in MIX^A between time t–1 and time t. In computing *FIXED* and *SHIFT* at time t, we used the average values of θ^S, θ^L, MIX^S, and MIX^L at t–1 and t.

25. The reallocation of credit from small to large firms may signal a *broad* credit channel (as Gertler and Gilchrist, 1993, argue). This interpretation would explain KSW's other empirical finding—that the aggregate debt mix (which, we have shown, contains information on the differential flows of credit for small and large firms) helps predict real activity. Given our result that the first necessary condition for a *bank*

TABLE 4

DECOMPOSING CHANGES IN MIX OF SHORT-TERM DEBT STOCKS FOR AGGREGATE MANUFACTURING

	MIX_{KSW}		MIX_O		MIX_{TD}	
	FIXED	*SHIFT*	*FIXED*	*SHIFT*	*FIXED*	*SHIFT*
ROMER DATES	–.046	–.018	–.016	–.024*	.003	–.004**
	(1.42)	(1.18)	(.65)	(1.95)	(.27)	(2.08)
FEDERAL FUNDS RATE	–.003	–.005**	.000	–.007**	.002	–.001**
	(.75)	(2.01)	(.06)	(3.07)	(1.15)	(2.37)

NOTES: Results derived from an OLS regression over 1975.Q2 to 1991.Q2 of each variable on a constant, four quarterly lags of itself, and eight quarterly lags of the monetary policy indicator. See the text for the definitions of *FIXED* and *SHIFT*. The only variable differenced for the regression was the federal funds rate; *FIXED* and *SHIFT* were not differenced because they are constructed from log differences of debt. Each table entry shows the sum of the coefficients on the lags of the monetary policy indicator, with the t statistic (in absolute value) in parentheses.
** Significantly different from zero at the 5 percent level.
* Significantly different from zero at the 10 percent level.

Given the similar properties of our data and that employed by KSW, this reallocation of credit likely explains as well their finding of a significant drop in MIX_{KSW} after a monetary tightening.[25]

V. MONETARY POLICY AND THE MIX OF TOTAL DEBT

This section examines the effect of monetary policy on the mix of *total* debt, measured as $TMIX_O = TB/(TB+CP+TO)$ or $TMIX_{TD} = TB/(TB+CP+TO+TD)$. As we discussed in Section III, a good case can be made for broadening the analysis to encompass long-term debt. In particular, because substitutions likely occur across the spectrum of debt maturities, the results obtained from short-term debt alone may distort the shifts in the debt mix induced by monetary policy.

Our empirical analysis of total debt parallels the analysis of short-term debt in Section IV. We first regressed the change in either $TMIX_O$ or $TMIX_{TD}$ on four quarterly lags of itself, eight lags of a monetary policy indicator, and a constant. Table 5 reports the sum of the coefficients on the lags of the monetary policy indicator and the associated t statistic. As can be seen, there is almost no evidence of a significant change in the total debt mix after a monetary contraction. For aggregate manufacturing and for large firms, the results are uniformly insignificant. Small

TABLE 5

MIX OF TOTAL DEBT STOCKS: RESPONSE TO MONETARY POLICY

	$TMIX_O$ $TB/(TB+CP+TO)$	$TMIX_{TD}$ $TB/(TB+CP+TO+TD)$
TOTAL MANUFACTURING		
Romer dates	–.013	–.010
	(.94)	(.93)
Federal funds rate	.000	.001
	(.06)	(.47)
LARGE FIRMS		
Romer dates	–.010	–.009
	(.62)	(.69)
Federal funds rate	.001	.001
	(.41)	(.62)
SMALL FIRMS		
Romer dates	–.027*	–.012
	(1.99)	(1.24)
Federal funds rate	–.003	.001
	(1.42)	(.58)

NOTE: See note to Table 2 for description of regressions.
* Significantly different from zero at the 10 percent level.

lending channel does not hold, the predictive power of the debt mix cannot reflect the existence of a bank lending channel. Indeed, in Oliner and Rudebusch (1995), we show that it is only the *SHIFT* component of the aggregate debt mix that helps predict real activity.

firms provide the only evidence of a decline in the debt mix, with $TMIX_O$ falling significantly after a Romer date.

