Brainard

Cecchetti

Fazzari

Gilchrist

Glauber

Hester

Himmelberg

Hubbard

James

Meltzer

Morgan

Oliner

Peek

Rajan

Rosengren

Schiantarelli

Walsh

Wilcox

Zakrajšek

Federal
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Is Bank Lending Important for the Transmission of Monetary Policy?

Joe Peek and
Eric S. Rosengren
Editors

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Is Bank Lending Important for the Transmission of Monetary Policy?

Bank lending has received increasing attention as an important component of the transmission of monetary policy. Proponents argue that changes in bank assets as well as bank liabilities influence the future course of the economy. Because financial constraints may alter firms' investment, employment, and financing decisions, it is important to understand which firms might be constrained and under what circumstances. Many economists remain skeptical of the role of banks, however, believing that a focus on interest rates or money aggregates is sufficient for understanding the transmission of monetary policy.

Is Bank Lending Important for the Transmission of Monetary Policy? An Overview

Joe Peek and Eric S. Rosengren*

The importance of banks for the transmission of monetary policy has been a major topic in monetary economics for some time, and several factors have served to heighten that interest recently. One such factor has been the slower than expected U.S. recovery from the 1990–91 recession, which was accompanied by slow growth in bank lending. This spawned a substantial literature on regulatory-induced credit crunches, with a number of studies finding that bank lending behavior was a major contributing factor to the slow expansion.

A second factor has been the importance of banks in recent international economic crises. Japan, Latin America, and Scandinavia have each experienced major problems in their banking sectors that coincided with severe recessions. The role of banks in both the crises and the subsequent recoveries is likely to be the subject of research for some time.

A third factor is the recent (and ongoing) structural change in banking, which may significantly alter the role of banks in the transmission of monetary policy. As the banking industry and financial markets in general continue to evolve, it is not yet clear how useful historical data will be in understanding future business cycle fluctuations. Thus, a major concern of policymakers must be understanding the ways that changes in the banking industry and in the patterns of firm finance may alter our ability to control, or even predict, business cycle fluctuations.

To improve our understanding of the role of banks in the transmission of monetary policy, the Federal Reserve Bank of Boston convened

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a conference in June of 1995 to consider the question "Is Bank Lending Important for the Transmission of Monetary Policy?" That banks are an important element in the transmission process is not an issue, because monetary policy operates through the banking sector. However, the description of the exact role played by banks remains hotly disputed, with the debate focusing on the importance of the role for bank lending as a transmission channel (the lending view) distinct from the generally accepted channel operating through interest rates (the money view).

The conference was designed to explore the conditions necessary for bank lending to be an important channel for the transmission of monetary policy. The first three papers, focusing on banks and bank loans, examined the conditions necessary for a distinct bank lending channel to be operative. Charles P. Himmelberg and Donald P. Morgan documented that, for many firms, other debt instruments were not perfect substitutes for bank loans, providing a rationale for why bank lending might be especially important for monetary policy. The second paper, by Joe Peek and Eric S. Rosengren, showed that both regulatory and monetary policy could alter the amount of bank lending, so that the financial condition of banks is an important factor in determining the size and nature of the effects of monetary policy that are transmitted through the banking sector. The paper by Carl E. Walsh and James A. Wilcox showed that bank lending can affect output and may indeed have played an important role in the slow recovery from the most recent recession.

The final two papers focused on borrowing by firms, in order to explore the conditions necessary for a distinct bank lending channel. Simon G. Gilchrist and Egon Zakrajšek examined the distributive impact of the bank lending channel and found that small firms rather than large firms reacted the most to tighter policy. Fabio Schiantarelli assessed the methodological issues involved in empirical tests of the implications of capital market imperfections. He also reviewed the firm-level panel data evidence from other countries, finding that in most countries it is the small firms that bear the brunt of financial fluctuations.

No clear consensus was reached on the importance of a bank lending channel distinct from the more traditional effect operating through movements in interest rates, but several themes did permeate the conference. First, credit market imperfections remain important for banks and for those firms that depend on banks for financing. Thus, banks continue to play an important role in evaluating and monitoring smaller firms with relatively little publicly disclosed financial information. However, it was also generally agreed that this role was likely to diminish as credit markets became deeper and more liquid, especially for small firms.

Second, one should not expect the impact of monetary policy to remain constant over time. Because the financial condition of firms and

banks will vary over a business cycle and from business cycle to business cycle, their responses to changes in monetary policy will also vary. Thus, the impact on the economy of changes in monetary policy will be sensitive to the state of firms' balance sheets and the health of the banking sector.

Third, significant financial innovation and regulatory changes may alter the future effectiveness of monetary policy, requiring policymakers to adapt their policy actions so as to incorporate the effect of these structural changes on the transmission of monetary policy. With the substantial change in financial markets and financial regulations in recent years, historical data on the transmission of monetary policy may not necessarily be a reliable guide for current or future policy. This presents a significant challenge to monetary policymakers to remain abreast of financial developments and to modify their policies accordingly.

The Role of Bank Lending

The first group of papers explores three conditions necessary for a distinct bank lending channel. First, to what extent is bank lending special for firms and, if it is critical for a subset of firms, is that subset large enough to have a macroeconomic impact? Second, if bank lending is special, can we influence bank lending with monetary or regulatory policy in a way that affects macroeconomic fluctuations? Finally, if policy can alter bank lending, will bank lending have a significant and predictable impact on GDP?

What Is Special about Bank Loans?

Charles P. Himmelberg and Donald P. Morgan contend that not only are bank loans special but a surprisingly large percentage of firms continue to depend on banks for financing. They first examine whether banks' declining share of nonfinancial business credit has made banks "obsolete." Despite much previous work emphasizing the dwindling role of banks, they show that the reliance of manufacturers on banks has not declined over the past decade, and that small manufacturers remain especially dependent on banks. They also show that while commercial paper has been a major source of funding for large, creditworthy firms, 83 percent of firms included in the Compustat file borrow only from financial intermediaries rather than directly accessing credit markets. Himmelberg and Morgan attribute this dependence on intermediated debt to the fact that financial intermediaries are better able to monitor borrowers and enforce covenants. This is substantiated by evidence that issuers of public debt are generally limited to large, capital-intensive firms, while borrowers dependent on intermediaries

are generally small, rapidly growing high-tech and inventory-intensive firms.

While a large percentage of firms depend on intermediated debt, they do not necessarily depend on bank debt. However, for borrowers, the substitutability of intermediated debt from alternative sources is limited by the fact that intermediated debt is to a large extent a segmented market. Insurance companies provide primarily long-term credit, to match the long-term liabilities generated by insurance products. Finance companies provide short-term credit that is collateralized by assets with high liquidation values. Banks, on the other hand, specialize in short-term credit that is collateralized by illiquid assets or is unsecured.

The authors conclude that bank lending remains an important source of funds for many businesses, and one that is not easily substituted for by funds obtained through other types of intermediaries or by debt directly placed in credit markets. Nonetheless, given the continuing evolution of credit markets and financial regulation, the degree of bank dependence of firms and the degree of substitutability among alternative sources of credit may be quite different in the future.

Robert R. Glauber agreed that both empirical and theoretical work support the view that a large group of firms is, and has been, dependent on banks. However, he was not convinced that this is likely to persist in the future. In particular, a maturity mismatch between assets and liabilities for insurance companies is not much of a barrier to entry into the shorter-term loan market favored by banks, given the ease of altering the maturity of loans with new financing techniques. And, finance companies are becoming more adept at making cash flow loans as well as asset-backed loans, which would allow them to make inroads into traditional bank lending markets.

Raghuram G. Rajan argued that bank-intermediated debt continues to be important. However, he shared Glauber's view that it was likely to be less important in the future. He emphasized that if monitoring hard-to-evaluate firms was banks' comparative advantage, this advantage would be eroded as more information and inexpensive computers made processing information easier and less costly. Nonetheless, even if banks continue to lose market share to other intermediaries, an operative lending channel is still possible, although it would not necessarily be limited to bank lending.

Do Monetary Policy and Regulatory Policy Affect Bank Loans?

Joe Peek and Eric S. Rosengren find evidence consistent with both monetary and bank regulatory policy altering the supply of bank loans. However, they emphasize that to the extent a distinct lending channel

exists, its magnitude is likely to be dependent on the financial condition of banks. They provide a simple static model to illustrate that capital-constrained and unconstrained banks react very differently to changes in monetary policy. In particular, when capital requirements are binding, the lending channel is eliminated. Because an increase in the availability of reserves will not release a binding capital constraint and allow a bank to expand, the increase in transactions deposits associated with the increase in reserves is exactly offset by a decrease in nontransactions deposits at capital-constrained banks. Using data for New England banks, Peek and Rosengren provide evidence that capital-constrained and unconstrained banks react differently to changes in the federal funds rate. Moreover, because so many banks in New England were capital constrained in the late 1980s and early 1990s, the total loans aggregate for all New England banks behaved in the same manner as that for the sample of constrained banks, failing to increase in response to lower federal funds rates.

A major implication of their findings is that the capital requirement constraint faced by banks, as well as the bank reserve constraint, should be taken into account in determining the likely effect of monetary policy. Both the nature and the size of the effect of monetary policy transmitted through the banking sector will be affected by the financial condition of banks (especially with respect to their capital) and by regulatory policy. In particular, the size of the effect operating through the lending channel will be especially sensitive, differing from one episode to another as more or fewer banks come under a binding capital constraint. Thus, it is critical that, when setting monetary policy, policymakers understand and take into account the financial condition of banks and the regulatory environment in which banks are operating.

R. Glenn Hubbard emphasized that it was difficult to distinguish fully between the effects of changes in the federal funds rate on constrained banks and on unconstrained banks, using only a limited time series for one region of the country. The limited number of observations available for the constrained sample severely limits the power of the empirical test. Hubbard suggested that a more convincing test would require a national data set, allowing for more regional comparisons and providing a better benchmark for unconstrained institutions. With the current sample, the large standard errors make it difficult to draw strong conclusions from the evidence. Furthermore, the results face the common problem of isolating loan supply from loan demand. He cautioned further that examining bank reactions to monetary policy shocks was only a small part of the lending view, and that more complete tests would match borrowers, loans, and lender characteristics.

Christopher James suggested that a discussion of banks' reactions to monetary policy must carefully consider more than just the leverage ratio constraints. Two institutional elements that are potentially impor-

tant, but not fully discussed in the paper, are deposit insurance and risk-based capital requirements. Deposit insurance is important because it affects the substitutability between implicitly or fully insured demand deposits and uninsured large CDs. Risk-based capital is important because it affects the substitutability between alternative assets in a bank's portfolio, for example, loans and Treasury securities. Because the degrees of substitutability among alternative bank assets and liabilities are critical for the effectiveness of the lending channel, it is important to understand fully how banking regulations alter those substitutabilities. Thus, while confirming that regulatory policies must be considered when examining the transmission of monetary policy, James emphasized that regulations other than the leverage capital constraint may be equally important.

How Is Bank Lending Related to Output?

James A. Wilcox presented a paper co-authored with Carl E. Walsh that examines whether bank lending is related to output, and whether that relationship has changed over time. They estimate a vector autoregression that includes the index of coincident indicators (their proxy for aggregate economic activity), the change in the consumer price index, the nominal federal funds rate, the prime interest rate, and real bank loans. They assume that shocks to bank loan supply are reflected in shocks to the prime rate and that shocks to loan demand are proxied by shocks to the quantity of real bank loans. They find this identification of supply and demand to be consistent with results of both a structural vector autoregression and the Choleski decomposition of their basic vector autoregression. Consistent with their use of shocks to the prime rate as a proxy for bank loan supply shocks, they find that upward shocks to the prime rate (which they interpret as a reduction in bank loan supply) are correlated with increases in bank capital ratios, increases in required reserves, and the imposition of credit controls in 1980, while these same factors are not correlated with their proxy for loan demand shocks.

Decomposing the shocks from their vector autoregressions, Walsh and Wilcox find that the supply of bank loans had less effect on bank lending than output or the federal funds rate but that, nonetheless, shocks corresponding to changes in capital ratios, reserve requirements, and deposit insurance fees did affect bank lending. However, in the early 1990s, reduced bank loan supply aggravated declines in lending already under way as a result of tighter monetary policy.

Walsh and Wilcox also relate loan demand and supply shocks to output and find that these shocks are not the dominant force in output movements over the past 35 years. Nonetheless, they do find that output was more affected by changes in loan supply than by changes in

loan demand, and that loan supply was a factor in the boom in the late 1980s and the recession in the early 1990s. Although loan supply shocks are not typically the primary determinant of recessions, Walsh and Wilcox show that they played an atypically large role in the 1990–91 recession. Still, over time the average response of both output and loan volume to loan supply shocks appears to have declined. While the bank lending channel may have been attenuated by greater substitutability of other forms of credit for bank loans, for now bank lending remains a determinant of aggregate output.

Stephen G. Cecchetti was not convinced that supply and demand had been appropriately identified. This is a problem for any empirical examination of whether bank lending affects output. Because bank assets equal bank liabilities, distinguishing between the effects of money (bank liabilities) and loans (bank assets) is problematic. Looking at interest rates does not necessarily obviate this problem, because banks often drop low-quality borrowers rather than raise interest rates, so that the reported interest rate does not reflect the marginal cost of bank funds to a constant-quality borrower. In addition, the prime rate used in this study has changed over the past 30 years in terms of both what it means and how it is set. Even without the data problems, Cecchetti was skeptical that vector autoregressions could be used to distinguish shifts of supply from those of demand. To really understand how monetary policy works through the banking system, disaggregated micro data, rather than aggregate time series data, are the most promising area for future research.

Alan H. Meltzer credited the authors with using a monthly output measure that appears to be an improvement over previous studies and with making a serious effort to show the validity of their measures of demand and supply shocks. However, he remained uncomfortable with the identification of supply and demand shocks. On the identification of supply shocks, he was particularly concerned with two characteristics not incorporated in the model, that borrowers can substitute nonbank sources of credit for bank lending and that banks can substitute nonreservable deposits for reservable deposits. In addition, the model is misspecified insofar as it omits both government securities and any measure of aggregate reserves or base money. Furthermore, Meltzer was not convinced that loan supply was a significant factor in the early 1990s. Instead, the drop in lending was a result of weak demand due to the recession and of the very slow rise in bank reserves due to restrictive monetary policy. His own view is that the effect of bank lending on output is close to zero: The supply of credit may have been important when Regulation Q was binding, but he is skeptical that bank lending has altered output at other times.

What Is the Distributive Impact of the Bank Lending Channel?

For a bank lending channel to be operative, firms must be unable to easily substitute other sources of credit for bank loans. Individual firm panel data can provide evidence of whether financial constraints alter firms' investment, employment, and financing decisions. The next two papers examined whether evidence of financial constraints was present in data for firms of different sizes, with the second paper providing an overview of the foreign evidence of the importance of financial constraints.

The Importance of Credit for Macroeconomic Activity: Identification through Heterogeneity

Simon G. Gilchrist and Egon Zakrajšek examine the role of credit in the transmission mechanism for monetary policy and as a propagation mechanism for business cycle shocks. They emphasize the financial accelerator, which, like the credit channel, relies on credit frictions. The financial accelerator emphasizes that the cost of external financing for a firm will depend on the condition of the firm's balance sheet. The premium on external finance should vary over the business cycle, across different-sized firms, and across firms with differing degrees of leverage, with these differences altering firms' investment financing decisions.

Gilchrist and Zakrajšek find that the ratio of the short-term debt of small firms relative to all short-term debt is a much better predictor of future economic activity than other debt mix variables, such as the mix between bank loans and commercial paper. They attribute these results to the effects of monetary tightening, which restricts the ability of small firms to raise external debt at the same time that large firms are expanding their debt in response to declining cash flows and rising inventories.

Gilchrist and Zakrajšek also examine firm-specific data and find that leverage as well as size alters firms' responsiveness to monetary policy shocks. They find that inventories of high-leverage firms are more responsive to a reduction of cash flow than those of low-leverage firms, and that this responsiveness increases during recessions. They conclude that monetary policy has distributional consequences, causing the effects of monetary policy to be altered by the financial condition of firms and the distribution of those firms in the economy. Thus, the impact of monetary policy will change as the composition of firms and their financial condition change, both over a business cycle and relative to similar stages of previous business cycles.

William C. Brainard emphasized that, to the extent that asymmetric information and moral hazard are still important credit market imper-

fections, their importance should continue to diminish as the costs of getting information and monitoring firms decrease. In addition, such imperfections are likely to be generated by concerns with ownership and control and with bankruptcy, considerations frequently not stressed when discussing the costs of external financing. A useful line of research would be to better document the costs of external financing and whether these costs were likely to vary over the business cycle. If the responses do vary, implying nonlinear responses, they are unlikely to be captured accurately by vector autoregressions. If the effects of the financial accelerator vary over business conditions and across cycles, a movement to firm-level micro data will be necessary in order to address these issues.

Stephen D. Oliner concurred that monetary policy has a much stronger effect on small firms than on large firms, although we have probably only scratched the surface on understanding the role played by small firms in the monetary transmission process. The evidence provides a fairly strong indication that some form of a credit channel is at work, but it is not clear whether it operates through banks or is a more general balance-sheet effect. In fact, because the composition of debt between bank and nonbank debt changes little for small or for large firms following a monetary contraction, the underlying mechanism may be a more generalized flight to quality for all lenders, rather than a distinct bank lending channel. While the evidence that large firms increase their market share of credit relative to small firms as a result of monetary contractions may indicate distributional effects, it does not necessarily tell us much about the aggregate importance of the credit channel for real economic activity. Two areas that warrant further investigation are the nature of bank relationships with small firms and the role of trade credit.

Financial Constraints and Investment: A Critical Review

Fabio Schiantarelli examines the empirical evidence from abroad on the importance of financial constraints. He begins with an overview of the difficulties faced by any empirical investigation of financial constraints. The basic approach has been to assess whether firms likely to suffer from informational and agency problems show significant departures from standard models, which are derived under assumptions of perfect capital markets and convex adjustment costs. Such tests are problematic because adjustment costs are not convex, the absence of perfect capital markets makes modeling the investment behavior of constrained firms difficult, and correctly partitioning the set of firms into subgroups of constrained and unconstrained firms is not straightforward. While these difficulties are a problem in any study of financial constraints, they can be particularly troublesome when examining

international evidence, where the industrial and institutional structure can be quite different across countries.

Despite the difficulties in estimation, Schiantarelli finds that a number of results appear consistently. First, information asymmetries and agency problems generate significant departures from standard models derived under the assumption of perfect capital markets. Second, even though financial structures differ substantially across countries, internal finance remains the dominant source of financing. Third, in many countries, firms create business groups that allow the formation of an internal capital market that supplements the capital allocation function of the external market and improves their access to external funds, and this access affects the relative importance of banks. Banks are particularly important in countries with less developed capital markets, but remain important even in countries with very well-developed capital markets, such as the United States.

Finally, the nature of financial constraints can vary with macroeconomic conditions, the stance of monetary policy, and the financial condition of firms. Thus, financial constraints will be influenced by both the business cycle and structural changes in financial markets, so they should not be expected to be invariant over time. Schiantarelli suggests that future research should attempt to identify more specifically the information and agency problems that cause external finance to be more expensive than internal finance, thus making financial constraints important for the transmission of monetary policy.

Steven M. Fazzari emphasized that the financial accelerator mechanism tested in the literature was not limited to a bank lending channel. Financial constraints also could work through a collateral channel, with higher interest rates reducing the value of collateral, which in turn would limit a firm's access to credit and raise the cost of internal finance, lowering investment. Alternatively, tighter monetary policy could reduce firms' profits, decreasing their cash flow. With a reduced supply of low-cost, internally generated funds, firms would reduce investment. Thus, if a bank lending channel is operative, one should find evidence of financial constraints, but such evidence is not sufficient to establish the importance of a bank lending channel. While financial constraints are important, the source of the constraints has yet to be clearly identified. Another major challenge remaining for empirical research on this topic is to separate the role played by financial variables that influence investment as a signal for future profits from their role as a signal indicating whether firms are financially constrained.

Donald D. Hester also emphasized the difficulty in testing for financial constraints. To the extent that the constraint is attributed to the banking sector, we must recognize that much commercial and industrial lending is done offshore and presumably is little affected by changes in domestic monetary and regulatory policy. He also emphasized that

evidence of financial constraints on firms cannot be taken as evidence of the importance of bank lending for the transmission of monetary policy. In particular, using a firm's net worth as a proxy for being constrained suffers from reliance on a measure of the difference between sums of arbitrarily valued assets and liabilities that are to a large degree endogenously determined by the firm itself. The difference between two arbitrarily valued series is likely to contain serious measurement errors, even if it were the appropriate proxy for financial constraints.

In addition, Hester notes, if firms feel credit-constrained, the market has developed substitutes. Capital-starved firms increasingly can lease equipment and structures, and joint ventures and mergers with firms with access to credit provide an obvious way of removing firm-specific constraints that might otherwise have macroeconomic consequences. In any case, the serious problems with identifying supply and demand make it difficult to conclude that the evidence provides any substantial support for the proposition that the severity of financial constraints varies over the business cycle and with the stance of monetary policy.

Conclusion

The importance of understanding the monetary policy transmission mechanism has increased with financial innovations and changes in banking structure that have the potential to alter traditional channels of monetary policy. While most conference participants agreed that financial constraints on firms may have been important in the past, it was less clear how important they would be in the future. Recent changes can be expected to alter not only the distributional impact of monetary policy, but also the magnitude of monetary policy effects on the economy.

Financial constraints are likely to be ameliorated over time as information technology and financial innovation give even relatively small firms increased access to national credit markets, but the extent of changes in the degree of financial constraints faced by firms will be difficult to quantify. The intensity of financial constraints will vary both over time and over business cycles. Separating secular changes in financial constraints from changes over the business cycle will present a challenge to policymakers attempting to identify optimal monetary policy.

The pace of financial innovation is not independent of public policies. Regulatory policy, merger policy, and trade policy, as well as monetary policy, will affect the role of banks both in the monetary policy transmission mechanism and in the economy more generally. Understanding these changes, and adjusting policy accordingly, will remain a significant challenge for setting monetary policy in the future.

What Is Special about Bank Loans?

For bank lending to be an important transmission mechanism for monetary policy, other credit instruments must be imperfect substitutes for bank lending. Given that numerous debt instruments other than bank loans exist, and that bank loans are a decreasing share of outstanding credit, what is special about bank loans? Do bank loans behave differently than other debt instruments and, if so, why?

Is Bank Lending Special?

Charles P. Himmelberg and Donald P. Morgan*

Is bank lending special? There are good reasons to ask. Absent good substitutes for bank lending, shocks to the supply of bank loans resulting from changes in monetary policy, bank capital, or bank portfolio preferences will affect the spending of bank borrowers. This implies new ways of thinking about the transmission of monetary policy. In addition to the familiar money/interest rate channel, there will be an additional "lending channel" (Bernanke and Blinder 1988). Moreover, monetary shocks will be borne by the borrowers who depend heavily on banks for loans.

In recent years, some observers have asked whether bank lending is *still* special, since banks have lost market share to financial markets and other intermediaries. For example, commercial banks' share of nonfinancial borrowing declined from approximately 36 percent in 1974 to about 22 percent in 1993 (Edwards and Mishkin 1994). In view of such trends, Edwards (1993) has suggested that the notion that banks are special is "obsolete."

This paper marshals theory and evidence to argue that bank lending is still special. In the first section we begin with some perspective on recent trends on business borrowing. We show that the manufacturing sector has not reduced its dependence on banks, and small firms still borrow almost exclusively from banks. Using a second data set that

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allows the identification of intermediated debt (but unfortunately not bank versus nonbank), we also show that the large majority of manufacturing firms use *only* intermediated debt, and that the employment share of such firms is large.

To explain why some firms still rely on banks and intermediaries, the next section reviews the theory of financial contracting. Initially, we follow the literature and distinguish between direct borrowing in public debt markets and intermediated borrowing. (Thus, in this section "bank" and "intermediary" are used interchangeably; a later section will distinguish between bank and nonbank intermediaries.) This theoretical literature argues that well-known, high-quality firms can borrow directly with simple bond and commercial paper contracts, while more information-problematic firms rely on short-term, secured loan contracts with complex covenants.[1] We review a variety of existing studies supporting the view that intermediaries are more efficient than direct lenders at monitoring and renegotiating these complex contracts.

In the third section we present new evidence in support of this view. First, we report regression results showing that reliance on intermediated debt varies with firm size and other common proxies for agency problems. Second, for firms that borrow exclusively from intermediaries, we show that reliance on short-term debt varies with these same measures of agency problems. Since most short-term borrowing is from banks, this evidence supports the view that bank lending is special for "information-problematic" firms.

In contrast to the second section, in which the discussion did not distinguish among intermediaries, the fourth section argues that banks differ from nonbank intermediaries—specifically, insurance companies and finance companies. We argue that because insurance companies have longer-term liabilities, they have a cost advantage in long-term lending, while the short-term liabilities of banks and finance companies make it cheaper for them to lend over the short term. Because short-term debt is a way to control agency problems, smaller, more information-intensive firms will tend to borrow more from banks and finance companies than from insurance companies. And for such firms, finance company loans would appear to be close substitutes for bank loans. But the evidence shows that finance companies specialize in leasing and lending against assets with thick secondary markets, such as automobiles, aircraft, and retail furnishings. Thus, firms with highly specialized or intangible assets may find it difficult (expensive) to substitute finance company loans for bank loans.

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[1] We use the terms "low-quality" and "high-quality" to refer to the degree of information asymmetry between borrowers and lenders. This is conceptually different from risk, which in general may be correlated with quality, but is otherwise distinct.

We conclude that bank lending is still special for some business borrowers. Smaller, lower-quality borrowers still require intensive screening and monitoring by intermediaries. Some low-quality firms can borrow from insurance companies but many do not. Only firms with easily collateralized assets seem able to borrow from finance companies. For the remainder of firms, bank lending is still special, thus establishing an important necessary condition for the existence of a lending channel.

Perspective on Recent Trends in Business Borrowing

In view of recent claims that banks are dead, we present some evidence that bank are still vital players in the commercial lending business. We stress commercial lending because the increasing securitization of consumer loans and mortgage loans means banks can originate such loans without funding them with deposits. Smaller, information-intensive business borrowers, we argue, still depend on banks and other intermediaries for credit.

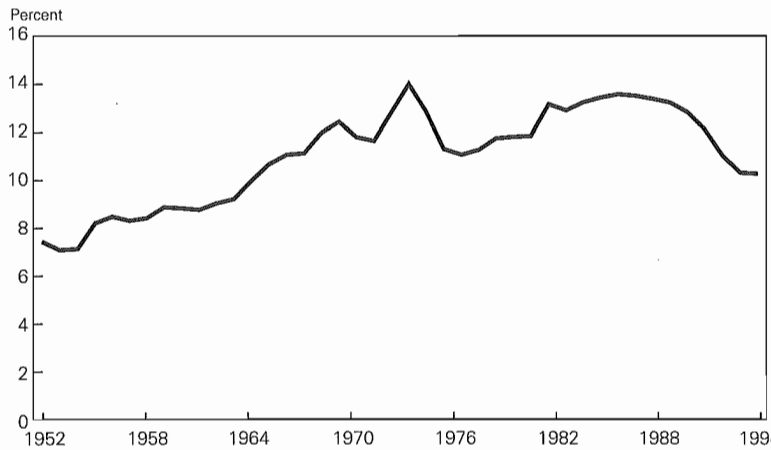
Because total indebtedness rose during the 1980s, Boyd and Gertler (1994) have pointed out that a more informative way to judge the importance of banks as business lenders is to measure bank loans relative to GDP (Figure 1). Even after the spectacular decline between 1989 and 1993, bank loans to nonfinancial business are still a larger share of GDP now than over most of the 1960s. And although it is too early to pronounce a trend, it is notable that the dramatic decline abated in 1994.

It is also instructive to measure bank loans as a fraction of nonfinancial business credit (Figure 2). These data understate business lending by banks to some extent because they exclude business mortgages held by banks. Even so, banks have provided a substantial and remarkably stable share of credit to nonfinancial business. While the share of credit from other sources shows pronounced trends over the last 40 years, the share from banks has been stable in comparison. Banks' share averaged 22 percent between 1952 and 1987 and never deviated from a range between 20 and 26 percent. Banks' share dipped below 20 percent for the first time in 1987 but it has since increased to 18.5 percent—still a substantial share and considerably more than finance companies' share. Note also that, while the share of credit raised directly in the commercial paper market has risen steadily since 1966, it is still less than 4 percent of nonfinancial business credit.

Table 1 narrows the focus to manufacturing firms. The table shows that their reliance on banks has not declined over the decade ending last year. This is notable because many observers have argued that lower information costs have allowed nonbank lenders to displace banks in lending to information-intensive borrowers. However, manufacturers'

Figure 1

RATIO OF BANK LENDING TO GDP



Source: Board of Governors of the Federal Reserve System, *Flow of Funds*; Datastream.

specialized assets and R&D intensity would seem to make them especially problematic borrowers, and they are still bank dependent.

Table 1 also shows that smaller manufacturers are especially bank dependent. In either decade shown, commercial banks held roughly two-thirds of the debt of firms with assets under $25 million. We divided the data into only two groups, but Gertler and Hubbard (1988) document that the inverse relationship between bank dependence and size is monotonic across many size classes.

Table 1
Percent of Manufacturers' Debt Owed to Banks

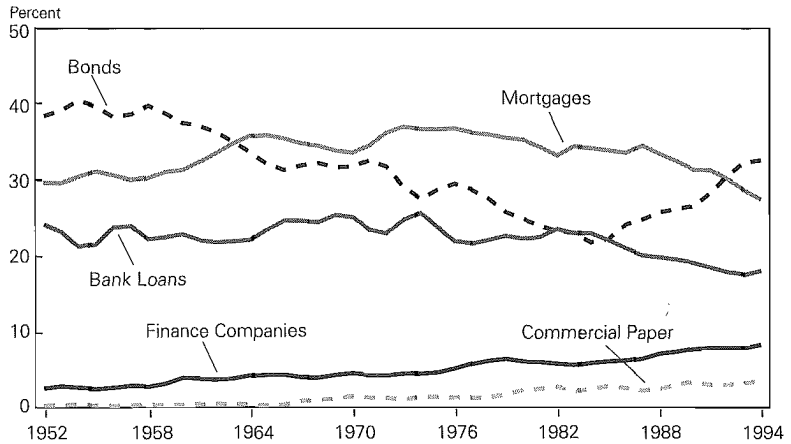
	1975–84	1985–94
All Firms	31	32
Assets < $25 Million	62	66
Assets > $25 Million	26	28

Note: The averages in the first column for firms greater than and less than $25 million are for the years 1980–84.

Source: U.S. Bureau of the Census, Quarterly Financial Reports.

Figure 2

SOURCES OF NONFINANCIAL BUSINESS CREDIT



Source: Board of Governors of the Federal Reserve System, *Flow of Funds*.

The most recent survey evidence indicate that smaller firms generally—not just manufacturers—still borrow almost exclusively from banks. The National Federation of Independent Business periodically surveys its 500,000 members about their sources of funds. Banks were the source of 84 percent of the loans in 1980 and 86 percent in 1987, the latest year available (Scott and Dunkelberg 1985; Dennis, Dunkelberg, and Van Hulle 1988). The Federal Reserve Board's National Survey of Small Business Finance (NSSBF) in 1987 tells the same story. Banks (and other depository institutions) supplied 89.4 percent of the firms with their most recent loan. Fewer than 1 percent of the firms reported that their most recent loan came from a finance company.

The aggregate data in Figure 2 might suggest to some observers that all firms are borrowing more in the commercial paper (CP) and bond markets and less from banks and intermediaries. The data in Table 2, however, indicate that a relatively small number of firms issued public debt of either type, even as late as 1992. The table divides 5,359 firms listed in the Compustat data base in 1992 into three mutually exclusive groups: firms rated for commercial paper, those rated to issue bonds but

Table 2
Reliance on Intermediated vs. Public Debt by Firms on Compustat—1992

	Commercial Paper Issuers	Bonds but No Commercial Paper	Intermediated Debt Only
Number of Firms	351	544	4,364
Percent of Firms	6.6	10.3	83.0
Employment (millions)	13.3	7.4	8.2
Percent of Employment in Sample	46.2	25.5	28.3

Note: Rows may not sum to 100 percent because of rounding.
Source: Standard & Poor's Compustat.

not commercial paper, and those with neither rating ("Intermediated Debt Only").

Only a small fraction of firms, 16.9 percent, is rated to issue either type of public debt. The commercial paper market comprises an especially select group of only 351 firms, under 7 percent of the sample. The vast majority of firms, 83 percent, borrow only from intermediaries. Although these are small firms, they are important in aggregate; they employed 8.2 million workers in 1992, or 28.3 percent of employment of all firms in the sample. Unfortunately, Compustat does not report the type of intermediary from which firms are borrowing. But it should be remembered that banks are still the largest financial intermediary in the United States.

Table 2 indicates that only a select group of firms can issue commercial paper and bonds as substitutes for intermediated debt. The simple fact is that the vast majority of firms rely exclusively on loans from intermediaries. The next section draws selectively from the literature on financial contracting under asymmetric information to explain why so many firms borrow only through intermediaries.

What Makes Intermediaries "Special": Theory and Evidence

The theory of financial contracting under asymmetric information provides a general framework for understanding why smaller, information-intensive borrowers rely on intermediaries. To reduce agency costs, such firms submit to tight, detailed loan covenants in their debt contracts. Because the monitoring and renegotiating of these contracts is costly, however, these tasks are more efficiently delegated to an intermediary. Intermediaries' lower monitoring and renegotiation costs mean they can write covenants that entail more frequent monitoring. More frequent monitoring, in turn, means intermediaries become better informed about firms over the length of a relationship. That, we argue,

is why intermediaries—especially banks, but also finance and insurance companies—are "special," in theory. (In the next to last section we will consider some differences between bank and nonbank intermediaries.)

In the following sections, we review a variety of evidence showing that covenants in private debt agreements are tighter and conditional on more volatile performance than those in public agreements. Even though private debt covenants are more frequently violated, intermediaries' flexibility in renegotiating reduces the cost of financial distress. We also review the contracting view of debt maturity, which predicts that smaller, more information-problematic borrowers will choose shorter-term debt. This is because they have higher contracting costs, which make it expensive to write and enforce covenants to control all possible agency problems. We conclude with a summary of existing evidence.

Covenants, Monitoring, and Intermediation

Lenders attempt to control agency problems by imposing restrictive covenants in lending contracts (Jensen and Meckling 1976). Typical covenants restrict firms' dividends and indebtedness and often require firms to maintain minimums of net worth and working capital. Borrowers are also required to submit regular accounting statements, which makes it relatively easy to determine if a covenant has been violated. However, because these covenants are based on noisy indicators of firms' true financial health, more intense monitoring is needed to determine how to handle a violation (Berlin and Loeys 1988).

Modern finance theory views banks and other intermediaries as delegated monitors (Diamond 1984; Boyd and Prescott 1986). Intermediaries are more efficient at monitoring these covenants for at least two reasons. First, intermediaries are less likely to free-ride on the information production of others because they have a larger stake. Thus, the intermediary is more likely to be informed about the event of a covenant violation and more likely to monitor to determine if the violation is serious. Second, intermediaries, acting unilaterally, can renegotiate a covenant more cheaply than dispersed bondholders. Obtaining the simple or two-thirds majority vote necessary to amend a bond covenant is costly and may fail if individual bondholders hold out for a better deal (Gilson, Kose, and Lang 1990).

The theory of intermediation suggests that, because intermediaries can renegotiate covenants more easily than public lenders, the covenants in bank contracts can be tighter. In his survey of the studies of covenant violations, Smith (1993) finds that virtually all of the violations were of covenants in private rather than public issues. Sweeney (1994) finds 90 percent of the violations of private covenants were of bank lending agreements, specifically. These findings suggest that bank covenants are set more tightly.

The covenants in public and private contracts also set their conditions depending upon different types of events. Public bond covenants tend to set their conditions on events that are relatively easy to verify, such as a major change in capital structure or a rating downgrading (Crabbe, Pickering, and Prowse 1990). In contrast, private loan contracts are conditioned upon performance measures, like working capital and net worth, that are less easily controlled by managers. Sweeney finds that these two covenants are the most frequently violated. Since these covenants require more monitoring, bondholders will be less likely to impose them (Kahan and Tuckman 1993).

The violation of a financial covenant often triggers financial distress. The "anatomy" of distress described by Asquith, Gertner, and Sharfstein (1994) reveals the flexibility banks have in negotiating with troubled borrowers.[2] When firms missed a payment or violated a covenant, banks could restructure many terms of the contract: waive covenants, extend maturity, extend more loans, reduce the line of credit, or require more collateral. Restructuring would often entail tightening some terms and relaxing others. For example, banks might waive the violated covenant but require security against the line of credit or lengthen the maturity.

This flexibility reduces the cost of financial distress. If monitoring and contracting costs were negligible, firms with good long-run prospects would not be affected by distress; lenders would simply renegotiate the debt. Information asymmetries and free-riding by bondholders, however, may force financially distressed firms into inefficient spending cutbacks and even bankruptcy.

Gilson, Kose, and Lang (1990) find that financially distressed firms are more likely to restructure their debt (thus avoiding Chapter 11), the larger the share of their debt that is owed to banks.[3] In particular, banks were much more likely to extend maturity on the loan than were bondholders. In contrast, public debt often entails exchanging the original bonds for ones with *shorter* maturities in order to prevent holdouts. Among Japanese firms in financial distress, Hoshi, Kashyap, and Scharfstein (1990) find that those with close bank ties invest more and sell more than those without close bank ties.

Firm Stock Prices Respond Favorably to News of Bank Relationships

Banks write tight, detailed loan covenants that entail substantial monitoring. All else equal, tighter covenants also mean more violations

[2] In a sample of 102 distressed junk-bond issuers, banks held 25 percent of the firms' debt and almost all firms had a revolving line of credit from a bank.

[3] Their definition of "banks" includes insurance companies. However, only 11 percent of the sample borrowed from insurance companies.

and hence more monitoring. Over the course of this banking relationship—with all the monitoring it entails—banks become better informed about the firm than public investors. A number of studies investigate this possibility by investigating how share prices respond to news about a firm's banking relationship.

A key finding by James (1987) is that a firm's stock price rises after an announcement that it has received a loan agreement from a bank. This contrasts with a negative (or insignificant) response to announcements of a public bond offering (Smith 1986). Subsequent event studies show the share response is larger, the closer the relationship and the smaller the firm.[4]

Some bank relationships are closer than others, of course. Loans to larger firms are often syndicated among many borrowers, both to diversify and to avoid regulatory limits. Preece and Mullineaux (1994b) point out that as the number of banks in the syndicate increases, the deal becomes more like a public bond issue, with the attendant problems of free-riding and higher negotiation costs. Consistent with that argument, they find that the stock price response to news of a bank loan agreement weakens as the number of lenders to the firm increases.

An innovative study by Slovin, Sushka, and Poloncheck (1993) examined a sample of firms that had banking relationships with Continental Illinois Bank, a bank that appeared bound to fail in the summer of 1984 until it was rescued by the Federal Deposit Insurance Corporation (FDIC). The share prices of these firms fell as Continental's prospects diminished over the early summer and then rebounded after the FDIC announced a rescue. Share prices responded only if Continental was a direct lender (signed a separate note with the borrower) or was lead lender in a syndicate, not if Continental was merely a participant in the syndicate.

Slovin, Johnson, and Glascock (1992) argue that the marginal information of a bank loan announcement is smaller for large firms because such firms are already carefully researched by public credit and equity analysts. In support, they find that stock prices of small firms increase after the announcement of a bank loan agreement, while stock prices of large firms are unaffected.

A lending channel requires that the supply of bank loans affect firm spending. Two recent studies find a link between firms' spending and the closeness of their banking relationships. Using a sample of Japanese firms, Hoshi, Kashyap, and Sharfstein (1991) show that investment by firms without close banking relationships is constrained by their cash

[4] For example, Lumer and McConnell (1989) show that share prices increase only upon renewal of an existing loan agreement, suggesting banks become better informed over the course of the relationship.

flow, while spending by firms with close banking relationships (firms in Keiretsu) was unconstrained. This finding suggests that the monitoring entailed by a close banking relationship reduces agency problems and lowers the cost of external funds relative to internal funds. However, banking relationships in the United States cannot be as close as in Japan, where banks may use both debt and equity. Morgan (1995) argues that in the United States a banking relationship essentially means that firms have a loan commitment from a bank, and he shows that investment by firms with a bank loan commitment is less liquidity constrained than investment by firms without a commitment.

Short-Term Debt Reduces Agency Costs

In the previous section, we discussed how lenders can impose covenants in loan agreements in order to keep the option to terminate or renegotiate the loan if a firm's balance sheet deteriorates. When these covenants can be cheaply observed and, if necessary, enforced by third parties, it is desirable to attach such agreements to long-term debt. On the other hand, a borrower may be able to increase the riskiness of its assets without affecting the balance sheet ratios on which covenants are typically written. In this case, it may be more effective for intermediaries to simply shorten the maturity of the loan, thereby insuring that the loan can be renegotiated or terminated if the firm's prospects deteriorate.

A number of theories in the literature seek to explain the maturity structure of debt. Barclay and Smith (1993) identified three broad approaches based on contracting costs, signaling, and taxes. While evidence exists to support each of these approaches, we will restrict our discussion in this section to the contracting view. The contracting view argues that short-term debt is useful because it preserves the option for lenders to terminate or renegotiate a lending arrangement. This option is valued by lenders, because long-term debt creates an incentive for borrowers to increase asset risk after taking on debt.

The main testable implication of this view is that firms with severe information asymmetries and fungible assets (and therefore agency problems) will borrow more from intermediaries and will also use more short-term debt. Recent evidence is consistent with these predictions. Barclay and Smith (1993) and Rajan and Zingales (1993) estimate regressions that show a positive relationship between maturity structure and proxies for agency problems. In the next section, we extend their results by estimating a similar model that explains not only the maturity choice, but also the choice of intermediated debt.

New Evidence on the Determinants of Intermediated and Short-Term Debt

Our discussion of intermediation and the design of debt contracts has identified two themes in the literature. First, intermediated debt dominates public debt when information problems create the need for continuous (ex post) monitoring of borrowers. Second, lenders prefer short-maturity debt when information problems make it difficult to monitor and enforce covenants. In this section, we report new empirical results that broadly support these two themes.

Using data from Standard & Poor's Compustat, we constructed a cross section of 5,108 firms from 1992.[5] This sample covers only publicly traded firms from a number of industries, including manufacturing, mining, retailing, wholesaling, and services. Compustat does not break down firms' debt by source, but it does indicate if a firm has a Standard & Poor's rating for bonds or commercial paper. Therefore, we use "no rating" to identify firms that use only intermediated debt.[6]

To relate our qualitative measure of intermediation to firm characteristics, we use an ordered probit model in which our indicator is assumed to be a function of an underlying (latent) variable that indexes the firm's "propensity for intermediation." We denote this index by y_i^* and assume that $y_i^* = x_i'b + e_i$, where x_i is a vector of firm characteristics that determine the propensity for intermediation (more on this below). We then define a discrete dependent variable, $y_i = 3$ if the firm relies only on intermediated debt (no bonds or commercial paper), $y_i = 2$ if the firm is good enough to issue bonds but not commercial paper, and $y_i = 1$ if the firm is good enough to issue commercial paper. Following the arguments in Calomiris, Himmelberg, and Wachtel (1995), this specification assumes that the quality of commercial paper issuers is higher than that of bond issuers that do not issue commercial paper.[7]

We also use an ordered probit to model short-term debt because there are substantial mass points at zero and at one that would create

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[5] We chose 1992 because it is the latest available year for which firms have completely finished filing their annual reports with the Securities and Exchange Commission. Our sample is the same set of 5,259 firms used to construct Table 2, but we removed 151 firms that had either missing data or large outliers for the ratios used as regressors.

[6] Our reliance on Compustat data may overstate the importance of intermediated debt by failing to identify some firms that have public debt outstanding. Though virtually all bond and commercial paper issues are rated by Standard & Poor's, some small issues are rated only by Moody's or other agencies. However, a random sampling of firms rated by Moody's indicated that the overlap is more than 95 percent.

[7] We get similar results when we specify only two classes, but we sacrifice some efficiency.

problems for a standard regression model.[8] We define $y_i = 12$ if the short-term debt ratio is one, $y_i = 11, \ldots, 2$ if the ratio falls in deciles 10 through one, respectively, and $y_i = 1$ if the ratio is zero (we also define $y_i = 1$ for firms with zero total debt). We estimate the short-term debt model using only the observations on firms that rely on intermediated debt, so the estimated model describes the debt maturity structure given that the firm is borrowing only from intermediaries.

Table 3 reports estimated coefficients for the above models. To proxy for information and contracting problems, we use several variables that are standard in the literature. The first two rows of the table report the coefficients on size variables, where size is measured by the log of sales (a squared term is included to allow for nonlinearities). In model 1, the negative coefficient on size confirms that large firms rely less on intermediated debt. In model 2, this coefficient shows that, conditional on using intermediated debt, small firms also use more short-term debt. To the extent that size is a proxy for information problems, this is consistent with the view that short-term debt is used to cope with agency problems. Since most commercial and industrial (C&I) lending by banks is short-term, this finding is also consistent with the view that small firms rely heavily on banks.

Rows 3 and 4 report the coefficients on capital intensity, defined as the ratio of property, plant, and equipment to sales[9] (a squared term is again included to allow for nonlinearities). This variable measures the extent to which the firm uses fixed capital in its production technology, as opposed to "soft" inputs like materials, labor, and technology. The prediction is that capital-intensive firms will find it easier to borrow from public debt markets because fixed capital, unlike technology and other intangible inputs, is more easily observed by outside investors and therefore less subject to agency problems. The negative and highly significant coefficient in model 1 shows that capital-intensive firms are indeed less likely to require intermediation. Capital intensity is also important in model 2, which further shows that among intermediated firms, capital-intensive firms are less likely to use short-term debt.

Among non-capital inputs, R&D expenditures are generally thought to create more information problems than labor and materials. We therefore include the ratio of R&D to fixed capital as a proxy for the importance of (intangible) technological capital (row 5). This variable is

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[8] Alternatively, we could have modeled short-term debt as a continuous variable with two-sided censoring. This is more efficient, but less robust. The ordered probit is sufficient for our purposes given the size of our sample.

[9] This variable can also be viewed as a point estimate of the capital share parameter. That is, if the production function is Cobb-Douglas, then profit maximization implies that the value of capital divided by the value of sales equals the exponent on capital. The magnitude of this parameter provides a measure of the firm's capital intensity.

Table 3
Determinants of Debt Structure

Ordered probit results showing the effect of firm characteristics on debt structure. Dependent variable in column (1) is classified 3, 2, or 1, respectively, if firm has no rating, a bond rating but no commercial paper (CP), or a CP rating. In column (2) the dependent variable is classified 12 if the ratio of short-term to total debt is 1, 11 to 2 if the ratio falls in deciles 10 through 1, and 1 if total debt is zero. Standard errors appear in parentheses.

	Dependent Variable	
Regressors	Model 1: Intermediated Debt	Model 2: Short-Term Debt
1. Size	−1.077**	−.156**
	(.131)	(.017)
2. Size, Squared	.028**	.002
	(.010)	(.002)
3. Capital Intensity	−.833**	−.625**
	(.143)	(.068)
4. Capital Intensity, Squared	.142**	.090**
	(.035)	(.016)
5. R&D Intensity	.036	.096**
	(.130)	(.023)
6. Investment	.314	.565**
	(.218)	(.079)
7. Short-Term Assets	.009	.263**
	(.180)	(.081)
8. Industry Dummies	(not reported)	(not reported)
9. Observations	5108	4273
10. Log-likelihood	−1528.4	−9847.3

Note: Model 2 indicates fewer observations than Model 1 because firms with public debt have been omitted.

"Size" = the log of total sales; "Capital Intensity" = ratio of fixed capital to sales; "R&D Intensity" = ratio of R&D to fixed capital; "Investment" = ratio of capital expenditures to fixed capital; and "Short-Term Assets" = ratio of inventories to inventories plus fixed capital. Industry dummies described in text.

One-tailed tests significant at the 1 percent level are denoted by **.

statistically insignificant in the model for intermediated debt, but it is positive and highly significant in the model for short-term debt. Thus, conditional on both size and capital intensity, the effect of R&D on intermediation is neutral, but R&D-intensive firms clearly rely more heavily on short-term debt.

The last two variables in the model—investment and short-term assets—are unimportant for public debt, but are highly significant in the model for debt maturity. The ratio of investment to fixed capital ("investment") is included as a proxy for the growth rate of the

firm.[10] Higher investment reveals that a lower fraction of future profits will be generated by existing fixed capital (our capital intensity variable in rows 1 and 2 measures only the current fraction). Thus, the scope for discretionary use of funds is higher, causing lenders to prefer short-term debt. We also included short-term assets to proxy for agency problems because such assets are, by definition, reacquired every year and therefore more subject to risk-shifting or other value-reducing activities. Our proxy for short-term assets is the ratio of inventories to inventories-plus-capital, and the estimates in row 7 indicate that lenders indeed seem to prefer short-term debt for firms with high levels of short-term assets.

To summarize, the results in Table 3 confirm our discussion of intermediation and short-term debt. In particular, public debt markets are restricted to large, capital-intensive firms. Such firms are evidently better known and, because of their heavy reliance on fixed capital, relatively less prone to agency problems. The vast majority of firms in our sample rely on intermediated debt. For these firms, size and capital intensity help the firm gain access to long-term credit. Otherwise, small, high-tech, rapidly growing, and inventory-intensive firms tend to rely more on short-term borrowing. Recent theories of intermediation and optimal debt contracting provide a parsimonious explanation for these facts.

Are Banks "Special" among Intermediaries?

The theory and evidence above make a good case that public debt is not a good substitute for loans from intermediaries. This section takes up the harder question of whether loans from other intermediaries—finance and life insurance companies in particular—are good substitutes for bank loans. We begin with the evidence and end with a discussion of why those other intermediaries do not provide perfect substitutes for bank loans.

Ten years ago, Fama (1985) concluded that banks must be different from other intermediaries, otherwise bank borrowers would not be willing to bear the reserve tax (since removed) on bank CDs. Economies of scope between deposit-taking and lending, he argued, give banks an information advantage over finance companies and other intermediaries. A firm's deposit history may inform banks, which tend to lend against cash flow, about a firm's credit risk. Information on deposit activity may also make it easier to monitor working capital covenants.

The idea that lending and deposit-taking are complementary is a

[10] In a cross section, this is probably the best available indicator of firm's growth rate. Using several lags of sales might have generated a more accurate measure, but this would have systematically removed newly public firms that do not have data for earlier years.

venerable one, yet Petersen and Rajan (1994) are the first to provide any evidence. Using data on individual small firms from the National Survey of Small Business Finance (NSSBF), they test whether close banking relationships increase the availability of credit to firms. The strength of the relationship is measured by its length and by the fraction of debt borrowed from a lender with whom the firm kept a deposit or purchased some other financial service from the lender. They find that 64 percent of the firms have a deposit with their current lender. These relationship variables significantly increase the availability of credit to firms, which they measure by the extent to which firms avoid more expensive trade credit.[11]

Using a subset of the NSSBF data, Berger and Udell (1994) find that firms are charged lower rates and are less likely to post collateral, the longer the firm has maintained a credit commitment with a bank. They find a stronger effect on interest rates than Petersen and Rajan (1994) because they focus on lending under commitments, which entails a relationship, and exclude loans driven largely by transactions—mortgages and equipment and auto loans, for example—that seem less likely to involve a relationship between the borrower and the lender.

Our look at the NSSBF data turned up some related evidence. Firms were asked why they chose to deal with a particular financial institution. After "convenience," the most common reason for choosing a bank was that the firm's owner had some sort of "relationship" with the bank. In contrast, firms dealt with finance companies primarily because they were "captive," that is, because they had bought or leased a capital good from the same company. In sum, personal relationships were far less important a reason for borrowing from finance companies.[12]

A recent study by Becketti and Morris (1993) also bears on this discussion. Although they are agnostic about whether C&I bank loans are special or not, they find no evidence that bank loans have become *less* special in recent years. If more or better substitutes had flattened the demand curve for bank loans in the 1980s, they reason, a decline in the supply of bank loans would have a larger affect on the equilibrium quantity of loans than before. Yet they find no evidence that increases in the federal funds rate have had a larger impact on bank borrowing since 1982.

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[11] They find that the strength of the relationship did not affect the rate charged on the most recent loan. The small effect of relationships on the interest rates, they argue, could reflect that banks ration credit through non-price terms.

[12] Event studies yield mixed evidence on whether banks are unique among intermediaries. James (1987) found that a firm's share price fell after an announcement that the firm was replacing a bank loan agreement with a private placement from an insurance company. Preece and Mullineax (1994a), on the other hand, find a positive share price response following announcements of a loan agreement from finance companies or nonbank subsidiaries of bank holding companies.

Insurance Companies versus Banks

Like banks, insurance companies specialize in originating and holding contracts that require both ex ante and ex post information production. And like bank loans, these contracts contain covenants and collateral provisions that seek to provide protection against moral hazard, as well as to alter the allocation of proceeds in the event of default. But unlike banks, insurance companies have longer-term liabilities on their balance sheets. The fact that maturity transformation is costly makes insurance companies an inefficient source of short-term loans. The short-term liabilities of banks, on the other hand, make them relatively efficient sources of short-term loans.

Carey, Prowse, Rea, and Udell (1993) provide evidence that markets for private placements and bank loans are segmented by maturity. The private placements in their sample have a median maturity of nine years, and no private placement had a maturity of less than one year. In contrast, 67 percent of all bank loans had maturities shorter than one year, and essentially none had a maturity greater than seven years.

These facts, combined with our earlier discussion of maturity structure, suggest that private placements are imperfect substitutes for bank loans. Moreover, they suggest that banks lend to information-problematic firms for which short-term debt is optimal, while insurance companies lend to firms for which information problems are small enough to permit long-term borrowing, but not small enough to access public bond markets. Carey et al. (1993) provide evidence on this point. For a sample of firms selected from Compustat, they show that relative to bank borrowers, the median borrower in the private placement market is larger (assets of $3.4 billion versus $0.04 billion), is less R&D intensive (R&D-to-sales ratio of 0.038 versus 0.070), and has a higher percentage of fixed assets (42 percent versus 31 percent).[13]

A related argument suggests that short-term bank lending dominates long-term private placements when the lender wants to impose covenants based on characteristics that are observable but not verifiable by a third party. When covenants are based on verifiable characteristics, it is easier for a lender to legally declare a loan to be in default. However, when the lender can observe that the loan is in default but cannot convey this information to a third party, short-term debt will be used because it gives the lender the ability the terminate the loan (Berlin and Loeys 1988; Hart and Moore 1989). Thus, "in many cases, a short-term loan without a covenant may dominate a longer-term loan with a covenant" (Carey et al. 1993).

[13] These variables are commonly used in the literature as proxies for information problems. For additional discussion of these proxies, see the previous section.

Finance Companies versus Banks

Unlike insurance companies, whose preferences for long-term lending are dictated by their long-term liabilities, finance companies are relatively free to structure their liabilities either long or short. In particular, they can assess the contractual requirements of the borrower (including maturity), and then structure their liabilities accordingly. Assuming that this flexibility is important, finance companies are better positioned to make short-term loans that would compete directly with banks. In practice, while the maturity structure of their lending is indeed shorter-term, it is not as short as the typical bank loan. Moreover, significant differences in collateral requirements are found between the loans made by banks and by finance companies. We argue that these differences effectively segment the market for business lending (excluding mortgages) between banks and finance companies.

Broadly characterized, the evidence suggests that finance companies specialize in "good collateral" lending and leasing. According to the *Federal Reserve Bulletin* (August 1995, Table 1.52), leases make up 47 percent of the $157 billion in credit provided by finance companies to business.[14] The balance of finance company lending is niche lending against assets that have thick secondary markets (and therefore high liquidation values). On the other hand, leasing or secured loans may not be an attractive option for firms with firm-specific assets. For example, leasing is relatively uncommon in the manufacturing sector (Sivarama and Moyer 1994). In contrast, a significant portion of bank commercial loans are unsecured (Becketti and Morris 1993). These facts suggest that relative to finance companies, banks specialize in lending against assets that are difficult to pledge as collateral.

Given that finance companies specialize in collateral, the nature of firm assets appears to determine whether firms borrow from banks or finance companies. Many assets make poor collateral; expenditures for R&D, advertising, and firm-specific fixed capital create assets that are difficult or impossible to sell in the event of a loan default. Because these assets have little value except as part of the firm as a going concern, the optimal loan contract will substitute tighter covenants and shorter

[14] The accelerated growth in the 1980s in part reflects a boom in leasing spurred by the Economic Recovery Tax Act of 1981 (Remolena and Wulfekuhler 1992). The Act allowed simplified and accelerated write-offs of depreciation. Finance companies could use the write-off to shelter their income while banks could offer only nonoperating leases and therefore could not shelter their income. The corporate debt buildup later in the '80s also increased the demand for leasing, as highly leveraged firms could protect their credit rating by leasing instead of borrowing.

maturity in place of collateral requirements.[15] These loan characteristics enhance the benefits of continuous monitoring and place more emphasis on the assets' contribution to cash flow rather than their value on secondary markets.

What accounts for the respective degrees of specialization between banks and finance companies? Regulatory restrictions on bank assets provide one explanation. Remolona and Wulfekuhler (1992) suggest that the large market share of finance companies in leasing is the combined outcome of Federal Reserve Regulation Y (which restricted bank leasing) and dynamic learning economies, through which finance companies gained valuable knowledge about secondary-market values for large-asset classes like commercial aircraft, construction equipment, machine tools, and medical equipment. This asset knowledge gave finance companies a significant cost advantage over banks in various niche markets where the nature of the asset being financed permits leasing or secured lending.[16]

With the exception of Remolona and Wulfekuhler (1992), we are not aware of attempts in the literature to explain the segmentation of loan markets between banks and finance companies. Specifically, given that finance companies are successful in markets for leasing and for highly collateralized loans, why do they not compete with banks in the market for short-term, unsecured loans? This puzzle is presumably explained by the bank franchise on deposit-taking. We can think of two reasons why deposit-taking might lower the cost of making short-term, relatively unsecured loans. First, as Fama (1985) and others have suggested, if deposit-taking lowers the cost of monitoring the firm's financial condition, then it confers an advantage in unsecured lending (especially for short-term lending). Second, if maturity matching reduces costs, then deposit-taking makes it cheaper for banks to lend short term. The large amounts of commercial paper floated by finance companies are short maturity (30 days, typically), but not as short as a demand deposit. As long as banks retain their franchise on deposit-taking, they seem likely to retain their dominant position in the market for short-term, unsecured C&I lending.[17]

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[15] In general, firms with intangible assets will also choose lower debt-equity ratios (Harris and Raviv 1990). Our analysis considers only the debt choice conditional on the debt-equity choice.

[16] Remolona and Wulfekuhler (1992) also point out that economies of scope could also provide finance companies with a cost advantage over banks in secured lending. For example, they note that IBM Credit uses information about the parent's product plans to inform its forecasts of residual asset values. On the other hand, they note that GE Capital successfully entered aircraft leasing even though its parent manufactures only engines.

[17] This assumes that innovations in transactions technology will not render deposit-taking obsolete.

CONCLUSION

While both theoretical and empirical research identify fundamental differences between intermediated and direct borrowing, more research is needed on the differences among intermediaries, especially those between banks and finance companies. Finance companies fund loans by selling commercial paper and medium-term notes to mutual funds, which in turn issue shares to savers. Is this "parallel banking system" (D'Arista 1994) merely an artifact of regulation (for example, the reserve tax), or has it arisen because of informational economies of scope between producing and selling capital goods and making loans secured by those same assets? Does the banks' franchise on demand deposits, the most liquid of liabilities, provide sufficient information and other advantages to stave off finance companies funded by one-month commercial paper?

Boyd and Gertler (1994) stress that most commercial paper is backed by a standby letter of credit from a bank, suggesting that banks add value to the market by monitoring issuers (or by providing indirect access to the discount window). Does this arrangement open a policy channel to the commercial paper market? Banks are required to hold capital against standby letters of credit, so a capital shock could affect the supply of standby letters and the cost of commercial paper.[18] Backup letters do not require reserves, however, so it seems doubtful that open market operations could directly affect the commercial paper market.

With such questions for future research in mind, we conclude that bank lending is still special, at least for some business borrowers. Smaller, lower-quality borrowers still require intensive screening and monitoring by intermediaries. Some such firms can borrow from insurance companies, but many do not. Only firms with easily secured assets seem able to borrow from finance companies. For the remainder of firms, bank lending is still special. Of course, the existence of a lending channel also requires that monetary or regulatory policy actually change the supply of bank loans. This topic is considered by other papers at this conference.

[18] D'Arista (1994, p. 456) cites evidence that the imposition of capital requirements against letters of credit tightened terms of banks' backup lines for finance company commercial paper.

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Discussion

Robert R. Glauber*

For bank lending to provide a distinct mechanism for the transmission of monetary policy, banks must occupy a special niche for some category of borrowers. This paper by Charles Himmelberg and Donald Morgan focuses directly on that issue and is an appropriate place to start this conference. My brief comments are directed to three questions raised by the paper. First, in the past has a discernible category of borrowers been dependent on bank loans? Second, are these borrowers likely to continue to depend on banks, or will nonbank substitutes compete effectively for them? Third, how effective is this bank lending channel as a transmission mechanism for monetary policy; specifically, does it reinforce what the Fed is seeking to do through other policy initiatives, or does it act at cross-purposes?

Using both theoretical and empirical evidence, the authors show, quite persuasively I believe, that a well-defined class of borrowers is and has been markedly dependent upon banks. This important group is characterized as small and non-capital-intensive firms and includes high-tech and rapidly growing companies. They may be responsible for only 28 percent of employment, but they create more than their share of jobs in cyclical expansions.

The theoretical support for identifying this group rests primarily on agency cost considerations. Because less information is published for them, smaller firms (and especially those non-capital-intensive firms whose value depends more on intangible assets, which provide less satisfactory collateral for loans) are more subject to classical agency costs

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than other firms. Naturally, both these firms and the market seek to reduce those agency costs, and one effective way to reduce them is by creating tight, detailed covenants in bank lending contracts. Intermediaries in general, and banks in particular, are well-equipped and have specialized in creating, negotiating, monitoring, and where necessary, renegotiating these contracts. That is the niche intermediaries occupy, and banks have become extremely skilled in that role. These skills have contributed importantly to reducing the cost of lending. The empirical support in the paper, beyond a review of past evidence, is contained in a probit analysis of new data confirming this image of a special category of bank borrowers: small, growing, non-capital-intensive firms.

But so much for the past; as the authors say, banks have been special until now. The question remains, will they be special in the future? First of all, how about competition for small-business lending from other intermediaries, specifically life insurance companies and finance companies? Looking forward, I am less convinced that banks will successfully hold off this competition.

First, why cannot life insurance companies offer serious competition? The major thrust of the argument is that the maturity mismatch that would occur when their naturally long-term liabilities are set off against short-term loans to these small, growing firms has kept insurance companies out of this business. Well, if that has been the reason in the past, I think it less likely to be a reason in the future. Techniques using derivative instruments are now available to transform maturities and reconcile mismatches with low risk and at very low cost. So if all that was keeping insurance companies out of short-term, small-business lending is the maturity mismatch, that is hardly going to be a great barrier in the future. There are, of course, other forces that may keep life insurance companies out of this market, not least the consolidation and continuing competitive pressure confronting insurers. But I would not rely on maturity mismatch to keep insurers from competing with banks for short-term business loans.

Finance companies, on the other hand, have already become an extraordinarily important competitor of banks. In the late '80s and early '90s, finance companies were providing short-term business loans at three times the rate of banks. It is true, historically, that these intermediaries have specialized in collateralized lending. Generally they grew from captive lenders of manufacturing firms, as the authors note. But in recent years, a number of the larger finance companies (for example, General Electric Credit Corp.) have become increasingly skilled at making non-collateralized, cash-flow loans and, I suspect, will continue to do so. The maturity issue is not significant here. There is no conceptual reason why finance companies will not continue to give banks serious competition for small-business lending.

Indeed, among intermediaries, what gives banks a competitive

advantage? The argument is, first, banks benefit from economies of scope derived from deposit-taking, which provides information useful in monitoring. No doubt that is true, but against that advantage one must consider the daunting list of disadvantages of being a bank. The list includes the reserve tax, deposit insurance rates, and the added burden that regulations impose, particularly the micro-management regulations imposed recently by FDICIA, and other regulations like CRA. Important regulatory costs are imposed on banks, as compared with nonbank intermediaries.

These disadvantages are quite substantial, even compared with the advantages that banks have. Indeed, when I was at the U.S. Treasury Department, several heads of large finance companies met with me to say they could not care less what kind of banking legislation we passed, they had absolutely no interest in becoming a regulated bank. They were quite happy to raise their funding as a non-government-insured borrower in the capital markets and lend it outside the regulation that is imposed on banks. Banks confront other intermediaries armed with some advantages but also carrying a great deal of added cost.

A second challenge to banks, and to bank lending as a channel, comes from the capital markets themselves. Exploiting information technology that supports the work of rating agencies, capital markets have relentlessly substituted direct lending via securities for intermediated lending, starting with large, high-quality borrowers and moving on to large, lower-quality firms (that is, the junk bond market). Consequently, intermediaries have been forced into a narrow corner—lending to small firms, a trend well described in the paper. To the question, "Will this corner become even narrower in the future?" my bet is "Yes." Securitization of small-business loans is difficult, to be sure, because of the heterogeneity in information demands, but I think it will continue to make progress. More and more of this niche will be carved out by the capital markets themselves, and the bank lending channel will become further attenuated.

The last question I want to address is this: Just how effective is the bank lending channel at transmitting Fed policy? What goes through this channel? Does this channel support Fed policy or work against it, at cross-purposes with that policy? On this issue, a good deal of the relevant research has been done here at the Boston Fed. The experience of the early '90s, as documented by Peek and Rosengren (1995) and by Randall (1993), suggests that, while Fed policy during the period was stimulative, supervisory and examination policy was operating to restrain lending.

Reacting to a variety of forces, not the least of which were political, examiners clamped down on bank lending just when monetary policy was seeking to be stimulative. Several actions have been cited: Leverage ratios were raised, classification standards were tightened. Examination

and supervisory policies plainly made it harder for banks to support the recovery. These policies were, simply, pro-cyclical. That, I believe, worked against the forces Fed monetary policy was trying to transmit. Of course, the problem lay not only with regulators, supervisors, and examiners; the banks themselves had a hand in turning the lending channel against the recovery. Banks failed to accumulate sufficient capital in good times to act as a buffer in bad times. They took on marginal loans in the expansion, which came home to roost in the recession.

In sum, there is much evidence that banks and regulators have acted to make supervisory policy operate cyclically, tightening in downturns and loosening in expansions. With a pro-cyclical supervisory policy, the lending channel becomes a transmission mechanism for monetary policy, but operates in reverse.

Bank lending as a proper transmission mechanism for monetary policy requires more than the convincing evidence in this paper that banks have carved out a special lending niche in the past. The future will likely see a further erosion of that niche. And, more disturbing, there is evidence that bank lending as a transmission mechanism may operate to undermine monetary policy, at least in part, during periods of both stimulation and restraint.

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Discussion

Raghuram G. Rajan*

Bank lending is "special" if firms do not have close substitutes for bank loans. An important premise of this paper by Charles P. Himmelberg and Donald P. Morgan is that bank lending has to be special for monetary policy to be transmitted through banks (the so-called "lending channel").

To understand if this premise is justified, we must first understand why one might think that monetary policy could be transmitted through banks. This is what I make of the received view: The monetary authority increases short-term interest rates. Transactions deposits fall off because the opportunity cost to depositors of holding money increases. A bank has to make up the funding shortfall through other sources. If transactions deposits were perfectly substitutable with these other sources, there would be no effect on the bank's assets. But if transactions deposits are special for some reason (for example, they enjoy a government insurance subsidy), then other forms of funding may not easily replace the lost deposits, because of capital market imperfections. Bank assets would then shrink, affecting securities holdings first, then bank loans. Finally, firms that do not have access to other financial institutions or markets—because of agency or asymmetric information problems—will find their investment credit-constrained, and real activity will be affected.

The necessary conditions for the "lending channel," it would seem, are as follows. (1) Banks do not have perfect substitutes for transaction deposits, so monetary policy affects bank liabilities and thus bank assets (that is, loans). (2) Firms do not have perfect substitutes for bank loans:

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Banks are special because they solve agency and asymmetric information problems at the firm level that other financial institutions cannot solve. This paper focuses on (2). But as an aside, I wonder if (1) is necessary? In other words, a fair amount of research effort (see the references in the paper) has been spent recently investigating whether banks themselves suffer from agency and asymmetric information problems, so that (insured) transaction deposits are indeed a special source of funding. But could the lending channel work directly off the asset side of banks, without necessarily flowing through the liability side?

The reason I think this is important is that most theories of banks (see, for example, Diamond 1984) would suggest that banks exist because they somehow convince investors that agency and asymmetric information problems will be low at the bank level. Otherwise, banks would simply add another layer of costs between the initial saver and the ultimate user of funds. So a theory of transmission of monetary policy that requires substantial agency costs and information problems at both the bank level and the firm level raises questions about why banks exist in the first place.

Here is one way monetary policy could work directly through the bank asset side. Suppose reserves are special. This could be motivated in a number of ways that do not require banks to be constrained on the liability side. For instance, suppose banks may be faced with a random demand for repayment by short-term creditors (not necessarily insured depositors). Banks would want to hold liquid assets to insure against this, because the price of liquidity fluctuates over time and banks do not want to raise funds when the price of liquidity is too high. Thus, banks have a demand for liquid assets and perhaps for reserves, which are more liquid than any other asset. Once banks do have such a demand, it is obvious that by increasing the short-term interest rate (and under the assumption that bank lending rates do not immediately adjust in full measure), the monetary authority reduces the opportunity cost to banks of maintaining a liquid reserve. Thus, loans decrease and the bank's holdings of short-term securities increase.

I do not claim that monetary policy does not affect the liability side. But if it works directly through the asset side also, then monetary policy may be transmitted through a variety of financial institutions that need liquidity, not just banks. The extent to which it would affect their lending would depend only on the extent to which they need liquidity. For instance, life insurance firms would be less affected than would banks.

This has an important bearing on the paper. From a firm's point of view, credit from a bank and credit from a finance company may be close substitutes (they both are institutional investors, capable of monitoring and controlling the firm). Banks may increasingly be displaced by

finance companies. If monetary policy is transmitted via the liability side of banks, it will have less and less effect as bank lending is displaced by finance company lending. But if it works directly off the asset side of financial institutions, to the extent that both finance companies and banks need liquidity, monetary policy would continue to affect lending even if (or when) banks decline in importance.

Let us move now to Himmelberg and Morgan's paper. They argue that institutional lending is special because institutions, unlike public investors, can enter into long-term relationships with borrowers that result in a richer set of contractual possibilities. Institutions also enjoy scale economies in monitoring and lower coordination costs than public investors in effecting changes in managerial actions. Furthermore, banks are special among institutions because banks have information from deposit accounts. A franchise in offering short-term deposits (because of entry restrictions/deposit insurance subsidy/access to payment system/access to discount window) gives banks a preference for liquid assets and a comparative advantage in making short-term monitored loans. Finally, the structure of bank assets and liabilities minimizes the cost of intermediation.

The paper, however, does not test much of this. It examines the following two issues. First, what determines whether a firm gets rated? The authors regress an indicator showing whether a firm is rated against explanatory variables such as size and capital intensity. They conclude that only large firms with tangible, collateralizable assets are likely to be rated and have access to public debt markets. While I believe the result, one must be careful in interpreting such regressions, because a number of firms may be quite capable of accessing the public debt markets but may not bother to get a rating. American Home Products, through much of the 1970s, is an example.

Second, the authors ask what determines how much short-term debt a firm uses. They conclude that agency problems restrict firms with high R&D and high growth to short-term borrowing. Of course, one has to be careful in concluding that short-term debt is institutional finance, because much of it could be commercial paper. Nevertheless, from this and other studies, it seems reasonable to conclude that institutional financing is likely to be more valuable and available for some firms than public financing. But are banks special among institutions? The paper is less illuminating here.

Finally, if banks are special, why has bank lending as a fraction of total financing been declining over the 1980s? Some argue that vast increases in computing power and informational technology have made monitoring the borrower easier for the public investor, and this is why banks are losing their comparative advantage. But since banks also could avail themselves of this technology, it is not clear why bank lending is declining. More plausible arguments relate to the fact that

markets have become more receptive to issuing firms. Since this reduces the value of long-term banking relationships, it could lead to an increase in disintermediation. Another possibility is that banks are valuable only as long as they have a deposit franchise. Since the value of that franchise has declined, the role of banks has declined. Which one of these possibilities (if any) explains the decline of bank market share awaits future research.

To conclude, substantial evidence is found in this paper and in others that financial institutions can overcome agency and information problems at the firm level. Whether such institutions need to be banks is debatable. What is even less clear is whether there is a lending channel for monetary policy, and whether such a channel operates through banks only. Obviously, more research is needed.

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Do Monetary Policy and Regulatory Policy Affect Bank Loans?

To be an important transmission mechanism for monetary policy, bank lending must react to changes in policy. How do banks respond to changes in monetary and regulatory policy? Do bank loans on the asset side of the balance sheet move differently than bank deposits on the liability side of the balance sheet? Are regulatory and structural changes in banking likely to alter the way loans react to policy changes?

Bank Lending and the Transmission of Monetary Policy

Joe Peek and Eric S. Rosengren*

A resurgence of interest in the role of banks in the transmission of monetary policy has resulted in a spate of theoretical and empirical studies. These studies have established that, under certain conditions, the traditional transmission mechanism for monetary policy ("the money view") may be augmented through changes in the supply of bank loans ("the lending view"). Because both the money view and the lending view operate through the banking sector, the health of the banking system, insofar as it affects bank behavior, is an important factor in the transmission of monetary policy. It affects both the nature and the size of bank responses to shifts in monetary policy, with particular relevance for the bank lending channel.

The traditional description of monetary policy generally emphasizes the reserve requirement constraint on banks. In this story, banks are an important link in the transmission of monetary policy because changes in bank reserves influence the quantity of reservable deposits held by banks. Because banks rarely hold significant excess reserves, the reserve requirement constraint typically is considered to be binding at all times. However, a second constraint on banks, the capital constraint, may be more important in accounting for the variability in the magnitude of the effect of monetary policy over time. The extent to which a capital constraint is binding, unlike the reserve requirement, is likely to vary

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over time and across regions, since it depends on a variety of factors such as regulatory shocks, capital shocks, and business conditions.[1]

The capital constraint is likely to have its greatest effect on bank lending, and thus be particularly important for the lending channel of monetary policy. For example, a bank facing a binding capital-to-asset ratio will be unable to expand its assets in response to an easing of monetary policy, even if loan demand increases with the ease in policy, since it is a shortage of capital, not reserves, that is preventing the bank from increasing its lending. Thus, to the extent that a lending channel is important, it is likely to be short-circuited for banks facing a binding capital constraint that can insulate the banks' loan portfolios from reserve shocks.

We show that capital-constrained banks should respond to both monetary policy and bank capital shocks quite differently from unconstrained banks. In particular, when banks are capital-constrained, the lending channel is eliminated, because decreases in bank reserves that decrease transactions deposits are exactly offset by an increase in nontransactions deposits. Furthermore, our simple model predicts that loans by capital-constrained banks will rise in response to a tightening of monetary policy, with the liability side of the balance sheet unchanged and both reserves and securities declining. On the other hand, when banks are unconstrained, changes in nontransactions deposits do not exactly offset changes in transactions deposits, and loans should decrease in response to a tightening of monetary policy. We find some empirical evidence, consistent with the implications of the model, supporting the view that the effects of a lending channel and, more broadly, monetary policy, may vary over time as conditions in the banking sector change.

The first section of this paper describes the lending view and illustrates why New England banks may be a particularly fertile ground for examining the role of banks in the transmission of monetary policy. The second section provides a simple one-period model that illustrates why capital-constrained banks should not be expected to contribute to a separate lending channel. The model implies that a constrained bank should react differently to a monetary shock or a capital shock than would an unconstrained bank (or the constrained bank itself, when it was unconstrained). The third section provides an empirical test of the implications of the model and finds evidence of portfolio shifts by unconstrained banks that are consistent with the implications of a lending channel. This section also highlights the finding that empirical

[1] Romer and Romer (1993) have argued that monetary policy may have been less effective recently because tighter monetary policy was not combined with credit actions, as it frequently had been in the past. The explanation in this paper differs in that it emphasizes not the absence of credit actions, but rather the extent of binding capital constraints at banks, as distinguishing the early 1990s from earlier periods.

investigations of the impact of monetary policy that do not control for capital-constrained banks potentially can provide misleading results. The final section offers some conclusions and suggests some areas for further research.

Overview of the Lending Channel

Because a number of previous articles have highlighted the differences between the money channel and the lending channel (for example, Romer and Romer 1990; Kashyap and Stein 1994; Miron, Romer, and Weil 1994), we will provide only a brief overview. Following the overview, we will show that capital at New England banks followed a pattern during the most recent recession that differs both from the national pattern during that recession and from the New England pattern during prior recessions. Furthermore, perhaps as a consequence of the widespread capital shocks, New England banks have exhibited patterns in their asset and liability holdings that differ from those over previous business cycles. By exploiting these differences, we may be able to better understand how the health of the banking system may alter the effectiveness of monetary policy.

The sources of an independent lending channel can be understood best by considering a simple bank balance sheet (Figure 1A). Consider a bank whose only assets are reserves and securities, and whose only liabilities are (reservable) transactions deposits and capital. Open market operations that decrease reserves will cause interest rates to rise and induce individuals and firms to hold fewer transactions deposits until transactions deposits have declined sufficiently to bring required reserves back into line with available reserves, with banks holding fewer

Figure 1

Representative Bank Balance Sheets

A.	Assets	Liabilities
	Reserves	Transactions Deposits
	Securities	Capital
B.	Assets	Liabilities
	Reserves	Transactions Deposits
	Securities	Nontransactions Deposits
	Loans	Capital

bonds and individuals holding more. Thus, the transmission mechanism operates solely through the user cost of capital, as interest rates rise to equate money demand and money supply. This is commonly called the traditional "money view."

An additional channel may arise with a more complicated financial intermediary, as shown in Figure 1B. This more complicated intermediary has three assets: reserves, securities, and loans. It also has three liabilities: (reservable) transactions deposits, (nonreservable) nontransactions deposits, and capital. In this case, an open market operation that decreases reserves potentially can have additional effects that operate through the asset side of the bank balance sheet. The decrease in reserves decreases transactions deposits, and this, if not offset by an increase in nontransactions deposits or a decrease in securities holdings, will result in a decrease in loans. Thus, a necessary condition for the lending channel to operate is that loans not be insulated from monetary policy changes by banks altering their nontransactions deposits and securities sufficiently to offset completely any change in their transactions deposits. It is this portfolio behavior that is the focus of this paper.

That monetary policy alters loan supply is a necessary but not a sufficient condition for the lending view. For the lending view to be operational, two other conditions must also be met. (See Kashyap and Stein (1994) for a detailed discussion of these requirements.) First, securities and bank loans must not be considered, by at least some firms, perfect substitutes as sources of funds. That is, some firms can be deemed to be bank-dependent for their credit needs, so that a change in the supply of bank loans has an impact on the real activities of firms. This proposition will be explored by other papers at this conference and has developed a significant academic literature in its own right (for example, Fazzari, Hubbard, and Petersen 1988; Gertler and Gilchrist 1994; Gertler and Hubbard 1988; Oliner and Rudebusch 1993). A second additional condition required for monetary policy to have real effects on the economy is that prices must be sticky, in order to prevent monetary policy from being neutral. This condition is critical for both the money and the lending views. While both of these additional conditions are critical for an operational lending channel, this paper will not consider them further but will explore only whether bank portfolio reactions to changes in monetary policy are consistent with the lending view.

Most empirical studies examining bank portfolio reactions to monetary policy have used vector autoregression techniques to examine the impact on lending of a change in monetary policy (for example, Bernanke and Blinder 1992). While such papers show that loans decline with a lag after a tightening of monetary policy, they cannot disentangle declines resulting from reduced loan demand from declines resulting from reduced loan supply. Kashyap and Stein (1995) attempt to over-

come this problem in aggregate data by distinguishing between large and small banks. Based on capital market imperfections that affect the ability of banks to attract marginal sources of financing, their argument states that supply effects may occur disproportionately at small banks. Using micro banking data aggregated into different bank-size categories, they find evidence consistent with their hypothesis that the effects of monetary policy tightening are largest at small banks, which make primarily small business loans. However, if small business activity is disproportionately (relative to larger firms) affected by monetary policy tightening, this result still could reflect changes in loan demand rather than loan supply.

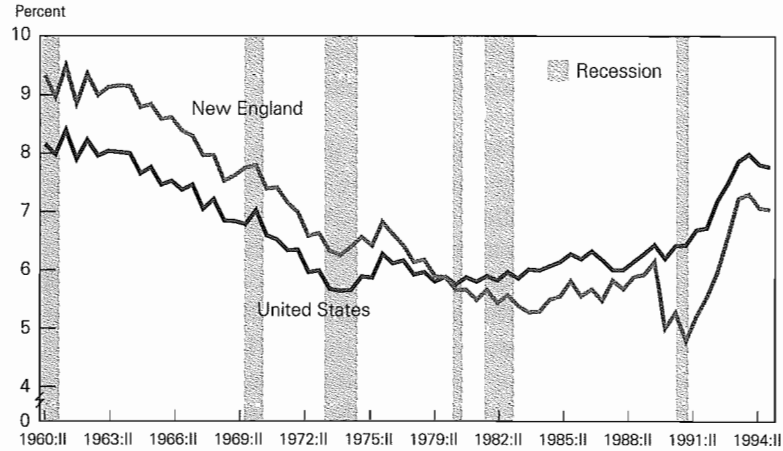
Kashyap and Stein (1995) recognize that the lending channel could be significantly reduced by banks being capital-constrained, but they find no evidence of this effect in their data. Figure 2, which presents capital-to-asset ratios for commercial banks in the United States and in New England from 1960:II to 1994:IV, shows why their results are unlikely to be affected by the capital crunch in the early 1990s. For the nation as a whole, capital ratios fell during the 1960s and 1970s, before gradually increasing in the 1980s and increasing more rapidly in the 1990s. However, capital ratios nationwide appear to be relatively insensitive to the business cycle; not only did they show no dramatic decline in the past recession, but they actually continued to increase.

While the general pattern of the New England bank capital ratio is similar to the national aggregate until the late 1980s, the two series differ sharply thereafter. Beginning in 1989, the capital ratio for New England banks declines dramatically, followed by a very steep increase in the 1990s. Thus, the capital crunch is likely to be reflected in data for New England, where capital-constrained banks represented a significant share of banks during the last recession, but not in aggregate national data, which are likely to be dominated by data for unconstrained banks. To the extent that the lending channel is severed for capital-constrained banks, differences between the portfolio reactions of constrained and unconstrained banks may best be tested using New England data.

This supposition is further supported by Figure 3, which shows the four-quarter change in real transactions deposits and nontransactions deposits (scaled by assets) at New England commercial banks. A necessary condition for the lending channel is that changes in nontransactions deposits not offset the changes in transactions deposits induced by changes in monetary policy. In fact, Romer and Romer (1990) have argued that the lending channel is unlikely to be supported because banks can offset changes in transactions deposits by substituting funds from alternative sources (in our model, nontransactions deposits) relatively costlessly. However, Figure 3 shows no clear pattern of offsetting changes in transactions and nontransactions deposits in

Figure 2

Ratio of Equity Capital to Total Assets at Commercial Banks in New England and the United States



Source: Board of Governors of the Federal Reserve System.

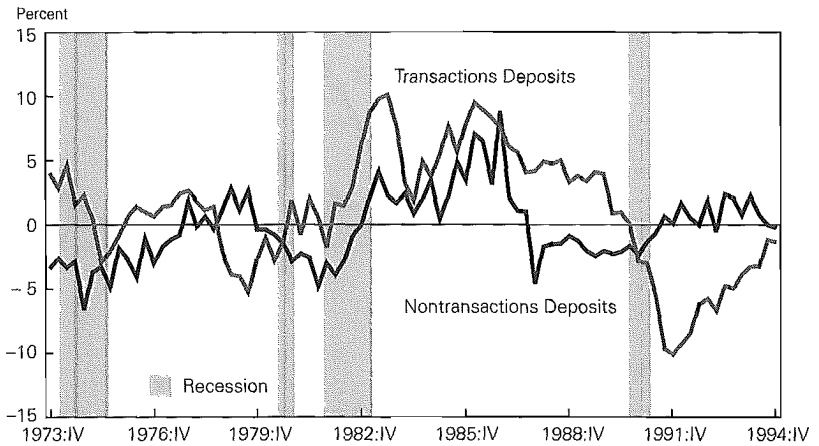
New England.[2] Furthermore, the figure shows that the behavior of bank deposits in New England was very different in the 1990s relative to earlier periods. In no previous recovery had nontransactions deposits exhibited a sustained decline at New England commercial banks. In the most recent episode, however, they showed a very substantial decline, one that more than offset the increase in transactions deposits as the federal funds target interest rate was reduced by the Federal Reserve in the early 1990s.

The recession in 1974 resulted in higher unemployment rates in New England than those of the 1990 recession, while the 1982 recession had a peak unemployment rate similar to that of the 1990 recession. However, the behavior of bank nontransactions deposits associated with the 1990 recession was quite different from that in either of the two

[2] The decline in nontransactions deposits in the late 1970s, the second largest shown in the figure, coincides with the introduction of NOW accounts in New England. Thus, it likely reflects the resulting substitutions out of nontransactions deposits and into NOW accounts, rather than being a consequence of a change in monetary policy.

Figure 3

FOUR-QUARTER CHANGE IN REAL TRANSACTIONS AND REAL NONTRANSACTIONS DEPOSITS (SCALED BY ASSETS) AT NEW ENGLAND COMMERCIAL BANKS

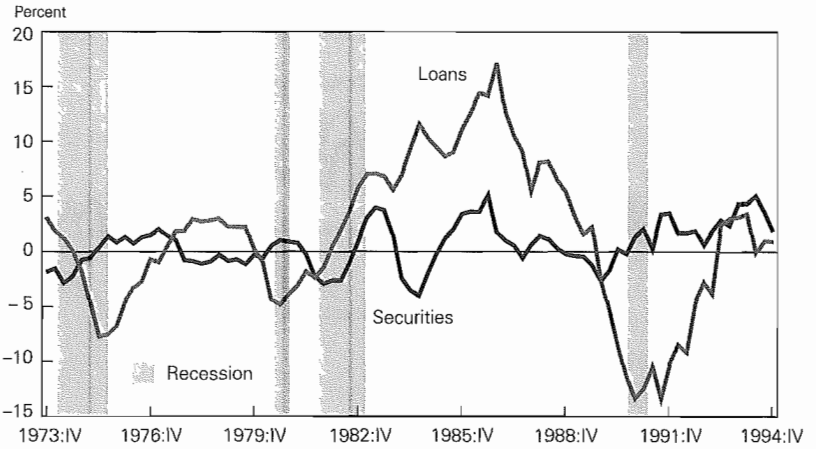


earlier recessions. As Figure 2 shows, this much more dramatic decline coincides with a large drop in bank capital, at a time when over 40 percent of bank assets in New England were held by banks under formal regulatory constraints (Peek and Rosengren 1995c). Changes in the proportions of constrained and unconstrained banks over time, in combination with the fact that constrained and unconstrained banks respond differently to changes in monetary policy, may help explain why this portfolio shift in bank deposits differed from earlier periods.

Recent movements in assets as well as liabilities at New England banks have differed from those in previous business cycles. Figure 4 shows the four-quarter change in real loans and securities (scaled by assets) at New England commercial banks. Bank loans in New England during the most recent cycle exhibited a much larger and more sustained decline that continued well after the bottom of the recession. Thus, while monetary ease appears to have stimulated lending in earlier recoveries, it failed to stem the significant declines in lending that continued through 1992 in New England. This evidence supports the view that bank lending may not respond to monetary ease at capital-constrained banks, but does react at banks that are unconstrained.

Figure 4

FOUR-QUARTER CHANGE IN REAL SECURITIES AND REAL LOANS (SCALED BY ASSETS) AT NEW ENGLAND COMMERCIAL BANKS



These figures also provide some evidence that bank portfolio behavior may differ between constrained and unconstrained banks and that New England may be a particularly fruitful place to look for these differences. The next section provides a theoretical model that examines why the strength of monetary policy is likely to be weakened when banks face binding capital constraints.