We do not regard this one significant result as grounds to reject the null hypothesis of no bank lending channel. First, the other mix responses reported in Table 5 are all insignificant, which casts doubt on the robustness of the one significant response. Indeed, in light of the large number of estimated responses given in Tables 2 and 5, a single significant response might be expected even if the debt mix did not actually react to monetary shocks (i.e., a type 1 error). Second, the lack of confirming evidence in Table 5 for large firms is particularly damaging. Because of their freer access to nonbank credit, large firms would be more able than small firms to secure nonbank financing if the supply of bank loans were constrained. The resulting rise in nonbank debt (N) in the denominator of the mix measure $B/(B+N)$ for large firms would cause their mix to drop especially sharply if there were a bank lending channel. Yet, we find no significant response of large-firm mix variables to a monetary shock.[26] Overall, Table 5 indicates that the case for a bank lending channel is extremely weak.

Table 6 displays the response of each component of $TMIX_O$ and $TMIX_{TD}$ to a monetary shock; each table entry again shows the sum of the coefficients on eight lags of the monetary policy indicator. As a rule, we find that total debt stocks decline for small firms after a monetary contraction, but increase for large firms, mirroring the pattern seen in Table 3 for short-term debt. $TMIX_O$ and $TMIX_{TD}$ generally

26. There are two other reasons for discounting the importance of the one significant change in small-firm mix. First, as shown in Appendix B, differences in the average maturity of bank and nonbank debt might have caused the debt mix to move spuriously in this particular case. Second, we have also analyzed the movements in the mix of total debt *flows*, complementing the analysis of total debt *stocks* in this section. The flow measure of the debt mix for small firms and large firms never declined significantly after a monetary contraction. (In the model presented in Appendix B, one can show that the flow and stock measures of the debt mix function equally well as indicators of the bank credit channel).

TABLE 6

TOTAL DEBT STOCKS: RESPONSE TO MONETARY POLICY

	INDIVIDUAL TYPES OF DEBT				TOTAL OF BANK LOANS PLUS	
	Bank Loans (*TB*)	Commercial Paper (*CP*)	Other Debt (*TO*)	Trade Debt (*TD*)	*CP+TO*	*CP+TO+TD*
TOTAL MANUFACTURING						
Romer dates	–.034	.139	.016	.001	.002	–.006
	(.51)	(.65)	(.54)	(.02)	(.08)	(.21)
Federal funds rate	.012	.076**	.007*	–.014*	.008*	.005
	(1.11)	(2.15)	(1.73)	(1.83)	(1.80)	(1.05)
LARGE FIRMS						
Romer dates	–.023	.139	.019	.016	.009	.007
	(.24)	(.64)	(.61)	(.34)	(.29)	(.22)
Federal funds rate	.019	.079**	.007	–.013	.009*	.007
	(1.28)	(2.17)	(1.63)	(1.48)	(1.89)	(1.45)
SMALL FIRMS						
Romer dates	–.095**	–.948*	.017	–.057	–.075**	–.076**
	(2.39)	(1.72)	(.33)	(1.41)	(2.19)	(2.72)
Federal funds rate	–.004	–.166**	.009	–.018**	.000	–.007
	(.69)	(2.22)	(1.31)	(2.99)	(.01)	(1.62)

NOTE: See note to Table 3 for description of regressions.
** Significantly different from zero at the 5 percent level.
* Significantly different from zero at the 10 percent level.

TABLE 7

DECOMPOSING CHANGES IN MIX OF TOTAL DEBT STOCKS FOR AGGREGATE MANUFACTURING

	$TMIX_O$		$TMIX_{TD}$	
	FIXED	*SHIFT*	*FIXED*	*SHIFT*
ROMER DATES	–.011	–.004**	–.008	–.002**
	(.75)	(2.04)	(.74)	(2.15)
FEDERAL FUNDS RATE	.001	–.001*	.001	–.0004**
	(.31)	(1.82)	(.71)	(2.34)

NOTE: See notes to Table 4 for description of regressions.
** Significantly different from zero at the 5 percent level.
* Significantly different from zero at the 10 percent level.

fail to change significantly after a monetary shock, because total bank loans for each group tend to move in tandem with its debt aggregate.