A SIMPLE MODEL OF BANK BEHAVIOR

To establish how the size of the effect of monetary policy is likely to be affected by capital-constrained banks, we provide a highly simplified one-period model of banks that is a variant of a model in Peek and Rosengren (1995a). The bank is assumed to have three assets, loans (L), securities (S), and reserves (R), and three categories of liabilities, bank capital (K), transactions deposits (DD), and nontransactions deposits (CD).

The balance sheet constraint requires that total assets must equal total liabilities.

$$R + S + L = K + DD + CD \tag{1}$$

On the liability side of the balance sheet, bank capital is assumed to be fixed in the short run. Transactions deposits are assumed to be inversely related to the federal funds rate (r_F). A general rise in market rates increases the opportunity cost of holding such deposits, causing bank customers to reduce their holdings of transactions deposits and shift into alternative assets paying market-related interest rates. Given that transactions accounts are tied to check-clearing services and convenience, this market tends to be imperfectly competitive. Banks set imperfectly competitive retail deposit interest rates (for example, NOW accounts) so as to maximize their monopoly rents from issuing these deposits. Thus, the quantity of imperfectly competitive transactions deposits can be treated as determined by profit-maximizing interest-rate setting, unrelated to the bank's overall need for funding.

$$DD = a_0 - a_1 r_F \tag{2}$$

Nontransactions accounts, on the other hand, serve as the marginal source of funds to the bank. We assume that a bank can expand total deposits by offering an interest rate on nontransactions deposits (r_D) greater than the mean rate in its market ($\overline{r_D}$). Offering a deposit rate greater than the mean deposit rate will draw funds not only from other banks inside and outside the banking region but also from financial instruments that are close substitutes, such as money market mutual funds and Treasury securities. The competitive nature of this market would suggest that the value of f_1, the sensitivity of nontransactions deposit inflows or outflows to changes in the bank's interest rate on such deposits, would be large.

$$CD = f_0 + f_1(r_D - \overline{r_D}) \tag{3}$$

On the asset side of the balance sheet, banks must hold reserves equal to their reserve requirement ratio (α) times their transactions deposits. We assume that banks hold no excess reserves. Securities are assumed to be a fixed proportion of transactions deposits (h) net of reserves. This is done in order to capture a buffer stock model for securities, whereby banks maintain securities for liquidity in the event of large withdrawals of transactions deposits.

$$R = \alpha DD \tag{4}$$

$$S = h_0 + h_1 DD - R \tag{5}$$

The bank loan market is assumed to be imperfectly competitive. A bank can increase (decrease) its loan volume by offering a loan rate (r_L) lower (higher) than the mean loan rate in its market ($\overline{r_L}$). Given the uniqueness of bank loans as a source of financing to many firms (see, for

example, James 1987), the value of g_1, the sensitivity of loan demand to a change in the bank's loan interest rate, is likely to be large.

$$L = g_0 - g_1(r_L - \overline{r_L}) \tag{6}$$

The market interest rates on nontransactions deposits, loans, and securities are each assumed to be a function of market-specific effects and an effect related to the federal funds rate.

$$\overline{r_D} = b_0 + \phi r_F \tag{7}$$

$$\overline{r_L} = c_0 + \phi r_F \tag{8}$$

$$\overline{r_s} = e_0 + \phi r_F \tag{9}$$

To simplify the algebra, we assume that each market rate increases by the same amount (ϕ) for a given change in the federal funds rate.

Finally, bank behavior may be further constrained by the required capital-to-asset ratio (μ).[3]

$$K \geq \mu(R + S + L) = \mu(K + DD + CD) \tag{10}$$

Banks are assumed to maximize profits (π). Because our profit function abstracts from fee income and overhead costs, total profits are simply the sum of interest income on loans ($r_L L$) net of loan losses (ΘL) and interest received from securities holdings ($r_s S$), minus both interest paid on transactions deposits ($r_{DD} DD$) and interest paid on nontransactions deposits ($r_D CD$). Thus, profits are:

$$\pi = (r_L - \Theta)L + \overline{r_s}S - r_{DD}DD - r_D CD. \tag{11}$$

Using equations (1) to (9) to eliminate R, DD, L, S, r_D, r_L, and the three market interest rates from equations (10) and (11), the maximization problem can be stated as a Lagrangian equation, maximizing the profit function with the Lagrangian multiplier associated with the capital ratio constraint. The Lagrangian equation is maximized with respect to CD to obtain the first-order conditions.[4] Next, we use the first-order conditions to solve for CD in both the constrained and the uncon-

[3] In this paper, we focus only on leverage ratio thresholds, for two reasons. First, risk-based capital ratios are not available before 1990. Second, for the period in New England under study here, leverage ratios rather than risk-based capital ratios tended to be the binding constraint on capital-constrained banks. This is consistent with evidence on nationwide samples that leverage ratios and not risk-based capital ratios affected bank behavior (for example, Hancock and Wilcox 1994).

[4] Of course, banks choose the level of CD by choosing r_D. However, because we are interested in quantities rather than interest rates, it is more direct to state the optimization problem in terms of choosing CD.

strained cases. This process can be repeated for the other variable of particular interest, loans. The testable hypotheses are then obtained by taking derivatives of the *CD* and the loan equations with respect to the federal funds rate and to bank capital.

It can easily be shown that when the capital constraint is binding, the following conditions will hold.

$$\frac{dCD}{dK} = \frac{1-\mu}{\mu} > 0 \tag{12}$$

$$\frac{dCD}{dr_F} = a_1 > 0 \tag{13}$$

$$\frac{d\ (total\ deposits)}{dr_F} = 0 \tag{14}$$

$$\frac{dL}{dr_F} = h_1 a_1 > 0 \tag{15}$$

$$\frac{dL}{dK} = \frac{1}{\mu} > 0 \tag{16}$$

When the capital constraint is binding, an increase in capital and an increase in the federal funds rate each increase nontransactions deposits. However, because a change in the federal funds rate causes offsetting changes in transactions and nontransactions deposits, total deposits are unchanged. One of the conditions of the lending view is violated: The contractionary (expansionary) effects of monetary policy on transactions deposits are completely offset by increases (decreases) in nontransactions deposits. Thus, the impact of a change in monetary policy will be much weaker when a substantial share of banks are capital constrained.

In fact, the binding constraint on bank capital causes loans to be positively related to the federal funds rate, as well as to bank capital. In this model, contractionary monetary policy actually increases bank loans. With the fall in reserves, transactions deposits fall, which in turn causes securities holdings to decline. With no change on the liability side of the bank balance sheet, the reduction in reserves and securities induces an increase in loans.

The unconstrained case generates results substantially different from those of the constrained case.

$$\frac{dCD}{dK} = \frac{-f_1}{f_1 + g_1} < 0 \tag{17}$$

$$\frac{dCD}{dr_F} = \frac{F_1 a_1 (1 - h_1)}{f_1 + g_1} > 0, \text{ assuming } h_1 < 1 \tag{18}$$

$$\frac{d(\text{total deposits})}{dr_F} = \frac{-a_1(g_1 + f_1 h_1)}{f_1 + g_1} < 0 \tag{19}$$

$$\frac{dL}{dK} = \frac{g_1}{f_1 + g_1} > 0 \tag{20}$$

$$\frac{dL}{dr_F} = \frac{-g_1(1 - h_1)a_1}{f_1 + g_1} < 0, \text{ assuming } h_1 < 1 \tag{21}$$

Nontransactions deposits increase with a decline in capital, in contrast to the decline that occurs in the constrained case, as banks substitute nontransactions deposits for some of their lost capital. Note that only the capital requirement matters for the reaction of nontransactions deposits to a capital shock in the constrained case, while only the interest sensitivities of both nontransactions deposits and loans (and not the required capital ratio) affect the reaction of nontransactions deposits to a capital shock in the unconstrained case.

For a monetary policy shock, these two interest sensitivities again play a key role in the unconstrained case, but are absent in the capital-constrained case. Nontransactions deposits increase with an increase in the federal funds rate as long as h_1 is less than 1. This is a reasonable assumption, given that only a proportion of deposits would be held in liquid form to cover possible withdrawals of transactions deposits. Note that while nontransactions deposits are positively related to federal funds changes in both the constrained and unconstrained cases, the effect is much smaller in the unconstrained case. Total deposits now decrease with an increase in the federal funds rate. Thus, unlike the constrained case, the effect of a monetary policy shock is only partially offset by a change in nontransactions deposits.

For loans, the results also differ. With a decrease in capital, loans decline, but less than one-for-one. In contrast, in the constrained case, the decline is the inverse of the capital requirement, which should be substantially greater than 1. With an increase in the federal funds rate, loans decline as long as h_1 is less than 1. Again, this is opposite to the result obtained in the constrained case. And, just as with the response of nontransactions deposits, the interest sensitivities of both nontransactions deposits and loans are important determinants of the magnitude of the response of loans to a change in the federal funds rate in the unconstrained case, but play no role when banks are capital-constrained.

Thus, this simple model yields several testable hypotheses concerning both the responsiveness of loans to changes in monetary policy and

the possible pitfalls of failing to control for both capital shocks and monetary policy shocks:

1. Nontransactions deposits at constrained banks should respond more to a change in the federal funds rate than nontransactions deposits at unconstrained banks.
2. Total deposits at constrained banks should be unaffected by changes in the federal funds rate, while total deposits at unconstrained banks should be negatively related to changes in the federal funds rate.
3. Loans at constrained banks should respond positively to changes in the federal funds rate, while at unconstrained banks the response should be negative.
4. Loans at constrained banks should respond more to a capital shock than loans at unconstrained banks.
5. Nontransactions deposits at constrained banks should respond positively to a capital shock, while nontransactions deposits at unconstrained banks will respond negatively to a capital shock.

Additional implications could be derived if one were to assume that bank size is related to the sensitivity of deposits and loans to changes in a bank's interest rates. Kashyap and Stein (1994) argue that large and small banks face different market conditions in raising marginal sources of funding (nontransactions deposits). If so, f_1 will be positively related to the size of the bank. In the constrained case, neither the results for nontransactions deposits nor those for loans should be affected by differences in f_1. In the unconstrained case, however, nontransactions deposits at larger banks will be more responsive to changes in the federal funds rate compared to those at smaller banks, and loans at larger banks will be less responsive (see equations 18 and 21).

Along these same lines, another possibility is that loans at large banks, whose borrowers have greater access to national credit markets, have greater sensitivity to changes in loan rates than loans at smaller banks. This implies that g_1 will be larger for larger banks. This greater loan rate sensitivity has no impact on the responses to federal funds rate changes in the constrained case. However, in the unconstrained case, nontransactions deposits at larger banks will be less responsive to changes in the federal funds rate than those at smaller banks, and loans will be more responsive.

Larger values of f_1 and g_1 are each associated with larger banks, yet they have opposite effects on the magnitude of the response to changes in the federal funds rate of both transactions deposits and loans, making the net effect ambiguous. Thus, focusing on differing responses by large and small banks, as emphasized in Kashyap and Stein (1994), may not provide clear evidence unless one has priors on the magnitudes of the effects of bank size on the values of f_1 and g_1. While we have reason to believe both f_1 and g_1 are large, we have little evidence on their relative

responses to changes in bank size. Thus, the clearest distinctions are likely to be between capital-constrained and unconstrained banks, rather than between large and small banks.

Empirical Tests

The theoretical model, while highly simplified, indicates that constrained and unconstrained banks should respond quite differently to changes in monetary policy. Banks that are constrained would change loans in the same direction as movements in the federal funds rate, and banks that are unconstrained would change loans in the opposite direction. Thus, we will focus the empirical work on the determinants of the change in bank loans. The key implication is that the response of loans to a tightening (an easing) of monetary policy at unconstrained banks should be to decline (increase) more than at capital-constrained banks. Thus, as more banks become capital-constrained, we would expect the thrust of monetary policy passed from the banking sector to the rest of the economy to be weaker.

The Data

All bank balance sheet data are taken from the quarterly bank Call Reports. While some of the data series begin quarterly observations as early as 1972:IV, our regressions span only the 1976:II to 1994:IV period because of limitations on the availability of some variables and the need for lagged observations. We limit our sample to commercial banks, because savings banks reported only semiannually prior to 1984. We also use bank structure information to identify de novo banks and merger and acquisition activity, which will cause discontinuities in individual bank data unrelated to their lending behavior.

To empirically test the above hypotheses requires identifying capital-constrained and unconstrained banks. We base our categorization on the presence or absence of a formal regulatory action, supplemented with information on regulators' CAMEL ratings of banks. Formal actions (written agreements and cease and desist orders) are legally enforceable agreements between regulators and bank management and the board of directors. For financially troubled banks, these agreements specify target capital ratios, most commonly a 6 percent leverage ratio (Peek and Rosengren 1995e).

These are the most severe regulatory actions taken, short of closing the bank. And, because they are legally enforceable agreements with civil penalties for noncompliance, banks are likely to alter their behavior when a formal action is implemented. In fact, Peek and Rosengren (1995c) have documented that banks do reduce their lending as a result of the imposition of a formal regulatory action, and that the response

occurs discretely at the time of the bank examination that results in the enforcement action. Furthermore, the imposition of formal regulatory actions was widespread in New England. At the peak in the early 1990s, the shares of both bank assets and bank loans in New England commercial and savings banks subject to formal actions exceeded 40 percent.

While formal actions will identify most capital-constrained banks, Peek and Rosengren (1995d) found that some banks do not receive formal actions because they are about to be closed or merged with another bank before the regulator can conclude the agreement. Because these institutions generally have very low capital, had they continued to operate as an independent entity they likely would have received a formal action. In these cases, the formal action information must be supplemented with supervisory ratings of banks. These ratings of the financial condition of the banks consider the capital adequacy, asset quality, management quality, earnings potential, and liquidity of the institution (CAMEL). The composite CAMEL rating, which can range from 1 to 5, provides an assessment by examiners of the strength of a banking institution. Banks with a composite rating of 4 (potential of failure, performance could impair viability) or 5 (high probability of failure, critically deficient performance), and some institutions with a CAMEL rating of 3 (remote probability of failure, flawed performance), normally will undergo an enforcement action. Thus, we define the set of constrained banks as those banks either under a formal action or having a CAMEL 4 or CAMEL 5 rating.

Banks with a composite rating of 1 (sound in every respect, flawless performance) and 2 (fundamentally sound, only minor correctable weaknesses in performance) are resistant to external economic and financial disturbances and are unlikely to be constrained by regulatory oversight. Thus, we define an unconstrained bank as any bank not under a formal action having a CAMEL rating of either 1 or 2. Because CAMEL 3 institutions not subject to formal actions are neither clearly constrained nor unconstrained, we do not include this set of banks in either of our two categories.

While a large share of New England banks were in our constrained category beginning in 1989, we were able to identify very few such banks during the period 1977 to 1988. First, information on formal actions is not publicly available prior to 1989. Second, through much of this period, fewer than five institutions in New England had a CAMEL rating of 4 or 5. Thus, the number of constrained institutions is not sufficient to form a constrained-bank aggregate prior to 1989, greatly limiting the length of time that can be used for comparisons. Until we can obtain the information required to expand the sample to include banks outside of New England, we can compare constrained and unconstrained institutions only from 1989:I through 1994:IV. However, because the large majority of banks in New England were relatively

healthy during the earlier period, we can form an unconstrained bank sample from 1977:I through 1994:IV.

To form the constrained bank and unconstrained bank aggregate time series, we must address a number of problems, the most important being that banks may shift between categories over time. We use a standard technique to deal with this problem: We calculate the change in a variable for a given category one quarter at a time, using only data for the set of banks in that category in that quarter (see, for example, Gertler and Gilchrist 1994; Kashyap and Stein 1995). These quarterly changes are then linked together to form a time series.

Specifically, we use the following procedure. For each quarter, we first eliminate any bank that underwent structure changes in that quarter (for example, acquired another bank) or was in its first eight quarters of existence.[5] We then categorize as constrained any remaining bank that is under a formal action or has a CAMEL rating of 4 or 5 at the beginning of the quarter. To obtain a measure of the change in a variable, say loans, over the quarter, we sum the change in loans over the set of currently constrained banks to obtain the change in loans for constrained banks for that quarter and divide by the sum of beginning-of-period assets for the set of constrained banks. The quarterly time series is formed by repeating the calculation for each quarter in the sample. This will provide a consistent set of growth rates for each variable for each bank category, although the individual institutions in a category will change over time.

This procedure is repeated for the set of unconstrained banks, those banks that are not de novo banks, have not undergone structure changes in the quarter, are not under a formal regulatory action, and have a CAMEL rating of 1 or 2 at the beginning of the quarter.[6] We also construct data series for a total bank category, all banks that are not in their first eight quarters of existence and have not undergone structure changes during the quarter. This category includes not only our sets of constrained and unconstrained banks, but also banks not under a formal action with a CAMEL rating of 3.

Our proxy for changes in monetary policy is based on the targeted federal funds rate. The target federal funds rate series is taken from Rudebusch (1995) and extended after September 1992 using the Federal

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[5] De novo banks show rapid growth and tend to have extremely high capital ratios. Since banks begin with all capital and no loans, and then quickly shrink capital and increase loans, their behavior during their initial quarters of existence is not representative of their behavior once they have matured. We thus omit the first eight quarters of operations of a new bank.

[6] Prior to 1982, there was no evidence of CAMEL 4 or 5 rated banks in New England. Because the number of banks with CAMEL ratings shrinks dramatically as we move to dates prior to the mid 1980s, in order to obtain a reasonable sample size we include all banks in our unconstrained category prior to 1982.

Reserve Bank of New York's internal "Report of Open Market Operations and Money Market Conditions."[7] The average of the federal funds rate target during the quarter, first differenced, is used as our proxy for changes in monetary policy. We include the contemporaneous value as well as two lagged values of this variable in the regressions.

Capital shocks are measured as the change in the equity capital of a bank category scaled by beginning-of-period assets. We include the contemporaneous value as well as two lagged values of this variable in the regressions. The regression equations also include the percentage change in New England employment over the previous year, two lags of the quarterly (CPI) inflation rate, and three quarterly seasonal dummy variables as explanatory variables.[8]

Empirical Results

Since the role of bank lending is at the core of the "lending view," we focus the empirical analysis on the change in bank loans.[9] Because of the limited length of the time series for constrained banks (23 quarters), the power of any test is likely to be weak. However, we are creating a national data base that will enable us to identify constrained institutions in earlier periods and to explore the disaggregated data at the level of the individual bank. Thus, the empirical work at this time is quite preliminary, but it does provide a crude test of the model presented in the earlier section.

Table 1 provides the results of comparing the effects of changes in monetary policy and capital shocks on loan growth from 1989:II to 1994:IV. The results are shown for the unconstrained, constrained, and total bank samples, with the results of both ordinary least squares (OLS) and two-stage least squares (2SLS) estimation techniques reported. We

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[7] From October 1979 until January 1984, no explicit federal funds target is available because the Federal Reserve was formally setting a reserves target. Since any reserves target should imply a federal funds target, we use the average quarterly federal funds rate during the reserve targeting period.

[8] Because the short length of the time series for the constrained bank sample severely restricts our degrees of freedom, we limit our set of explanatory variables to contain at most only two lagged values. However, we did consider as many as four lagged values in regressions for the unconstrained bank sample estimated over the entire sample period, obtaining results that were qualitatively the same as those obtained when the set of explanatory variables was limited to two lagged values.

[9] Ideally, we would use a measure of new loans originated, that is, lending, rather than the change in loans outstanding in a bank's portfolio. The change in loans differs from lending because the loans on a bank balance sheet are affected by loan charge-offs, conversions of real estate loans to OREO, and net loan sales. Unfortunately, these data are not available for our sample period. However, in an earlier study that covered a shorter sample period when the data were available, we did make such adjustments (Peek and Rosengren 1995c), finding that the responses to formal actions were similar for the change in loans and measures of net new lending.

Table 1
The Effects of Monetary Policy and Capital Shocks on Loan Growth[a]
1989:II to 1994:IV

	Unconstrained Banks		Constrained Banks		Total Bank Sample	
Variable	OLS	2SLS	OLS	2SLS	OLS	2SLS
CFF	−.909	−1.341	−2.378	−2.380	−.803	−.917
	(.48)	(.68)	(1.44)	(1.44)	(.80)	(.89)
CFF(−1)	−.466	−.135	1.290	1.293	−.175	−.074
	(.28)	(.08)	(.91)	(.911)	(.21)	(.08)
CFF(−2)	.298	.084	3.272*	3.26*	2.922**	2.850**
	(.20)	(.05)	(2.37)	(2.36)	(3.80)	(3.63)
CEQ	2.009	1.054	1.181**	1.814**	3.222**	2.947**
	(.93)	(.45)	(3.38)	(3.18)	(3.77)	(2.92)
CEQ(−1)	−.216	−.253	3.471**	3.471**	−.133	−.162
	(.07)	(.09)	(4.67)	(4.67)	(.12)	(.14)
CEQ(−2)	.098	−.323	.427	.427	1.086	1.057
	(.02)	(.07)	(.61)	(.61)	(1.10)	(1.07)
ΣCFF	−1.077	−1.392	2.184	2.182	1.944	1.859
	(.51)	(.65)	(1.10)	(1.10)	(1.79)	(1.68)
ΣCEQ	1.891	.477	5.717**	5.712**	4.176*	3.84*
	(.31)	(.07)	(4.69)	(4.62)	(2.25)	(1.95)
$\bar{R}^2$	.0794	.0615	.799	.799	.818	.816
SER	.0163	.0164	.0166	.0166	.093	.093
DW	1.986	2.027	2.481	2.482	1.918	1.983

[a]Each regression also included a set of three seasonal dummy variables, two lagged values of the CPI inflation rate, and the percentage change in New England employment over the previous year. Absolute values of t-statistics in parentheses.

*Significant at the 5 percent confidence level.

**Significant at the 1 percent confidence level.

use two-stage least squares techniques to account for the possible endogeneity of the contemporaneous value of the change in bank equity capital. We use as instruments each of the other explanatory variables in the equation as well as an additional lagged value of the federal funds target interest rate, the change in equity capital, and the inflation rate, and two lagged values of both the change in other real estate owned and the change in loan loss reserves, each scaled by total assets. The OLS and 2SLS results are qualitatively similar.

The model implies that an increase in the federal funds target rate should have a negative effect on loans in the unconstrained bank sample and a positive effect for constrained banks. Or, if taken less literally, the relative implication of the model is that unconstrained banks should reduce loans by more than constrained banks in response to a tightening

of monetary policy. Table 1 shows that the sum of the three coefficients on the change in the federal funds target rate (CFF, CFF(−1), and CFF(−2)) is negative for the unconstrained banks and positive for the constrained banks, although neither sum is significantly different from zero at the 5 percent confidence level. With respect to the individual coefficients, only the second lagged value of CFF in the constrained sample is significant. Still, these results highlight the differences in the estimated impact of monetary policy changes operating through constrained as compared to unconstrained banks, implying that the net impact of monetary policy at any given time may be quite sensitive to the health of the banking sector and the share of banks facing binding capital constraints.

For the total sample, the sum of the CFF coefficients is positive and significant only at the 10 percent confidence level, although the second lagged value is again highly significant. Thus, the results for the total sample appear to mimic those of the constrained, rather than the unconstrained, sample. If one were to base conclusions about the presence of an operational lending channel on this sample, the lending view would be rejected. Yet, it appears that the results from the total sample reflect only the fact that through much of this period, a significant proportion of loans were with capital-constrained banks.

The results for capital shocks are also consistent with the predictions of the model. The sum of the coefficients on the change in equity capital (CEQ) is positive in each case, and much larger (and significant at the 1 percent confidence level) for the constrained bank sample. Again, the total sample results mimic those for the constrained sample.

The adjusted R^2 is much higher for the constrained sample than for the unconstrained sample. The much better fit is not surprising, given the earlier equations. For constrained banks, little other than capital ratios and the interest sensitivity of transactions accounts determines loan growth, while at unconstrained banks, idiosyncratic characteristics such as the conditions in the local lending and deposit markets (as reflected, for example, in the values of f_1 and g_1 for a particular bank) may be much more important.

One should keep in mind that with only 23 quarters of data, the power of the statistical test is low. Nonetheless, the results are broadly consistent with the simple model from the previous section. Moreover, the evidence highlights the fact that ignoring the differing responses of constrained and unconstrained banks potentially can affect the size of the impact of monetary policy on the economy and the ability to find evidence of an operational lending channel in aggregate data.

Table 2 shows the effects of monetary policy and capital shocks on loan growth for the unconstrained bank sample for the entire 1976:II to 1994:IV period. For this specification, we have omitted the 1980:II-1981:II observations to avoid the effects of the Carter credit controls on

Table 2
The Effects of Monetary Policy and Capital Shocks on Loan Growth:[a]
Unconstrained Bank Sample
1976:II to 1994:IV

Variable	OLS	2SLS
CFF	−.684**	−.893**
	(2.82)	(2.90)
CFF(−1)	−.196	−.084
	(.77)	(.28)
CFF(−2)	−.558*	−.733*
	(2.02)	(2.18)
CEQ	4.817**	−2.134
	(3.45)	(.44)
CEQ(−1)	.922	2.891
	(.48)	(1.17)
CEQ(−2)	−1.506	−.624
	(.67)	(.22)
ΣCFF	−1.438**	−1.615**
	(3.50)	(3.32)
ΣCEQ	4.233	1.315
	(1.476)	(.33)
$\bar{R}^2$	.594	.477
SER	.015	.017
DW	.914	1.046

[a] Each regression also included a set of three seasonal dummy variables, two lagged values of the CPI inflation rate, and the percentage change in New England employment over the previous year. Absolute values of t-statistics in parentheses.

* Significant at the 5 percent confidence level.

** Significant at the 1 percent confidence level.

contemporaneous and lagged data, the 1984:I observation because of discontinuities in the call report data, and the 1986:IV and 1987:I observations because of the effects on the timing of investment and loans associated with the Tax Reform Act of 1986.

For the entire unconstrained bank sample, the sum of the coefficients on the federal funds target rate is negative and statistically significant at the 1 percent confidence level. Furthermore, the coefficient sums for both the OLS and 2SLS specifications are in the same range as those for the 1989:II to 1994:IV sample in Table 1, being only slightly larger in absolute value. The sums of the coefficients on the change in capital are positive, but not significantly different from zero.

The Durbin-Watson statistics are low, indicating that the equations for the full sample may be misspecified. However, when the equations are reestimated allowing the coefficients on CFF and CEQ during the

period after 1989:I to differ from those in the earlier period, no evidence is found of serial correlation in the error term. A Chow test splitting the sample at 1989:I produces an F-statistic of 2.82, significant at the 1 percent confidence level. However, it appears that it is the difference between the CEQ coefficients across the two subperiods rather than those for CFF that accounts for the low Durbin-Watson statistics. The F-statistic for the test of CFF coefficient equality across the two subperiods is only 0.79, while that for CEQ is 11.05, significant at the 1 percent confidence level. This suggests problems in treating the predominantly positive capital shocks during the earlier subperiod in the same way as the predominantly negative capital shocks that occurred during the later subperiod, even at banks that were not capital-constrained.

Conclusion

This paper highlights the importance of considering regulatory factors when investigating the size and nature of the impact of monetary policy on the economy. Since monetary policy operates through the banking sector, one must take into consideration the effects of regulatory policy on the banking sector, as well as the sector's general health, to be able to predict bank responses to a change in monetary policy. In particular, one must recognize that banks may face not only a binding reserve requirement but also a binding capital requirement. In a simple one-period model, we show that capital-constrained and unconstrained banks are likely to react differently to both monetary policy and capital shocks. By constructing time series data for constrained and unconstrained bank samples in New England, we find some evidence consistent with the implications of our model.

While the econometrics are preliminary and the power of the tests is restricted by the absence of a constrained bank sample prior to 1989, we find evidence that monetary policy effects operating through unconstrained banks should be expected to have a stronger effect on the economy compared to the effects transmitted through capital-constrained banks. This suggests that the large number of capital-constrained banks in New England in the early 1990s may have played an important role in the slow recovery of this region from the 1990 recession. We also find evidence that unconstrained banks behaved in a manner consistent with an operational lending channel. Furthermore, we find that evidence from aggregate data for all banks for the most recent period yields results consistent with the constrained bank sample, making one more likely to reject the hypothesis of an operational lending channel.

To fully test the importance of capital constraints on the impact of monetary policy, we need to expand our sample nationwide to cover a longer time period containing a sufficient number of constrained banks to make the constrained-unconstrained bank comparison sharper. We

are currently constructing a national panel data set that will examine differences in bank behavior over business cycles and regulatory regimes. However, this initial work does support the contention that the transmission of monetary policy must be considered in the context of regulatory as well as monetary policy shocks.

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Discussion

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The interesting paper by Joe Peek and Eric S. Rosengren is a contribution to the debate over the so-called "lending view" of the monetary transmission mechanism. As I elaborate below, the lending view channel for monetary policy requires that some group of borrowers be "bank-dependent" and that the central bank be able to affect the supply of bank loans through monetary policy. The essential idea put forth by the authors is that comparing loan responses of "capital-constrained" and "capital-unconstrained" banks to changes in monetary policy offers a way to test the second requirement of the lending view.[1]

Following the Peek and Rosengren paper, my remarks are organized around five questions: Is an effect of monetary policy on bank loan supply necessary or sufficient to corroborate the importance of capital-market imperfections in spending decisions? Second, does the authors' model of bank behavior illustrate the lending view? Third, why study lending in the New England region? Fourth, are the empirical tests convincing? Finally, where do we go from here?

Putting the Lending View in Context

Let me begin by characterizing the traditional "money view" of the monetary transmission mechanism.[2] In this view, financial intermedi-

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[1] The other requirement is not addressed in the paper (but see the paper by Himmelberg and Morgan in this volume).

[2] More detailed descriptions of alternative monetary transmission mechanisms can be found in Bernanke and Gertler (1995) and Hubbard (1995b).

aries ("banks") offer no special services on the asset side of their balance sheet. On the liability side of their balance sheet, banks perform a special role; the banking system creates money by issuing demand deposits. Underlying assumptions about borrowers is the idea that capital structures do not influence real decisions. To keep the story simple, suppose that there are two assets—"money" and "bonds." In a monetary contraction, the central bank reduces reserves, limiting the banking system's ability to sell deposits. Depositors must then hold more bonds and less money in their portfolios. If prices do not instantaneously adjust to changes in the money supply, the fall in household money holdings represents a decline in real money balances. To restore equilibrium, the real interest rate on bonds increases, raising the user cost of capital for a range of planned investment activities, and interest-sensitive spending falls.

The search for a richer transmission mechanism reflects two concerns. The "macro" concern is that cyclical movements in aggregate demand appear too large to be explained by monetary policy actions, which have not generally led to large, prolonged changes in real interest rates. This has pushed some macroeconomists to identify financial factors in propagating relatively small shocks, factors that correspond to "accelerator" models that explain investment data relatively well.

The "micro" concern relates to the growing literature studying information imperfections in insurance and credit markets. In this line of inquiry, problems of asymmetric information between borrowers and lenders lead to a gap between the costs of external finance and internal finance. The notion of costly external finance stands in contrast to the more complete markets approach underlying the conventional interest-rate channel, which does not consider links between real and financial decisions.

While a review of this literature is beyond the scope of these remarks, let me mention three common empirical implications. The first is that uncollateralized external finance is more expensive than internal finance. Second, the spread between the costs of external and internal finance varies inversely with the borrower's net worth—internal funds and collateralizable resources—relative to the amount of funds required. Third, an adverse shock to a borrower's net worth increases the cost of external finance and decreases the ability of the borrower to implement investment, employment, and production plans. This channel provides a "financial accelerator" magnifying an initial shock to net worth.

One can extend this argument to include a channel for monetary policy. In the money view, policy actions affect the overall level of interest rates and interest-sensitive spending. The crux of models of information-related financial frictions is a gap between the costs of external and internal finance for many borrowers. It is possible for monetary policy (open market operations or regulatory actions) to affect

this gap. Two such channels have been identified: financial constraints on borrowers (a "balance sheet" channel), and the existence of "bank-dependent" borrowers (the "lending" channel). A significant body of empirical research supports the former channel (see the review in Hubbard 1995a). The latter channel is the one related to the Peek-Rosengren analysis. Specifically, Peek and Rosengren focus on a necessary precondition for the lending channel, namely, that the central bank can affect the supply of bank loans.

Two significant concerns have been raised about the precondition that central bank actions can affect loan supply. The first is the difficulty in identifying exogenous changes in banks' ability to lend. The second is the need to explain why it is costly to substitute nontransactions deposits or new equity for transaction deposits in order to fund loans. I discuss these concerns below in the context of the authors' model.

Model of Bank Behavior

The model of bank decisions presented extends earlier work by the authors. The basic idea is to use balance sheet relationships at a point in time to examine comparative statics (the response of bank loans to changes in the target federal funds rate or to changes in equity capital). Peek and Rosengren stress three predictions. First, capital shocks generate (directionally) different effects on CD borrowing for "constrained" and "unconstrained" banks. Second, policy shocks (changes in the funds rate target) generate (directionally) different effects on loan supply for constrained and unconstrained banks. Third, total deposits in constrained banks do not change in response to a change in the funds rate target, while total deposits in unconstrained banks fall in response to an increase in the funds rate target. The authors argue that capital constraints are a more useful way to group banks than bank size, because the values of model parameters that govern the response of loans to changes in the funds rate target and changes in equity capital likely vary across bank size groups.

The authors need the model really only to establish that an effect of monetary contraction on loan supply is greater for banks with no binding capital constraint than for banks facing a binding capital constraint. This point can be illustrated somewhat more simply and in a way that avoids counterintuitive implications—for example, that loans by constrained banks rise in response to a monetary tightening.[3]

[3] It is the difference in the effects that is important for the subsequent empirical work. The prediction of the model that loans by capital-constrained banks will rise in response to a monetary tightening is an artifact of the assumed form of the securities demand relationship.

To see this, let me reformulate the model articulated by Peek and Rosengren; variable definitions match those in their paper. In the example below, I make two assumptions different from those in the Peek and Rosengren paper: The interest rate on demand deposits is zero, and the loan market is competitive. Banks maximize profits subject to a reserve requirement, liquidity constraint, balance sheet identity, and capital adequacy constraint:[4]

$$\max\ [(r_L L - \theta)L + r_s S - r_D CD] \qquad \text{(Profit maximization)}$$

subject to:

$$R \geq \alpha\, DD \qquad \text{(Reserve requirement)}$$

$$R + S \geq h_0 + h_1\, DD \qquad \text{(Liquidity constraint)}$$

$$R + L + S = CD + DD + K \qquad \text{(Balance sheet identity)}$$

$$K \geq \mu L \qquad \text{(Capital adequacy constraint)}[5]$$

If all constraints bind except the capital constraint, $r_L = \theta + r_D + (r'_D)CD$, where $r'_D = (1/f_1)$ in their model. If $r'_D = 0$ ($f_1 \to \infty$), then the loan rate equals the CD rate; absent increasing marginal costs of CD financing, no scope remains for the lending view. When $r'_D > 0$, banks face a rising marginal cost of CD finance. In the short run, if $(r_L - r_D)$ does not change, the volume of CD borrowing is pinned down; a decrease in reserves of \$1 reduces deposits by $(1/\alpha)$, loans by $(1 - h_1)/\alpha$, and securities by $(h_1/\alpha - 1)$. In equilibrium, the loan-CD spread may change, depending in part on the size of r'_D (or f_1). The bottom line is that when loans and CDs are imperfect substitutes, both $(r_L - r_D)$ and loan supply will be affected by shocks to reserves.

The capital constraint may bind if raising additional equity is costly under asymmetric information. In this case, the liquidity constraint will not bind, because banks hold more securities than required for liquidity (capital constrains the volume of loans). With loans tied down by the capital constraint, changes in the bank's portfolio in response to a change in reserves occur through changes in securities holdings.

While some caution in interpretation is in order (for example, because these exercises ignore dynamics and the possibility of expected future constraints), such simple models illustrate the potential usefulness of capital constraints for tests of whether monetary policy affects bank loan supply.

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[4] As do Peek and Rosengren, I abstract from the more complicated structure of capital and leverage requirements in practice.

[5] This assumes a zero capital requirement on securities.

Why New England?[6]

Peek and Rosengren note that Kashyap and Stein (1995) fail to find much of an effect from capital constraints on the lending channel in their analysis of data for the nation as a whole. While capital-asset ratios rose over the late 1980s and 1990s (and through the 1990–91 recession) for the nation as a whole, they fell in New England over the period from 1989 through mid 1991, increasing sharply thereafter. Hence, the New England region may offer a better laboratory for studying the interaction of capital constraints and the lending channel.

While the intuition behind this regional focus is clear, I have a concern: The period of falling bank capital-asset ratios corresponds to a period in which the net worth of many New England borrowers (especially in real estate) is falling, so that it is difficult to isolate a causal link between changes in bank capital and bank lending. I return to this point later.

Empirical Tests and Results

The authors' tests use quarterly Call Report data for New England banks. To measure "capital constraints," they use the presence or absence of a formal regulatory action, supplemented by information on supervisory CAMEL ratings (for example, for institutions about to be closed or merged with other banks). Before discussing the results, two pitfalls in using the data should be acknowledged (as they are by the authors): the shortness of the time period for the constrained bank sample (1989 to 1994), and the use as a control group of an unconstrained bank sample including data from an earlier period (1977 to 1994). With respect to the latter point, a better idea would be to use a control group drawn from other regions in the United States.

The paper's empirical results are presented in its Tables 1 and 2. The results reported in Table 1 examine the response of loans in the constrained and unconstrained subsamples to changes in the federal funds rate target and changes in equity. Loans by unconstrained banks respond more to changes in the federal funds rate target than those by constrained banks, though the differences are not statistically significant. Equity changes have a larger positive effect on loans for the constrained subgroup.

Peek and Rosengren suggest that findings in Table 1 do not support the lending view, but I have two concerns. First, the fact that "total sample" patterns follow "constrained sample" patterns might simply

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[6] I am, of course, discounting the explanation that the research program is supported by the Federal Reserve Bank of Boston.

indicate that more loans were made by (large) capital-constrained banks. Second, the test is not really one of the "lending view" but of the relationship between changes in the funds rate and bank lending. More convincing differences between the two groups are observed for changes in equity capital. That capital shocks affect lending by constrained banks is certainly reasonable but, again, this is not a test of the lending view per se.

Table 2 reports results for the longer-period sample of unconstrained banks. In these tests, the change in the federal funds rate target has a negative and statistically significant effect on loans; changes in capital have an insignificant effect on loans. Even this evidence is somewhat difficult to interpret. Large standard errors make it difficult to use the results as a benchmark to compare against Table 1. Again, a comparison of results from different regions might be more fruitful.

The paper concludes noting "evidence that unconstrained banks behaved in a manner consistent with the lending channel." Perhaps. On a narrow level, the standard errors are really too large to make convincing the claim that an increase in the federal funds rate target reduces bank loan supply. On a broad level, neither for Table 1 nor for Table 2 can one be sure that the authors are estimating *loan supply* rather than *loan demand*. Nonetheless, the evidence suggests potentially promising future research with the national panel data set.

Where Do We Go From Here?

Because the "lending view" involves assumptions about capital-market imperfections for both banks and borrowers, more complete tests of the lending view require analysis of banks and borrowers jointly. In an ideal world, data matching borrower, loan, and lender characteristics could be used to sort out "lending view" and "balance sheet view" channels. Short of that, research could focus on two questions. First, are small or low-net-worth borrowers more likely to be the customers of constrained banks? Second, do low-net-worth firms have limited opportunities to substitute credit from unconstrained financial institutions when cut off by constrained financial institutions? Researchers have begun considering these questions,[7] and I suspect we will have much more micro evidence about the validity of the lending view in the near future.

[7] See, for example, Calomiris, Himmelberg, and Wachtel (1995) and Himmelberg and Morgan (1995).

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Discussion

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The paper by Joe Peek and Eric S. Rosengren addresses an important and timely issue: Do binding bank capital requirements affect the way monetary policy is transmitted? Using a simple model of the banking firm, the authors show that capital-constrained banks will respond to monetary policy shocks differently than unconstrained banks. Specifically, they show that the so-called "lending channel" for monetary policy is more important for banks that are unconstrained by capital requirements than for banks subject to binding capital requirements. Using a sample of New England banks, the authors provide preliminary empirical evidence consistent with the predictions of their model.

The major contribution of the paper, in my opinion, is its demonstration that the regulatory environment in which banks operate can have an important influence on the way monetary policy is transmitted to the real economy. However, just how capital requirements affect the relationship between loan growth and monetary policy is, I believe, more complicated than the predictions of the authors' simple model suggest. Specifically, the authors' conclusion, that the lending channel does not operate when banks are capital constrained, is the result of several assumptions that are likely to be violated in the real world. My comments will focus on the implications of relaxing these assumptions.

Background

For a lending channel for monetary policy to operate, several conditions must be met. First, banks must view reservable transaction ac-

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counts and nontransaction accounts as not perfect substitutes for one another. In Peek and Rosengren's model (as in similar work by Kashyap and Stein 1995), this is accomplished through assuming that the volume of transaction deposits for individual banks is determined by monetary policy (and is not a decision variable for individual banks). In contrast, the amount of CDs and other nontransaction deposits is assumed to be determined by the interest rate an individual bank pays.

A second condition for a lending channel is that loans and securities be imperfect substitutes in bank portfolios. In the lending channel literature, securities are assumed to be held as a precaution against deposit outflows. Loans, on the other hand, are assumed to be illiquid and acquired in less than perfectly competitive markets. Peek and Rosengren employ a similar set of assumptions in their model, except that they assume that securities are held as a fixed proportion of demand deposits. As I will discuss in a moment, this assumption is peculiar given that, with leverage-based capital requirements, securities are also held as a precaution against capital shocks.

If these first two conditions are met, it is straightforward to show that monetary policy will affect loan supply. For example, consider a decrease in reserves that causes a decline in demand deposits. So long as the decline in demand deposits is not completely offset by a decline in securities holdings, the bank must rely more on costly external debt (CDs and other nontransaction accounts). This increase in bank funding costs in turn results in a decline in the supply of loans. To complete the story, the decrease in the supply of bank loans will affect aggregate investment and output, if firms view bank loans and other forms of external financing as imperfect substitutes for one another.

How Have Regulatory Changes Affected the Lending Channel?

Assuming the conditions for a lending channel are met, how have regulatory changes over the past decade affected its operation? Two bank regulation changes appear to be particularly important (but working, perhaps, at cross-purposes). First, beginning in the late 1980s, implicit deposit guarantees on large uninsured bank liabilities were significantly curtailed. Specifically, the passage of FDICIA in 1991 signaled the formal abandonment (in theory) of the extension of implicit deposit insurance to large deposits and nondeposit liabilities of commercial banks. Since it is reasonable to assume that implicit insurance had a greater effect on the cost of CDs and other potentially information-sensitive deposits than on the cost of transaction accounts, the curtail-

ment of deposit insurance should reduce the degree of substitutability between demand deposits and other sources of deposit financing. The reduction in the degree of substitutability in turn works to increase the sensitivity of loan supply to changes in monetary policy, thereby strengthening the importance of the lending channel.

The second set of regulatory changes affecting the lending channel were changes in capital requirements. Specifically, risk-based capital requirements were implemented, the required level of capital was raised, and enforcement became more stringent, beginning in 1990. The implications of these changes are the primary focus of the authors' paper. While I agree with the paper's conclusion that binding capital requirements serve to decrease the sensitivity of loan supply to monetary policy, the authors' conclusion that capital-constrained banks respond to monetary policy in a qualitatively different way than unconstrained banks is, I believe a special case. In particular, this result holds only when risk-based capital requirements are binding.

Capital requirements affect the lending channel through their effect on the substitutability of loans for securities in a bank's portfolio. One of the least well understood parts of bank portfolio management, I believe, is why banks hold government securities. Models of lending channels (including the present model) generally assume that banks hold securities as a precaution against deposit withdrawals. In these models, securities are a substitute for external debt financing. The greater the cost of external debt financing and the greater the volatility in the supply of demand deposits, the greater the demand for securities as an inventory of liquidity.

With capital requirements based on overall leverage, there is a second reason to hold securities: as a buffer against capital shocks. In particular, with capital requirements based on total assets, banks can respond to a capital shock by selling securities and shrinking their asset base. The demand for securities should therefore depend on the volatility of bank earnings or capital as well as the cost associated with a binding capital requirement. In summary, one advantage of holding securities when operating under leverage-based requirements is that securities reduce the dependence of loan growth on internally generated capital.

In contrast, with binding risk-based capital standards, securities can no longer buffer loan growth from capital shocks. Specifically, since government securities have a zero risk weight, liquidating securities does not free up capital to fund loans. While the authors focus on the effects of binding leverage requirements, their assumption that securities holdings are a fixed proportion of transaction deposits effectively means that "risk-weighted" capital requirements are binding. In a more general model, such as Kashyap and Stein's (1995), the lending channel

of monetary policy continues to operate even though leverage-based capital requirements are binding.[1]

To summarize, the effect of capital requirements on the transmission of monetary policy depends on whether the risk-weighted capital requirement is binding or not. The greater emphasis on risk-weighted capital requirements since the 1989–90 period is likely to reduce the importance of the lending channel for capital-constrained banks. I think this explains the authors' preliminary results concerning the absence of a lending channel among capital-constrained banks beginning in 1989. The introduction of risk-based capital requirements may also explain the structural shift the authors find for unconstrained banks beginning in 1989 (see their Table 2).

Let me conclude by suggesting a way of empirically determining the importance of risk-related capital requirements and, indirectly, the operation of the lending channel of monetary policy. As I mentioned earlier, a necessary condition for a lending channel is that external financing is costly relative to internally generated funds and demand deposits. As a result, one would expect bank loan growth to be sensitive to the amount of internally generated funds. I would also expect loan growth at capital-deficient banks to be more sensitive to internally generated additions to capital. Moreover, whether a bank's security holdings affect the sensitivity of loan growth to internally generated funds will depend on whether the leverage requirement or the risk-based capital requirement is binding. If the leverage requirement is binding, then I would expect the sensitivity of loan growth to internally generated funds to vary inversely with a bank's holdings of securities. On the other hand, finding no relation between securities holdings and the sensitivity of loan growth to internally generated funds would be evidence that the risk-based capital standard is binding. A finding that risk-based requirements are binding would also suggest that the lending channel is relatively unimportant (since bank loan growth is restricted by the amount of equity capital).

Reference

Kashyap, Anil K. and Jeremy C. Stein. 1995. "The Impact of Monetary Policy on Bank Balance Sheets." *Carnegie-Rochester Conference Series on Public Policy*, vol. 42, June, pp. 151–95.

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[1] In fact, in Kashyap and Stein's model, the responsiveness of loan growth to changes in monetary policy is unaffected by binding leverage requirements. Leverage requirements serve to reduce initial loan volume and increase the proportion of securities held in the bank's portfolio (reflecting the fact that securities can be used as a buffer against capital shocks). The sensitivity of loan demand to changes in monetary policy is not affected by a binding leverage constraint because loan growth depends only on the cost of substituting debt financing for deposit financing.

How Is Bank Lending Related to Output?

Even if policy can affect bank lending, is lending related to GDP? What are the typical dynamic responses of bank loans, nonbank lending, and output to various shocks? If lending is reduced, can businesses substitute other forms of credit to prevent any effect on output? Is the relationship between lending and GDP stable?

Bank Credit and Economic Activity

Carl E. Walsh and James A. Wilcox*

The role of banks in regional as well as in national economic fluctuations has been the subject of renewed interest in recent years. With what seems like amazing prescience, Bernanke and Blinder (1988) recently revived the theoretical literature on the role of bank credit typically associated with Brunner and Meltzer (1972). The trickle of empirical papers written before the 1990s that focused on bank credit turned into a torrent during the 1990s.

The primary impetus for this renewed interest was the 1990–91 recession, which seemed contemporaneously to have been distinguished by the large, and perhaps initiating, role played by reduced bank lending. Statements by government policymakers and the outpouring of research on the role of bank credit in macroeconomic fluctuations over the past five years generally indicated that banks' capital shortfalls, whether due to regulatory changes or loan losses, reduced bank lending and were highly correlated with reduced output.

The strong correlation between loans and output is long-standing. Indeed, the U.S. Department of Commerce classifies various measures of the dollar volume of business and consumer credit outstanding as lagging indicators of output, and it classifies various measures of the change in business and consumer credit as leading indicators of output.

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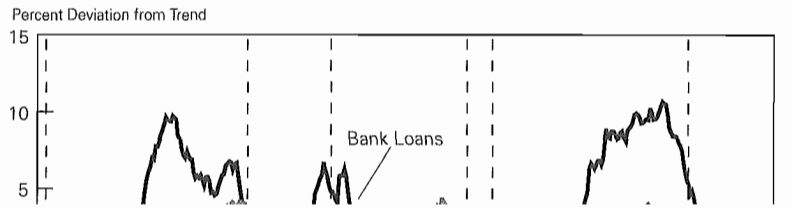
Figure 1

BANK LOANS AND OUTPUT [a]



sors. The extent to which lending fell short of its trend in 1992 and 1993 was atypical, not in its magnitude, but in how long the recovery in lending lagged the recovery of output. Also atypical about the business cycle that began in 1982 was how much lending rose relative to trend during the expansion of the 1980s and how much lending then fell from those lofty heights in the early 1990s.

Rising Interest in the Declining Role of Banks?

One intriguing aspect of the increased attention recently paid to banks is that we might have expected banks to be relatively less important in recent business cycles than ever before. Financial deregulation and innovations in financial instruments and institutions might have been expected to reduce the extent to which banks played a "special" role in supplying either businesses or households with credit. The removal of interest rate ceilings on bank deposits reduced the extent of disintermediation that disrupted flows of credit and economic activity in the past. The deepening of the commercial paper and other nonbank markets for business loans, the widespread use of credit cards by households and small businesses, and the explosive growth of the secondary markets for residential mortgages and other forms of credit presumably expanded greatly the range of relatively close substitutes for commercial bank loans over the past few decades.

Figure 2 plots the ratio of the (dollar) volume of commercial and industrial loans at commercial banks to the sum of those loans and the outstanding (dollar) volume of commercial paper issued by nonfinancial corporations. This ratio has declined steadily over the past two decades, from about 95 percent in 1973 to 80 percent in 1993.[3] This one measure of banks' market share indicates that banks no longer have the near-monopoly in the market for short-term business finance that they once did. Though banks remain the dominant suppliers of short-term business credit, they are no longer effectively the only supplier. Measures of banks' share of credit extended to households (including mortgage credit) would likely show a downward trend as well. Nonetheless, banks still command a large share of the credit extended to the private sector. How much shifts in bank lending per se have contributed to economic fluctuations is the focus of our study.

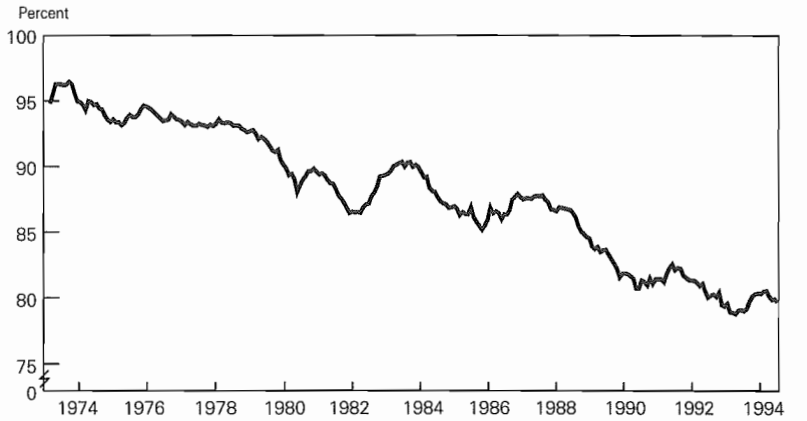
Plan of the Paper

This paper provides estimates of the separate effects on bank lending and on output of shifts in the demand for bank loans and of

[3] See Laderman (1993).

Figure 2

BANKS' SHARE OF SHORT-TERM BUSINESS CREDIT



shifts in the supply of bank loans.[4] It will also provide estimates of some of the proximate determinants of those shocks to bank loan supply over the 1960–94 period.

Evaluation of banks' contributions to fluctuations in aggregate lending and output requires distinguishing changes in bank loans that arise from changes in the supply of bank loans from those that arise from changes in the demand for bank loans. Identifying the separate effects of loan supply and demand has proved to be quite difficult.[5] Hall (1993), Hancock and Wilcox (1993, 1994), Peek and Rosengren (1994, 1995a, 1995b), and studies by many others have argued that shortfalls of bank capital relative to some target level of capital reduced the supply of bank loans.[6] Whether the other factors that they considered reduced the supply of bank loans, the demand for bank loans, or both, they could not say. As a consequence, these studies could not assess the timing or

[4] Throughout, unless explicitly noted otherwise, when we say loans, we refer to *bank* loans.

[5] See Bernanke's comments on Friedman and Kuttner (1993) and on Ramey (1993).

[6] For a dissenting view, see Berger and Udell (1994).

relative importance of bank loan supply shocks in toto to bank lending or to output.[7]

This study uses vector autoregressions (VARs) to assess a number of hypotheses about the interaction of bank lending, monetary policy, and aggregate economic activity. Evidence is presented to support the view that applying the standard Choleski decomposition method to VARs does a creditable job of distinguishing shocks to the supply of bank loans from shocks to the demand for bank loans. Despite the difficulties in measuring both the price and the non-price aspects of loan pricing that serve to ration loan supply, we argue that shocks to the prime interest rate seem to capture empirically the effects of shifts in bank lending behavior that correspond to loan supply disturbances. We then show that these shocks have had important effects on bank lending and on aggregate output.[8]

Unless bank lending is affected by loan supply shocks, output will not be. Thus, the study estimates how much effect shocks to bank loan supply have on the outstanding (dollar) volume, or quantity, of bank loans. It also shows what the estimates imply about the effects of bank loan supply shocks on aggregate output. The estimates are used to calculate the contributions of loan supply shocks to output fluctuations over the past three decades. Though loan supply shocks are not typically the primary determinant of recessions, we show that they played an atypically large role in the 1990–91 recession.

Also estimated is the extent to which the estimated time series of loan supply shocks was correlated with changes in some of the presumed determinants of bank loan supply. For example, it might be expected that loan supply would be reduced by increases in FDIC deposit insurance fees, in reserve requirements, in the amount of capital banks held, in the difference between deposit interest rates ceilings and open market rates, and so on. The estimates indicate that these factors did affect the aggregate supply of bank loans during the 1960–94 period.

We then estimated vector autoregressions (VARs) over subsamples to provide evidence on whether the responses to loan supply shocks changed over time. A priori, less influence of loan supply shocks might be expected in later periods, when more close substitutes for bank loans were available to businesses and to households. The estimates suggest that in recent years the effects of loan supply shocks both on loan volume and on output were smaller than they were historically.

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[7] They could provide estimates of the effects of capital shortfalls on bank lending and on output, but capital considerations presumably were only one of several potential sources of shocks to banks' loan supplies.

[8] Here we do not explicitly address the related issue of whether monetary policy operates through its effects on the supply of bank loans.

The Data

The estimates reported below were based on VARs that used data for aggregate output, inflation, the federal funds rate, the prime interest rate, and bank loans.[9] The data were monthly and covered the period January 1959 (1959:01) through December 1994 (1994:12). Except for interest rates, the data were seasonally adjusted.

In previous empirical investigations of the relation between bank lending and output, and in numerous other investigations that used aggregate data, either quarterly data were used or, if the data frequency was monthly, the index of industrial production typically was used as a proxy for aggregate output. We used monthly data, but avoided problems introduced by the narrowness of industrial production as a measure of aggregate economic activity by using (the logarithm of) the U.S. Department of Commerce's Index of Coincident Indicators (ICI). The ICI is an average of four real series: (1) employees on nonagricultural payrolls, (2) real personal income less transfers, (3) industrial production, and (4) real manufacturing and trade sales. Thus, the ICI subsumes the index of industrial production. Because the ICI is constructed so as to match the aggregate level of economic activity, we refer to the ICI as output.

The measure of inflation, PI, is 100 times the change over the prior 12 months in the log of our measure of the consumer price index (CPI). Starting in January 1983, the U.S. Bureau of Labor Statistics (BLS) changed its calculation of the official measure of the CPI by switching to a rental-equivalence measure of housing costs. This change was intended to reduce biases in the CPI associated with nominal mortgage interest rates. To make the measure of the CPI for the period before 1983 comparable with the later data, we used as the measure of the CPI an unofficial series calculated by the BLS for the period from January 1967 through December 1982, CPIUX1NS. We used the official BLS measure of the CPI from 1959 through 1966. In the period before 1967, nominal mortgage interest rates were low and stable enough that the differences between the series produced by the old and new methodologies would likely have been small.

The monthly nominal federal funds interest rate, denoted by FYFF, is the average of daily rates, each of which was a weighted average of rates on trades at New York federal funds brokers. The prime rate, the nominal interest rate on short-term business loans that banks charged to the lowest-credit-risk customers, was denoted as FYPR. The monthly data for FYPR are averages of daily data.[10]

The data on total loans and leases at commercial banks came from

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[9] We used RATS4.1 to obtain all our estimates.

[10] Data for the federal funds rate and the prime rate came from the Board of Governors of the Federal Reserve System release G.13.

the Board of Governors of the Federal Reserve System. The bank loan data were adjusted by the staff at the Federal Reserve Board for the change in definition that took place in January 1973. We adjusted the data for the data break due to the Federal Reserve's changed method of calculation that took effect in January 1988.[11] Data on bank loans were converted to real terms by dividing them by our measure of the consumer price index. Logged, real bank loans are denoted RBL.

Strategy and Results

Estimates from vector autoregressions (VARs) were used to assess a number of hypotheses about the interaction of bank lending, monetary policy, and aggregate economic activity. Three exogenous variables were included in each of the VARs we estimated: two trend variables and (current and seven lagged values of) the producer price index for crude petroleum.[12] The first trend variable begins in the first period of the sample; the second is zero until January 1974, when it takes on a value of one. It rises by one each month thereafter. The trend terms together are meant to allow for a once-broken linear trend in the log of potential real GDP. Statistical tests of lag length indicated that seven lags of each variable should be included.[13] To allow for lags, the estimation period was shortened to 1960:08 through 1994:12.

Similarities to and Differences from Earlier Findings

Because using the monthly ICI as a proxy for aggregate output is surprisingly *un*common, we began by estimating VARs similar to those based on quarterly data reported by Friedman and Kuttner (1993). We find the common use of the monthly index of industrial production in lieu of the ICI especially surprising because the index of industrial production is one component of the ICI and the other components of the ICI provide information about economic activity in the non-industrial part of the economy, which is probably larger than the industrial part. We were also interested in the effects of moving to higher-frequency data. Friedman and Kuttner used real GDP as a proxy for output

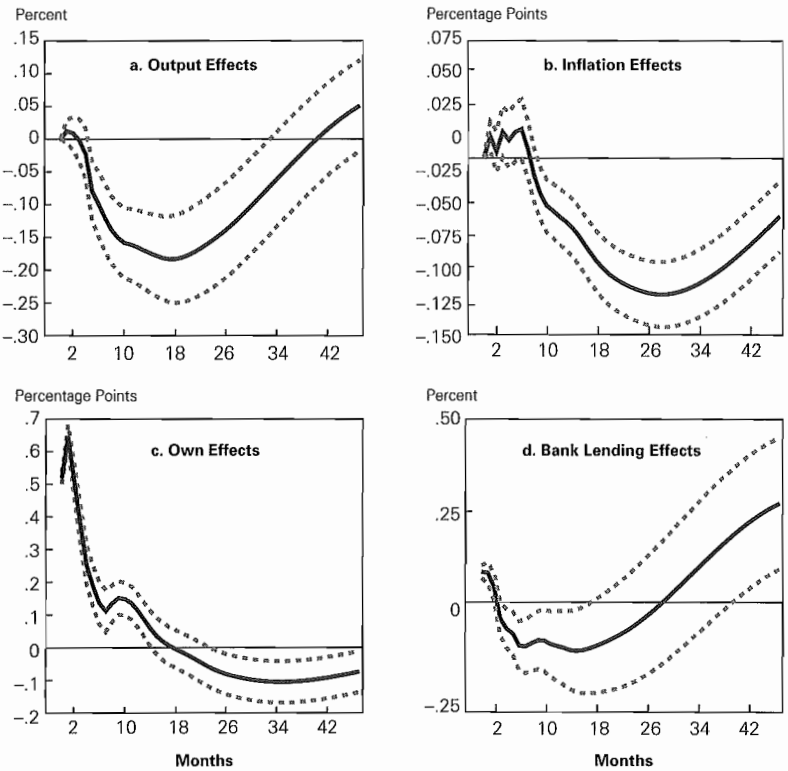
[11] To do so, we multiplied the data for the period before January 1988 by 0.9955.

[12] The PPI was deflated by our measure of consumer prices to make it a relative price and then was logged.

[13] Based on DeJong, Nankervis, Savin, and Whiteman's (1992) test for the null of trend stationarity, we could reject the null only for the real loan series (test statistic of 0.26 compared to a 5 percent critical value of 0.24). Using the first difference of RBL in place of the level had no substantive effects on our results. The residuals from the VAR passed standard tests for stationarity and showed no signs of serial correlation. Based on a likelihood ratio test, the null of six lags versus the alternative of seven lags could be rejected easily; seven lags could not be rejected against the alternative of eight lags. We used seven lags throughout.

Figure 3

Responses to a Funds Rate Shock



Note: Dashed lines indicate one-standard-error bands.

and the change in the implicit deflator for GDP as their measure of inflation, neither of which is available at a monthly frequency. Their sample period was 1960:QII through 1992:QIV, which is quite similar to ours. They reported impulse-response functions from four-variable VARs that included, in order, real GDP, inflation, and the federal funds rate, as well as one additional variable from among a set of various financial market variables. Each of their VARs included four lags of each endogenous variable.

Figure 3 shows our estimates of the responses of output, inflation, the funds rate itself, and (the quantity of real) bank loans to a one-

standard-deviation shock to the federal funds rate; also shown for the impulse-response functions are the one-standard-error bands, which were obtained by Monte Carlo integration.[14] The VAR specified the endogenous variables in the following order: ICI, PI, FYFF, and RBL.[15] This specification was chosen because of its similarity to the Friedman and Kuttner specification.

Panel (a) of Figure 3 shows that, in response to a positive shock to the funds rate, output first briefly rose by a small and statistically insignificant amount. It then declined rather sharply, troughed about 20 months after the funds rate shock, and rebounded to its pre-shock level about three and one-half years after the shock. Thus, we found a pattern based on monthly data with ICI used as a proxy for output that was broadly consistent with estimates based on quarterly data with real GDP used as a measure of output.[16] Panel (a) shows that output troughed at about a 0.17 percent decline relative to baseline, whereas Friedman and Kuttner reported a maximum decline of about three times that amount, which seems consistent since they used quarterly rather than monthly data. Bernanke and Mihov (1995), using a monthly GDP series, found a somewhat larger effect for a funds rate increase.[17] As expected, the response of inflation, plotted in Panel (b), trailed and was generally smaller than the response of output to a funds rate shock.[18]

After a short, sharp, significant increase in response to an upward shock to the funds rate, bank lending moved below baseline and stayed there for about two years, as shown in panel (d).[19] We attribute the rise in lending that immediately followed a monetary contraction to the increased credit needs of firms that find cash flows declining in the face of reduced aggregate demand.[20]

The estimates in Figure 3 also differ in noteworthy ways from those obtained by Friedman and Kuttner. For example, we found that output both declined and rebounded more rapidly; this difference could result solely from their use of quarterly average rather than monthly data. In contrast to the results in panel (d), Friedman and Kuttner estimated that

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[14] Standard error bands were generated based on 1,000 draws.

[15] We omitted FYPR from the VARs used to generate Figure 3.

[16] Bernanke and Mihov (1995) find a similar response using a monthly GDP measure.

[17] Note that over the 1960–94 period the variance of detrended (log) quarterly real GDP was smaller (3.85 percent) than that of the detrended (log) monthly index of coincident indicators (4.34 percent).

[18] Panel (b) of Figure 3 shows the "price puzzle," that inflation initially rises in response to a funds rate shock. Though it has been argued that including a commodity price variable in a VAR tends to eliminate the puzzle, our specifying the real price of petroleum as exogenous did not eliminate it. The positive responses of output and inflation were small enough that the one-standard-error bands always contained the baseline.

[19] This is similar to the pattern reported by Bernanke and Blinder (1992).

[20] For example, Wilcox (1992) reports that while commercial and industrial loans initially rise in response to a funds rate shock, consumer and real estate loans decline.

a funds rate shock *raised* bank lending above baseline for three years; this is difficult to reconcile with our a priori belief that an increase in the funds rate represented a tightening of monetary policy.[21] To the extent funds rate shocks approximated shifts in monetary policy, the estimates delivered by our specification seemed more plausible.

In principle, the demand for bank loans may have shifted importantly, for example, because of substantial changes in the supply of nonbank finance. A priori, we did not expect loan demand shocks to be important determinants of changes in the volume of bank loans or of changes in output. In that regard, we concurred with Bernanke and Blinder's (1988) view that, in contrast to shocks to loan supply, it might be "difficult to think of or identify major shocks to credit demand, that is, sharp increases or decreases in the demand for loans at given interest rates and GNP." The evidence presented below supports that view.

To help judge whether shocks to the real quantity of bank loans were important, Figure 4 shows the estimated responses to them. Panel (a) shows that output rose briefly but by only a very small amount in response to a positive shock to loan volume. The ensuing responses of output to the loan quantity shock were always small and insignificant. This contrasts with the Friedman and Kuttner finding that, in response to a loan volume shock, output rose continually over a three-year period. Inflation also responded by small and insignificant amounts to loan quantity shocks. The funds rates' response being noticeably above baseline during the first year following the positive shock to bank loans, shown in panel (c), presumably reflected a countercyclical reaction on the part of the Federal Reserve.

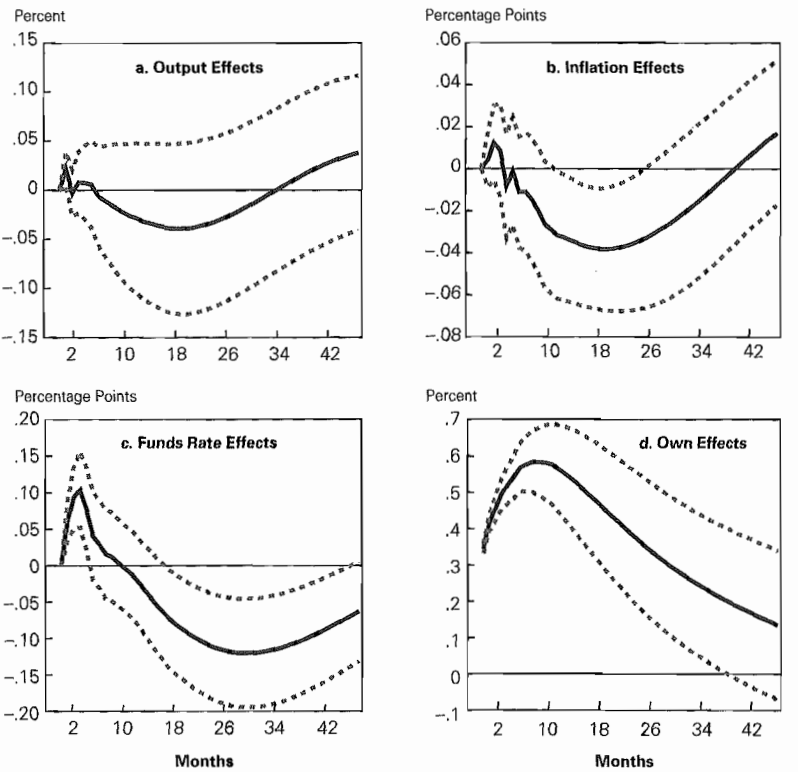
Figure 5 shows impulse-response functions obtained when we substituted the prime interest rate for the volume of bank loans in the four-variable VAR. A prime rate shock was estimated to lower output and inflation initially. As in Figure 3, the inflation response trailed that of output. These responses are consistent with a prime rate shock being identified as a loan supply shock. But they contrast with the Friedman and Kuttner finding that shocks to the bank loan interest rate, which they measured as a spread over the commercial paper rate, led to a rise in output.

Figure 5 also shows that a positive prime rate shock was followed by a decline in the federal funds rate, again presumably reflecting a countercyclical policy response of monetary policy by the Fed. Since output reversed its decline and eventually rose temporarily above the baseline path, the policy response appeared to overcompensate for the prime rate shock. Though the typical response of the funds rate can

[21] This judgment is perhaps more accurately term our "posterior" belief, since it has been influenced by the evidence presented in a number of earlier studies.

Figure 4

RESPONSES TO A BANK LOAN QUANTITY SHOCK



Note: Dashed lines indicate one-standard-error bands.

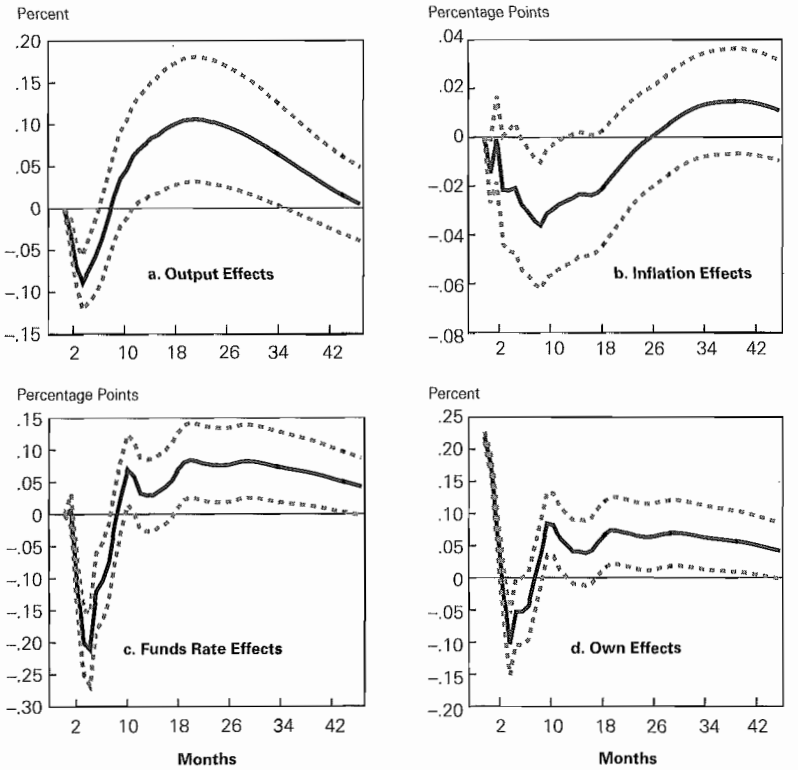
hardly be blamed for being "too late," it might be judged to be "too much."

Identifying Loan Supply and Loan Demand

Above, we have demonstrated that the responses reported in Figures 4 and 5, and our interpretation of shocks to loan quantity and to the prime rate as loan demand and supply shocks, respectively, are robust to having included only one of the two variables from the bank loan market at a time. Next we report estimates of a VAR that included

Figure 5

RESPONSES TO A PRIME RATE SHOCK



Note: Dashed lines indicate one-standard-error bands.

both the prime rate and the real quantity of bank loans. The effects on output, inflation, the funds rate, the prime rate and bank lending of shocks to the two loan market variables are shown in Figures 6 and 7. In calculating these impulse-response functions, we ordered the variables as: ICI, PI, FYFF, FYPR and RBL, respectively. Reversing the ordering of the two loan market variables had little effect on the estimated impulse-response functions.

If the prime rate and the real quantity of bank loans are jointly determined in the market for bank loans, the recursive structure imposed by a Choleski decomposition would fail to separately identify

supply and demand disturbances. To check this possibility, we also experimented with the specification of a "structural VAR" in which the prime rate and loan quantity were assumed to be simultaneously determined, with both responding contemporaneously to both loan supply and demand shocks. These shocks were then identified through a priori restrictions on the contemporaneous relations among the basic disturbances. Specifically, maintaining the recursive structure for output, inflation, and the funds rate that was used in the basic VAR formulation, we allowed the residuals in the equations for FYPR and RBL to be linear combinations of underlying loan supply and demand disturbances. We identified these equations by excluding the funds rate from the loan demand equation and contemporaneous output and inflation from the loan supply equation. In addition, we included the credit-policy dummies developed by Romer and Romer (1993) as instrumental variables when we estimated the loan demand equation.

The estimated loan supply shock series obtained via the structural VAR was highly correlated with the prime rate shock series obtained via the Choleski decomposition. Similarly, the loan demand shock series was highly correlated with the loan quantity shock series obtained via the Choleski decomposition. Thus, the estimates of the shocks to loan supply and to loan demand appeared robust to the alternative structural VAR identification scheme. In addition, the correlation between the structural loan supply shocks and the loan quantity shocks from the astructural Choleski decomposition was small, and the correlation between the structural loan demand shocks and the prime rate shock from the astructural Choleski decomposition was small.[22] These small correlations suggest that the Choleski decomposition separated supply from demand about as effectively as the structural VAR did. Consequently, we report results below only for the Choleski decomposition.

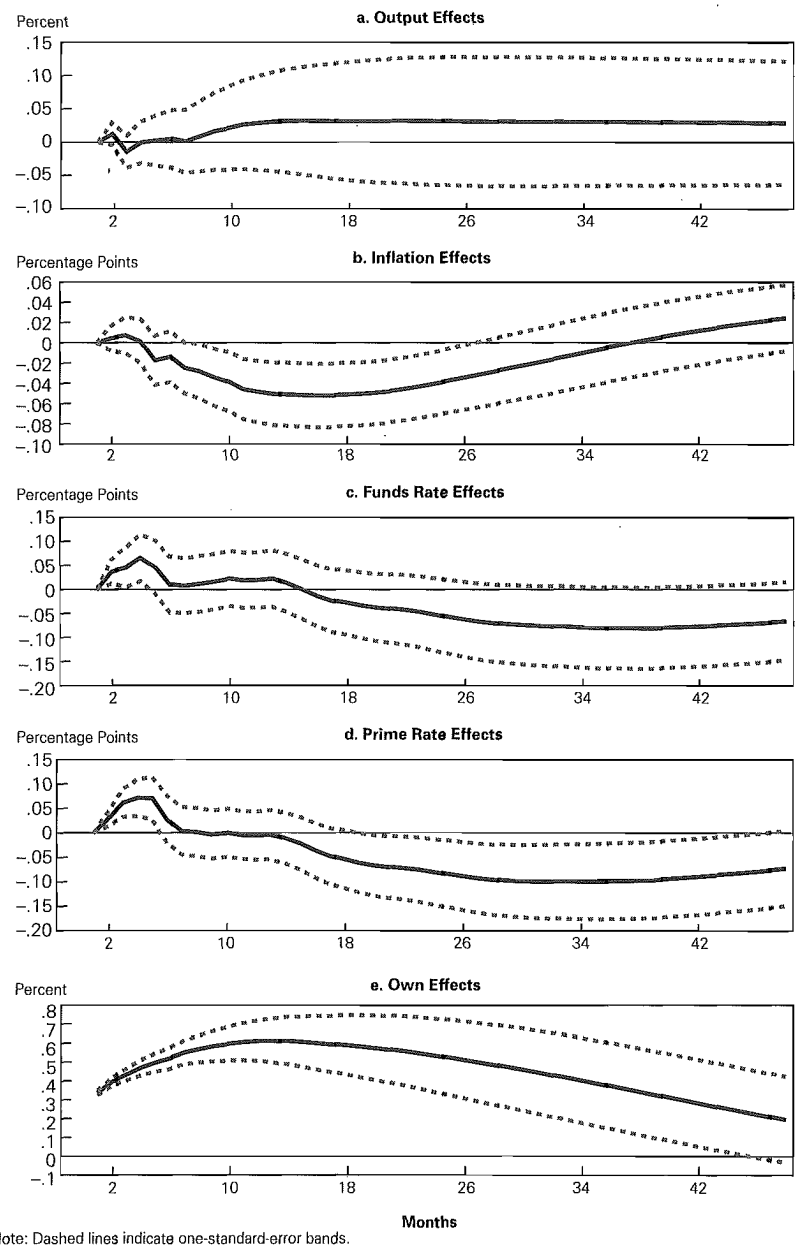
What Were the Effects of Shocks to Loan Supply and Loan Demand?

Figures 6 and 7 plot the responses of the five endogenous variables to the loan quantity and prime rate shocks identified via the Choleski decomposition. In Figure 6, panel (e) shows that loan quantity remained above baseline for several years following an upward shock to itself. Similarly, output tended to rise above baseline within six months of a positive shock to loan demand and stayed above baseline for at least

[22] Letting (s d) denote the estimated structural shocks and (pr l) denote the shocks from the Choleski decomposition, correlation(s, pr) = 0.972, correlation(d, l) = 0.937, correlation(s, l) = −0.171, correlation(d, pr) = 0.149.

Figure 6

Responses to a Bank Loan Quantity Shock



Note: Dashed lines indicate one-standard-error bands.

four years following the shock.[23] Shocks to loan demand also generated temporarily higher funds rates, as the Fed apparently responded countercyclically to the higher output and inflation rates. The prime rate traced out a response path similar to that of the funds rate, presumably both because the increased demand for bank loans allowed banks to increase the spread they charged between the prime interest rate and bank funding costs and because the higher funds rate raised banks' funding costs. Each of these responses was consistent with loan quantity shocks effectively measuring shocks to loan demand. Inflation staying below baseline, however, did not support this interpretation.[24]

In contrast, the responses in Figure 7 to a prime rate shock were consistent with responses to a loan supply shock. The response of the quantity of bank loans supported the idea of an upward shock to the prime rate being interpreted as a reduction in the supply of bank loans. Panel (e) shows that loan quantity began to decline almost immediately following the rise in the prime rate, fell to a level significantly below baseline, and remained below baseline for about one and one-half years.

Output also fell in response to an increase in the prime rate, just as would be expected if the shock to the prime rate could be associated with a change in the supply of "special" bank loans. About one year after the shock, output reverted to baseline and for the subsequent two years was above baseline. In fact, in the second and third years following the shock to the prime rate, each of the responses, including that of the prime rate itself, was reversed. One possible explanation for this positive effect is that the initial increase in the prime rate led to a more-than-offsetting decline in the funds rate, as shown in Panel (c). To the extent the Federal Reserve "overreacted" in lowering the funds rate, it might eventually have raised the funds rate to a level higher than baseline when bank loans, output, and inflation each moved above their baseline levels. Also consistent with a positive shock to the prime rate being associated with a reduction in the supply of bank loans was the decline in the inflation rate. This decline tended to trail that of output, as would be expected.

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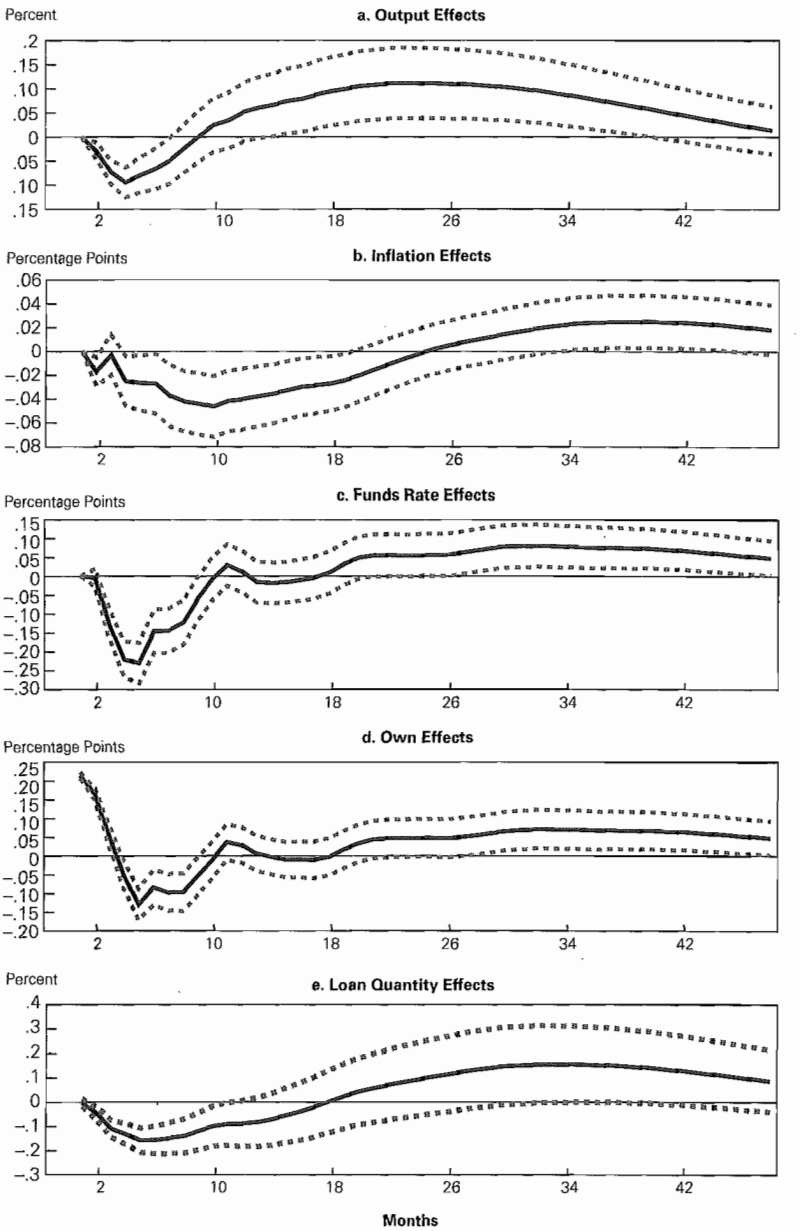
[23] Bernanke and Blinder (1988) argued that shocks to loan demand might be relatively small. That is different from arguing that the responses will be small. Shocks to bank loan demand might be larger than shocks to the demand for total (bank plus nonbank) credit.

[24] Because of the bank's balance sheet identity, our use of a bank asset variable, real loans, could actually be capturing the effects of disturbances to bank liabilities and therefore the money stock. However, if our loan demand shock is actually a money demand shock that, given the funds rate, leads to an expansion of reserves and the money supply, we would expect the prime rate to decline as banks attempt to expand lending. The estimated impulse-response functions show the prime rate rising in response to a shock to the real quantity of bank loans, which is more consistent with our interpretation.

Figure 7

RESPONSES TO A PRIME RATE SHOCK



Note: Dashed lines indicate one-standard-error bands.

How Important Were Loan Shocks to Output and to Bank Lending?

Table 1 reports the shares of the variance of the forecast error at various horizons for output (panel a) and for bank loan quantity (panel b) attributable to shocks to the bank loan market variables in the five-variable VAR. The fraction of output forecast error variance attributed to orthogonalized shocks to the prime rate was much larger than that attributed to bank loan shocks, although neither explains much of the forecast error variance of output.[25] Taken together, loan supply and demand accounted for less than 2 percent of the variance of output at a 12-month horizon and about 5 percent at a 36-month horizon. Reversing the order of the two loan market variables (so that FYPR entered before RBL) had virtually no impact on the variance decompositions. Note also that the shares of forecast error variance of lending associated with output (about 20 percent at a horizon of two years) were considerably larger than the shares of forecast error variance of output associated with the bank loan variables (less than 4 percent at a horizon of two years).

Although in principle one might expect that the residuals from the real loan quantity and prime rate equations in the VAR would be determined simultaneously by the interaction of loan demand and loan supply factors, they were nearly independent disturbances. The similarity between the results from the four-variable systems reported in Figures 3 and 4, each of which excluded one of the loan market variables, and the five-variable system (which included both bank loan market variables) suggests that prime rate shocks and real loan quantity shocks were essentially orthogonal. That view was buttressed by the low (0.14) correlation between the unorthogonalized residuals and by the variance decompositions being hardly affected by the ordering of FYPR and RBL.

Panel (b) shows that shocks to the prime rate accounted for about 5 percent of the forecast error variance of bank lending at a six-month horizon, but typically less than half that amount at longer horizons. Thus, loan supply shocks had effects on loan volume that were also quite small. Forecast errors in loans themselves of course accounted for most of the variance. Somewhat surprising was the infinitesimal share of forecast error variance attributable to the funds rate, especially in light of the funds rate's contribution to the forecast error variance of output, shown in panel (a). One reason that the funds rate may have smaller shares here than in previous studies is that Table 1 is based, not on industrial production as a measure of aggregate output, but on the index of coincident indicators. Industrial production is likely to be more

[25] Very similar shares emerged when the bank loan volume and prime rate variables are included separately.

Table 1
Variance Decompositions for Output and Bank Lending

a. Which Shocks Drove Output?

Horizon (months)	Share of Output Forecast Error Variance Attributable to:				
	ICI	PI	FYFF	FYPR	RBL
3	96.9	1.4	.1	1.5	.1
6	91.7	5.5	.3	2.4	.0
12	82.3	12.8	3.3	1.4	.1
18	71.6	19.2	6.9	2.0	.3
24	63.1	23.6	9.8	3.1	.3
36	55.6	27.2	12.2	4.6	.5
48	56.1	26.6	11.9	4.7	.6

b. Which Shocks Drove Bank Lending?

Horizon (months)	Share of Bank Loan Quantity Forecast Error Variance Attributable to:				
	ICI	PI	FYFF	FYPR	RBL
3	6.3	8.9	2.2	2.6	80.0
6	9.6	11.6	1.6	5.1	72.2
12	15.8	18.6	1.3	3.2	61.1
18	19.1	27.4	1.5	1.7	50.1
24	19.4	34.2	1.7	1.3	43.4
36	17.1	41.3	1.5	1.8	38.4
48	15.8	42.3	1.7	2.2	38.0

heavily weighted toward output such as durable goods, demand for which might be more interest-sensitive than the broader measure of output for which ICI served as a proxy.

When Was the Loan Market Shocked?

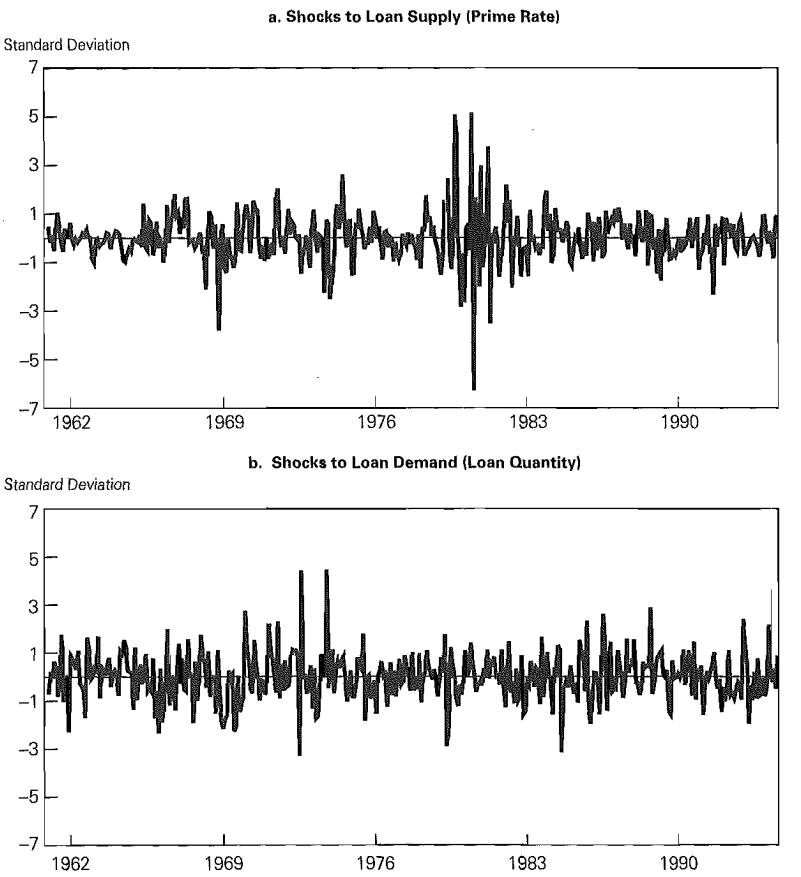
Figure 8 plots the time series of orthogonalized loan market shocks implied by the five-variable VAR. The top panel plots shocks to loan supply (that is, to the prime rate) and the bottom panel plots shocks to loan demand (that is, to loan quantity). Because loan supply shocks pertained to the prime interest rate and loan demand shocks pertained to the quantity of loans outstanding, we scaled each series by its own estimated standard deviation to make them more comparable.

Loan supply shocks were estimated to have been unusually large during 1980 and 1981. Indeed, the single largest negative shock was recorded in early 1980, the time when the Federal Reserve imposed credit controls.[26] The estimates indicated that loan supply shocks were

[26] See Romer and Romer (1993).