To complete our analysis of total debt stocks, Table 7 presents the decomposition of $TMIX_O$ and $TMIX_{TD}$ into their *FIXED* and *SHIFT* components. Recall that *FIXED* represents the change in the debt mix for aggregate manufacturing after controlling for changes in the shares of debt held by small and large firms, while *SHIFT* represents the effect of any such changes in shares on the aggregate mix variable. Echoing the results we obtained for short-term debt, Table 7 shows that a monetary contraction has no significant effect on the *FIXED* component of $TMIX_O$ or $TMIX_{TD}$. This result is not surprising, as Table 5 provided little evidence of movements in $TMIX_O$ and $TMIX_{TD}$ for either small firms or large firms. In contrast, *SHIFT* declines significantly for every case shown in Table 7. Thus, for total debt stocks, there is strong evidence that monetary contractions induce a significant shift in overall lending—not merely bank loans—away from small firms. Taken together, the results in Tables 5 through 7 for total debt are inconsistent with the existence of an important bank lending channel, as were the earlier results for short-term debt.

VI. CONCLUSION

The crucial shortcoming of most previous empirical work on the bank lending channel is the inability to identify whether movements in bank debt reflect shocks to overall credit demand or shocks to bank loan supply. KSW attempt to solve this problem by controlling for demand shocks with changes in commercial paper outstanding. With this identification of demand shocks, KSW interpret movements in bank loans relative to commercial paper after a monetary shock as reflecting changes in bank loan supply. However, in an economy with heterogeneous agents, aggregate results must always be treated with caution. We find that for both small and large firms bank debt behaves little differently from nonbank debt after a monetary shock. This is true regardless of whether trade credit is included in the analysis. Thus, at the disaggregated level, there is no evidence that monetary contractions limit the supply of bank debt relative to other forms of finance. Our conclusion, like those of Gertler and Gilchrist (1993) and Eichenbaum (1994), is that the disaggregated data provide no evidence for a bank lending channel.

We should stress, however, that our results do not rule out the possibility of "credit crunches" in the banking sector. Indeed, many observers believe that such a credit crunch began before the onset of the 1990–1991 recession, brought on by a combination of increased bank capital requirements, more stringent regulatory practices, and a sharp deterioration in bank balance sheets. A number of studies, reviewed in Sharpe (1995), have tried to determine why bank lending weakened before the recession and then remained anemic for several years. Although the results of these studies are often hard to interpret, Peek and Rosengren (1995) have provided compelling evidence that regulatory actions limited the supply of bank loans in New England during this period. We see no inconsistency between our results and evidence that bank lending is at times depressed by sector-specific shocks. Our point is that, at least since the mid-1970s, *monetary contractions* have not systematically reduced the supply of bank loans relative to other sources of credit.

Finally, as noted in the introduction, our evidence is consistent with a broad view of the credit channel that emphasizes the information asymmetries faced by all lenders, rather than any unique features of bank debt. In this mechanism, increases in the riskless interest rate induced by the monetary authority magnify the premium for external debt charged to certain borrowers. One such class of borrowers is small firms, which likely face severe credit market imperfections. Our finding that monetary contractions redirect credit away from small firms toward large firms accords with this view of the credit channel.

APPENDIX A

This appendix details several aspects of the procedure for constructing the debt series used in our empirical work. See Table A.1 for a listing of the *QFR* series that served as our source data.