Figure 8

Estimated Shocks to Bank Loan Supply and Bank Loan Demand



predominantly positive from 1985 through 1988 and predominantly negative in 1989 and 1990, which conforms to popular accounts of banks' lending practices during these periods. It is notable that the estimated loan supply shocks have not been particularly large since the late 1980s.

The largest loan demand shocks occurred during 1973 and 1974, and the shocks tended to be positive during 1988 and 1989. Loan demand showed no particular pattern during the 1990s.

How Much Did Loan Supply Shocks Affect Bank Lending?

Changes in the real volume of bank loans outstanding can be expressed as the sum of the contributions of the endogenous variables. Figures 9A and 9B plot the historical decomposition of the effects on loan quantity of shocks to output, to the funds rate, and to the prime rate.[27] Figure 9A plots data for the entire period, while Figure 9B plots data for the 1985–94 period. The vertical lines indicate the dates of business cycle peaks.

Panel a of Figure 9A shows that shocks to output contributed much more than the funds rate or the prime rate contributed to variations in bank loan quantity. Changes in monetary policy, identified here with fed funds rate shocks, also had appreciable effects on bank lending, as shown in panel b. Panel c shows that changes in bank loan supply as proxied by shocks to the prime rate generally were the least important contributors to bank loan quantity.

Figure 9B shows that the relative contributions of output, the funds rate, and the prime rate typical of the longer term were also in evidence over the most recent decade. Even during the most recent recession, output (panel a) contributed considerably more to the decline in loans than did reduced supplies of bank loans, as measured by the prime rate (panel c). Over the past decade, the contributions of monetary policy apparently were a mirror image of those of output. Tightened monetary policy restrained bank lending beginning in 1988, two years before the onset of the recession in July 1990, while an eased policy contributed ever more positively to bank lending by 1991.[28]

During 1989 and 1990, bank lending was greater than it would have been otherwise because of prior increases in the supply of bank loans. By early 1991, however, the contribution of loan supply to lending was declining and, through 1992 and 1993, the contribution of loan supply was negative. Figure 9B then suggests that monetary policy reduced the growth rate of lending before the recession began (which may have led to a recession even without the subsequent reduction in loan supply) and that, once the recession was under way, shocks to loan supply aggravated the decline in lending. By the end of 1994, the contractionary effects of loan supply on lending appeared to have been spent.

How Much Did Loan Supply Shocks Affect Output?

Figure 10 plots the contributions of shocks to bank loan supply and demand to movements in output. Panel a plots the sum of the contri-

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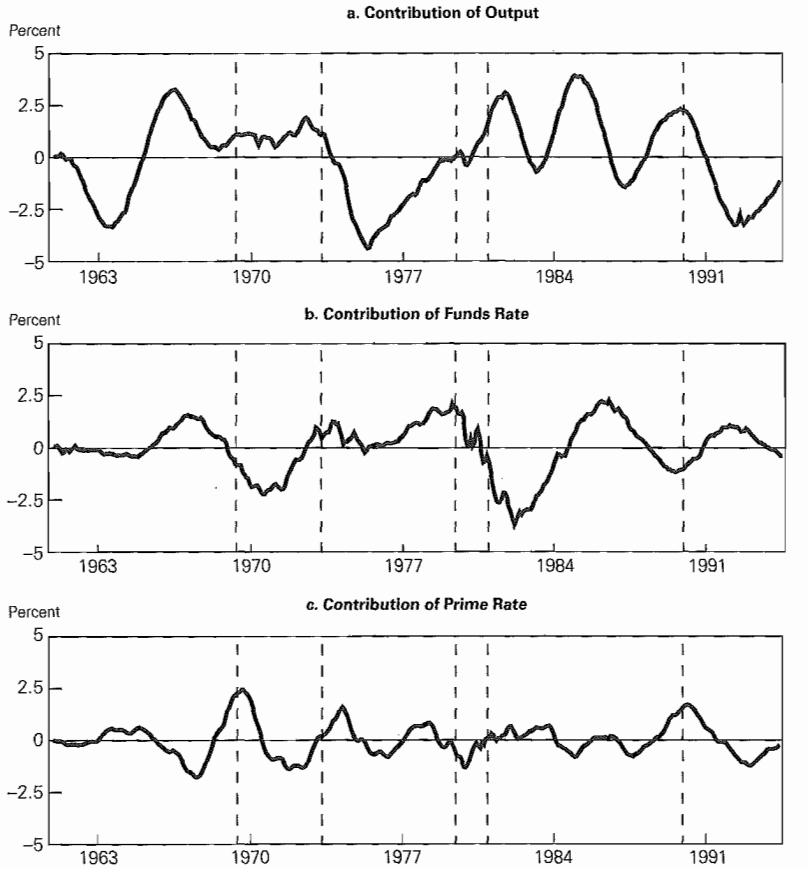
[27] Figure 9 does not plot the historical contributions of inflation shocks or of shocks to loan demand (quantity) itself.

[28] The contribution of the funds rate is similar to that of the money supply reported by Walsh (1993).

Figure 9A

Contributions of Output, the Funds Rate, and the Prime Rate to Changes in the Volume of Real Bank Loans, 1961 to 1994

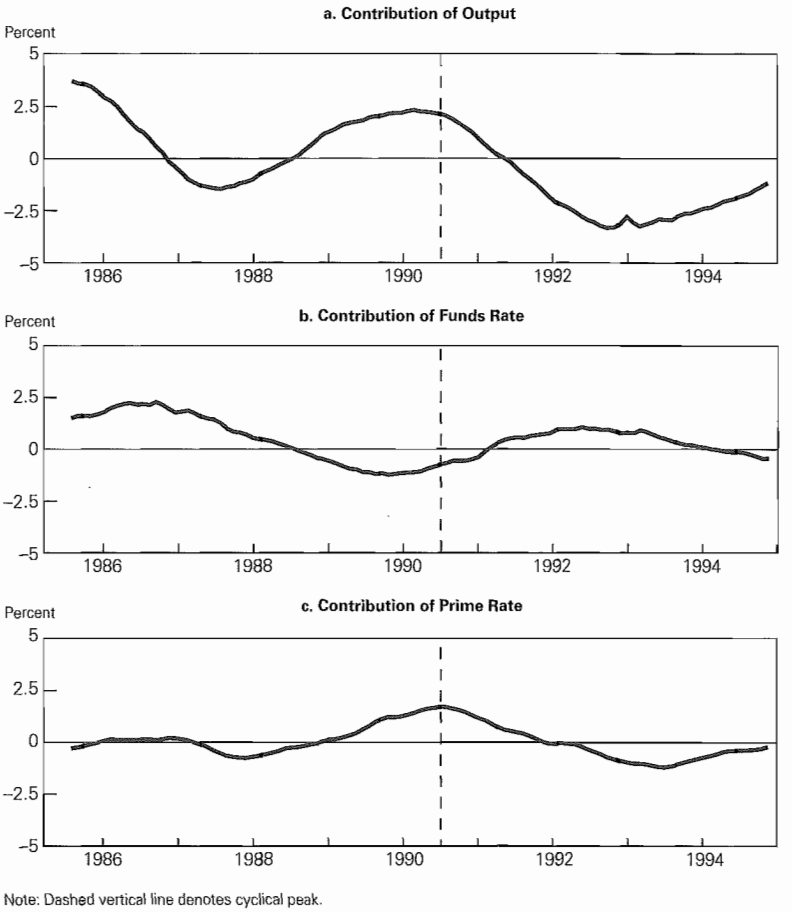


Note: Dashed vertical lines denote cyclical peaks.

butions of the two loan market variables to variation in output for the entire sample period; panel b plots the separate contributions of loan supply and loan demand shocks to output. As already shown by the variance decompositions, loan market disturbances generally were not the dominant force in output movements over the 1960–94 sample

Figure 9B

Contributions of Output, the Funds Rate, and the Prime Rate to Changes in the Volume of Real Bank Loans, 1986 to 1994

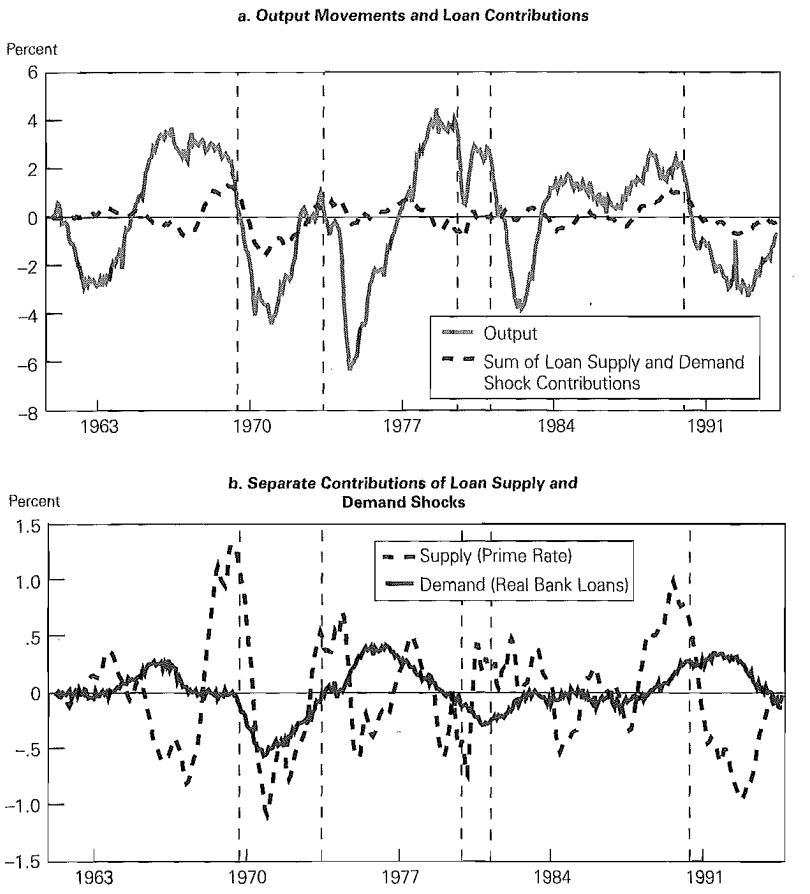


Note: Dashed vertical line denotes cyclical peak.

period. Together they contributed noticeably to the 1970 recession and the ensuing recovery and to the late 1980s boom and the ensuing shortfall of output that started in 1990. In that regard, the focus on bank lending during the 1990–91 recession seems warranted. More attention during the late 1980s to the role of bank lending in the boom of 1988–89 would have been equally warranted.

Figure 10

Contributions of Loan Supply and Loan Demand Shocks to Movements in Output



Note: Dashed vertical lines denote cyclical peaks.

Panel b suggests that output typically was affected more by changes in loan supply than by changes in loan demand. But the relative contributions of supply and demand vary a great deal from episode to episode. For example, in the mid 1960s, positive shocks to loan demand contributed to output being well above its deterministic level, while the effect of loan supply was to hold back output. In contrast, in the early 1970s, both supply and demand restrained output. In the late 1980s,

loan demand contributed relatively little to output, while the eased loan supply provided considerable propulsion to output. And, finally, during the first half of the 1990s, the contractionary contributions of loan supply more than offset expansionary effects coming from loan demand. By the end of 1994, neither loan supply nor loan demand was pushing output away from its trend level.

What Shocked Bank Loan Supply?

We specified the VARs so that we could estimate the values of shocks to bank loan supply and the effects of those shocks. Though the estimated shocks to the prime rate shown in Figure 8 are not forecastable on the basis of the variables used in the VARs, they may be explicable with other variables that affect bank loan supply. For two reasons, we want to know whether the estimated shocks to the prime rate were correlated over the 1960–94 period with identifiable factors that would be expected to affect bank loan supply. First, finding appreciable correlations between the estimated prime rate shock series and factors expected to affect loan supply supports our judgment that prime rate shocks can be interpreted as loan supply shocks. Because our empirical specification includes only bank loan variables and not measures of total credit, the loan market shocks we identify could simply be proxying for disturbances to total credit supply and demand. Evidence that the loan supply shocks we identify are related to bank-specific factors would give some evidence that it is *bank* lending disturbances that are producing the effects on output that we estimate, and that these effects are not just reflecting disturbances to total credit supply. Second, because the magnitudes of some of the factors can be determined by policymakers, knowing which factors affected loan supply, and by how much, helps predict the effects of policies that affect banks.

Among the reasons that banks may reduce the supply of bank loans are changes in regulations that raise bank costs. Table 2 presents the results of regressing the estimated loan supply shock series (plotted in Figure 8) on various measures of regulatory variables. We used a number of the variables that Laderman (1993) suggested as candidates to explain the competitiveness of banks in the face of nonbank competition for short-term business loans: banks' capital ratio, reserve requirements, the spread between open-market interest rates and the regulatory ceiling on savings account deposit rates, and deposit insurance premiums. We also included dummy variables to allow for the imposition and removal of credit controls in 1980.

Data limitations restricted the estimation period to quarterly data

from the fourth quarter of 1961 through the second quarter of 1990.[29] In columns 1, 2, and 3, the dependent variable is the (quarterly average of the) estimated loan supply shock series (ELSQ). The dependent variable in column 4 is the estimated loan demand shock series (ELDQ), whose monthly values are also plotted in Figure 8. The dependent variable in the fifth column is the first-difference of WILLING, D(WILLING), the net percentage of banks indicating more "willingness" to make consumer installment loans.[30]

As approximations to the shocks to the explanatory variables that might account for shocks to loan supply, we used differences of the Laderman (1993) data. To allow for the extra costs imposed on banks by higher capital ratios and to allow for the seasonality of reported bank capital, we included D4A4, the four-quarter difference in the aggregate capital ratio of banks. To allow for changes in the implicit tax on banks associated with zero-interest-bearing required reserves, we included DRRR, the first difference of the ratio of required reserves not adjusted for changes in reserve requirements to required reserves adjusted for changes in reserve requirements.[31] We included D80Q1 and D80Q2, dummy variables that take the value zero for each quarter except 1980:I and 1980:II respectively, when they each take the value one, to allow for the imposition and removal of credit controls on banks.

To allow for the increased costs associated with higher deposit insurance fees, we included a measure of the change, PREMLED1, in the ratio of net aggregate deposit insurance premiums to total insured deposits, led one quarter. We specified this variable to be led one quarter, because banks typically were given notice of upcoming changes in deposit insurance fees. Because preliminary regressions indicated that the first difference of PREMLED1, D(PREMLED1), was more highly correlated with ELSQ than was PREMLED1, we included D(PREMLED1) in the regressions reported in Table 2.

We also included the change in the difference between the levels of the 3-month Treasury bill rate and the regulatory ceiling on savings account deposit rates, SPREAD, to allow for the reduction in bank loan supply attributable to disintermediation associated with open-market rates rising above deposit rate ceilings. We set SPREAD equal to zero in quarters when the difference between the Treasury bill rate and the

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[29] Because the Laderman data were available at a quarterly frequency, we took quarterly averages of the estimated loan supply and demand series. Her data began in 1961 and ended in 1990.

[30] The series comes from the Board of Governors of the Federal Reserve System's Senior Loan Officer Opinion Survey of Bank Lending Practices. Because data for WILLING begin in 1966:III, the estimation periods for regressions reported in Table 2 that included it begin in 1966:IV. We divided WILLING by 1,000.

[31] This variable did not come from Laderman (1993), who used a measure of required reserves adjusted for the level of nominal interest rates.

Table 2
Determinants of Shocks to Loan Supply
Estimation Period: 1961:IV to 1990:II Ordinary Least Squares

	Dependent Variable				
Explanatory Variables	ELSQ (1)	ELSQ (2)	ELSQ (3)	ELDQ (4)	D(WILLING) (5)
Constant	.006	.007	.008	−.002	.000
	(.51)	(.53)	(.57)	(−.09)	(.22)
D4A4	8.60	9.28	8.24	−9.78	.537
	(1.41)	(1.52)	(1.18)	(−.86)	(.56)
DRRR	.509	.605	.572	−.261	−.186
	(1.62)	(1.87)	(1.47)	(−.41)	(−3.73)
D80Q1	.300	.306	.303	−.029	−.000
	(2.39)	(2.44)	(2.21)	(−.13)	(−.14)
D80Q2	−.254	−.193	−.206	−.291	−.043
	(−1.98)	(−1.39)	(−1.33)	(−1.15)	(−2.04)
D(PREMLED1)	983	860	840	−51	−125
	(2.31)	(1.96)	(1.72)	(−.06)	(−1.89)
D(SPREAD)	—	.013	.012	−.004	−.004
		(1.13)	(.91)	(−.20)	(−2.40)
D(WILLING)	—	—	−.228	−.740	—
			(−.29)	(−.59)	
R^2	.135	.145	.148	.029	.235
S.E.E.	.125	.125	.136	.222	.019
F	3.410	3.062	2.167	.369	4.497
Prob(F)	.007	.008	.045	.918	.001

ceiling rate was negative. Because preliminary regressions again indicated that the first difference of SPREAD, D(SPREAD), was more highly correlated with ELSQ than was SPREAD, we included D(SPREAD) in the regressions reported in Table 2.[32]

Column 1 of Table 2 shows that bank loan supply shocks were indeed larger when banks' capital ratios increased, when required reserves increased, when credit controls were imposed in 1980 (and were smaller when those credit controls were removed), and when deposit insurance fees were increased. Of these, the last three were statistically significant. Column 2 adds D(SPREAD) to the variables included in Column 1. Though D(SPREAD) was not statistically signif-

[32] In preliminary regressions, we included both the levels and first-differences of the changes of each of the right-hand-side variables, in order to assess which specifications were more closely associated with shocks to loan supply.

icant, a more tightly binding interest rate ceiling was associated with reduced supply of bank loans. In columns 1, 2 and 3 of Table 2, the impact of removing the 1980 credit controls was estimated to be roughly the same as having imposed them. In each of the first three columns, the F-statistic for the regression indicates a significant relation overall, as indicated by the probabilities of obtaining F-statistics that large being less than 5 percent.

To the extent that D(WILLING) can be interpreted as a predetermined measure of the extent to which banks are willing to extend credit to households, we expect it to negatively affect loan supply. (An alternative interpretation is given below and discussed in connection with the results in Column 5.) Column 3 shows that increases in D(WILLING) only insignificantly reduced bank loan supply. In results not shown in Table 2, we found that including the dummy variable for credit actions developed by Romer and Romer (1993) did not add significantly to the explanation of loan supply shocks, regardless of whether the 1980 credit control variables were included.

Columns 1 and 2 suggest that the variables we posited would reduce bank loan supply are significantly related to shocks to the prime rate, which we interpret as shocks to bank loan supply. To cross-check these results, we also regressed shocks to real bank loans, which we interpret as shocks to bank loan *demand*, on the same explanatory variables used in Column 3. Column 4 reports the results of testing the null hypothesis that none of the determinants of supply affected bank loan demand. Indeed, not one of the variables was significantly correlated with our measure of demand. Nor was the F-statistic of 0.369 anywhere near its 0.05 critical value.

Column 5 treats D(WILLING) as a dependent variable. One interpretation of willingness to lend is that it is itself a measure of bank loan supply. As would be expected on that interpretation, willingness to lend to households declines significantly with increases in reserve ratios and with disintermediation due to higher values for D(SPREAD). Weaker support emerged from the negative but insignificant effect of higher deposit insurance fees on banks' willingness to lend to households.

Taken together, the columns of Table 2 suggest that positive shocks to the prime rate are correlated with identifiable changes in regulations and conditions that would be expected to reduce bank loan supply. At the same time, those changes are not correlated with shocks to the demand for loans. These results give additional support to our earlier interpretation of the shocks from the Choleski decomposition of the VAR residuals. And finally, banks' self-reported willingness to lend is correlated with the measures of changes in regulations and conditions that would be expected to affect bank loan supply.

Are Banks Now Less Important?

Because several substitutes for bank loans to businesses and consumers have developed over time, we expected that shocks to bank loan supply of a given size should have ever-larger effects on bank lending and ever-smaller effects on output over time. Borrowers may now have greater access to nonbank lenders (such as finance companies and the market for commercial paper). They may also be less subject to credit rationing by banks because of pre-arranged loan commitments and credit card lines. Thus, a reduction in the supply of bank loans might now lead borrowers to move more readily to nonbank sources of credit and to sidestep credit rationing. As a consequence, a reduction in bank loan supply might now have less effect on total (bank plus nonbank) borrowing and thus on output than it had in the past.

Panel a of Figure 11 plots the impacts on bank loans and panel b the impacts on output of a 50-basis-point prime rate shock. The solid line in each panel represents the responses calculated from data for the more recent half (1978 to 1994) of the sample. The grey line represents the responses calculated from the data for the first half (1960 to 1977) of the sample. In general, and in contrast to our hypothesis, the response of bank loans to loan supply shocks was somewhat larger in the earlier period.

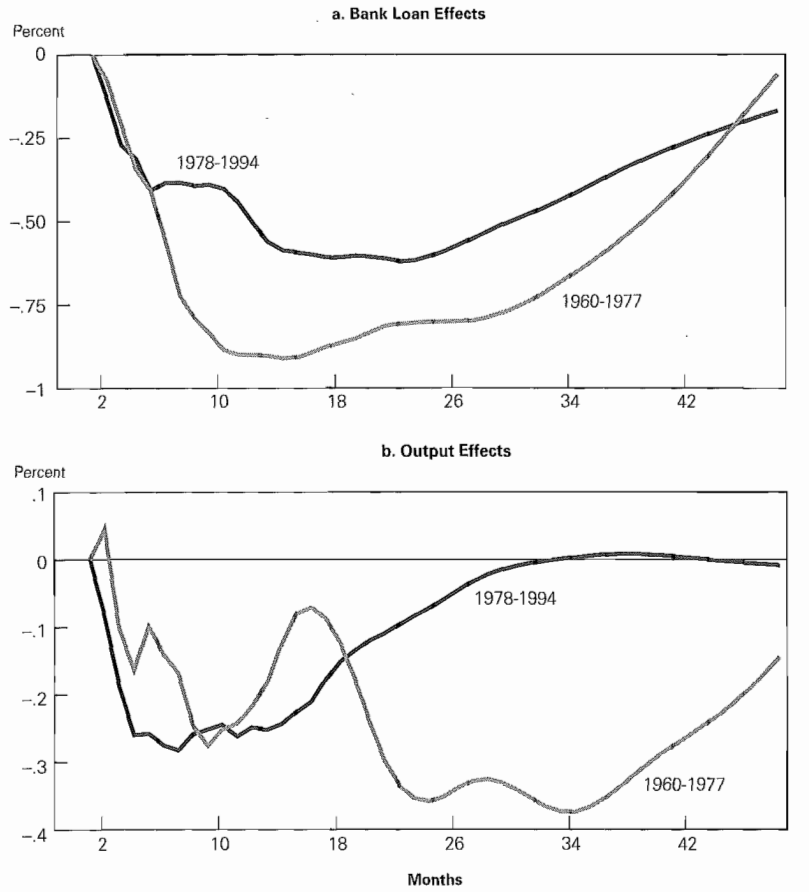
Output on average was less affected by loan supply shocks in the more recent period than in the earlier period. The initial responses of output were actually larger in the more recent period; the change was noticeable but probably not statistically significant. The major difference in the response of output shows up in the second, third, and fourth years following a loan supply shock. In contrast to the lingering and sizable effects on output estimated for the period before the mid 1970s, in the more recent period, the effects on output of loan supply shocks are near zero in the third and fourth years. Thus, the changes in the responses of loans and output are only partially consistent with the financial deepening view of credit markets. At the same time, evidence for the early 1990s reminds us that bank loan supply shocks can still be important. Borrowers may have greater access to credit substitutes, but shocks to bank loan supply still act like sand in the gears of credit and output markets.

Conclusions

We have argued that a simple VAR framework that includes the prime rate and real bank lending appears to provide estimates of the separate effects on bank lending and on output of shifts in the demand for bank loans and of shifts in the supply of bank loans. The estimates suggest that shocks to banks' loan supply were sometimes important

Figure 11

Effects of a Loan Supply Shock[a]



[a] A 50-basis-point prime rate shock.

determinants of the volume of bank loans outstanding and of aggregate output. They were particularly important over the most recent business cycle. In that sense, banks mattered.

We provided estimates of some of the proximate determinants of shocks to bank loan supply. Loan supply was reduced by increases in FDIC deposit insurance fees, increases in reserve requirements,

increases in bank capital, and the imposition of credit controls in 1980. By their effects on bank loan supply, these factors may have considerable impact on output.

Although loan supply shocks typically were not the primary determinant of recessions, we show that they played a larger role during the 1990–91 recession than they had in two decades. At the same time, the response of output to loan supply shocks may have been tempered in recent years by the development of substitutes for bank loans. In that regard, banks may be less important than they were in the past.

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Discussion

Stephen G. Cecchetti*

The central question at the heart of Walsh and Wilcox's paper is: *Does monetary policy affect output through bank assets or bank liabilities?* Using aggregate data and a vector autoregression (VAR), they attempt to estimate the quantitative importance of different channels of monetary transmission. More specifically, they try to identify the impact of bank loan demand shocks and bank loan supply shocks on output, and to measure the relative size of their effects. The results suggest that neither loan demand shocks nor loan supply shocks have much impact on output.

My comments can be divided into three parts. First is a brief review of the literature on the monetary transmission mechanism. Next, I describe several pitfalls inherent in using aggregate data to try to distinguish the channels of monetary transmission. Finally, I discuss the methods and results of Walsh and Wilcox's paper, beginning with a description of how they identify loan supply from loan demand, and ending with my interpretation of their results.

Theories of the Monetary Transmission Mechanism

What are the views of monetary transmission, and why do we care to distinguish them? The answer to the second part of the question is straightforward. If bank assets (that is, loans) are important in the transmission mechanism, then monetary policy will have important distributional consequences that may entail efficiency losses. When credit market imperfections and 'bank loan supply' effects are quantita-

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tively meaningful, then policy's impact depends on the characteristics of borrowers that are unrelated to the inherent creditworthiness of their investment projects. As a result, an entrepreneur may be deemed unworthy of credit simply because of a currently low net worth, for example, regardless of the social return to the project being proposed.

As I describe in a recent survey,[1] the two views of the monetary transmission mechanism can be labeled the Money View and the Lending View.[2] In the Money View, reductions in the quantity of outside money raise real rates of return. This, in turn, reduces investment, as fewer profitable projects are available at higher required rates of return—this is a movement along a fixed marginal efficiency of investment schedule.

The Lending View has two parts, commonly labeled 'broad' and 'narrow.' The broad lending view is based on the existence of credit market imperfections.[3] The basic idea is that information asymmetries and moral hazard problems, as well as bankruptcy laws, imply that the state of a firm's balance sheet has implications for its ability to obtain external finance. As a result, monetary policy-induced increases in interest rates (which are both real and nominal) can cause a deterioration in the firm's net worth, both by reducing expected future sales and by increasing the real value of nominally denominated debt. With lower net worth, the firm is less creditworthy, as it has an increased incentive to misrepresent the riskiness of potential projects. As a result, potential lenders will increase the risk premium they require when making loans. The asymmetry of information makes internal finance of new investment projects cheaper than external finance.

The narrow lending view is associated with bank loans. The argument has two clear parts. First, some borrowers cannot finance new projects except through loans. And second, policy changes have a direct effect on loan supply, since bank loans and outside money (that is controlled by the monetary policy authority) are complements. It is important to emphasize that banks need not be explicitly involved, as this could be a result of the complementarity of 'small business loans' and outside money in investors' portfolios. The most important impact of a policy innovation is cross-sectional, as it affects the quantity of loans to loan-dependent borrowers.

Walsh and Wilcox's goal is to measure the relative importance of loan supply and loan demand effects on output. They are not trying to

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[1] See Cecchetti (1995).

[2] In his comments on an earlier paper, R. Glenn Hubbard labels the first of these by the more accurate term, the *user-cost-of-capital* view.

[3] Bernanke, Gertler, and Gilchrist (1994) have labeled this the 'financial accelerator.'

distinguish the money view from the broad lending channel. Rather, they are studying the size of the narrow lending channel.

Pitfalls in Testing with Aggregate Data

The work in this paper focuses solely on aggregate data, utilizing total real bank loans economy-wide. But a number of well-known pitfalls are associated with use of such data in this context. I will discuss three.

First, can aggregate timing relationships tell us anything about the transmission mechanism? The fact is that credit lags output—it is countercyclical. But since individuals must continue to service credit even after income falls, credit falls after income, regardless of whether it is the fundamental source of fluctuations.[4]

Second, can forecasting power, or correlations, tell us anything? What if credit measures contain information about output fluctuations beyond what is already accounted for in monetary aggregates? Monetary aggregates are a measure of bank liabilities, while credit aggregates are measures of bank assets. Since these are calculated slightly differently, they will not be identical. But it is these technical measurement differences that are likely to account for the differences in forecasting ability, not anything about the transmission mechanism.[5]

Walsh and Wilcox examine a VAR with real activity, inflation, the federal funds rate, and real bank loans. My interpretation of this is that their bank loans measure provides information about fluctuations in 'money' that is not included in the federal funds rate.

Finally, can we learn anything from interest rate data? Walsh and Wilcox employ the prime rate as their measure of the *price* of bank loans. The theory tells us that what we need is a measure of the change in the marginal cost of bank funds to a constant-quality borrower. But during recessions, banks drop lower-quality borrowers rather than raising interest rates. This suggests that we really cannot observe the interest rate we would like to see, as it is the rate on loans that are not made. It is *not* the prime rate. We would be happy with observations on the secondary market for small business loans, but these are also hard to come by.

To put the same point slightly differently, movements in the prime rate do not give us a very good indication of the change in the *composition* of bank loan portfolios. Are they making more loans under commitment? Is higher-quality collateral being required? Beyond this is the problem that the prime rate is an administered price, whose

[4] See Kiyotaki and Moore (1995) and Bernanke, Gertler, and Gilchrist (1994).

[5] This argument is due to Bernanke (1993).

meaning has changed dramatically over the 30-year sample period Walsh and Wilcox study.[6]

Identification Issues

The heart of Walsh and Wilcox's paper is the section on identifying loan supply and loan demand. This is what allows them to conclude that:

> [S]hocks to banks' loan supply were sometimes important determinants of the volume of bank loans outstanding and of aggregate output in general. They were particularly important over the most recent business cycle. In that sense, banks mattered.

How can we evaluate this? Overall, I believe that, even if taken at face value, their results provide very little support for such a statement. Their measured impact of loan demand and loan supply innovations on output is rarely different from zero at standard levels of statistical significance. (Keep in mind that they plot *one*-standard-deviation bands on their impulse-response figures.)

But more importantly, a careful examination of Walsh and Wilcox's methods suggests that we should not accept their interpretation of their results. I will provide a summary of what they do.

Their main conclusions are based on estimation of a simple VAR, which I will write as

$$\begin{bmatrix} y_t \\ \pi_t \\ r^{ff}_t \\ r^{p}_t \\ q^{l}_t \end{bmatrix} = A(L) \begin{bmatrix} \epsilon_{yt} \\ \epsilon_{pt} \\ \epsilon_{mt} \\ \epsilon_{st} \\ \epsilon_{dt} \end{bmatrix}, \tag{1}$$

where $A(L)$ is a matrix of lag polynomials in the lag operator L, y is activity, π is inflation, r^{ff} is the federal funds rate, r^{p} is the prime lending rate, q^{l} is the real quantity of bank loans, ϵ_y is the output 'shock,' ϵ_p is the inflation 'shock,' ϵ_m is the monetary 'shock', ϵ_s is the loan supply 'shock,' and ϵ_d is the loan demand 'shock.' The error process is assumed to be independently and identically distributed, with covariance matrix equal to the identity matrix.[7]

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[6] In addition, as Mester and Saunders (1990) emphasize, the prime rate behaves asymmetrically, rising more quickly than it falls.

[7] It is worth making a small technical disgression here. It is standard in this literature to use the log of the price level. See Christiano, Eichenbaum, and Evans (1994) for a review. In addition, Walsh and Wilcox use overlapping observations of the 12-month

Standard methods involve estimating the reduced form of (1), and then identifying the structural errors by calculating *A(0)*. Walsh and Wilcox assume that *A(0)* is lower triangular. This imposes a very clear structure on the supply and demand curves. While it is rarely done in this context, I find it instructive to actually write the equations down. Ignoring output and inflation, as well as lags of all variables, the supply and demand curves are

$$r_t^p = \beta r_t^{ff} + \epsilon_{st} \qquad \textit{Supply} \tag{2}$$

$$q_t^l = \alpha_1 r_t^{ff} + \alpha_2 r_p^t + \epsilon_{dt} \quad \textit{Demand} \tag{3}$$

Identification is achieved by assuming that the contemporaneous quantity of bank loans does not appear in the supply equation. This means that (after removing the impact of the federal funds rate) contemporaneous loan supply is flat at the current prime interest rate! Changes in the quantity of real loans outstanding are ascribed to loan demand shocks. My sense is that this cannot be right. The cost of funds to loan suppliers, that is, banks, must rise with quantity even in the very short run.

Beyond the issue of identifying loan supply shocks from loan demand shocks, an even more fundamental question is raised by the Walsh and Wilcox VAR methodology. Can a VAR structured in this way actually address the question of interest? I take the issue to be whether *monetary policy* is transmitted to the real economy through bank assets or bank liabilities. Implicitly, this question takes policy as the fundamental disturbance to the economy, and examines its effects. Walsh and Wilcox examine the relative importance of ϵ_{st} and ϵ_{dt} on output. These are *not* monetary policy shocks. If ϵ_{mt} is the policy shock, then ϵ_{st} and ϵ_{dt} are shocks to the financial system that are constructed to be *uncorrelated* with policy disturbances, and so do not address the central issue.

Given this, how do I interpret their conclusions—principally the results in their Table 1? What they show is that shocks to bank loan supply—*that by construction are unrelated to monetary policy*—have virtually no impact on output. Furthermore, shocks to bank loan demand have a small (but probably statistically insignificant) impact on the real economy. On the other hand, monetary policy shocks explain a bit over 12 percent of the variance in output after three years. But the bulk of the variation in output is explained by 'own' shocks, ϵ_y, which may be aggregate supply disturbances, and by shocks to prices, ϵ_p, which might be aggregate demand disturbances that are uncorrelated with the rest of

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inflation rate and do not correct for the induced serial correlation structure in their error process—it is an MA(11). This affects the standard error bands on the impulse responses.

the shocks. This rings true, as it is not too dissimilar from results reported by Galí, in his estimation of a structural VAR.

Conclusion

Let me close with the following points. It is my strongly held opinion that financial innovation will lead us to the virtual elimination of banks as depository institutions in the not too distant future. As a result, to know if the impact of monetary policy is weakening, we must understand whether something about banks is particularly important in the monetary transmission mechanism. But to do this, we have to separate the cross-sectional effects due to credit market imperfections from those that are the result of banks per se. The work of Walsh and Wilcox does not help us with this.

On the other hand, Kashyap, Lamont, and Stein (1994) suggest one possible way of distinguishing. If one can find a recessionary period that was *not* preceded by a monetary contraction, and show that interest rates rose but that bank dependence was irrelevant to individual firms' experiences, this would mean that banks are responsible for the distributional effects induced by monetary shocks. I know of no such evidence.

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Discussion

Allan H. Meltzer*

With commendable timing, academic economists rediscovered bank lending just before the start of the 1990–91 recession. Bernanke (1983) claimed that the shifts in loan supply made a major contribution to the Great Depression of the early 1930s. Bernanke and Blinder (1988) developed a small model interrelating loans, deposits, and output. I refer to this work and the many papers that followed as "the lending view."

The Lending View

The lending view became an active research area just before the Federal Reserve and the Bush Administration argued publicly that reduced willingness of banks to lend contributed to the 1990–91 recession and the slow recovery. One metaphor of the time was that a 50-mile-an-hour head wind was blowing against the expansion. The (intended) presumption was that the Federal Reserve was doing its prudent utmost to foster expansion but was stymied by the refusal of banks to lend aggressively. I argued at the time that this view was wrong (Meltzer 1991).

The lending view consists of two principal propositions. First, spending by some group of borrowers depends on bank loans. Second, monetary policy shifts the supply of bank loans relative to other types of credit.

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The first proposition is not in doubt if "depends" means only that bank loans are a main source of external finance for many small and medium-sized firms. Alternative lenders exist for these firms, however, including finance companies, trade credit, credit card debt, venture capitalists, families, and others. At issue is how much substitution occurs among types of credit. This issue is usually neglected, and the current paper is not an exception. Studies of bank lending and borrowing cannot by themselves establish that borrowers could not or did not obtain credit or that they were forced to contract.

The second proposition is more doubtful. The principal problem for the lending view is to show that autonomous shifts in banks' offers to lend contribute significantly to cyclical changes in total lending and output. The alternative view is that bank lending responds to demand. Critics of the lending view point out that banks can borrow Eurodollars, issue certificates of deposit, sell securities, and in other ways finance lending if it is profitable. And, if the banks face an excess demand for loans, why do other intermediaries fail to satisfy the excess demand?

The Walsh-Wilcox Analysis

The paper by Carl E. Walsh and James A. Wilcox is a serious effort to analyze part of the second proposition. The authors try to separate shocks to supply and shocks to demand, using the prime rate to measure supply effects and the real value of loans to measure customers' demand. The general idea is to treat borrowers as price takers and banks as price setters. Banks set the prime rate and allow borrowers to decide how much to borrow. Borrowing and lending decisions are part of a five-equation monthly model interrelating the real amount of bank lending, and the prime lending rate, with measures of output, inflation, and monetary policy. The monthly output measure appears to be an improvement on previous work.

The authors deserve credit for making a serious effort to show that the demand and supply shocks they estimate are not spurious; they obtain similar measures using alternative procedures. They can be faulted for treating all loans as homogeneous and made at the prime rate. This is not entirely consistent with the lending view. On that view, small borrowers are subject to non-price rationing.

Walsh and Wilcox summarize their findings as showing: (1) supply shocks have had "important" effects on bank lending (p. 87); (2) the principal supply shocks in the recent past were changes in banks' capital

ratios, required reserves, and deposit insurance fees (p. 109);[1] and (although the conclusion blurs this finding) (3) output was on average *less* affected by loan supply shocks in the recent cycle than in past periods (p. 112).

Problems with the Analysis

Despite the authors' careful work, I am skeptical about their findings, for two main reasons. First, their model is misspecified in a way that is important for the identification of demand and supply shocks. Unless we are reasonably certain that we have identified demand and supply shocks accurately, we cannot conclude reliably about relative effects of shifts in demand and supply. Second, the model is incomplete. The authors barely mention other intermediaries and sources of credit. Even if we correctly identify supply effects, we cannot conclude that loan supply affects output if we do not control for two types of substitution. Borrowers can substitute other forms of lending for bank lending, and bankers can substitute for reserves by borrowing in the Eurodollar, CD, and other markets.

Let me state what is and is not at issue. First, it is not surprising that the amount of bank lending changes with the costs of bank lending. Increases in reserve requirements, deposit insurance premiums, and other costs reduce the size of banks relative to competitors. Borrowers shift to lower-cost suppliers. At issue is how quickly the adjustment occurs, whether there is full substitution, and whether part of the adjustment occurs by banks acquiring liabilities that are not subject to the new rules. Large CDs have not been subject to reserve requirements since 1970, debentures are not subject to deposit insurance, and so on. Second, I have no quarrel with the lending view when it claims that intermediation matters. The issue is whether intermediaries can prevent Federal Reserve policy from affecting output and prices or change the size of those effects in the way described by the lending view. If banks were less likely to lend in 1991 because of new capital requirements or deposit insurance fees, why did the Federal Reserve not add more to the supply of reserves to encourage more expansion?

Walsh and Wilcox write their model with five variables: the federal funds rate, the prime loan rate, output, inflation, and the real value of total commercial bank loans and leases. Bank lending is independent of the stock of bank reserves or the monetary base, and the federal funds rate contains all information about Federal Reserve policy. In practice,

[1] Only the last two are statistically significant. Walsh and Wilcox also report effects of the 1980 credit controls. I omit the 1980 credit controls as raising separate issues. It is notable that the Basle capital requirements do not have a significant effect.

the Federal Reserve shifts the federal funds rate and allows bank reserves to adjust. Hence, at any preset federal funds rate, banks can obtain (or reduce) reserves and expand (or contract) bank loans if the return to lending is positive (negative). In other words, the federal funds rate alone does not tell us whether bank reserves are rising or falling. An essential part of the monetary mechanism is missing. The missing pieces are important when the economy changes direction or speed, particularly if the Federal Reserve is slow to change the funds rate. Some measure of aggregate reserves or base money should be part of the model to test for an independent or non-monetary lending channel.

A peculiar feature of the work on the lending view that I have seen is that nonbank financial assets are nowhere to be found. Banks hold both loans and securities, such as Treasury bills and government bonds. Omitting government securities is a second misspecification.

To show why, let me describe where the misspecification enters. Suppose a shock to bank lending has occurred, such as is discussed in the Walsh–Wilcox paper and in the lending view generally. Banks in the aggregate now lend less per dollar of reserves than in the past. Since they lend less, two outcomes are possible, given the supply of reserves or base money and the stock of government securities. Banks either hold excess reserves or buy more securities. Since bank reserves have zero interest return, banks minimize excess reserves. Hence, a decision to reduce loans is a decision to buy more securities. Banks bid for securities in an open market, so their decisions change the yield on securities relative to other yields. Other intermediaries such as thrift institutions, mortgage lenders, finance companies, and the like, faced with the resulting change in relative yields, acquire an alternative asset. They supply the loans, mortgages, or leases that the banks forgo. The net effect is a change in the banks' supply of loans without a corresponding change in total credit extended. The only alternative is that banks hold idle excess reserves. There is no evidence that this occurred in the 1990s. If it had occurred, the solution would have been simple. The Federal Reserve could have supplied more base money by lowering the funds rate, as they soon did.

Let me summarize. Bank lending is not informative about whether or not output would have expanded more in the 1991–92 period. The authors are right to separate loan demand and supply, but their analysis cannot answer the question: Did restrictions on bank lending reduce output in 1991 and in 1992? No evidence in the movement of excess reserves shows that banks refused to lend or reduced lending. Even if they did, the banks' actions tell us nothing about the total supply of credit offered to business and households.

Two main reasons that bank lending fell during the early 1990s were that the economy was in recession and bank reserves rose very slowly. Bank reserves are the raw material for aggregate bank loans and money.

In the two years ending with the fourth quarter of 1990, total bank reserves rose at a 0.6 percent annual rate; total reserves increased by less than $1 billion during the two years as a whole. In the next two years, total reserves rose at an 11.7 percent compound annual rate, and the addition to reserves was $18.6 billion. The funds rate was reduced from 8 percent in the fall of 1990 to 4¼ percent in the fall of 1991. Talk about a credit crunch and 50-mile-an-hour head winds ended. In my view, the lending problem was in part a monetary problem and in part a problem of anticipations set off by lower inflation and falling asset prices in many markets—especially real estate markets. Whether judged by interest rates or reserve growth, monetary policy was very restrictive (as the Shadow Open Market Committee argued at the time).

Before leaving this part of my discussion, let me narrow some of the differences with Walsh and Wilcox. My claim is that the effect of bank lending on output, given the growth of money and government debt, is close to zero, so I set it at zero. The authors find that 6 to 18 months after a lending shock, bank lending explains about 2 percent of the unexplained variance of output.

We can further narrow the differences. Walsh and Wilcox use monthly data from 1959 through 1994. From the mid 1960s to the end of the 1970s, Regulation Q ceilings were binding at times. Until 1970, the ceiling rates applied to all CDs, even the largest. The ceilings worked to reverse the relation between growth of money and bank credit (loans and securities). When the ceiling was binding, wealth owners reduced time deposits and bought securities directly. Bank credit, including loans, declined relative to money, currency, and demand deposits. Some of these effects are hidden in the Walsh–Wilcox estimates because they do not isolate the effects of Regulation Q and the credit crunches it fostered. I believe that if they separated the effects of Regulation Q, their estimate would be less biased, smaller, and closer to mine at zero.

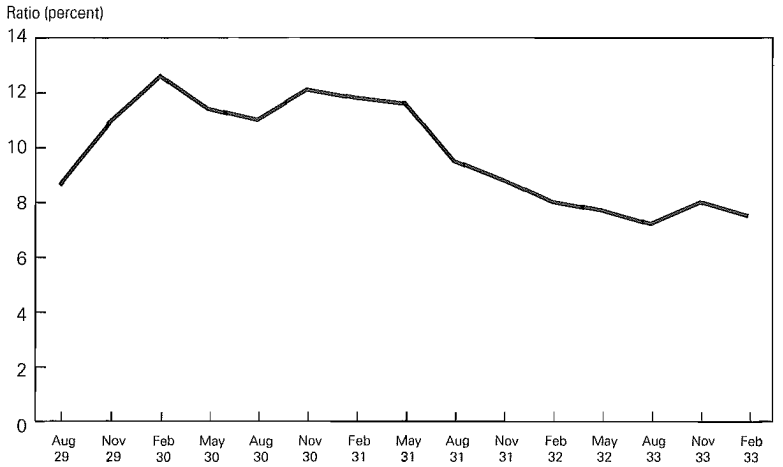
A Final Test

A main piece of evidence in favor of the lending view comes from the Great Depression. Bank failures, corporate failures, and increased risk make a plausible case for the lending view in this period. If declines in bank lending have an independent effect, the Great Depression is the period when that effect should be most obvious.

Remember that, according to the lending view, the effect occurs because small firms are much more dependent on banks. Small firms are forced to curtail activity because they cannot borrow. Plausible as this story seems, it is not supported by the data. During the Great Depression, open market borrowing in the form of commercial paper and bankers' acceptances declined relative to commercial bank loans (in 101 cities). Figure 1 shows the ratio of open market borrowing to bank loans.

Figure 1

RATIO OF OPEN MARKET CREDIT TO BANK LOANS
AUGUST 1929 - FEBRUARY 1933



Then as now, larger, more secure firms were the main borrowers on the open market. The fall in open market borrowing relative to bank borrowing is counter to the lending view.

None of this denies that intermediation is important. My conclusion is that restrictive Federal Reserve policy explains the decline in both money and bank lending during the Great Depression and in the most recent recession. Credit crunches had an independent effect on lending under regulation Q rules, but this is well-known and not part of the lending view.

POSTSCRIPT

Shortly after completing this comment, I received two new studies of bank lending and the lending view. Morris and Sellon (1995, p. 73) write: "[C]oncern that structural changes in the banking system may affect the transmission mechanism does not appear to be warranted." Sharpe (1995, pp. 32–33) concludes that there is little evidence supporting claims that the decline in lending in the 1990–91 period was the result of capital standards. These studies add to the growing skepticism about the main tenets of the lending view.

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What Is the Distributive Impact of the Bank Lending Channel?

If small firms are more bank dependent, are they disproportionately affected by changes in monetary or regulatory policy? If bank-dependent firms are more affected by policy, what is the implication for employment patterns, lending patterns, and bankruptcies?

The Importance of Credit for Macroeconomic Activity: Identification through Heterogeneity

Simon G. Gilchrist and Egon Zakrajšek*

Recent work in macroeconomics emphasizes the role of credit in the transmission mechanism for monetary policy and as a propagation mechanism of business cycle shocks.[1] While much evidence has been gathered, not all researchers agree on the relevance of credit for the transmission of monetary policy or as a propagation mechanism of business cycle shocks. For the most part, every one agrees on the facts at hand but differs on their interpretation. In short, the argument is over identification. The primary purposes of this paper are to clarify the identification issues involved; to highlight those identification schemes that are promising avenues for measuring the importance of credit in aggregate fluctuations; and to discuss both previous and new evidence in light of the identification schemes proposed.

The role of credit in the monetary transmission mechanism can be divided into two separate phenomena. The first has been dubbed the "credit channel" of monetary policy. The second has been called the "financial accelerator." Both rely on credit frictions that are absent in the standard neoclassical models that economists typically use to explain business cycle fluctuations. Both, however, are complementary to the standard "money channel" described in textbook treatments of monetary transmission. As such, they provide an additional rather than a competing mechanism for the propagation of monetary policy shocks.

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[1] See Gertler (1988) and Bernanke (1993) for exhaustive reviews of the literature.

The credit channel emphasizes the importance of bank lending in the monetary transmission mechanism. The existence of the credit channel presumes that capital markets are imperfect, owing to information asymmetries between borrowers and lenders. As a consequence, some borrowers are unable to borrow on the open market without paying large premiums on external finance. Banks specialize in information-intensive loans and are able to reduce the premium for bank-dependent borrowers. Monetary policy has real consequences because of its effect on banks' ability to lend. Open market operations lead to a contraction in reserves and a decrease in funds available for lending. As long as banks face imperfections in issuing certificates of deposit (CDs) to offset the contraction in reserves, bank lending must fall. Bank-dependent borrowers, consequently, are forced to seek funds at a much higher cost on the open market—to the extent they are able to obtain funds at all. As a result, spending by bank-dependent borrowers contracts.

The financial accelerator emphasizes the importance of balance sheet conditions in propagating shocks to the economy. As with the credit channel, the existence of the financial accelerator depends on the assumption that capital markets are imperfect, and that external and internal finance are not perfect substitutes. The crucial point for the financial accelerator is that the size of the premium on external funds depends on the firm's balance sheet condition. As balance sheets deteriorate following a contractionary monetary policy—regardless of whether the initial effect comes through interest rates or the initial decline in spending by bank-dependent borrowers—premiums on external finance rise, exacerbating the overall decline in spending.

Because the financial accelerator relies only on the assumption of credit market frictions and not on the additional assumption that a contraction in reserves limits banks' ability to lend, it is both a broader phenomenon than the credit channel and a necessary condition for the existence of the credit channel. Thus, evidence in favor of the financial accelerator is crucial for proving the existence of the credit channel, while the converse is not true.

All convincing evidence in favor of either a credit channel or the financial accelerator comes from studies that focus on the differential behavior of agents. This is the premise of our paper. The focus on differential behavior is important for two reasons. First, models that incorporate financial frictions are more relevant for certain types of agents, certain classes of borrowers, and certain sectors of the economy. The propagation mechanisms generated by these models are more relevant at certain points in the business cycle, namely, when cash flows are dropping and balance sheets are deteriorating. Second, because of the difficulties associated with formulating and estimating true structural models, empirical exercises seeking to establish the validity of

either a credit channel or a financial accelerator must make comparisons against benchmarks where such credit effects are less likely to be relevant. By observing and measuring the differential behavior of economic agents under consideration, one can potentially attribute some, if not all, of the difference in behavior to frictions caused by credit markets. We elaborate on this premise in the next section. We then turn to a discussion of the existing evidence and provide some new evidence on the relevance of credit for monetary policy and macroeconomic fluctuations.

To limit the scope of the discussion, we address only firm behavior, although all of the identification issues apply equally well to consumers; see Attanasio (1994) for a recent discussion of credit issues on the consumer side. To further limit the scope of the paper, we center the discussion around evidence generated from one data set: the U.S. Bureau of the Census's *Quarterly Financial Report for Manufacturing, Mining and Trade Corporations* (QFR). Thus, a secondary purpose of this paper is to provide a progress report on research using the QFR data. Because it is available at high frequency and at various levels of aggregation, the QFR data set is uniquely suited for analyzing credit issues and how they relate to macroeconomics. As will be discussed below, the QFR data have already provided valuable insights into the identification issues raised by credit market imperfections. In addition, the QFR data have provided substantial evidence in favor of a credit mechanism, especially through the financial accelerator described above.

Identification through Heterogeneity

To understand the essential role that heterogeneity plays in any identification scheme used to measure the importance of credit in the economy, it is useful to review briefly the theoretical underpinnings that motivate the existence of a premium on external funds, and how such a premium would respond to changes in interest rates and aggregate demand conditions. We then turn to a discussion of financial intermediaries and the role of monetary policy.

As a starting point, consider the implications of neoclassical investment theory. According to this theory, firms make investment decisions to maximize the net present value of profits. If interest rates rise, the net present value of profits falls, making investment less attractive. If expected future profits fall, net present value also falls, once again leading to a drop in investment spending. It is important to note that the firm's investment decision depends entirely on the future returns of the specific project under consideration and not on the current or past financial position of the firm. If the firm must borrow to complete or undertake the investment project, creditors are willing to lend the necessary funds at the current open-market interest rate. Thus, we have

the celebrated Modigliani–Miller (1958) result that real and financial decisions of the firm are completely separable.

In the presence of capital market imperfections, the separation of real and financial decisions no longer occurs. Balance sheet conditions affect the firm's ability to borrow at current interest rates. The theoretical motivation for this link can be found in the vast literature on asymmetric information and moral hazard in credit markets. An important insight from this literature is that such credit market imperfections create a wedge between the costs of external and internal finance. This wedge exists to compensate lenders for the risk that a borrower may either ex ante misrepresent the value of a given investment project or ex post behave in a manner that expropriates value from the lender. To mitigate such risk, the lender must monitor the borrower, incurring costs in the process.

In general, the premium on external funds will be highest where information asymmetries are the most severe and where the risk of opportunistic behavior is hardest to mitigate. Thus, small firms with idiosyncratic projects that are more difficult to value than those of large firms will face higher premiums. Younger firms with returns less known to the market will face higher premiums. By the same token, firms with projects backed by collateral will face lower premiums. More generally, the lower the collateralizable net worth of the firm, the greater the premium on external funds.

An example of such a situation is displayed in Figure 1.[2] The *dd* line represents the demand for funds by the firm. It is a downward-sloping function of the cost of funds. The *ss* line represents the supply of funds. Up to the point *W* (the firm's net worth), lenders face very little risk of opportunistic behavior and are willing to lend at the open market interest rate. Beyond *W*, however, lenders charge a premium over the open-market rate to compensate for the increased probability of opportunistic behavior on the part of borrowers. Because of the premium on external funds, the supply of funds curve for the individual firm is upward-sloping, leading to an investment level I^*, below the perfect markets level I^P.

While the under-investment result is interesting in its own right, what matters for understanding the effects of monetary policy shocks is how the premium on external funds varies with both the state of aggregate demand and the risk-free interest rate. We consider both in turn. Figure 1A shows the effects of a rise in demand. In the perfect

[2] This example is based on the costly state verification (CSV) model presented in Gertler and Gilchrist (1991). Early examples of CSV models are Townsend (1979), Gale and Hellwig (1985), and Williamson (1987). Additional models that incorporate financial frictions in various guises include Jensen and Meckling (1976), Jaffe and Russell (1976), Leland and Pyle (1977), Stiglitz and Weiss (1981), and Myers and Majluf (1984).

Figure 1

THE PREMIUM FOR EXTERNAL FUNDS

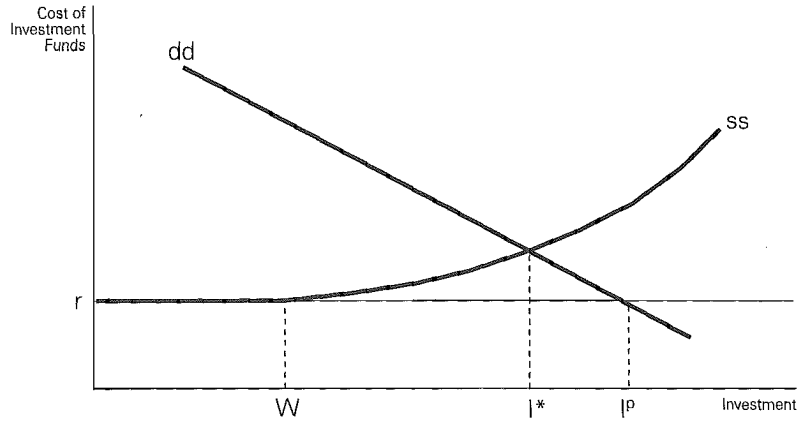


Figure 1A

THE PREMIUM FOR EXTERNAL FUNDS
IMPACT OF A RISE IN DEMAND

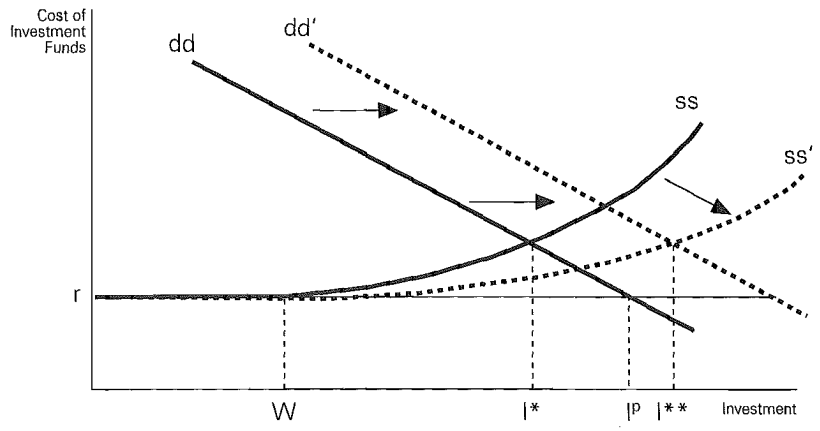
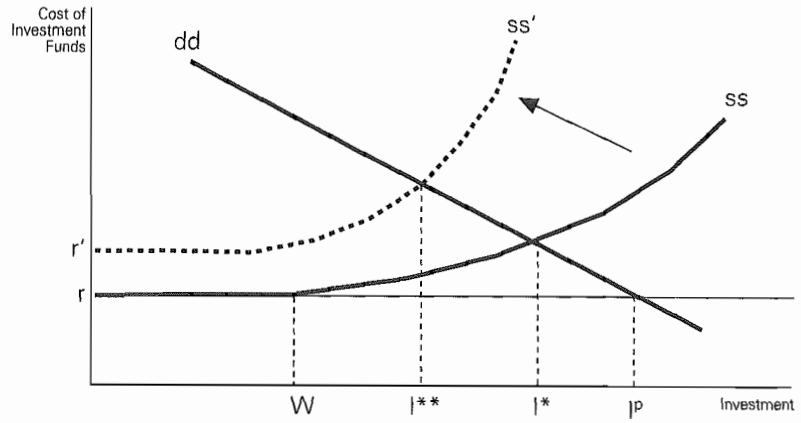


Figure 1B

THE PREMIUM FOR EXTERNAL FUNDS
A RISE IN THE RISKLESS INTEREST RATE



markets case, as demand increases, expected future profits rise, making firms more willing to invest. This shifts out the demand curve to *dd'* and raises investment spending for a given cost of funds. The credit market frictions amplify this effect. At higher profit levels, net worth has increased for a given project size, and the benefits of reneging on contractual obligations are lower. Borrowers are less likely to default, and lenders need not monitor as often. With less monitoring, the required premium on external funds falls (a rightward shift in the *ss* curve), and the effect of the demand shock on investment spending is magnified.

A rise in risk-free rates has a similar magnification effect, as shown in Figure 1B. At higher interest rates, default probabilities rise, causing lenders to increase the premium on external funds. An increase in the premium puts firms at even greater risk of default. This leads to an increase in the required premium that is much larger than the rise in the open-market interest rate. Once again, the initial shock is magnified through its effect on the premium for external funds.

The connection between the financial accelerator and the credit channel is easily understood, once one recognizes the special role that banks play in the credit intermediation process. Given the high cost of

obtaining information for certain classes of borrowers, it is natural to expect certain institutions to specialize in information-gathering activities. Traditionally, banks have performed this role, in part because of the information advantage they obtain through observing would-be-borrowers' deposit flows.[3] Over time, institutions such as banks develop knowledge specific to their class of borrowers in general and to their own customers in particular. By reducing the information asymmetry, financial intermediaries can lower the premium on external funds. Because such knowledge is difficult to convey to third-party lenders, disruptions in the supply of credit available through these intermediaries can have immediate and large consequences on spending.[4] With traditional borrowing relationships destroyed, many bank-dependent firms and consumers will be forced into the market, where they face stiff premiums on external funds. At the prevailing rates, many may simply forgo planned investment projects, leading to large sudden drops in spending by certain classes of borrowers.

The link between theory and empirical work is established by determining factors that are likely to influence the size of the premium on external finance, the degree of the magnification effects, and the extent to which a firm must rely on bank loans rather than some other form of finance less subject to supply shocks through open market operations. Both the size of the premium on external finance and the degree to which a firm is tied to the bank loan market rather than other forms of external finance are heavily influenced by the firm's size, age and previous financial track record. Industry-specific characteristics such as the riskiness of projects, the degree to which investments are collateralizable, and the difficulty associated with evaluating borrowers' claims are also likely to be important determinants of the premium on external funds. By comparing the behavior of firms with such characteristics relative to the behavior of firms that have little difficulty obtaining funds at the open-market rate, we can test for the presence of financial frictions and measure the extent to which these frictions distort firm hiring and investment patterns.

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[3] Fama (1980) outlines the special role of banks; Himmelberg and Morgan (1995) provide a more recent discussion.

[4] A central issue in the literature, of course, is the link between monetary policy and credit supply disruptions. According to the traditional credit view, contractions in monetary policy drain reserves from the system and force a contraction on both the asset and the liability sides of the balance sheet. As long as banks do not face a perfectly elastic supply-of-funds schedule in the CD market, monetary policy contractions reduce the supply of bank loans. Romer and Romer (1990) forcefully argue against any such link between reserve contractions and loan supply, owing to the ability of banks to issue certificates of deposit not subject to reserve requirements. Kashyap and Stein (1994), on the other hand, argue in favor of such a link; see Bernanke and Gertler (1995) for a recent discussion of the issues and the evidence.

For the magnification effect, a key determinant of the premium on external funds is W—the net worth of the firm, or the level of unencumbered assets or future earnings available as collateral for new investment projects. Given the complexity of present day financial contracts, it is difficult to quantify such a concept precisely. Nonetheless, some basic indicators of financial health commonly used by market analysts seem informative. Firms with high leverage ratios are likely to face greater difficulties obtaining new funds on the market, as are firms with low coverage ratios—that is, firms with a high level of current interest payments relative to their earnings. By using disaggregated data to compare the behavior of firms in different financial positions, we can potentially measure the distortions created by financial frictions.

In addition to being useful indicators of firms with imperfect access to credit markets, both of these variables are intuitively appealing in understanding the asymmetric nature of the financial accelerator discussed above. In good times, as profits increase and firms become flush with cash, borrowers have little trouble financing new investment projects and making existing debt payments. Under such conditions, a shock to earnings or interest rates will have very little magnification effect through the premium on external funds. As the economy turns down and balance sheet positions are weakened, however, a greater number of firms find themselves saddled with large debt, high interest payments, and low cash flow. In such precarious financial positions, these firms will face high premiums on external funds, either through direct price effects, credit rationing, or more severe non-price contract terms such as restrictive debt covenants. With only aggregate time series, however, one cannot identify the extent to which firms are moving from one class to another and, therefore, how important a credit mechanism is in creating business cycle asymmetries.

The identification strategy of comparing one class of firms to another in order to measure the extent and importance of financial frictions takes advantage of the inherent heterogeneity underlying most aggregate time series data. In addition, it emphasizes the limitations of models that focus on representative agents. The limitation of representative agent models does not come from our inability to formulate representative agent models with important credit frictions.[5] Rather, the limitation comes from our inability to distinguish such models from business cycle models with alternative propagation mechanisms that do not rely on credit frictions. Only by relying on the fact that some firms, at least some of the time, do not face the adverse consequences associated with limited access to credit markets, can we identify how other firms, at other times, are seriously affected by such restricted access.

[5] Bernanke and Gertler (1989) present one example of such models.

Evidence from Financial Data

We now turn to a discussion of identification through the use of financial data, focusing on the comparison between aggregate lending data and disaggregated lending data. We argue that only disaggregated lending data can provide convincing evidence of the presence of either a credit channel or the financial accelerator. We also wish to emphasize that evidence from lending data alone is not sufficient to establish the relevance of credit frictions in propagating and amplifying business cycle shocks. Also needed is supporting evidence from nonfinancial data. This is discussed in the next section.

Interpreting the Existing Evidence

Prominent studies that attempt to gauge the importance of credit in the macroeconomy have focused on the following criterion: To what extent do movements in aggregate credit or aggregate bank loans either explain or lead movements in real variables? Both King (1986) and Ramey (1993) show that total bank lending has no marginal forecasting power for either industrial production or other macro real variables. Romer and Romer (1990) show that monetary aggregates fall immediately following a shift to tight monetary policy and nine months prior to the ensuing drop in output, whereas bank loans fall only coincidently with the resulting decline in output. These results are taken by the authors as strong evidence against a credit channel for monetary policy and, at least in King's case, as strong evidence against credit mattering at all for the transmission of monetary policy shocks.[6]

As Bernanke and Blinder (1992), Gertler and Gilchrist (1993), and Bernanke, Gertler, and Gilchrist (1994) all emphasize, however, such empirical exercises do not provide information on either the relevance of a credit channel for monetary policy or the presence of a financial accelerator. First, banks liquidate securities rather than contract loan volume immediately following a tightening of monetary policy. Banks do so in part to offset the effects that tight money will have on their ability to lend to valued customers. Thus, the fact that bank loans only fall with a nine-month lag rather than immediately following a switch to tight monetary policy provides no information about banks' ability to obtain funds through CD issuance and, consequently, cannot be considered as a relevant test for the existence of a credit channel.

Second, the notion that bank lending should have marginal predictive power, once one controls for monetary policy through either a

[6] Both Ramey (1993) and Romer and Romer (1990) are careful to point out, however, that their findings do not provide evidence against the importance of a broader credit mechanism such as the financial accelerator.

monetary aggregate or an interest rate instrument such as the federal funds rate, assumes that credit disruptions provide an important independent source of shocks. According to the general equilibrium theories linking balance sheet conditions to real activity, however, no such shocks need exist.[7] The financial accelerator is an amplification device, not an independent source of variation. Although disruptions to credit supply—through independent shocks to bank lending such as changes in regulatory policy, for example—may have large effects, such shocks need not be empirically important for credit to matter in conditioning the economy's overall response to either changes in monetary policy or other sources of variation.

Finally, once it is recognized that the effects of credit frictions on debt quantities are most likely identified through the differential behavior of certain classes of borrowers, the relevance of any exercise that focuses only on aggregate lending patterns must be questioned. Kashyap, Stein, and Wilcox (1993) (KSW hereafter) were the first to make this point empirically. They argued that a credit channel for monetary policy could be identified more readily through the differential behavior of bank loans relative to commercial paper movements than by looking only at total lending. According to KSW, bank loans would shrink following tight money, whereas commercial paper would expand, in part because customers shut out of the bank loan market would naturally turn to commercial paper.

The evidence presented by KSW supports this contention. Bank loans drop relative to commercial paper following tight money, though the mechanism is not quite what KSW described. Using even more disaggregated data for the manufacturing sector, both Oliner and Rudebusch (1992) and Gertler and Gilchrist (1993) show that movements in the aggregate mix between commercial paper and bank loans are not driven by bank versus nonbank lending but by small-firm versus large-firm borrowing. In particular, following tight money, all types of borrowing by small firms fall, whereas borrowing by large firms actually expands in the first few quarters following a monetary contraction.

The expansion of credit to large firms following tight money is not often recognized and is worth emphasizing in the context of identifying the effects of monetary policy shocks through aggregate lending behavior. As Gertler and Gilchrist (1993) point out, many firms have a strong countercyclical demand for short-term credit, as inventories rise and cash flows fall in the first few quarters following a tightening of monetary policy or at a business cycle turning point. If funds were

[7] Examples of dynamic general equilibrium models that incorporate a financial accelerator include Greenwald and Stiglitz (1993), Bernanke and Gertler (1989, 1990), Calomiris and Hubbard (1990), Gertler (1992), and Kiyotaki and Moore (1993).

available at prevailing open-market rates, all firms would increase their borrowing to smooth the effect of declining cash flows. Only those firms with relatively unimpeded access to credit, however, are able to obtain the desired funds. Thus, following a shift to tight money, "high-quality" firms with access to the commercial paper market expand their credit (Calomiris, Himmelberg, and Wachtel 1995); firms with bank commitments draw down their lines of credit (Morgan 1994); and the "high-quality" bank customers receive the funds obtained through the banking system's liquidation of securities (Lang and Nakamura 1995). Those left out in the cold are the smaller, riskier, less-valued bank customers, which, once shut out of the bank loan market, have no recourse but to curtail operations, liquidate inventories, cut investment spending, and reduce their work force. Their reductions in spending further exacerbate the downturn, leading to an even greater contraction than before.

Once the countercyclical demand for credit generated by an adverse shock to monetary policy is recognized, it becomes immediately obvious that important credit frictions may be at work with very little observable effect on aggregate credit quantities, especially over the first few quarters following a switch to tight monetary policy. If this were the case, we would not necessarily expect any observable relationship between aggregate credit movements and future output movements. We would expect, however, an observable relationship between the differential borrowing rates of high-quality versus low-quality borrowers and future output movements, especially in a framework that does not control for the original source of the shock. In addition, we would expect monetary policy to have a strong effect on the relative borrowing patterns of these two types of firms.

Some New Evidence from Financial Data

In this section, we test the proposition that the borrowing rates of "low-quality" firms relative to those of "high-quality" firms have predictive power for aggregate real variables. We also test the proposition that differential movements in such borrowing rates are influenced by monetary policy. To obtain a debt measure for "low-quality" and "high-quality" firms, we follow Gertler and Gilchrist (1993) and use the ratio of short-term debt of small manufacturing firms relative to short-term debt of all manufacturing firms, constructed from the published QFR data. We call this ratio the small/all mix.[8] We view the first test as

[8] Other lending variables that reflect potential differences in borrower quality are available, though generally not for as long a time period. In addition, the QFR data are disaggregated by size as well as by type of debt (for example, bank vs. nonbank, commercial paper, and so on). The data are therefore well-suited for making additional

complementary to Ramey (1993), who uses the QFR data to examine the predictive power of short-term debt issued by small firms relative to that of large firms for aggregate industrial production. We view the second test as complementary to the evidence presented in Gertler and Gilchrist (1993), who characterize the behavior of small-firm and large-firm borrowing in response to monetary policy shocks, using impulse response functions. In addition, both tests complement the analysis of small-firm versus large-firm borrowing patterns provided by Oliner and Rudebusch (1992).

We test the first proposition by examining the predictive power of the small/all mix for the following measures of aggregate economic activity: real GNP, manufacturing industrial production, manufacturing inventories, and manufacturing employment.[9] We also examine the predictive power of the small- and large-firm debt series separately, as well as the relative behavior of bank and nonbank debt for small and large firms. Table 1 reports the results of these exercises in the context of a bivariate VAR system. The top panel reports probability values from the exclusion tests for each debt variable across the various measures of real economic activity.[10] The bottom panel reports the t-statistics for the sums of coefficients on the debt variables and, thus, provides an indication of the sign of the effect that each debt variable has on real activity.

The bivariate results provide strong support for the hypothesis that credit flows between small and large firms predict real economic activity. The probability values from the exclusion test for the small/all mix are less than 0.01 in three out of the four cases. In addition, the t-statistics on the sums of coefficients indicate that an increase in the small/all debt ratio leads to a highly significant increase in the growth rates of GNP, manufacturing industrial production, and manufacturing employment, as one would expect. The effect on inventories is ambiguous and probably reflects the dynamics associated with unexpected inventory buildup following a slowdown in economic activity.

Separating these variables by small firms versus large firms and

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comparisons of bank vs. nonbank debt. We focus on short-term rather than long-term debt to avoid the measurement problems associated with disentangling stocks and flows when only stocks are observable. As Gertler and Gilchrist (1993) show, the overall conclusions regarding disaggregated debt movements do not depend on the use of short-term rather than long-term credit quantities. In addition, Oliner and Rudebusch (1992) provide similar evidence based on total debt.

[9] We focus on the manufacturing variables since the lending data are constructed using manufacturing firms only. Ramey (1993) provides a similar test of predictive power for aggregate industrial production alone, although she uses the ratio of small- to large-firm borrowing rather than small- to all-firm borrowing. Since these variables are simple transformations of each other, it makes very little difference which one is used.

[10] We start the estimation in 1975: QI to allow for the fact that credit conditions may have changed following the regulatory change that allowed banks to issue large time deposits without being subject to reserve requirements.

Table 1
Short-Term Debt and Aggregate Economic Activity: Results from a Bivariate VAR System

p-values from Exclusion Tests on Debt Variables

	Dependent Variable			
		Manufacturing		
Debt Variable	Real GNP	Indust. Prod.	Inventories	Employment
Manufacturing Mix[a]	.04	.01	.08	.07
Large Firm Mix[b]	.76	.32	.79	.56
Small/All Mix[c]	.00	.00	.07	.00
Small Firm				
Short-Term Bank Debt	.84	.28	.74	.62
Short-Term Nonbank Debt	.80	.19	.82	.47
Large Firm				
Short-Term Bank Debt	.02	.00	.05	.02
Short-Term Nonbank Debt	.01	.00	.07	.01

t-statistics on Sums of Coefficients for Debt Variables

	Dependent Variable			
		Manufacturing		
Debt Variable	Real GNP	Indust. Prod.	Inventories	Employment
Manufacturing Mix[a]	2.75	2.60	1.75	2.11
Large Firm Mix[b]	.73	.73	.30	.42
Small/All Mix[c]	4.31	3.87	1.37	3.34
Small Firm				
Short-Term Bank Debt	−.12	−1.06	.29	−.11
Short-Term Nonbank Debt	−.09	−1.05	.41	−.07
Large Firm				
Short-Term Bank Debt	−3.17	−3.96	−1.08	−3.37
Short-Term Nonbank Debt	−3.52	−4.35	−.83	−3.52

Notes: The bivariate system includes four lags of the growth rate of the dependent variable and four lags of the growth rate of the debt variable. Sample range: 1975: QI to 1991:QIV.

[a] Ratio of short-term bank loans to commercial paper plus short-term bank loans, for all manufacturing firms.

[b] Ratio of short-term bank loans to commercial paper plus short-term bank loans, for firms above the 30th percentile in sales.

[c] Ratio of short-term debt for firms below the 30th percentile in sales relative to short-term debt of all firms.

bank versus nonbank debt indicates a number of interesting patterns. First, differences in the predictive power of debt variables arise through differences in class of borrower and not through differences in class of debt. Thus, bank debt and nonbank debt behave in a similar manner, but small-firm versus large-firm debt does not. In particular, for large

firms, increases in either bank or nonbank debt predict *declines* in real economic activity, while for small firms the opposite occurs. Although the similarity in predictive power of bank versus nonbank debt provides potential evidence against a "direct credit channel" for monetary policy, it is important to be cautious with this interpretation. As argued above, we would expect banks to continue to make loans to their larger, more valued customers as they sell off securities. In addition, for small firms, the nonbank category is very small and is not as reliable an indicator of credit behavior.[11]

Second, the t-statistics and p-values for exclusion tests of the first three lending variables confirm that the predictive power of the mix between bank loans and commercial paper for manufacturing comes entirely through the ratio of small-firm borrowing relative to total borrowing (that is, the small/all mix) and not through differential movements between bank loans and commercial paper by firms with potential access to both markets.[12] This finding further supports the evidence presented in Oliner and Rudebusch (1992), Gertler and Gilchrist (1993), and Calomiris, Himmelberg, and Wachtel (1995) that differential movements between bank loans and commercial paper reflect differential movements in debt by type of borrower and not by type of debt.

Finally, it is worth noting that much of the predictive power of the small/all mix can be captured by looking only at large-firm behavior in the bivariate regressions. When these regressions are augmented to include other variables such as the federal funds rate and inflation, as in Table 2, the predictive power of large-firm debt variables vanishes, while the small/all mix still retains significant predictive power for the growth rates of GNP, manufacturing inventories, and manufacturing employment. Overall, we find that the ratio of small-firm borrowing relative to total borrowing has both the predictive power and sign one would expect based on credit theories.

The second prediction to be tested is whether monetary policy has any effect on the borrowing patterns of small and large firms. To test this hypothesis, each debt variable is regressed on four lags of itself and four lags of the federal funds rate. We also consider a multivariate specification that includes the growth rate of industrial production for the manufacturing sector. The probability values from exclusion tests and

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[11] It is also possible that some firms are pushed out of the commercial paper market into the bank loan market as their credit quality deteriorates. Such an effect would mute any differential response for large firms.

[12] Gertler and Gilchrist (1994) show that manufacturing firms with total assets of less than $250 million have virtually no commercial paper outstanding. In addition, 90 percent of manufacturing commercial paper is issued by firms with total assets greater than $1 billion.

Table 2
Short-Term Debt and Aggregate Economic Activity: Results from a Multivariate VAR System

p-values from Exclusion Tests on Debt Variables

	Dependent Variable			
		Manufacturing		
Debt Variable	Real GNP	Indust. Prod.	Inventories	Employment
Manufacturing Mix[a]	.40	.17	.21	.36
Large Firm Mix[b]	.91	.52	.98	.73
Small/All Mix[c]	.05	.13	.02	.06
Small Firm				
Short-Term Bank Debt	.98	.36	.55	.67
Short-Term Nonbank Debt	.95	.35	.77	.65
Large Firm				
Short-Term Bank Debt	.32	.11	.02	.13
Short-Term Nonbank Debt	.28	.11	.06	.11

t-statistics on Sums of Coefficients for Debt Variables

	Dependent Variable			
		Manufacturing		
Debt Variable	Real GNP	Indust. Prod.	Inventories	Employment
Manufacturing Mix[a]	1.61	1.43	1.95	1.20
Large Firm Mix[b]	.15	.11	.16	−.12
Small/All Mix[c]	2.69	2.27	2.59	2.31
Small Firm				
Short-Term Bank Debt	.17	−1.04	.27	−.38
Short-Term Nonbank Debt	.33	−.91	.43	−.22
Large Firm				
Short-Term Bank Debt	−1.85	−2.70	−1.97	−2.49
Short-Term Nonbank Debt	−1.70	−2.68	−1.66	−2.28

Notes: The multivariate system includes four lags of the growth rate of the dependent variable, four lags of the growth rate of the debt variable, and four lags of the change in the federal funds rate. Sample range: 1975:QI to 1991:QIV.

[a] Ratio of short-term bank loans to commercial paper plus short-term bank loans for all manufacturing firms.

[b] Ratio of short-term bank loans to commercial paper plus short-term bank loans for firms above the 30th percentile in sales.

[c] Ratio of short-term debt for firms below the 30th percentile in sales relative to short-term debt of all firms.

t-statistics for sums of coefficients on the federal funds rate are reported in Table 3. The results from both the exclusion tests and the tests of sums of coefficients provide strong support for the hypothesis that monetary policy significantly affects the differential growth rates of short-term debt between small and large firms. In particular, an increase

Table 3
The Effect of the Federal Funds Rate on Short-Term Debt

p-values from Exclusion Tests on the Federal Funds Rate

Debt Variable	Bivariate System[a]	Multivariate System[b]
Manufacturing Mix[c]	.12	.31
Large Firm Mix[d]	.82	.95
Small/All Mix[e]	.00	.06
Small Firm		
Short-Term Bank Debt	.01	.13
Short-Term Nonbank Debt	.02	.13
Large Firm		
Short-Term Bank Debt	.00	.26
Short-Term Nonbank Debt	.00	.10

t-statistics on Sums of Coefficients of the Federal Funds Rate

Debt Variable	Bivariate System[a]	Multivariate System[b]
Manufacturing Mix[c]	−2.35	−1.90
Large Firm Mix[d]	−.50	−.69
Small/All Mix[e]	−3.81	−2.70
Small Firm		
Short-Term Bank Debt	1.59	.05
Short-Term Nonbank Debt	1.53	.14
Large Firm		
Short-Term Bank Debt	3.29	2.07
Short-Term Nonbank Debt	3.61	2.44

[a] The bivariate system includes four lags of the growth rate of the debt variable and four lags of the change in the federal funds rate.

[b] The multivariate system includes four lags of the growth rate of the debt variable, four lags of the change in the federal funds rate, and four lags of the growth rate of manufacturing industrial production.

[c] Ratio of short-term bank loans to commercial paper plus short-term bank loans for all manufacturing firms.

[d] Ratio of short-term bank loans to commercial paper plus short-term bank loans for firms above the 30th percentile in sales.

[e] Ratio of short-term debt for firms below the 30th percentile in sales relative to short-term debt of all firms.

in the federal funds rate leads to a contraction of small-firm borrowing relative to large-firm borrowing.

In conclusion, the evidence from financial data disaggregated by size class in manufacturing confirms the fact that the differences in short-term borrowing behavior between small and large firms have substantial predictive power for real economic activity. In addition, the data are consistent with the view that monetary policy plays a crucial role in determining the pattern of such differences in borrowing behavior, in the direction suggested by credit-based propagation theories.

Evidence from Nonfinancial Data

While consistent with a role for credit in the economy, the evidence using financial data alone cannot solve the identification problems posed by the literature. We must ask why funds flow from one class of borrower to another, and why such flows might have forecasting power for aggregate economic activity. One alternative explanation that does not rely on credit is that small, bank-dependent firms are subject to a different set of shock processes and adjustment mechanisms than large firms, or firms identified as having free access to credit markets. If, for example, small firms are on the fringes of the industrial process as suppliers or niche market producers, they may well be subject to more rapid and deeper contractions than their large-firm counterparts. If this were true, we might indeed expect the ratio of small- to all-firm borrowing to respond to monetary policy shocks and lead the business cycle, as the above evidence suggests.

Two approaches can be taken to solving the identification problem here. The first approach is to rely on additional time series evidence that is also consistent with a credit interpretation but much harder to explain with an alternative non-credit-related phenomenon. The other approach is to go directly to micro data and control for as many of the alternative shock and adjustment processes as possible, using both reduced-form and structural techniques. We discuss both in turn.

Evidence from the Aggregate QFR Data

To identify credit effects through time series data, one must have a data set that provides both a long time series dimension and enough heterogeneity to form a basis of comparison between agents with differential access to capital markets. By providing balance sheet and income statement data over the period from 1959:QI to 1991:QIV across different size classes of manufacturing firms, the QFR data are uniquely suited to the task. Using these data, Gertler and Gilchrist (1994) provide substantial evidence on the differential behavior of small versus large firms over the business cycle and in response to monetary policy shocks.

Regardless of the source of this differential behavior, the Gertler–Gilchrist evidence is striking. Following a shift to tight monetary policy, the contraction of small manufacturing firms—defined as firms in the bottom 30th percentile of the sales distribution—is 2.5 times greater than that of large firms, over a 12-quarter horizon. This contraction can be seen across a wide variety of variables, but it is most noticeable in sales, inventories, and short-term borrowing. While one could potentially explain the differential response of sales with an alternative demand story, it is much harder to explain the differential response of the inventory/sales ratio and the debt/sales ratio with such a story. The

evidence clearly suggests that large firms obtain additional funds to finance inventories as sales are declining, whereas small firms do not. In addition, Bernanke, Gertler, and Gilchrist (1994) show that controlling for industry-specific demand conditions does not substantially reduce the differential response of the inventory/sales ratio between small and large firms, as one would expect if a demand-based alternative were the true explanation.

Perhaps the most compelling evidence from a skeptic's point of view is the finding that spending by small firms is highly responsive to current credit conditions, even after controlling for the lagged dynamics normally associated with spending equations. Two pieces of evidence are relevant here. The first piece is the finding by Gertler and Gilchrist (1994) that inventory investment by small firms is highly responsive to a coverage variable that measures the ratio of income to short-term debt payments, whereas inventory investment by large firms is not. Thus, balance sheet conditions affect real decisions for small firms but not for large firms. This is true even after controlling for alternative sales processes and inventory adjustment speeds. A related piece of evidence is the finding by Oliner and Rudebusch (1994) that business fixed investment by small firms is highly responsive to cash flow shocks during recessionary periods. Such an asymmetric response arises naturally from a model with credit frictions but is much more difficult to reconcile with a model that assumes perfect capital markets.

Evidence from the Firm-Level QFR Data

While the time series evidence based on small versus large manufacturing firms paints a compelling picture of the process one would expect to observe if credit conditions play an important role in both the monetary transmission mechanism and business cycle fluctuations, the fact that the data are aggregated by size rather than by a more direct indicator of capital market access is a major limitation. Additional problems are posed by attempts to control for industry effects and other aggregation issues. Fortunately, the underlying firm-level data set that is used to construct the published QFR data aggregated by size class is available through the Center for Economic Studies at the U.S. Bureau of the Census for the period 1977:QI to 1991:QIII. Unlike Compustat or other firm-level data bases more commonly used in micro studies that seek to identify the effect of credit frictions on real behavior, the firm-level QFR data set is comprehensive for manufacturing, covering all corporations and not just publicly traded ones.[13] The fact that the

[13] In fact, the firm-level QFR data form the only known U.S. data base that systematically provides either high-frequency or firm-level information about corporations

data set is comprehensive implies that one can correctly aggregate results to obtain macroeconomic implications. The quarterly frequency of the data allows one to consider issues at a business cycle frequency. While work on this data base is preliminary, some interesting results have already emerged. We discuss these results again in the context of identifying the role of credit in the macroeconomy.

The principal identification problem posed at the micro level is, how does one separate a firm's response to a change in its financial position from its response to new profit opportunities? This identification problem can be easily understood in the context of standard firm-level investment regressions. As discussed above in the section "Identification through Heterogeneity," a positive shock to profits has two effects. First, to the extent that high profitability today signals high profitability tomorrow, firms will want to invest more. This is the standard neoclassical response. Second, higher profits today signal greater net worth and an improved financial position. The improved financial position lowers the premium on external funds and boosts the investment spending of constrained firms. In this manner, investment expenditures are more responsive to innovations in current earnings than the neoclassical model would suggest.

To test this hypothesis of "excess sensitivity" of investment to cash flow, past researchers regressed investment on Tobin's Q and either current or past earnings.[14] The identifying assumption of this approach is that Tobin's Q adequately proxies for future profit opportunities through the forward-looking behavior captured by the stock market.[15] To the extent that current or past earnings still had explanatory power for investment—even after controlling for future profit opportunities through Tobin's Q—they did so because of credit market frictions. This identification scheme, however, was called into serious doubt by researchers who found either little observable relationship between in-

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that are not publicly traded. In addition, the firm-level QFR data provide information for the retail, wholesale, and mining sectors of the economy. Unlike the case of the manufacturing sector, the sampling of these sectors is not comprehensive; income and balance sheet statements are provided only for firms with assets above $50 million; see Long and Ravencraft (1993) and Zakrajšek (1995) for detailed descriptions of the firm-level QFR data base.

[14] The most influential paper in the literature is Fazzari, Hubbard, and Petersen (1988). Other examples include Devereux and Schiantarelli (1989), Hoshi, Kashyap, and Scharfstein (1991), Blundell, Bond, Devereux, and Schiantarelli (1992), Chirinko and Schaller (1993), Oliner and Rudebusch (1992), and Schaller (1993).

[15] Tobin's Q is defined as the market value of the firm divided by the replacement value of its capital stock. The market value includes the stock market value of equity and the market value of debt outstanding. According to the Q theory of investment, Tobin's Q represents the shadow value of an additional dollar of investment. Thus, when Q is greater than one, the value of an additional unit of investment inside the firm is greater than its replacement cost and the firm should invest more.

vestment and Q or implausibly high adjustment cost estimates (low Q coefficients). These results suggest that Tobin's Q is not an adequate proxy for future profit opportunities. Since, in principle, Tobin's Q measures the present value of future earnings streams attributable to new investment, cash flow might help predict this stream, in which case one could not attribute the large, positive coefficient on cash flow solely to financial effects.

Gilchrist and Himmelberg (1994) (G-H hereafter) formalize this point by using a VAR forecasting framework to decompose the effect of cash flow on investment into two separate components—a component that forecasts future profitability under perfect capital markets, and a residual component that may be attributable to financial frictions. The results of their methodology provide the following insights for identification of credit effects. By relying on Tobin's Q to control for future profit opportunities, rather than a VAR-based alternative that controls for predictive power of cash flow, one dramatically overstates the effect of cash flow on investment. This is especially true for firms classified as financially "unconstrained" and for which Tobin's Q is a particularly bad proxy for future profit opportunities. Thus, without properly controlling for such profit opportunities, even large firms with commercial paper ratings appear overly responsive to cash flow shocks, relative to the perfect markets benchmark. Once one controls for the forecasting power of cash flow, however, all evidence of excess sensitivity disappears for "unconstrained" firms, and it is reduced for "constrained" firms.