Creating Time Series for the Small-Firm Group

This discussion supplements the brief description in Section II of our method for creating time series for the small-firm group. First, for each quarter of the sample period, we identified what we call the "marginal size class." Aggregating the size classes starting with the smallest, the marginal size class is the final one that must be included to obtain an aggregate that holds at least γ percent of the total capital stock in manufacturing. We denote the resulting aggregate by $CU(\gamma)$ and denote by $CL(\gamma)$ the aggregate that contains all size classes up to but not including the marginal size class. By construction, $CU(\gamma)$ contains $\gamma+\omega^U$ percent of the manufacturing capital stock, while $CL(\gamma)$ contains $\gamma-\omega^L$ percent, where ω^U and ω^L are both greater than zero. $CU(\gamma)$ and $CL(\gamma)$ are upper and lower bounds, respectively, for the small-firm group. The simplified description in Section II assumed that $CU(\gamma) = CL(\gamma) = C(\gamma)$, i.e., that an aggregate with exactly γ percent of the manufacturing capital stock could be formed without splitting the marginal size class.

Now, for each quarter of the sample period, we computed the growth rate of a given variable for the small-firm group as a weighted average of the growth rates for that variable in *CL* and *CU*. The weights applied to the growth rates in *CL* and *CU* are, respectively, $\omega^U/(\omega^U+\omega^L)$ and $\omega^L/(\omega^U+\omega^L)$. To illustrate the intuition behind these weights, let $\gamma=15$, and assume that *CU* contains 16 percent of the manufacturing capital stock, while *CL* contains 12 percent; in this example, $\omega^U=1$ and $\omega^L=3$, so that a weight of ¾ is applied to the growth rate of the variable in *CU* and a weight of ¼ to its growth rate in *CL*. *CU* receives the greater weight because it approximates the desired 15 percent share of the manufacturing capital stock more closely than does *CL*.

This procedure yields a quarterly series of growth rates for each debt stock for the small-firm group. When applied to an initial level, this series of growth rates yields a quarterly series in levels. The initial level for each debt stock was taken to be a weighted average of its value in *CU* and *CL*, where the weights are the same as those defined above.

Our last step was to calibrate the resulting level's series, so that its value in the final period of the sample, 1991.Q2, equaled the weighted average of its value in *CU* and *CL* in that period. We retrended each series to hit this final target value. It should be stressed that this retrending does not distort the cyclical properties of each series, which are determined solely from the quarterly growth rates of the variable in *CU* and *CL*.

TABLE A.1

SERIES USED FROM THE *QUARTERLY FINANCIAL REPORT*

VARIABLE	CORRESPONDING SERIES IN *QFR*
Bank loans, short-term	"Loans from banks," original maturity of one year or less.
Bank loans, long-term	"Loans from banks," sum of (1) installments on long-term debt due in one year or less and (2) long-term debt due in more than one year.
Capital stock	Sum of "Depreciable and amortizable fixed assets" and "Land and mineral rights."
Commercial paper	"Commercial paper."
Other debt, short-term	"Other short-term debt," original maturity of one year or less.
Other debt, long-term	"Other long-term debt," sum of (1) installments on long-term debt due in one year or less and (2) long-term debt due in more than one year.
Trade debt	"Trade accounts and trade notes payable."

Deflation

We converted the various series for debt stocks to constant 1987 dollars using the implicit price deflator for GDP from the Bureau of Economic Analysis. No attempt was made to revalue the *QFR*'s book-value measures of debt stocks to current market value prior to deflation.

Each short-term debt series was deflated with the contemporaneous value of the GDP deflator. In contrast, for the long-term debt stocks, we used a moving average of this price measure in order to capture the price levels prevailing at the time of original issue for the current stock of debt. The length of the moving average equaled the ratio of the book value of long-term debt outstanding to the book value of long-term debt due within one year; for example, if $1 million in long-term debt were outstanding and $100,000 were scheduled for retirement within one year, the ratio would equal 10 years. This ratio is a rough measure of the original maturity of the long-term debt and thus provides an estimate of the age of the oldest debt still outstanding at a given time. We calculated this ratio for long-term bank debt and long-term nonbank debt for both small and large firms.

Seasonal Adjustment

We seasonally adjusted the deflated debt series 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 1981 were 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.

APPENDIX B

This appendix analyzes a two-period version of KSW's (static) model of the optimal debt mix. Our goal is to assess the indicator properties of the debt mix for relative loan supplies when the mix variable combines short-term and long-term debt.

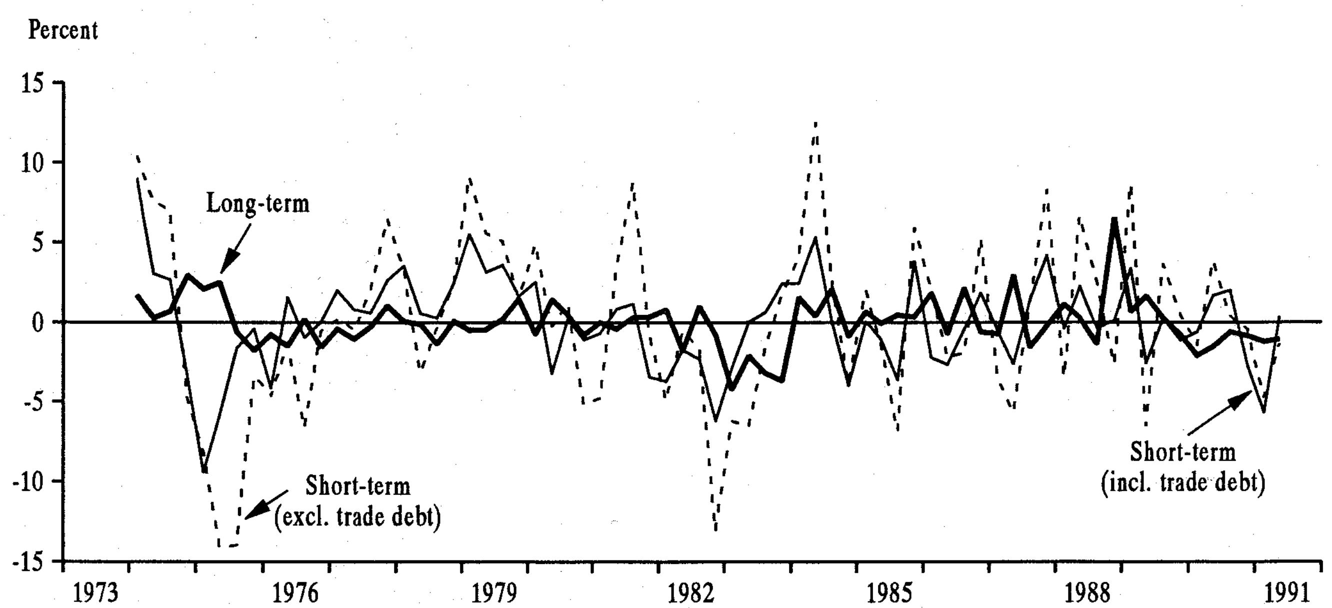
Variability of Short-Term and Long-Term Debt

Our concern about combining debt of different maturities stems from a simple observation: In the *QFR* data, the stock of long-term debt fluctuates considerably less over time than does the stock of short-term debt. The relative smoothness of long-term debt calls into question KSW's key assumption—that monetary shocks affect equally the demand for all types of debt. That is, in response to a monetary shock, the observed mix of total debt may be affected not only by shifts in loan supply, but also by differences in the degree to which borrowers adjust their desired stocks of debt. As a result, the share of bank loans in total debt can change after a monetary shock even when there has been no shift in the relative loan supplies.

Figure B.1 documents the difference in variability between short-term and long-term debt for aggregate manufacturing. The figure plots the quarterly growth rate of each type of debt, expressed as the deviation from the series'

FIGURE B.1

GROWTH OF DEBT FOR AGGREGATE MANUFACTURING
(QUARTERLY RATE, EXPRESSED AS DIFFERENCE FROM AVERAGE RATE OVER SAMPLE PERIOD)



mean growth rate over 1974.Q1–1991.Q2; a smoothly growing series would appear as a horizontal line at zero. Even with the inclusion of trade debt in the short-term debt measure, the standard deviation of its quarterly growth rate is still twice that of long-term debt.