The other lesson for the identification of credit effects provided by G-H is that although the level of response of investment to cash flow effect differs substantially with and without controlling for the forecasting component, the difference in the response of investment to cash flow across constrained and unconstrained subgroups is actually greater, once one controls for the predictive content of cash flow for future profit opportunities. This result is encouraging because it suggests that even if we cannot correctly identify the underlying investment model, by making comparisons across subgroups of firms we are still likely to obtain a reasonably correct answer for the degree of excess sensitivity of constrained firms relative to unconstrained firms.[16]

While the G-H results are informative, it is not clear how robust they are to alternative time frames, data sets, and forecasting rules. The last are particularly important, since G-H rely on a VAR forecast that is

[16] It is worth emphasizing that many papers in the literature, including Fazzari, Hubbard, and Petersen (1988), either explicitly or implicitly acknowledge the identification problems posed by using Tobin's Q and are more likely to rely on comparisons across firms rather than focus on the overall cash flow coefficient, when assessing the importance of financial frictions.

restricted to be common across all manufacturing firms, once they control for fixed firm and time effects. To the extent that such a restriction is invalid, we may not obtain a good proxy for future profit opportunities and may seriously bias the parameter estimates on cash flow.

Gilchrist and Zakrajšek (1995) investigate this point using the quarterly frequency, firm-level QFR data. The application of the VAR-based measure of profit opportunities is particularly important for the QFR data set, since many of the firms in the sample are not publicly traded and, therefore, do not have a stock-market-based measure of profit opportunities available. Using the G-H methodology, Gilchrist and Zakrajšek (1995) compare a variety of forecasting rules, including firm-specific, industry-specific (2-digit SIC), sector-specific (durables versus nondurables) as well as aggregate forecasting equations, and find the G-H results robust to these alternatives. In fact, of all forecasting systems considered, the G-H restriction that the forecasting equation is common across all firms in manufacturing, after controlling for fixed firm and time effects, provides the smallest residual sensitivity of investment to cash flow for both financially constrained and unconstrained subgroups. In addition, Gilchrist and Zakrajšek (1995) confirm the G-H result that unconstrained subgroups show no excess sensitivity of investment to cash flow, once one controls for cash flow's forecasting power of future profit streams. Nonetheless, a large residual correlation remains between investment and cash flow for constrained subgroups, even after controlling for the predictive power of cash flow for future profit opportunities. In fact, Gilchrist and Zakrajšek (1995) find that the investment of constrained firms is just as responsive to cash flow shocks as it is to future profit opportunities, with an elasticity around 0.12. This latter finding, combined with the fact that, by their definition, financially constrained firms account for over 30 percent of the capital stock in the economy, strongly suggests that financial frictions are an important determinant of business fixed investment in the manufacturing sector.

The methodology used by Gilchrist and Himmelberg (1994) and Gilchrist and Zakrajšek (1995) follows that of numerous other researchers who start with a well-specified investment equation and then look for departures from this equation that are consistent with a model based on financial frictions. The alternative model under imperfect capital markets is neither specified nor estimated. Therefore, although these exercises are useful in providing evidence against the null hypothesis of perfect capital markets, they do not provide an alternative set of parameter estimates that can be used to identify the decision rule of the financially constrained firm. A major limitation is the difficulty involved in specifying the alternative, since theoretical models incorporating credit frictions are either too simple or too intractable to be tested by empirical data.

Some headway has been made in constructing investment models

with financial frictions that can be tested empirically. One approach is to specify ad hoc, realistic rules that govern a firm's ability to obtain external funds and then solve the model using numerical techniques. Gross (1994) is a recent example of this approach. Not only does Gross (1994) specify the alternative to the perfect capital market case, but he also takes the model to data by estimating the reduced-form of the decision rule using non-parametric methods. While the reduced-form results provide additional evidence in favor of a credit mechanism for firm-level investment, we still do not obtain the underlying parameter estimates that are necessary to fully evaluate the decision rule and, thus, to quantify the overall importance of credit for investment spending. For this type of exercise, we must still rely on reduced-form interpretations of the data.

Identification of capital market frictions using reduced-form equations at the micro level depends on methods similar to those used with time series data. The point is to develop empirical evidence that is consistent with a model based on capital market frictions but would be much more difficult to explain in a world where such frictions were absent. For example, although we would expect cash flow to be an important explanatory variable for investment even in the absence of capital market frictions, this is not so obviously true for inventories, since nearly all structural models of inventory behavior rely on sales rather than profits as the principal determinant of optimal inventory investment. In addition, to the extent that cash flow has greater explanatory power for firms that are likely to be constrained, we have further evidence in favor of a financial markets imperfection story.[17]

This identification scheme is used by Zakrajšek (1994) to measure the importance of financial frictions in the retail sector, using a sample constructed from the firm-level QFR data. The advantage of the data set that provides information on non-publicly traded firms is particularly important for the retail trade, where a much lower proportion of total assets is held by publicly traded firms. The focus on inventory investment in retail trade is motivated by the fact that inventory investment in this sector is the most volatile component of aggregate inventory investment (see Blinder and Maccini 1991). Both the cross-sectional and the time series results from Zakrajšek (1994) are consistent with the presence of a financial accelerator in the retail trade sector. First, cash flow is, both statistically and economically, a significant predictor of inventory investment for firms with "weak" balance sheet conditions—that is, firms with large debt burdens and no access to the commercial

[17] Kashyap, Lamont, and Stein (1994) and Carpenter, Fazzari, and Petersen (1993) provide recent evidence on the importance of internal finance for manufacturing inventory investment, using reduced-form equations at the firm level.

paper market.[18] Second, the predictive power of cash flow for inventory growth of firms with weak balance sheet conditions is highly asymmetric over the course of the business cycle, increasing considerably in recessions relative to normal times.

Some New Results from Firm-Level QFR Data

While the results of Zakrajšek (1994) are interesting, it is important to examine their robustness across broader sectors of the economy. Accordingly, we apply the identification scheme used in Zakrajšek (1994) to a similarly constructed, firm-level QFR data set for the manufacturing sector. We estimate an inventory regression that includes lags of both inventories and sales in order to capture desired inventory behavior, and lagged cash flow to capture a financial effect. We rank observations based on last period's net leverage ratio and split the data into four quartiles based on this ranking.[19] The details of the exact econometric specification and data construction are provided in the appendix.

Table 4 provides the first set of estimation results. It compares the response of inventory investment to cash flow shocks across the four subsets of firms, classified by leverage. All four categories show a positive response of inventory investment to cash flow, with the coefficient on cash flow increasing monotonically across the four leverage categories. The monotonic increase in cash flow coefficients is consistent with the view that internal funds are an important determinant of inventory investment for financially constrained firms. Nonetheless, the fact that inventory investment of firms in the lowest quartile of the net leverage distribution responds to cash flow is difficult to interpret, and it highlights the costs of eschewing structural models even as benchmarks. An extreme interpretation would attribute all of the explanatory power of cash flow to the effect of capital market frictions. An alternative interpretation would attribute the explanatory power of cash flow for low net leverage firms to an underlying perfect capital markets model and attribute the differential effect across different quartiles to capital market frictions. Even with this more restrictive

[18] Zakrajšek (1994) relies on a "net-leverage" measure of balance sheet conditions proposed by Sharpe (1994) and recently used by Calomiris, Orphanides, and Sharpe (1994).

[19] It is worth noting that the choice of sample-splitting criterion is also a relevant identification issue. Although we do not explicitly address the issue in this paper, evidence on the importance of financial effects in micro spending equations is robust to a wide variety of sample-splitting methodologies, using both exogenously determined criteria such as size, dividend policy, and ownership structure (see Fazzari, Hubbard, and Petersen (1988), Hoshi, Kashyap, and Scharfstein (1991), Oliner and Rudebusch (1992) and Ng and Schaller (1993)) and endogenously determined criteria derived from switching regime models (see Hu and Schiantarelli 1994).

Table 4
The Effect of Cash Flow on Manufacturing Inventory Investment
Dependent Variable: $\Delta \ln N_{it}$

	Quartile I	Quartile II	Quartile III	Quartile IV
$\ln(N/S)_i$	.145	.124	.127	.161
	(.004)	(.004)	(.004)	(.004)
$\ln(N_{it-1}/S_{it})$	−.144	−.124	−.127	−.169
	(.003)	(.004)	(.004)	(.004)
$\Delta \ln N_{it-1}$	−.145	−.085	−.081	−.028
	(.006)	(.006)	(.006)	(.006)
$\Delta \ln S_{it-1}$	−.081	−.067	−.072	−.069
	(.005)	(.005)	(.005)	(.005)
Π_{it-1}/TA_{it-2}	.282	.396	.493	.582
	(.031)	(.027)	(.035)	(.040)
R^2	.098	.077	.074	.088
Observations	29,612	29,869	29,575	28,484

Notes: Standard errors in parentheses. All equations included fixed time effects (not reported) and are estimated with OLS. A minimum of 8 quarters and up to 51 quarters of data were used to compute a consistent estimate (the sample mean) of the firm-specific inventory-sales target ratio $(N/S)_i$. The log of this variable is included to control for fixed individual effects. Sample range: 1979:QIII–1991:QIII.

interpretation, we have substantial evidence of excess sensitivity of inventory investment to earnings, for high net leverage firms.

While Table 4 provided information on the average response of inventories to cash flow across the full sample, Table 5 provides information on the cyclicality of the response over the business cycle. We do this by reestimating the inventory equation across two-year subintervals for firms divided into two categories—low and high net leverage.[20] In Table 5, we report the cash flow coefficient and its standard error for both the low and high net leverage categories in each subsample. We also report the differential response of inventories to cash flow shocks across the two subgroups as well as the associated standard errors. Table 5 clearly shows the cyclical nature of the importance of internal funds for inventory investment. The highest differential responses occur in the 1980–1982 downturn and following the 1989 monetary contraction that preceded the 1990 recession. In these episodes, the differential effect of cash flow on inventory investment is nearly twice as high as in 1985–86, the period with the lowest differential response.

It is worth emphasizing that the findings here come not from small

[20] The low net leverage observations represent the firms with net leverage less than the median value over the two-year estimation period. We use two rather than four classifications for ease of comparison.

Table 5
The Effect of Cash Flow on Manufacturing Inventory Investment
Asymmetric Effects over the Business Cycle

Time Period	Unconstrained[a]	Constrained[b]	Difference[c]
79:QIII–80:QIV	.384	.612	.228
	(.052)	(.065)	(.083)
81:QI–82:QIV	.320	.649	.329
	(.055)	(.067)	(.087)
83:QI–84:QIV	.410	.552	.142
	(.055)	(.070)	(.089)
85:QI–86:QIV	.395	.526	.131
	(.056)	(.058)	(.081)
87:QI–88:QIV	.357	.540	.183
	(.051)	(.065)	(.083)
89:QI–90:QIV	.247	.564	.317
	(.056)	(.076)	(.094)

Notes: Standard errors in parentheses. All equations included fixed time effects (not reported) and are estimated with OLS. A minimum of 8 quarters and up to 51 quarters of data were used to compute a consistent estimate (the sample mean) of the firm-specific inventory-sales target ratio $(N/S)_i$. The log of this variable is included to control for fixed individual effects. Sample range: 1979:QIII–1991:QIV.

[a] Point estimates on cash flow for firms in Quartiles I and II.

[b] Point estimates on cash flow for firms in Quartiles III and IV.

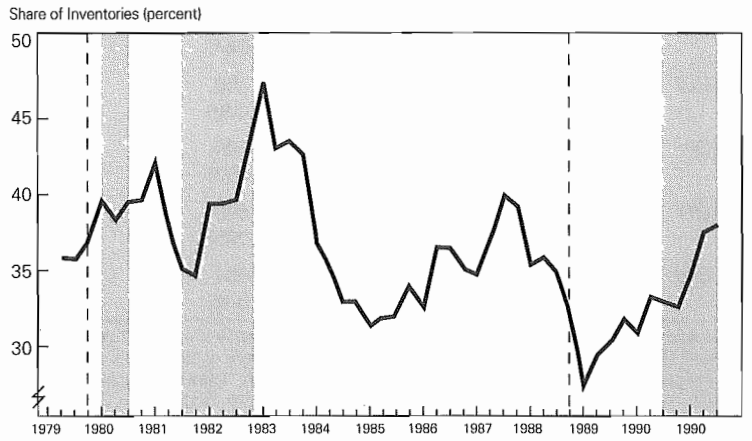
[c] Difference in point estimates on cash flow between constrained and unconstrained firms.

versus large firm comparisons as in Gertler and Gilchrist (1994), but from a sample of firms classified by financial policy. As such, one cannot easily explain away the differences in inventory investment response by attributing them to unmodeled industry or size effects. In addition, besides providing independent support for the idea that the differential inventory behavior between firms documented by Gertler and Gilchrist (1994) is driven by financial factors, this evidence confirms the findings of Kashyap, Lamont, and Stein (1994) on the cyclical nature of credit effects in inventory equations.

While these regressions provide strong micro evidence in support of a financial accelerator for inventory investment, it is important to ask, "Why do these differential effects matter in the aggregate?" Although a complete answer to this question is beyond the scope of this paper, we provide two pieces of evidence to suggest they would indeed matter. We proceed by calculating the share of inventories that would fall into the two quartiles with high net leverage (that is, firms above the 50th percentile of the net leverage distribution). This percentage is plotted in Figure 2. This figure has two noteworthy aspects. First, high net leverage firms account for a significant share of inventories—at least 30 percent. Second and more striking, the share of inventories held by high net leverage firms rises dramatically following tight-money episodes

Figure 2

THE RELATIVE IMPORTANCE OF FINANCIALLY CONSTRAINED FIRMS



Note: Dashed lines represent Romer dates. The shaded regions represent NBER-dated recessions. Seasonally adjusted data.

and during recessions, with at least a 15 percent increase during the 1981–82 recession and a steady climb after the onset of tight money in 1989 through the 1991 recession. Based on this evidence, it is easy to see how one could obtain asymmetric responses of inventory investment to financial conditions using the aggregate data. As more firms become highly indebted throughout the economic downturn, and as the responsiveness to earnings of highly indebted firms increases throughout the downturn, the amplification effects associated with the financial accelerator become more relevant for aggregate economic activity.

CONCLUSION

This paper addresses the issues surrounding the identification and quantification of the effects of financial market imperfections on firm behavior. The paper emphasizes the essential role that heterogeneity plays in assessing the importance of credit market frictions, and the need for data sets that accurately reflect such heterogeneity when measuring the relevance of financial frictions. The paper also provides some new empirical evidence using time series data on debt. In

particular, we find substantial evidence that small-firm versus large-firm borrowing has predictive power for a variety of measures of aggregate economic activity. We also find that monetary policy has a substantial influence over the differential behavior of these debt variables, with a tightening of monetary policy leading to a drop in small-firm debt relative to large-firm debt.

Using firm-level data, we find substantial evidence that inventory investment is highly responsive to the availability of internal funds, for firms that find themselves in weak balance sheet positions. In addition, the percentage of manufacturing inventories held by such firms increases dramatically during economic downturns, making overall inventory investment much more sensitive to balance sheet conditions during such periods of low economic activity. Overall, these results provide substantial support for the view that a credit mechanism plays an important role in conditioning the macroeconomy's response to underlying economic disturbances.

Appendix

From the certainty component of the firm-level QFR data base, we selected an *unbalanced* panel of firms from 1979:QI through 1991:QIII.[21] From this unbalanced panel, we dropped all firms that had tenure of less than 8 quarters or had any discontinuities in their time series record.

- **Inventories:** The QFR data report the book value of total inventories. Firms in the sample were required to hold strictly positive inventories at each point of their tenure in the panel. In order to eliminate the inflation bias from the inventory growth rate, inventory stocks were deflated by the implicit GNP deflator prior to constructing growth rates. We let N_{it} denote the real value of inventories of firm i in period t.
- **Sales:** To construct a real measure of sales, the reported nominal value of sales was deflated by the implicit GNP price deflator. As with inventories, firms were required to have strictly positive sales at each point of their tenure in the panel. We let S_{it} denote the real value of sales of firm i in period t.
- **Internal Finance:** The measure of internal funds in this paper is defined as cash flow relative to last period's total assets. Cash flow is defined as income (or loss) from operations plus depreciation, depletion, and amortization of property, plant, and equipment. Both cash flow and the book value of total assets are deflated by the implicit GNP price deflator prior to constructing the internal finance ratio. We let Π_{it}/TA_{it-1} denote the ratio of real profits of firm i in period t to its real assets in period $t-1$.
- **Net Leverage:** Financial leverage (the ratio of total debt to total assets) is normally thought of as a measure of a firm's balance sheet condition. A potential problem with identification strategy that classifies firms into "constrained" and "unconstrained" subgroups according to leverage ratio is that total assets consist of a variety of different assets. In particular, a highly liquid component of total assets, in addition to cash stocks, includes time deposits, CDs, and other readily marketable securities that can be quickly and at little cost converted to cash-on-hand

[21] Even though the firm-level QFR data are available from 1977:QI–1991:QIII, we started our sample in 1979:QI, because the 1978:QIV data are missing and we wanted to avoid discontinuities.

and used to finance inventory investment if internal funds are low and external credit is unavailable; see Kashyap, Lamont, and Stein (1994) for the evidence of this phenomenon during the 1982 recession. A more comprehensive measure of a firm's overall balance sheet condition is, according to Sharpe (1994), the net leverage. The measure of net leverage is constructed by subtracting a firm's net short-term assets from both the numerator and the denominator of a firm's leverage ratio. Net short-term assets consist of cash stock, all short-term investment, and trade receivables, minus trade payables.

- **Quartiles:** In each period t, a firm is assigned to one of four quartiles, based on its $t-1$ period's net leverage. The first quartile contains all firms with net leverage below the 25th percentile; the second quartile contains all firms with net leverage between the 25th and the 50th percentiles; the third quartile contains all firms between the 50th and 75th percentiles; and, finally, the fourth quartile contains all firms with net-leverage above the 75th percentile. We allow the cutoff points (that is, the 25th, 50th, and 75th percentiles) to vary over time by computing them for each *year* of our sample separately. For example, a firm in 1980:QII is assigned to the first quartile if its net leverage in 1980:QI is less than the 25th percentile of the net leverage distribution computed over all four quarters of the year 1980.

We use the following econometric specification to measure the effect of credit frictions on inventory investment:

$$\Delta \ln N_{it} = \beta_1 \ln\left(\frac{N}{S}\right)_i + \beta_2 \ln\left(\frac{N_{it-1}}{S_{it}}\right) + \beta_3 \Delta \ln N_{it-1} + \beta_4 \Delta \ln S_{it-1} + \beta_5 \left(\frac{\Pi_{it-1}}{TA_{it-2}}\right) + d_t + \epsilon_{it}.$$

The dependent variable is the growth rate of inventories. The first two terms reflect the effect of the deviation of the current log inventory/sales ratio from its firm-specific target, $\ln(N/S)_i$. A consistent estimate of the target inventory/sales ratio for firm i is computed according to

$$\ln\left(\frac{N}{S}\right)_i = \frac{1}{T_i} \sum_{t=1}^{T_i} (\ln N_{it} - \ln S_{it}),$$

where T_i denotes the number of quarters that firm i is in the sample (a minimum of 8 quarters and a maximum of 51 quarters). The lag of Π_{it}/TA_{it-1} is meant to capture the effect of financial frictions on inventory investment; the fixed time effect, d_t, is added to control for aggregate shocks such as overall price movements or interest rate shocks, while lags of $\Delta \ln N_{it}$ and $\Delta \ln S_{it}$ are included to capture any additional short-run dynamics.

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Discussion

William C. Brainard*

It is a pleasure to discuss Simon Gilchrist and Egon Zakrajšek's stimulating paper on the importance of credit for macroeconomic activity. The authors and others at this conference are to be commended for their efforts to improve our understanding of the role of bank lending in the monetary transmission mechanism and the extent to which market imperfections may be important in shaping that role. I will begin with some general remarks about the dichotomy drawn between the "money" and "credit" views of the transmission mechanism, and then make some specific comments about the authors' analysis and conclusions.

The Money and Credit Views

At such a conference 30 years ago, the debate might have focused on whether the quantity of money affected expenditure directly or through interest rates. In the current discussion, the "money view" has been identified as the view that monetary policy works through its effect on the cost of capital, rather than through credit. The view of the cost of capital itself could be quite narrow, limited to a single or limited number of market interest rates, or it could be quite broad, reflecting the prices and rates of return on a wide spectrum of assets and liabilities and stretching all the way to equities and the market value of firms.

Many monetary economists, for example, Brunner–Meltzer and Tobin–Brainard, recognizing the wide spectrum of financial assets and institutions in our highly developed economy, have long taken the

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broad view of the cost of capital. This view is entirely consistent with asset demands and supply of credit by bank and nonbank intermediaries playing an important role in the transmission of monetary policy. In this view, the markets for "credit" and monetary assets are highly interdependent, with financial intermediaries, households, and firms interacting in many markets. Hence, it suggests that the magnitude of the response to monetary policy of interest rates and broader measures of the cost to capital such as Tobin's q is importantly affected by the behavior of a broad array of financial markets and institutions. So the broad "money" view is quite different from the stylized picture that has become popular in the money versus credit debate, in which there is clear separation between the two channels—a money channel that goes from money directly to the cost of capital, and a credit channel that traces the effect through the asset side of banks and other intermediaries. As might be expected, I am not a fan of this dichotomy and prefer to analyze the transmission of monetary policy in a general equilibrium model in which the interdependencies of markets are explicitly recognized.

The current "credit view" stresses still another aspect of financial markets and the transmission mechanism, the presence of imperfections in credit and capital markets reflecting significant costs of gathering information and monitoring. Recent theoretical work has formalized and clarified the difficulties for financial markets implied by the presence of asymmetric information and moral hazard. Such phenomena have long been recognized and included in the catalog of reasons for credit rationing, collateral requirements, and other terms and conditions in financial contracts, and indeed for the existence of specialized financial intermediaries themselves. When Franco Modigliani attempted to capture the monetary transmission mechanism in the early versions of the MPS model many years ago, it seemed essential to include quantities of deposit and credit flows. Market interest rates and the rates on mortgages and commercial loans did not appear to capture adequately the effect of monetary events on economic activity. I applaud the resurgence of interest in these phenomena and in the more rigorous analysis of their theoretical foundations, but I find it somewhat ironic that this attention comes at a time when one might suspect that their quantitative importance has declined.

Market imperfections are a matter of degree: The markets for many commodities are imperfect and the textbook model of perfect competition is a caricature of reality, but we do not usually argue that such imperfections negate the central role we attribute to prices in allocating resources. At a formal level, these imperfections, which may drive a wedge between the shadow price (or rate of return) on internal funds and external rates, can be explicitly modeled in an equilibrium model of financial markets. For many of the issues raised at this conference, however, I do not think that it is a gross error simply to regard

information asymmetries and moral hazard as among the many reasons it is important to treat the assets and liabilities of firms and various intermediaries as less than perfect substitutes. In the equilibrium system of James Tobin, however, distinguishing between "low-quality" and "high-quality" firms does require disaggregation of firms, distinguishing the required rates of return or Tobin's q for different types of firms.

Innovation and the Effectiveness of Policy

One issue discussed at this conference can be addressed in this framework without modification. This is whether the growth of nonbanking intermediaries and financial innovations—new financial instruments and financial markets—destroys the effectiveness of a monetary policy that focuses on the reserves of a single intermediary, banks. Multi-asset equilibrium models show that for a wide range of substitutabilities among various assets and liabilities, monetary policy remains effective. Innovations may change the bang per buck, but as long as the dose of medicine can be adjusted for its effectiveness, this is not by itself reason for alarm. But the same innovations that decrease the expected bang per buck may also reduce the predictability of the effect of policy actions, or even increase the magnitude of the shocks with which monetary policy has to cope. So this analysis left many of us concerned about potential loss of monetary control. But so far the loss of control has not materialized. It is not even clear that monetary policy is less effective, requiring more vigorous actions by the monetary authorities to have the same effects. While it is always possible that with even greater proliferation of competitors for banks, and new substitutes for their assets and liabilities, policy effectiveness will suffer, I do not think we have immediate cause for alarm.

One of the predictions of these models does appear to have come true. These models always predicted that the relationship between output and the quantities of any particular notion of money was likely to be unreliable. Indeed, one feature of such models is that the quantities of particular near moneys or financial assets might even move opposite to the direction of narrowly defined money. So while financial innovations do not appear to have become a major problem for the conduct of monetary policy focusing on interest rates and user costs, they have perhaps fatally wounded monetary aggregate targets as a guide to policy.

Market Imperfections and the Difference between Internal and External Finance

Although I am not a fan of the dichotomy between the money and credit views emphasized in much recent literature, I am a fan of the efforts to understand better the role of financial market imperfections in

the transmission of policy. We do not live in an Arrow–Debreu world, or even a Modigliani–Miller world, in which a separation exists between the financial structure of a firm and its investment decisions. Asymmetric information and moral hazard, stressed by the authors and by much of the recent literature, are almost surely reasons for a wedge between the cost of internal and external funds. This literature tends to stress the need to compensate lenders for the cost of gathering information and monitoring, and for the risks and losses reflecting moral hazard that remain even after incurring those costs. Hence the premium shows up on the supply side, as in Gilchrist and Zakrajšek's Figure 1.

It is interesting to note that Meyer and Kuh, in their classic work *The Investment Decision*, stress the other side of the market in arguing that a wedge exists between the internal and external costs of capital. They emphasize reasons why the borrowers, managers, and entrepreneurs impute a higher cost to external than to internal funds. Arguing that in the modern firm there is a substantial separation of ownership and control, they give a long list of reasons for a preference for internal finance: bankruptcy and loss of their job, dilution of control, imposition by creditors of covenants and restrictions on their behavior, a minor share in equity returns. These reasons for a wedge are in the same spirit as, and complementary to, the reasons emphasized by the authors of the paper under discussion. I wish we knew more about the magnitude of both of these sources of market imperfection. My own guess is that the sources stressed by Meyer and Kuh are even more important than those emphasized by Gilchrist and Zakrajšek.

It would be very instructive, but probably quite difficult, to obtain quantitative measures of the magnitude of the wedge and of its sources on each side of the market. It is probably easier to get measures of the lender's premium because the lender's costs are more readily identified and because data on the lending of financial institutions are more readily available than the information required to estimate the borrower's premium. To my knowledge, remarkably little work of this sort has been done since the early work by Don Hester which investigated "the commercial loan offer function" and attempted to determine how the terms and conditions of bank loans, and their profitability, depend upon the characteristics of the borrowers. I hope such studies will be on the agenda for future research.

One could believe that a wedge is present between the costs of internal and external funds for the typical firm but not believe in the "financial accelerator," which creates a systematic variation in the wedge over the cycle or with the tightness of monetary policy. However difficult it is to get a precise estimate of the magnitude of the average wedge, it is going to be even more so to get at the more subtle question of its cyclical variation. My own guess is that much of the time, and for many cycles, the financial accelerator is relatively unimportant, but that

in episodes like the recent New England experience, the accelerator is at work in an important way. The lesson is not to assume that what you see every day is what you are going to see in the extreme; and monetary authorities are well advised to worry about the increased sensitivity of response to their actions in circumstances where unusually large numbers of firms have unusually high leverage or low coverage.

Testing the Usefulness of Credit Flows in Predicting Economic Activity

One way to test for the presence of financial market imperfections is to examine the value of the borrowing rates of "low-quality" firms relative to "high-quality" firms in predicting aggregate variables. The authors report four sets of vector autoregressions testing the usefulness of such variables in forecasting economic activity. They find that in bivariate regressions relating various debt measures to GNP, industrial production, inventories, and employment, the ratio of the short-term debt of small manufacturing firms to that of all manufacturing firms does well. In their words, the results provide "strong support for the hypothesis that credit flows between small and large firms predict real economic activity." However, as the authors note, there is an awkwardness, in that the predictive power of this variable is captured almost entirely by the quantity of large-firm, short-term debt; large-firm debt is significantly and negatively related to economic activity. Small-firm debt has a positive but insignificant effect.

The authors downplay this result, noting that the predictive power of the small/all mix remains when other variables, including the federal funds rate and inflation, are included. They also note that with the inclusion of such variables, the predictive power of large-firm debt variables is diminished. In these multivariate VARs, the only case where large-firm debt by itself is even marginally significant is the case of inventories. In these multivariate regressions, I am puzzled by the difference in results for the exclusion tests and for the tests on the sum of coefficients. For example, the sum of coefficients for large-firm, short-term debt is significant for both industrial production and employment, but not for inventories, whereas according to the exclusion tests it is most significant for inventories. Of course this result is logically possible, but with the number of degrees of freedom it seems somewhat surprising. The sensitivity of results to the precise specification is disconcerting and suggests that the power of the tests is low; in any case, it may be desirable to downplay the significance of the bivariate results. The authors also note that, contrary to the suggestion of the theory, the ratio of bank loans to bank loans plus commercial paper does not do too well—it is only marginally significant in the bivariate regressions.

How are we to interpret the success of the ratio of small-firm to all-firm debt in predicting economic activity, particularly when small-firm debt by itself does not to appear to play a particularly important role? One possibility is that it simply reflects the nonlinear treatment of large-firm debt, which does so well in the bivariate regressions and which enters in the denominator in these regressions. Another possibility is that small-firm and large-firm debt move together much of the time, but that during downturns or credit crunches, something special happens that is picked up by the ratio. Possibly the variable is a proxy for a subsample of the period that is particularly important for the results—for example, the highly inflationary period at the end of the 1970s and the tight money period that followed. This suggests, together with the significant changes in institutions, regulations, and market instruments over the sample period, the desirability of testing for the stability of the relationships over time. In the same spirit, the presumption that a firm's financial conditions are nonlinearly related to borrowing premiums suggests examining special episodes—credit crunches or periods of widespread financial stress—where these effects would be largest. While the authors do not report such tests for the VARs, they do follow this strategy when they explore the effect of cash flow on inventories.

Just as it is interesting to know what we can infer about future economic activity from the debt variables, it is desirable to have some sense of the proximate determinants of the debt variables themselves. The authors provide a set of VARs that include the debt variables, the federal funds rate, and, in some cases, industrial production. In the bivariate VARs the federal funds rate appears to have a significant effect on small-firm and large-firm bank and other debt, as well as on the small/all mix. However, the significance of the federal funds rate is reduced when industrial production is included, suggesting that much of this effect is indirect; it appears that economic activity, which could be affecting either the demand for or the supply of credit, is the major determinant of the debt variables.

The authors also exploit the firm-level QFR data to examine the sensitivity of inventory investment to cash flow, controlling for sales and a firm-specific inventory/sales ratio. Classifying firms into four categories by leverage, they find that the higher the leverage, the larger the effect of cash flow on inventory holdings, suggesting highly levered firms have a larger external finance premium. The use of firm data also provides the degrees of freedom to enable them to estimate the importance of cash flow for two-year subperiods. An interesting and suggestive finding is that the differential response for low- and high-leverage firms, always in the expected direction and frequently significant, is most dramatic in the 1980–82 downturn and following the monetary contraction in 1989. The authors calculate that the share of

inventories that falls into the high-leverage category not only is significant but rises dramatically following tight-money episodes and during recessions. These results suggest that the credit effects are not only significant in the aggregate but likely to become even more important in sustained downturns.

In closing, I would like to congratulate the authors for producing an interesting and stimulating paper. It is an excellent model of how to use firm-level data to shed light on the behavior of the aggregate economy and on the interplay between financial and real activity. Yet much remains to be done, and I look forward to the next installments.

Discussion

Stephen D. Oliner*

Over the past few years, the team of Mark Gertler, Simon Gilchrist, and Egon Zakrajšek has produced important research on the transmission of monetary policy. Their work has highlighted the differential effect of policy actions on small and large firms, based on a careful analysis of data presented in the Census Bureau's *Quarterly Financial Report for Manufacturing, Mining and Trade Corporations*, the so-called QFR data. This experience makes Gilchrist and Zakrajšek eminently qualified to write the paper for this session of the conference.

The core of their paper is a progress report on research using the QFR data. Most of the results will be familiar to readers who have followed this literature, but the authors also present several new findings. The results, they argue, provide compelling evidence in favor of an important credit channel for monetary policy, especially one that operates beyond the confines of the banking sector. I agree with most of the points in the paper. In particular, I am persuaded that a credit channel does exist and that bank loans are not the sole vehicle for this channel. However, in my view, the research to date has yet to establish that the credit channel is a consistently important part of the transmission mechanism. Much further research is needed, both to determine the aggregate importance of the credit channel and to expand our still incomplete understanding of the differential effects of monetary policy.

Before turning to more specific comments, it may be helpful to

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clarify some terminology concerning a credit channel for monetary policy. The paper correctly distinguishes two possible forms of the credit channel. In the first, which the authors call simply the "credit channel," policy actions affect the supply of loans from commercial banks and other depositories and, in turn, the real spending of borrowers with limited access to nonbank funding. Because this channel ascribes a special role to banks, I will refer to it as the "bank credit channel," eschewing the less precise term used in the paper. The second possible form of a credit channel emphasizes capital market imperfections that have nothing to do with banks per se. That is, owing to information asymmetries, some borrowers must pay a premium to obtain external finance. Monetary contractions can magnify this premium by worsening the balance sheets of such borrowers. The authors call this mechanism the "financial accelerator." However, to draw a sharper contrast with the transmission channel that stresses the role of banks, I will term this mechanism the "broad credit channel."

Review and Evaluation of Main Results

The paper begins by arguing that aggregate data are useless for assessing the existence or importance of either version of the credit channel. This point is surely correct and indeed has become the conventional wisdom in recent years. The basic problem is that aggregate data cannot distinguish shifts in loan supply from shifts in loan demand. Evidence that both output and borrowing drop after a monetary contraction 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. Given this severe identification problem, researchers have focused on the behavioral differences across firms to test for a credit channel. All the QFR research reported in the paper follows this testing strategy.

As noted in the introduction, the paper builds a strong case for the *existence* of a credit channel. The authors present several lines of evidence to make this case, relying mostly on results obtained from research with the QFR data. I will briefly review the principal conclusions to be drawn from this research.

The first conclusion is that *monetary policy actions have a much stronger effect on small firms than on large firms*. This was clearly established in Gertler and Gilchrist (1994), who used QFR data for the manufacturing sector to examine the effects of monetary contractions. After a shift to tight money, they find that sales, inventories, and short-term debt all contract at small firms relative to large firms. A skeptic could argue that these differences reflect unequal shifts in demand faced by small and large firms, rather than the operation of a credit channel. However, Bernanke, Gertler, and Gilchrist (1994) show that the relative contraction

of small firms persists after controlling for differences in the industry mix of the two groups.

Moreover, *considerable evidence suggests that a credit channel of some type operates for small firms.* The first strand of evidence concerns the behavior of the inventory-sales ratio and the ratio of short-term debt to sales across small and large firms. As shown in Gertler and Gilchrist (1994), both ratios rise at large manufacturing firms after a monetary contraction, as these firms apparently borrow to finance an unexpected inventory accumulation and, more generally, to smooth through an unanticipated drop in cash flow. In contrast, these ratios increase little if at all for small firms, suggesting that they have limited access to the credit needed to perform this smoothing. The second strand is the large body of work that documents the "excess" sensitivity of inventory accumulation and fixed investment of small firms to balance sheet conditions. The paper discusses much of this work—especially that based on QFR data—and adds several new results that bolster the conclusions of the existing literature. This research implies that monetary policy operates, in part, through a credit channel for small firms by affecting the health of their balance sheets and hence their access to credit.

Although the precise form of this credit channel is still open to debate, *the QFR research to date is more consistent with a broad credit channel than with one that operates exclusively through the banking sector.* As shown in Gertler and Gilchrist (1993), Oliner and Rudebusch (1995a, b), and the current paper, monetary contractions since the mid-1970s have prompted a general reallocation of credit toward large firms but not a significant shift in the mix of bank and nonbank debt for either small or large firms. If monetary policy operated strictly through a *bank* credit channel, we would expect to observe a decline in bank loans relative to nonbank debt for at least some firms. The absence of such a shift in mix argues against the bank version of the credit channel. At the same time, the widespread diversion of credit away from small firms provides support for the broad credit channel, which stresses the information asymmetries faced by all lenders. That is, a move to tighter monetary policy tends to worsen balance sheet conditions. In that environment, firms that present severe information problems—notably, small firms—will find that all forms of credit become less available, consistent with the QFR results.

The authors argue not only that a credit channel exists but also that it represents an important part of the monetary transmission mechanism. They present two pieces of evidence to support this assertion. First, they show that reallocations of credit toward large firms are strongly associated with a subsequent weakening of aggregate activity. Second, they note that the firms found to be credit-constrained in various QFR studies account for a sizable part of the manufacturing

sector—roughly one-third of the sector's sales, inventories, and capital stock.

Although I do not dispute these points, neither one establishes that the credit channel is important. The basic problem is that actions by unconstrained firms may offset the adverse effects of monetary policy on firms that face financial constraints. For example, assume that the Fed tightens monetary policy, reducing demand for automobiles through the standard interest rate channel. In response, General Motors cancels an order for auto parts with one of its small suppliers. This supplier, already financially shaky, cannot obtain credit to offset the lost revenue and has to shut down. However, if a larger, healthy competitor can step in immediately and fill the firm's remaining orders with no rise in price, the net effect of the credit channel would be zero. If this scenario were repeated throughout the economy, the data would show a significant redistribution of sales from small to large firms. Yet the decline in aggregate activity would be unrelated to the credit channel. Although this example is admittedly extreme, it illustrates a key point: The evidence in the paper shows only that the credit channel is potentially important, not that it is important. No convincing case for the importance of the credit channel can be made until much more is known about the strategic reactions of firms to the financial distress of their competitors.

Areas for Further Research

Overall, the QFR research has yielded some valuable stylized facts: (1) that small firms bear a disproportionate hit from monetary contractions, due at least in part to the operation of a credit channel, and (2) that the credit channel does not appear to be confined to bank lending. However, our understanding of the microeconomic mechanisms behind these stylized facts is still seriously incomplete. The remainder of my remarks will identify areas in which I see a high payoff from further research.

Behavior of Nonbank Financial Institutions

To determine whether banks play a special role in the transmission of monetary policy, we need to better understand the response of nonbank financial institutions, principally finance and insurance companies, to policy actions. Such information would provide a benchmark against which to evaluate the lending behavior of banks.

As discussed earlier, the QFR data show that monetary contractions over the past 20 years have not significantly altered the mix of debt for either small firms or large firms. This finding suggests that banks, as a rule, have not tightened credit supply to a greater degree than nonbank

lenders. However, this result is based on the published QFR data, which disaggregate total manufacturing only into broad size classes. An obvious next step would be to repeat this analysis using the underlying firm-level QFR data, which the authors could do rather easily. This would indicate whether the limited disaggregation in the published QFR data has masked interesting movements in the debt mix for individual firms.

While that exercise would be useful, we must move beyond the QFR data to fully understand the lending behavior of nonbank financial institutions. Both the published QFR data and the underlying micro data lump together all forms of nonbank debt other than commercial paper. As a result, one cannot discern anything about the relative movements of publicly issued bonds, loans and leases from finance companies, private placements of debt with insurance companies and other investors, and loans from family members, friends, and other nonfinancial businesses.

Two projects now under way at the Federal Reserve may eventually shed light on the lending behavior of nonbank financial institutions relative to banks after monetary shocks. Carey, Post, and Sharpe (1995) have begun to analyze a large data set of business loans extended by banks and finance companies to publicly traded firms, the terms of which have been disclosed in filings to the Securities and Exchange Commission. Their results, though still quite preliminary, clearly show that the finance companies lend, on average, to firms with weaker balance sheets than do banks. At the same time, they find little difference across the bank and finance company borrowers with regard to variables often viewed as proxies for the degree of information asymmetry—the ratio of R&D to sales, the ratio of market to book value, the growth of sales, and firm size. These results indicate that banks have no monopoly on lending to information problematic borrowers. Consequently, one might expect their data to show that banks and finance companies respond in a roughly similar manner to a tightening of monetary policy.

The second project involves the analysis of data collected by the 1993 National Survey of Small Business Finances, which was cosponsored by the Federal Reserve Board and the Small Business Administration. This is the second wave of the Small Business Survey; the first was conducted in the late 1980s. Both waves collected a wealth of data on the characteristics of small businesses and their use of financial services. (See Cole and Wolken (1995) on the 1993 survey, and Elliehausen and Wolken (1990) on the earlier survey.) The 1993 survey will be especially valuable for comparing the behavior of banks and other intermediaries, as it obtained information about each firm's most recent experience applying for credit, including applications that were denied. Although a public-use data tape is not yet available, Federal Reserve

staff have begun to analyze the 1993 survey data, and I would expect to see interesting results in the near future.

Trade Credit

The role of trade credit in the monetary transmission mechanism is a second area worthy of further research. Going back at least to Meltzer (1960), some observers have argued that the extension of trade credit can offset tighter loan supply at banks and other intermediaries, short-circuiting any credit channel. That is, firms with large cash holdings or free access to credit markets can, in effect, provide credit to constrained firms by allowing slower payment for purchased goods. Typically, this trade credit is believed to flow from large firms to small firms.

The analysis to date with QFR data, however, does not support the operation of this mechanism. Both Gertler and Gilchrist (1993) and Oliner and Rudebusch (1995a) examined the movements in trade payables for small manufacturing firms. After monetary contractions, Oliner and Rudebusch found that small-firm trade payables declined about in proportion with their other short-term debt, while Gertler and Gilchrist found that trade payables actually fell as a share of such debt. Although these results cast doubt on the Meltzer story, they are based on the publicly available QFR data and thus do not indicate what is happening for individual firms. It would useful to repeat this analysis with the micro QFR data, which would show whether trade credit functions as a substitute for other debt for certain types of small firms—especially those with sharply deteriorating balance sheets. Case studies likely would be of value as well. A case study could identify each of the firm's suppliers, enabling one to examine the behavior of trade credit with each individually. This level of detail is needed to reconcile the available QFR results with the notion that trade credit provides a buffer against shortfalls in loan supply.

Heterogeneity of Small Firms

The QFR research to date has treated small firms as a homogeneous group, showing that these firms behave differently than large firms. This approach ignores the interesting differences within the population of small firms. Notably, the dependence of small firms on bank loans varies widely by firm size. For firms with fewer than 10 employees, the 1993 Small Business Survey found that only about one-third obtained any credit at all from commercial banks. These firms often lack the track record and collateral required to obtain loans. In contrast, more than three-quarters of firms with 100 to 499 employees had outstanding bank loans. This pattern suggests that a bank credit channel would be less relevant for the smallest firms in the economy than for those slightly

further up the size distribution.[2] Further study of this issue would enhance our knowledge of the differential effects of monetary policy.

Related to this point, we need to better understand the effect of banking relationships on credit availability for small firms. This conference has stressed the importance of these relationships, and rightly so. From the bank's perspective, an ongoing relationship has value because it generates inside information about the firm that can yield monopoly rents. Ending the relationship can be costly because the bank gives up its monopoly power. Thus, banks must make hard decisions when rationing credit after a monetary tightening, and one might expect a long-standing relationship to mitigate any restriction of loan supply. Deeper knowledge about the operation of a credit channel requires that we investigate who gets rationed and why.

Conclusion

The authors should be commended for writing a useful summary of the research on the differential effects of monetary policy on small and large firms. They provide strong evidence that small firms contract relatively sharply after a shift to tight monetary policy and that this difference reflects, at least in part, the existence of a credit channel. In addition, any such credit channel does not appear to operate exclusively through the banking sector. However, the paper does not provide a persuasive answer to the central issue of this conference—namely, "Is bank lending important for the transmission of monetary policy?" This is not a failing of the paper per se. Rather, the profession has yet to establish that *any* credit channel accounts for much of the real effect of policy actions, much less a credit channel that focuses on the role of bank lending. My comments have outlined some avenues for fruitful research, and clearly much work remains to be done.

[2] Of course, the broad credit channel remains quite relevant for the smallest firms. Given their limited access to bank loans and other types of credit, these firms are less able to smooth through shocks to cash flow than are firms that face a smaller premium for external funds.

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What Is the Experience from Abroad?

What is the international evidence on the effects of financial constraints on firms' decisions? How do capital market imperfections influence fixed investment, inventories, employment, and debt decisions? Are these effects dramatically different between developed and developing countries?

Financial Constraints and Investment: A Critical Review of Methodological Issues and International Evidence

Fabio Schiantarelli*

In recent years there has been a resurgence of interest in the determinants of firms' investment decisions. The empirical shortcomings of existing models, developed mainly under the assumption of perfect capital markets, and theoretical advances in the field of information economics have stimulated an explosion of studies focusing on the effects of financial constraints on investment.

The purpose of this paper is to provide a critical assessment of the methodological issues involved in testing the implications of capital market imperfections for investment, and to offer a critical review of the econometric evidence on this topic. In particular, the paper will concentrate on the empirical contributions that have used firm-level panel data. It is the increased availability of panel data that has resulted in the burst of empirical work in recent years. With firm-level panel data, a researcher can examine how the incidence and severity of information and incentive problems vary across firms and over time and investigate the differential effects on investment. Finally, I will adopt an international perspective and comment on the econometric evidence on firm investment behavior available for both developed and less developed countries.