The more stable growth of long-term debt likely results from factors that make such debt costly to adjust. One such factor could be the provisions in contracts for publicly issued bonds that constrain the borrower's ability to pay down outstanding long-term debt.[27] With restrictions on repayment, borrowers will refrain from using long-term debt to meet what they perceive to be relatively short-term changes in funding needs, such as those that might arise from a change in monetary policy. Thus, a restriction on downward adjustments could cause long-term debt to be sticky in both directions.

Adding Adjustment Costs to KSW's Model

We now explore how KSW's basic equation relating the debt mix to relative loan supplies, equation (3) in the text, would be affected by the inclusion of long-term debt in the mix variable. To model the effect of long-term debt, we add costs of adjustment for debt stocks to KSW's model and assume that the costs are greater for long-term debt than for short-term debt. With this setup, the adjustment costs for bank and nonbank debt will differ to the extent that they have unequal average maturities. To capture the effects of maturity differences, we specify that the adjustment costs of bank (B) and nonbank (N) debt depend inversely on the proportion of outstanding debt of that type retired each period (δ_i, $i=B,N$). We embed this dependence on the retirement rate in an otherwise standard specification of quadratic adjustment costs:

$$\text{(B.1)} \qquad A_B = \frac{\phi}{2\delta_B}\left(\frac{B-B_0}{B_0}\right)^2 B_0$$

$$\text{(B.2)} \qquad A_N = \frac{\phi}{2\delta_N}\left(\frac{N-N_0}{N_0}\right)^2 N_0 \,,$$

where B_0 and N_0 are the initial stocks of bank and nonbank debt, and B and N are the final stocks of debt.

With the inclusion of adjustment costs, the choice problem in KSW's model becomes

$$\min_{B,N} C = r_B B + r_N N + \frac{\phi}{2\delta_B}\left(\frac{B-B_0}{B_0}\right)^2 B_0 + \frac{\phi}{2\delta_N}\left(\frac{N-N_0}{N_0}\right)^2 N_0 - f(B/D)D \qquad \text{s.t. } B+N=D,$$

where B_0 and N_0 are predetermined. The first-order conditions for B and N yield

$$\text{(B.3)} \qquad r_B - r_N = f'(B/D) + \phi\left(\frac{1}{\delta_N}\frac{N-N_0}{N_0} - \frac{1}{\delta_B}\frac{B-B_0}{B_0}\right).$$

Differentiating (B.3) with respect to the stance of monetary policy implies

$$\text{(B.4)} \qquad \frac{d(r_B - r_N)}{dMP} = f''(B/D)\frac{d(B/D)}{dMP} + \phi\left(\frac{1}{\delta_N}\frac{dN/dMP}{N_0} - \frac{1}{\delta_B}\frac{dB/dMP}{B_0}\right).$$

To write (B.4) in a form that highlights the implications for the mix variable *B/D*, assume that the changes in the debt stocks are small, so that N_0 and B_0 in (B.4) can be replaced by N and B, respectively. In addition, note that $N=D-B$ implies

$$\text{(B.5)} \qquad \frac{dN/dMP}{N} = \frac{dD/dMP}{D}\frac{D}{N} - \frac{dB/dMP}{B}\frac{B}{N}.$$

Substituting (B.5) into (B.4), and then rearranging terms, we obtain

$$\text{(B.6)} \qquad \frac{d(B/D)}{dMP} = \frac{1}{\Omega_1}\frac{d(r_B - r_N)}{dMP} - \frac{\Omega_0}{\Omega_1}(\delta_B - \delta_D)\frac{dD/dMP}{D},$$

where $\delta_D = (B/D)\delta_B + (N/D)\delta_N$, a weighted average of the retirement rates for bank and nonbank debt,

$$\Omega_0 = \phi D/(\delta_B \delta_N N) > 0 \text{, and}$$

$$\Omega_1 = f'' - (\Omega_0 \delta_D D/B) < 0 \,.$$

Equation (B.6) characterizes the response of the debt mix *B/D* to a monetary contraction in the presence of adjustment costs. In general, the movement in the debt mix depends not only on the change in the interest rate spread $r_B - r_N$, but also on $\delta_B - \delta_D$ and the change in total debt induced by a monetary contraction (*dD/dMP*). These additional influences break the direct link between the debt mix and the rate spread, which may make the debt mix an unreliable indicator of changes in bank loan supply.

However, under either of two conditions, the debt mix depends solely on the spread $r_B - r_N$ even in the presence of adjustment costs. These conditions are:

27. Examining a large sample of bonds issued by U.S. industrial corporations over 1977–1990, Crabbe (1991) found that 39 percent of these bonds (measured in terms of initial face value) were noncallable—that is, could not be paid down before maturity. Moreover, even for callable bonds, the terms of the debt contract usually prohibited repayments for several years after issuance.

CONDITION 1: *Bank and nonbank debt have the same original maturity:* $\delta_B = \delta_N = \delta_D$.

In our model, this equality implies that all types of debt have the same adjustment costs. Because the adjustment costs equally impede changes in all debt stocks, the mix of debt is unaffected by the adjustment costs.[28]

CONDITION 2: *A monetary shock leaves total loan volume unchanged:* $dD/dMP = 0$.

Under this condition, differences in adjustment costs across debt types are irrelevant, because the firm does not adjust its total debt stock.

When either condition holds, (B.6) reduces to

$$\text{(B.7)} \qquad \frac{d(B/D)}{dMP} = \frac{1}{\Omega_1}\frac{d(r_B - r_N)}{dMP}.$$

Because $\Omega_1 < 0$, (B.7) has the same form as the basic equation derived by KSW (equation (3) in the text). Thus, under either Condition 1 (C1) or Condition 2 (C2), movements in the debt mix *B/D* remain a valid indicator of changes in bank loan supply.

Because C1 cannot be assumed to hold when the mix variable combines short-term and long-term debt, C2 becomes the key condition for assessing the indicator properties of the total debt mix for relative loan supplies. When C2 holds, the results reported in Section V for the total debt mix can be regarded as valid tests of the bank lending channel; conversely, when C2 does not hold, the results may have little power to distinguish the bank lending channel from the null hypothesis of no change in relative loan supplies.

The final two columns of Table 6 contain the information needed to check condition C2 for the total debt mix—namely, whether a monetary contraction leaves total loan volume unchanged. For the most part, the changes in total debt shown in these columns of the table are not significantly different from zero, indicating that C2 holds. Thus, in the context of this model, most of the results reported in Table 5 for the total debt mix provide useful information about relative loan supplies. However, in a few cases, Table 6 does show a significant movement in total debt, notably the decline found for small firms after a Romer date. For these cases, C2 does not hold, and the corresponding results in Table 5 for the effect of monetary contractions on the debt mix should be disregarded. Importantly, this set of results includes the only instance of a significant decline in the debt mix in Table 5.

28. This condition, which holds (at least approximately) when the mix is constructed exclusively from short-term debt, provides the theoretical basis for our analysis of the short-term debt mix in Section IV.

Stocks versus Flows for Constructing the Debt Mix

One might wonder, as we did, whether the problems with a mix variable constructed from total debt *stocks* could be alleviated by switching to a mix variable constructed from total debt *flows*. Our intuition was as follows. Although the adjustment of long-term debt stocks to a monetary shock might be quite slow, the proportionate changes in gross flows for such debt would be considerably larger and might be of the same magnitude as the changes in flows for short-term debt. However, we found that this intuition, while qualitatively correct, does not yield a superior measure of the debt mix. One can derive the flow counterpart to (B.6), which shows that the flow-based mix depends solely on the interest rate spread $r_B - r_N$ under exactly the same conditions as does the stock-based mix; the derivation of this result can be obtained from the authors on request. Because nothing is gained by using the flow mix instead of the stock mix, we conducted all tests in this paper with the mix of total debt stocks.

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