I begin with a brief review of the theoretical arguments that explain why information and incentive problems introduce a wedge between the costs of internal and external finance; the paper then outlines the implications for investment decisions. The following section explores

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the methodological issues involved in testing for the importance of financial constraints using Q models of investment. The tests for the presence of financing constraints have consisted mainly of adding proxies for the availability of internal funds and/or firms' net worth to the model derived under the assumption of perfect capital markets, and investigating whether these proxies are significant for the firms thought most likely to face information and incentive problems. The potential weaknesses of Q-based models will be discussed, in particular whether average Q adequately captures future profit prospects, and possible solutions to this problem will be reviewed. The most widely used alternative approach has been to estimate the Euler equation for the capital stock. Its advantages and drawbacks are reviewed as well.

In both the Q and the Euler equation approaches, it is necessary to partition the sample of firms (or firm-year observations) according to the likelihood that they will suffer from information or incentive problems. The next section, therefore, investigates the conceptual and econometric problems involved in the choice of the criteria used in splitting the sample. The main issue here is how to deal with the potential endogeneity of the sample stratification criteria commonly used. Another important problem is the choice between time-invariant and time-varying classifications, and between criteria based on single or multiple indicators of firms' financial status.

A critical assessment of the evidence available for several developed and developing countries follows. The discussion is organized around the various criteria used to classify the observations both cross-sectionally and over time (dividend payout behavior, association with business groups and banks, size, concentration of ownership, and the like). I also review the evidence on variations over time in the tightness of financial constraints due to changes in business cycle conditions or in the stance of monetary policy, and those due to financial markets reforms. In the final section, I offer some concluding remarks and suggestions for future work.

Information and Agency Problems, Substitutability between Internal and External Finance, and Investment

According to the Modigliani-Miller theorem (1958), a firm's capital structure is irrelevant to its value. Internal and external funds are perfect substitutes and a firm's investment decisions are independent of its financing decisions.

However, the irrelevance hypothesis fails in the presence of informational asymmetries and contract enforcement problems. These problems may give rise to agency costs. Myers and Majluf (1984) point out the informational asymmetry problems of equity financing. They show

that if outside investors are less well informed than managers about the value of the firm's assets, then, because of adverse selection, they will demand a premium to purchase the firm's shares, in order to offset the losses incurred from financing "lemons."

Stiglitz and Weiss (1981) show that informational asymmetries may cause credit rationing in the loan market. Since the project risk is unobservable, lenders cannot discriminate by price between good borrowers and bad. When the interest rate rises, relatively good borrowers drop out of the market, increasing the probability of defaults on loans made and, possibly, decreasing lenders' expected profits.[1] In equilibrium, lenders may set an interest rate that leaves an excess demand for loans. The possibility of credit rationing in the context of optimally designed contracts has also been suggested by Williamson (1987), using the costly state verification model in which profit outcomes can be observed only at a cost.[2]

Jensen and Meckling (1976) argue that the presence of limited liability debt will give rise to moral hazard problems, in the sense that a firm may have the incentive to opt for excessively risky investment projects, even if these projects are value-decreasing. When debt holders anticipate this behavior, they will demand a premium on the debt they purchase or covenants that restrict the firm's future use of debt. Moreover, Myers (1977) shows that when a firm is partly debt-financed, it may forgo projects with positive net present value because the returns from such investment may be captured by debt holders.

Jensen and Meckling also consider the potential conflict of interest that may arise between managers and outside shareholders. If managers have less than a 100 percent stake in the company, they may have an incentive to use firm resources in the form of perquisites or other wasteful activities. Such activities can be monitored, at a cost, and ultimately the insiders will bear the cost in terms of a reduced price that prospective shareholders are willing to pay for a stake in the firm.

The informational asymmetries, costly monitoring and contract enforcement, and incentive problems outlined above lead to an imperfect substitutability between internal and external funds. The consequences of these information and incentive problems for investment have been explored in a set of more recent papers by Bernanke and Gertler (1989, 1990), Gertler and Hubbard (1988), Calomiris and Hubbard (1990), Gertler (1992), Kiyotaki and Moore (1993), and Greenwald and Stiglitz (1988, 1993). Although the models differ in their details, two

[1] See also Jaffee and Russell (1976).

[2] See Townsend (1979) and Gale and Hellwig (1985).

main results emerge from this literature.[3] First, unless the loans are fully collateralized, external finance is more costly than internal finance. Second, the premium on external finance is an inverse function of a borrower's net worth (liquid assets plus the collateral value of illiquid assets). It follows that negative shocks to net worth lead to an increase in the premium and, therefore, to a reduction in investment and production. For this reason the initial impact of the shock will be amplified (the so-called "financial accelerator" effect).

All this has important consequences for the channels of transmission of monetary policy. An increase in the interest rate will work not only through the traditional impact on the user cost of capital, but also through the adverse impact on the present value of collateralizable net worth, widening the wedge between the costs of external and internal finance. Moreover, insofar as some borrowers are dependent upon banks because of information problems, monetary policy may restrict the supply of loans or increase their cost for this category of borrowers, inducing them to reduce their investment.[4] Finally, the existence of information and incentive problems means that tax policy will operate through both marginal and average rates. Although it is marginal rates that matter in calculating the tax benefits of an additional unit of capital spending in a world of perfect capital markets, it is the average tax rate on cash flow from existing assets that determines the (post-tax) availability of internal funds for investment.

Testing for Financial Constraints Using Q Models

The basic approach to testing for the importance of financial constraints has been to assess whether firms that suffer more from information and incentive problems experience significant departures from standard models derived under the assumption of perfect capital markets. Such models are more likely to be misspecified, and these firms' investment is likely to be more sensitive to fluctuations in the availability of internal finance and in proxies for internal net worth.

Many of the empirical tests of the importance of financial constraints for investment have used, as a point of departure, the standard model of investment based on the assumption of convex adjustment costs. Consider, for simplicity, a firm that can only finance itself either through retentions or new share issues. Under the assumptions of perfect competition, linear homogeneous technology, and capital as the

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[3] See Gertler (1988); Bernanke, Gertler and Gilchrist (1995); and Hubbard (1995) for another perspective on the set of issues discussed in this paper.

[4] See Bernanke (1993); Kashyap and Stein (1994); Hubbard (1994); and Cecchetti (1994) for a fuller discussion.

only quasi-fixed input, average Q is a sufficient statistic for investment. Conditional on Q, no other variable should matter when the firm is either paying positive dividends or issuing new shares. The investment equation under quadratic adjustment costs can be written as:

$$\frac{I_{it}}{K_{it}} = a + \frac{1}{b} Q_{it} + \varepsilon_{it}. \tag{1}$$

I_{it}/K_{it} denotes the investment rate. b is the multiplicative parameter in the adjustment cost function, a is the nonstochastic additive parameter. ε_{it} includes its stochastic additive component.

When the tax rate on dividends exceeds the tax rate on capital gains, it is well known that the standard formulation of Q models implies that firms will not pay dividends and issue new shares at the same time. Under retention financing, the definition of tax-adjusted Q_{it} is:

$$Q_{it} = \frac{\beta_{it}(V_{it} - H_{it})}{\gamma_t(1 - \tau_t)P_{it}(1 - \delta)K_{it}} - \frac{P^k_{it}(1 - \xi_t)}{P_{it}}, \tag{2}$$

where β_{it} is the firm discount factor, V_{it} the market value of the equity, H_{it} the present value of tax savings on existing capital goods, P_{it} the price of output, P^k_{it} the price of investment goods, τ_t the corporate tax rate, ξ_t the present value of the tax savings on new investment, and δ the depreciation rate. γ_t is the tax price of retentions in terms of dividends and equals $(1 - m_t)/(1 - z_t)$, where m_t is the tax rate on dividends and z_t is the tax rate on capital gains.[5] When the firm finances itself through new share issues, the only difference is that γ_t is replaced by one in the definition of Q_{it}. Let us think of the error term as containing a firm-specific, time-invariant component, ν_i, an idiosyncratic component, υ_{it}, and a common time component, η_t; that is, $\varepsilon_{it} = \nu_i + \upsilon_{it} + \eta_t$. We can eliminate the firm-specific, time-invariant component of the error term by appropriate transformations of the observations and include time dummies to account for time effects that are common across firms.[6] Even after these transformations, one should consider that Q_{it} is likely to be correlated with the idiosyncratic component of the error term, either because the latter is the stochastic additive component in the adjustment cost function or because of measurement error. For this reason, an Instrumental Variable (IV) or Generalized Method of Moments (GMM) procedure is appropriate, although many empirical contri-

[5] Tax parameters have been assumed constant across firms for simplicity. Moreover, it has been assumed that new investment becomes productive immediately.

[6] Taking first differences, deviation from firm means or orthogonal deviations would accomplish the desired effect.

butions rely on the Least Squares Dummy Variables (or Within) estimator.[7]

If dividends have been exhausted and yet it is not profitable to issue new shares today, or if this is expected to be the case in the future, marginal Q and average Q no longer are equal to each other, and it is not possible to find a relationship between average Q and the investment rate that does not involve present or future values of the unobservable non-negativity multiplier for dividends.[8] In this financing regime, investment simply equals cash flow. If a researcher estimates equation (1) using a definition of Q_{it} derived under the assumption that the firm either has not exhausted retentions or is issuing new shares, this will lead to misspecification. This model can be enriched by specifying the kind of capital market imperfection that firms may face. For instance, Fazzari, Hubbard, and Petersen (1988) in their seminal paper suggest that firms have to pay a lemon premium s_{it} for issuing new shares, as suggested by Myers and Majluf (1984). In this case, $1 + s_{it}$ should replace γ_{it} in the definition of Q_{it}. The existence of a premium on new equity issues increases the range of values of Q_{it} for which dividends have been exhausted, and yet it is not profitable to issue new shares.

Debt can also be introduced in the problem. Assume that incentive problems are more severe when the amount of debt is large relative to the value of collateral. If the premium above the safe rate increases linearly in leverage, the only change in the model is that the value of debt must be added to the market value of shares in the numerator of Q_{it} so that this form of imperfection per se does not call into question the validity of Q models. Obviously, in this case also the Q model is misspecified if the firm pays zero dividends and issues no new shares. Another form of misspecification can also be generated if a ceiling on the amount of debt a firm can issue is introduced, and such a ceiling is binding.[9] Even if the firm pays and is expected to pay dividends in the future, it is easy to show that additional linear and quadratic terms in the debt-to-capital ratio should appear in equation (1).

The implementation of the test for the presence of financial constraints has consisted, following Fazzari, Hubbard, and Petersen (1988), of adding proxies for the availability of internal funds and/or net worth to the equation and checking whether they are significant for the firms that a priori are thought more likely to face information and incentive

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[7] See Arellano and Bond (1992) for a discussion of the GMM estimator in the context of panel data. See also Hayashi and Inoue (1991) and Blundell, Bond, Devereux, and Schiantarelli (1992) for a discussion in the context of Q models. If a first-difference transformation is used, and the error term in the level equation is white noise, the investment rate or Q lagged twice would be legitimate instruments.

[8] It is assumed for simplicity that the minimum dividend payment is zero.

[9] This issue is discussed at length below in the context of the Euler equation approach.

problems. The measurement of net worth (liquid assets plus the collateralizable value of illiquid assets) is a very difficult problem in an intertemporal context, since it is related to the expectations of future returns. Typically, cash flow is used as a proxy for internal net worth in empirical work. Sometimes stock measures of liquidity are also included. Both cash flow and liquid assets not only act as proxies for net worth (which is inversely related to the premium to be paid for external finance), but also convey information about what proportion of investment spending can be internally financed. All the theories surveyed above suggest that internal funds are less costly than external finance, so that an increase in liquidity is likely to lead to greater investment.

The cross-sectional criteria most commonly used to identify firms for which information and agency problems are more severe are the dividend payout ratio (Fazzari, Hubbard, and Petersen 1988), the affiliation to industrial groups and to banks (Hoshi, Kashyap, and Scharfstein 1991), size and age (Devereux and Schiantarelli 1990), the presence of bond ratings (Whited 1992), degree of shareholder concentration, and one or more of the above (Oliner and Rudebusch 1992, Schaller 1993). The next section will discuss the issues involved in choosing the criterion for sample separation; then the international evidence will be reviewed in detail. On the whole, the evidence from both developed and developing countries suggests that, for a subset of firms, internal and external finance are not perfect substitutes and that, for these firms, investment decisions display excess sensitivity to the availability of internal resources.[10] Evidence also shows that cash flow is significantly related to investment for the group of firms that are thought a priori to be less likely to face financial constraints (although not as strongly as for constrained firms).

The basic problem with testing for financial constraints in the context of Q models is that average Q may be a very imprecise proxy for the shadow value of an additional unit of new capital. The model can be extended to allow for imperfect competition in output markets and for the presence of more than one quasi-fixed factor. This introduces a wedge between marginal and average Q that is a function of observable

[10] Chirinko (1994) argues that care must be taken in interpreting the difference in the cash flow coefficients as a sign that firms are differentially constrained. He produces a model based on the presence of flotation costs in which the size of the latter depends upon the ratio of the cash flow and Q coefficients. It is debatable, however, if one would want to summarize the degree of financial constraints faced by firms on the basis of the parameters of the flotation cost function. Nevertheless, there is a genuine difficulty in giving a "structural" interpretation to the cash flow coefficient, since one is forced to specify the precise form of the capital market imperfection to be included in the firm's optimization exercise. This problem had been noted by Devereux and Schiantarelli (1990), who had assumed that the interest rate paid by firms was a function of the cash flow rate, as well as leverage.

variables, and Q models can be reformulated to account for all this.[11] However, when stock markets are not efficient and stock prices are driven by fads and fashions, or when market expectations and insider expectations diverge, this problem is not easily fixed.[12] When Q does a bad job in measuring investment opportunities, the significance of cash flow may simply reflect the fact that it contains information about future profitability. This may be particularly true for firms that are classified a priori as more likely to suffer from information problems, so that differences in cash flow coefficients across firms cannot be interpreted as representing only the incidence and severity of such problems.

One way to address this issue is to estimate the Euler equation for the capital stock derived from the same underlying model. Although this is the prevalent solution found in the literature (see the next section), I will first discuss other approaches that have been used to isolate the role of cash flow as a proxy for a firm's net worth. An attempt to separate the liquidity and informational content of cash flow is contained in Gilchrist and Himmelberg (1994). Following Abel and Blanchard (1986), they use a simple VAR on the profit rate and sales-to-capital ratio (in addition to aggregate variables) to calculate an estimate of the present value of profits resulting from an additional unit of capital today (its shadow value). This proxy is used in place of average Q in an investment equation that also contains cash flow. If the information set used in generating this proxy adequately represents the one used by the agents, the cash flow coefficient in the investment equation should reflect only its role as a source of internal liquidity or as a proxy for net worth. The evidence suggests that, even controlling for future profits, the previous conclusion on the relative magnitude of cash flow sensitivities between constrained and unconstrained firms is not affected.

Another approach is to identify changes in cash flow that represent variations in internal net worth or liquidity and at the same time are not correlated with investment opportunities. Lamont (1993) analyzes the investment behavior of U.S. companies that operate both in oil-related

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[11] If imperfect competition exists in the output market, the shadow value of the capital stock also depends upon present and future values of the capital output ratio. See Schiantarelli and Georgoutsos (1990) on estimating Q models under imperfect competition and Galeotti and Schiantarelli (1991) for a model that allows also for adjustment costs for labor.

[12] Under the assumption of perfect and efficient markets, a relationship exists between the quasi-difference in investment and dividends. Galeotti and Schiantarelli (1994) show that when a proxy for stock market fads is added to this model, it is a significant determinant of investment. On this issue see also Blanchard, Rhee, and Summers (1993) and Mork, Shleifer, and Vishny (1990). Both papers find that cash-flow-based proxies for fundamentals play a bigger role than Q in explaining investment. Again, however, the problem remains of sorting out the informational and liquidity roles of cash flow.

and non-oil-related lines of business. He finds that variation in the oil-related cash flow has an effect on the investment in non-oil-related business. This likely reflects the fact that cash flow plays a role that goes beyond providing information about future profitability. Calomiris and Hubbard (1993) and Cummins, Hassett, and Hubbard (1994) use, instead, changes in tax policies to identify changes in cash flow not related to future profitability. In particular, they analyze how investment reacts to changes in the relative taxation of retentions relative to dividends. If internal and external funds are perfect substitutes, one would anticipate that such tax changes should affect payout behavior but not necessarily investment. Conversely, firms should respond to a reduction, for instance, in the tax rates on retained earnings by increasing investment only if they face financing constraints. The evidence here is somewhat mixed. Tax-related fluctuations in cash flow had an effect on investment in some U.S. firms in the 1930s, but not in Germany, France, and Japan in the 1980s and 1990s.

Fazzari and Petersen (1993) sidestep the multiple roles played by cash flow by analyzing the relationship between investment and the variation in (end-of-period) working capital. Under the assumption that working capital is less costly to adjust than fixed investment, one would expect a negative relationship between the latter and the former in the presence of capital market imperfections, because working capital is used as a buffer to avoid changing investment when external funds are more expensive than internal resources or impossible to obtain. Since changes in working capital are likely to be positively related to profit expectations, their expectational role would instead generate a positive correlation with fixed investment. The fact that working capital is significantly and negatively related to fixed investment for low-dividend-paying U.S. firms is suggestive of the importance of capital market imperfections.

Controlling for Profit Opportunities Using the Euler Equation Approach

The main alternative to using augmented Q models of investment consists in directly estimating the Euler equation for the capital stock. The advantage of the Euler equation approach is that it avoids relying on measures of profitability based on firms' market value. The Euler equation is a different way to rearrange the first-order conditions from the same maximization problem used to derive Q equations.[13] It states

[13] It should be clear that neither the Q nor the Euler equation approach yields an investment *rule*, in which investment is written as a function of predetermined variables and present and expected values of exogenous variables.

that the value of the marginal product of capital today, net of adjustment costs, must equal the cost of a new machine minus the cost savings due to the fact that the firm can invest less tomorrow and still maintain the capital stock on its optimal path. More precisely, allowing for imperfect competition in the output market:

$$\frac{1}{1+\mu}\left[F_K(K_{it}, L_{it}) - G_K(I_{it}, K_{it}) - G_I(I_{it}, K_{it})\right] = \frac{(1-\xi_t)P^k_{it}}{(1-\tau_t)P_{it}} -$$

$$E_t\left\{\psi_{i,t+1}\beta_{i,t+1}\frac{(1-\tau_{t+1})P_{i,t+1}}{(1-\tau_t)P_{it}}\cdot(1-\delta)\left[\frac{(1-\xi_{t+1})P^k_{i,t+1}}{(1-\tau_{t+1})P_{i,t+1}} + G_I(I_{i,t+1}, K_{i,t+1})\right]\right\}, \tag{3}$$

where output, Y_{it}, equals $F(K_{it}, L_{it}) - G(I_{it}, K_{it})$. $\psi_{i,t+1}$ represents $(\gamma_{t+1} + \lambda^D_{i,t+1})/(\gamma_t + \lambda^D_{i,t})$, where λ^D_{it} is the non-negativity multiplier for dividends. μ denotes the markup of prices over marginal costs assumed to be constant through time and $E_t(\cdot)$ the expectation formed at time t.[14]

For estimation purposes, under quadratic adjustment costs and linear homogeneity the equation can be written (omitting the constant term) as:

$$\frac{I_{it}}{K_{it}} = \left(\frac{I_{it}}{K_{it}}\right)^2 + \psi_{i,t+1}\beta_{i,t+1}(1-\delta)\frac{I_{i,t+1}}{K_{i,t+1}} + \left(\frac{1+\mu}{b}\right)\cdot\left[\frac{\pi_{it}}{P_{it}K_{it}} - \frac{(1-\xi_t)P^k_{it}}{(1-\tau_t)P_{it}} + \right.$$

$$\left. \psi_{i,t+1}\beta_{i,t+1}(1-\delta)\cdot\frac{(1-\xi_t)P^k_{i,t+1}}{(1-\tau_{t+1})P_{i,t+1}}\right] - \frac{\mu}{b}\left(\frac{Y_{it}}{K_{it}}\right) + v_{i,t+1} \tag{4}$$

π_{it} is net revenue minus variable costs and $v_{i,t+1}$ now also includes the error generated because expected future variables have been replaced by their realizations.[15]

Again, if the firm pays dividends in both periods, both λ^D_{it} and $\lambda^D_{i,t+1}$ will be zero. In this case $\psi_{i,t+1}$ will equal γ_t/γ_{t+1} and, conditional on defining a proxy for $\beta_{i,t+1}$, the Euler equation can be consistently estimated by IV or GMM techniques using, for instance, appropriately lagged values of the included variables as instruments. If no stochastic component is present in the adjustment cost function and there are no measurement error problems, $v_{i,t+1}$ is only an expectational error and variables dated $t-1$ are potentially legitimate instruments, after

[14] See the Appendix for details.

[15] Note that in equation (4), the term in square brackets is operating revenue minus Jorgenson's user cost of capital.

differencing to eliminate firm-specific, time-invariant components. Otherwise, variables lagged at least twice should be used as instruments. The test of the validity of the orthogonality conditions proposed by Hansen (1982) can be used as a general misspecification test. If the firm faces the zero dividend constraint in either of the two periods, the instruments will be invalid and the test of overidentifying restrictions should, in principle, lead to a rejection of the model.

When debt is introduced in the model, one has to make a choice on the source and form of the capital market imperfection. One possibility is to assume an exogenous limit on the amount of debt the firm can issue (Whited 1992; Hubbard and Kashyap 1992; Hubbard, Kasyap and Whited 1995). The Euler equation for capital is still equation (4). Using the first-order condition for debt, one can show that:

$$\beta_{i,t+1} = \frac{1 - \lambda_{it}^{B} + \omega_{i,t+1}}{\psi_{i,t+1}(1 + (1 - \tau_{t+1}))i_{t+1}}, \tag{5}$$

where λ_{it}^{B} is the multiplier associated with the debt ceiling and $\omega_{i,t+1}$ is the error in forecasting future variables in the first-order condition for debt. Substituting out $\psi_{i,t+1}$ in the Euler equation for capital using (5), and forgetting about $\omega_{i,t+1}$ for the moment, one can see that the firm discount rate equals the interest rate only when the firm is at an interior solution for debt. When the firm is at a debt ceiling, λ_{it}^{B} will differ from zero and this will invalidate the orthogonality conditions used in estimation; this will, hopefully, be detected by the test of overidentifying restrictions.

Notice that in order to implement this approach, the somewhat unpalatable assumption must be made that the conditional covariance between $\omega_{i,t+1}$ and the future variables in the Euler equation for capital is constant. The restrictiveness of this assumption must be traded off against the necessity to choose, again somewhat arbitrarily, a proxy for $\beta_{i,t+1}$ when the latter is not substituted out of the estimating equation.

Since the power properties of the test of overidentifying restrictions may be poor in some circumstances, in order to sharpen the test for financial constraints, the three papers mentioned above also adopt a different approach and they allow the multiplier to depend in an ad hoc fashion on variables that capture firms' internal net worth, like cash flow or general macroeconomic conditions. The coefficients on these variables measure the responses of the firm's discount rate to micro or macro factors, when financial constraints are binding.

Another option in modeling the nature of the financial constraints is to assume that the premium paid over the safe rate is a function of the debt-to-capital ratio. If this premium is linear in the degree of leverage and equals

$$\frac{c}{2}\frac{B_{i,t-1}}{P^k_{i,t-1}K_{i,t-1}},$$

then one needs simply to add the following term to the right-hand side of equation (4) (see Bond and Meghir 1994):

$$\frac{c(1+\mu)}{2b}\frac{\psi_{i,t+1}\beta_{i,t+1}(1-\tau_{t+1})B^2_{it}P^k_{it}}{(1-\tau_t)(P^k_{it}K_{it})^2P_{it}}. \tag{6}$$

This term basically contains the squared value of leverage and reflects the fact that an increase in capital lowers the premium for debt finance. Its significance is suggestive of the existence of a premium on debt. The augmented Euler equation will still be misspecified if the dividend constraint is binding in any period. Note that the sign of the leverage term should be positive, which means that a negative partial correlation should exist between leverage (squared) at the beginning of the period and investment during that period.[16]

A combination of the two approaches illustrated so far allows for a premium over the safe rate and uses the first-order condition for debt in order to substitute out $\psi_{i,t+1}$ from equation (4). If the solution for debt is an interior one, then:

$$\beta_{i,t+1} = \frac{1+\omega_{i,t+1}}{\psi_{i,t+1}\left(1+(1-\tau_{t+1})\left(i_{t+1}+\frac{c}{2}\frac{B_{it}}{P^k_{it}K_{it}}\right)\right)}. \tag{7}$$

This introduces additional nonlinear interaction terms between leverage and future variables in the model (see Johansen 1994b for a linearized version of this model).[17]

The assumption of an exogenous ceiling on debt is rather unsatisfactory. The firm's accumulation of collateralizable assets is likely to affect the maximum amount that firms are allowed to borrow. A simple way to capture this is to assume that a ceiling exists on the debt-to-capital ratio, implying that the maximum amount of debt is proportional

[16] Both capital and debt are defined as end-of-period quantities, so that equation (4) implies that leverage at the end of period t is negatively related to investment in t+1.

[17] For evidence of the effect of leverage on investment in the context of a more ad hoc specification of the investment equation, see also Harris, Schiantarelli, and Siregar (1994) for Indonesia; Calomiris, Orphanides, and Sharpe (1994) and Lang, Ofek, and Stulz (1995) for the United States; and Schiantarelli and Sembenelli (1995) for Italy. For evidence of the impact of the degree of indebtedness on the response of employment to demand shocks in U.S. firms, see Sharpe (1994) and Calomiris, Orphanides, and Sharpe (1994). Nickell and Nicolitas (1994) analyze the effect of leverage on employment, productivity, and wages in U.K. companies.

to the capital stock; that is, $B_{it}/K_{it} \leq M_{it}$. Assume, moreover, that the firm has to pay a premium for debt that is linear in leverage. Then the following term should be added to the right-hand side of the Euler equation (Jaramillo, Schiantarelli, and Weiss 1994):

$$\frac{c}{2}\frac{(1+\mu)\psi_{i,t+1}\beta_{i,t+1}(1-\tau_{t+1})B_{it}^2P_{it}^k}{(1-\tau_t)(P_{it}^kK_{it})^2}+\frac{\lambda_{it}^BB_{it}}{\gamma_t(1-\tau_t)P_{it}P_{it}^kK_{it}^2}. \tag{8}$$

The term containing the multiplier associated with the ceiling reflects the fact that additional units of capital are beneficial because they relax the borrowing constraint. Even if dividends are strictly positive in both periods, the unobservable multiplier associated with the debt ceiling appears in the equation when the ceiling is binding, and this again would invalidate the orthogonality conditions. However, if dividends are strictly positive, the first-order condition for debt can be used to substitute λ_{it}^B out in the Euler equation. This leads to the inclusion in equation (4) of the terms:

$$-\frac{c(1+\mu)}{2b}\left[\frac{\gamma_{t+1}(1-\tau_{t+1})\beta_{t+1}B_{it}^2P_{it}^k}{\gamma_t(1-\tau_t)(P_{it}^kK_{it})^2P_t}\right]+\frac{(1+\mu)}{b}$$
$$\cdot\left\{\frac{\gamma_t-\beta_{i,t-1}\gamma_{t+1}(1-\tau_t)i_{i+1}B_{it}P_{it}^k}{\gamma_t(1-\tau_t)P_{it}^kK_{it}P_{it}}\right\}. \tag{9}$$

The presence of a term that is linear in leverage and the fact that the sign of the quadratic term has changed relative to the case of a nonbinding ceiling (see equation (6)) allow one to assess which form, if any, of the imperfection is consistent with the data.

A detailed critical summary of the results will be provided in a later section. The overall evidence, however, suggests significant departures from the perfect capital market paradigm. Tests of the overidentifying restrictions tend to be rejected for the subsample of firms thought a priori to face more severe information and agency problems. For those firms, leverage terms also tend to be significant, indicating the existence of a premium on external finance and sometimes the existence of binding credit constraints. In some cases, signs of misspecification are also present for the firms for which the perfect capital markets assumption is thought to be more reasonable.

The main advantage of the Euler equation approach is that it does not rely on average Q to measure expected profitability. The market value of the firm (relative to the replacement value of the capital stock) may be a poor proxy for investment opportunities and, moreover, it precludes an investigation of those firms that are not quoted on the stock market; it is likely that information problems are particularly

severe for this kind of firm. Notice that in many countries, a significant fraction of production takes place in private companies. This is certainly true for developing countries, but it also applies to many developed countries.

What are the drawbacks of the Euler equation approach? A first potential problem has been outlined by Zeldes (1989) in the context of liquidity constraints on consumption. The Euler equation approach may fail to detect the presence of financial constraints if the tightness of such constraints is approximately constant over time. This can easily be seen by focusing on the non-negativity multipliers for dividends. If λ_{it}^{D} and $\lambda_{i,t+1}^{D}$ are close in value, then the evolution of $\psi_{i,t+1}$ in equation (4) will be dominated by the changes in the tax parameters. In this case, tests of overidentifying restrictions may not be able to detect departures from the null hypothesis of no constraints. Although this is a risk in very short panels, it seems less of a problem when data are available over a period of time long enough to record changes in individual firms' financial strength and in overall macroeconomic conditions. Moreover, we have seen that if one is willing to formulate the nature of the alternative hypothesis to be the one of perfect capital markets, this may introduce additional financial variables (like leverage or cash flow) into the investment equation. The significance of their coefficients may provide a sharper test of the financial constraints hypothesis.

Furthermore, parameter estimates in Euler equations are often sensitive to the normalization rule (Mairesse 1994). Although the overall conclusions on the importance of capital market imperfections tend not to be affected, the change in parameter estimates across normalizations is somewhat worrisome. Although it could be simply the result of the poor small sample properties of the GMM estimators used, it may, instead, be suggestive of some general form of misspecification that goes beyond capital market imperfections.[18] Some studies also show evidence of instability over time in the underlying adjustment costs parameters for both Euler and Q models.[19] Obviously, parameter instability in models derived under the assumption of perfect capital markets may be the result of the existence of financing constraints. For instance, changes in the tightness of the non-negativity constraints for dividends lead to variations in $\psi_{i,t+1}$, while changes in the tightness of the exogenous ceiling on debt lead to a non-stable relationship between the interest rate and the firm's discount rate $\beta_{i,t+1}$ in equation (4). However, parameter instability might also have a different origin. Ideally, what is needed are

[18] In order to sort out the origin of the problem, it would be useful to estimate the Euler equation with a method that is not sensitive to the choice of normalization, like limited information maximum likelihood (LIML).

[19] See Demers, Demers, and Schaller (1993); Oliner, Rudebusch, and Sichel (1995); and Hayashi and Inoue (1991).

tests of parameter stability for different categories of firms. Evidence of instability for firms that are not likely to suffer from financial constraints would be suggestive of the existence of additional specification problems. Both the Euler equation and Q types of investment equations share the same underlying model based on the assumption of convex adjustment costs. If there are fixed or linear components to adjustment costs, irreversibility constraints on investment, or other forms of asymmetries in adjustment costs, both models would be misspecified in a fundamental way for both groups of firms. Still, it is comforting that the model tends to be rejected more often for firms classified as constrained. The possibility remains that one may also be picking up differences in adjustment technology. This topic certainly deserves further investigation.

A final issue with the specification of the standard model of investment is the choice of the maximand itself. The underlying assumption in the standard models discussed so far is either that ownership and control coincide or that the managers' objective is to maximize the market value of shares of existing shareholders. However, managers may have incentives to make the firm expand beyond its optimal size because this increases their power by increasing the resources under their control. Moreover, their compensation may be directly tied to growth, or their chances of promotion may be de facto related to an increase in the size of the organization. In this situation Jensen (1986) suggests that the availability of "free cash flow" (cash flow in excess of that required to fund positive net present value projects) will lead to an increase in investment spending.[20] For this reason, the association between cash flow and investment may not reflect the information problems associated with new share issues or debt. It may instead be a sign of the non-value-maximizing behavior of management. This issue of interpretation affects the tests of the imperfect substitutability of internal and external funds conducted using either the Q or the Euler equation approach. Both models, in fact, include cash-flow-type variables.

The main problem with the "free cash flow" hypothesis is that it is difficult, if not impossible, to test, since the variable central to the hypothesis is essentially unmeasurable. However, the merit of the "free cash flow" hypothesis is to reemphasize the importance of agency problems between management and outside shareholders, described originally in Jensen and Meckling (1976), and to focus on managers' incentives and behavior as a potential source of the correlation between investment and liquidity. The actions taken to control management behavior (audits, budgetary restrictions, design of compensation sys-

[20] See Grossman and Hart (1982), Stulz (1990), and Hart and Moore (1990) for formal models of financial structure based on the disciplinary role of debt.

tems) are costly and generate a cost premium for outside equity finance. It may be difficult to distinguish this cost from the information costs due to adverse selection problems, described by Myers and Majluf (1984). More generally, it is possible that the desire by managers not to be subject to the close scrutiny that may occur when they resort to external finance, or the fear of being replaced in case of bankruptcy or changes in ownership, may lead them to rely primarily on internal funds in order to finance investment spending. These are certainly open and difficult questions for which no definitive answers are available, and they deserve further investigation. I will review the empirical results that bear on some of these issues in a later section.

Sample Separation Criteria

The common feature in almost all the tests of the effects of capital market imperfections on investment is that they are based on the identification of a subset of firms (or firm-year observations) for which financial constraints are likely to be more important. In this section I want to examine some of the general issues and problems involved in deciding how to partition the sample.

First, in some papers, a firm's classification in the financially constrained group or the unconstrained group is fixed over the entire sample period.[21] However, it is possible for firms to face financial constraints of varying intensity at different points in time. For instance, if average firm characteristics over the sample (like dividend behavior or size) or pre-sample characteristics are used, one is neglecting the information that the financial constraints may be binding for the same firm in some years but not in others. It would be more advisable in these cases to allow firms to transit between different financial states.

A second observation concerns the endogeneity of the sample-splitting criteria. Some, if not most, of the criteria used to split the sample are likely to be correlated with the firm-specific, time-invariant component of the error term, as well as with the idiosyncratic component. This is certainly true when one uses contemporaneous or average dividend payout behavior or firm size. Correlation with the time-invariant component can be easily eliminated by appropriate transformations of the variables used in the model (taking deviations from the firm's mean, first-differencing, and so on). Correlation with the idiosyncratic component can also be addressed in most, but not all, cases.

[21] For instance, in the paper by Fazzari, Hubbard, and Petersen (1988), firms are classified as low-paying or high-paying using the prevalent dividend payout ratio over the entire period used for estimation (1970 to 1984). Whited (1992) uses the pre-sample existence of a bond rating to classify firms. Hubbard, Kashyap, and Whited (1995) split the sample on the basis of dividend behavior in the two years preceding the estimation period.

Probably the simplest strategy is to use contemporaneous information in partitioning the observations in the context of a single equation, and use lagged information as instruments in the context of IV or GMM procedures. For instance, one could interact the cash flow coefficient with a dividend (size) dummy depending upon whether dividends are high or low (the firm is above or below a certain size). Alternatively, if we think that the severity of financial constraints varies continuously with certain characteristics like size, we may simply want to interact a measure of size with cash flow. In any case, consistent estimates can then be obtained using appropriately lagged values of these interaction terms.[22] If the model is first-differenced and the idiosyncratic component of the error term in the level equation is white noise, endogenous variables lagged twice would be legitimate instruments.

Thus, it is not necessary to split the sample on the basis of predetermined criteria in order to obtain consistent estimates of the parameters. For instance, using pre-sample information is certainly legitimate but may lead to a misclassification of firms in the later years of the panel. However, it is much more difficult to obtain consistent estimates when past, present, and future values of endogenous variables are employed in defining the dummy used to partition the sample (unless truly exogenous instruments are available that are reasonably correlated with the endogenous variables). This is the case when average (or prevalent) endogenous characteristics are used as sample separation criteria, because even lagged values of the interaction terms between the dummy and other regressors are correlated with the error term.

The issue of getting consistent coefficient estimates may not appear to be that important. Even if the estimates are biased, it could be argued, the estimated difference is not, provided that the bias is the same for the two sets of firms. This is a potential rationale for using the Least Squares Dummy Variable estimator when estimating Q equations. However, even abstracting from the issue of measurement errors that would invalidate this procedure, not properly accounting for the endogeneity of the selection criteria is likely to generate different biases for the two sets of firms. For instance, firms classified as constrained may be those with a higher correlation between cash flow and the unobservable component of investment opportunities, which is likely to lead to a larger upward bias on the cash flow coefficient.[23]

Another issue should be discussed in relation to sample separation.

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[22] See Harris, Schiantarelli, and Siregar (1994); Jaramillo, Schiantarelli, and Weiss (1994); and Bond and Meghir (1994), among others.

[23] This problem is related to the one that occurs in the Q formulation of the investment equation, when the variable that is assumed to capture investment opportunities (Q and possibly sales) does a good job for unconstrained firms but not for the others.

A characteristic common to most of the work on financial constraints is that firms or observations are partitioned into groups on the basis of a single indicator that may or may not be a sufficient statistic for the existence of liquidity constraints. In some cases, two indicators are interacted, typically when a cross-sectional classification criterion is used in conjunction with period dummies that capture changes in macroeconomic conditions or structural characteristics of the financial system at different times. In theory, there is no reason not to use more than one cross-sectional characteristic in order to partition the sample. It is obvious, however, that the interaction terms and, consequently, the number of parameters to be estimated increase rapidly and this may lead to imprecise inferences.[24]

One possible way to address this issue, and at the same time allow the data to speak as to which firm-year observations belong to constrained or unconstrained regimes, is to use endogenous switching regressions methods with sample separation unknown (Hu and Schiantarelli 1994, using panel data for U.S. firms). In this case, the probability of being constrained or unconstrained is determined by a switching function that is written as a function of a vector of firm characteristics and macroeconomic conditions. Depending upon the switching function, the firm can be in either of two regimes ("constrained" and "unconstrained"), each characterized by different values of the coefficients on Q and cash flow in the investment function.[25] The model can be estimated by Maximum Likelihood. Using the data to endogenously determine which set of multiple characteristics determines the likelihood of financial constraints and how this set evolves over time is obviously attractive, but this gain comes at the cost of having to make precise assumptions about the distribution of the error term. This has to be contrasted with the absence of such needs when one uses IV or GMM procedures.

Another example of the use of switching regression models to assess the importance of financial constraints is given by Nabi (1989), who uses cross-sectional data for 119 firms in Pakistan to estimate an accelerator model of investment. In this case, the sample separation criterion is known (whether or not the firms have access to the formal credit market) and the estimation is carried out using standard two-step methods.

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[24] Faroque and Ton-That (1995) suggest the use of non-nested tests in order to select the "best" among different stratification criteria. Although the idea is interesting, it relies as well on the belief that a single criterion is adequate to partition the sample.

[25] Notice that the researcher does not observe which regime each firm is in, for a given year.

International Evidence on the Effects of Financial Constraints: Cross-Section and Time Series Variations

In this section I will review in detail the international evidence on the impact of capital market imperfections on investment decisions. The discussion is organized around the more commonly used criteria that have been employed to identify firms more likely to suffer from financial constraints.[26] Most of these criteria emphasize the cross-sectional differences that exist across firms. However, the importance of financial constraints is likely to vary over the course of the business cycle and with the stance of monetary policy. Moreover, structural changes in financial markets can potentially affect the degree of substitutability between internal and external finance. For these reasons, the evidence concerning the variation of the severity of financial constraints over time will be considered as well.

Most of the empirical contributions surveyed are based on individual-firm-level panel data. In some cases, the individual firm data are aggregated into size classes. Unless otherwise stated, the results are based on individual-firm-level data. In addition to evidence based on Q and Euler equations, results based on variations on the flexible accelerator model will be discussed as well. In this case, future profit prospects are summarized by changes in sales. These models can be rationalized as being derived from the standard neoclassical model of investment without adjustment costs (Jorgenson 1963) when the real user cost of capital is (relatively) constant, or from a putty clay model when the cost of labor relative to the purchase price of a machine does not change significantly (Nickell 1978, ch. 11).

Dividend Payout Behavior

The original contribution by Fazzari, Hubbard, and Petersen (1988) classified U.S. firms according to their prevalent payout behavior over the period used for estimation, and showed that firms with a low dividend-payout ratio were more sensitive to cash flow, in the context of Q models of investment. The use of payout behavior tries to identify the group of firms that have exhausted their retentions and are forced to rely on external financing that is an imperfect substitute for internal finance.

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[26] An interesting way used to partition U.S. companies has been the presence/absence or quality of a firm's bond rating. However, this information is not generally available for other countries. Whited (1992) finds that firms with a bond rating display less sensitivity of fixed investment to cash flow. Similarly, Calomiris, Himmelberg, and Wachtel (1995) find that inventory investment of firms with a commercial paper rating is less sensitive to cash flow fluctuations.

As we have argued above, the use of prevalent (or average) payout behavior does not take into account that firms may transit between states in which they face binding constraints and states in which they do not, and it is likely to make it virtually impossible to obtain consistent parameter estimates.[27]

Hubbard, Kashyap, and Whited (1995) produce evidence that the test of overidentifying restrictions in an Euler equation model points to a rejection for low-dividend-paying firms, but not for high-dividend-paying firms. Firms are sorted on the basis of average payout behavior in the two pre-sample years. This addresses the econometric issues of endogenous sample selection, but firms are still not allowed to transit between different financial states. Moreover, the classification criteria are less accurate for the later years compared to the earlier ones.

Bond and Meghir (1994) allow firms to transit between constrained and unconstrained states by defining a dummy variable that equals zero when dividends are positive in both adjacent periods, and one otherwise. They then interact this variable with all the regressors in the Euler equation for capital. Obviously, the dummy variable is endogenous, but appropriately lagged values of the interaction terms provide valid instruments. The results indicate that the cash flow coefficient is wrongly signed (negative, instead of positive, in the context of equation (4)) and significant for the constrained firms, while it is not significantly different from zero for the unconstrained firms.[28] This result is not as clearly supportive of the importance of financial constraints as the ones obtained for the United States. In fact, in terms of the sign and significance of the cash flow coefficient, the Euler equation for U.K. firms is not satisfactory for either group of firm-year observations, although it is less satisfactory for those in which the dividend constraint binds.

Alonso-Borrego (1994) follows Bond and Meghir (1994) using data for Spanish firms. He also finds that the standard Euler equation model is rejected by the test of overidentifying restrictions and that the coefficient of cash flow is wrongly signed when estimated over the entire sample, while it performs somewhat better for firms that are paying dividends.

In a recent paper, Kaplan and Zingales (1995) undertake a closer analysis of the 49 low-dividend firms identified by Fazzari, Hubbard, and Petersen (1988) as financially constrained. Using qualitative infor-

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[27] The econometric results in the paper are mostly obtained using the Least Square Dummy Variable (or Within) estimator.

[28] Basically, in equation (4), the data demand a positive correlation between the investment rate at time t and cash flow at $t-1$. A negative or, at best, nonsignificant coefficient for cash flow is also obtained by Rondi, Sembenelli, and Zanetti (1994), using a panel of large Italian companies.

mation in the companies' financial statements, including statements by managers, they suggest that only 15 percent of the firm-year observations can be classified in the constrained group. They then show that the sensitivity of investment to cash flow is greater for the unconstrained group, contrary to the implications of information-based stories. However, the Kaplan-Zingales classification is open to criticism because of its subjective nature. Moreover, it is likely to identify financially distressed firms, which had been excluded by design from the sample used by Fazzari et al., who had chosen firms with positive real sales growth during the sample period. It should not, therefore, be a surprise that only a small number of firm-year observations are included in the constrained group. As we have already argued, the original choice by Fazzari et al. of classifying firms on the basis of their prevalent dividend payout behavior has serious potential drawbacks. Indeed, many of the contributions that have followed have addressed these problems and the others mentioned in previous sections. Although for different reasons, the Kaplan and Zingales finer classification within the group of constrained firms is also open to criticism, and it is not clear what general conclusion can be derived from the econometric results they obtain.[29]

Association with Business Groups and with Banks

Business groups are a pervasive form of organization in several countries. Although this is certainly not the only way to look at them, business groups can be seen as an organizational form that helps to cope with information and contract enforcement problems in the capital markets. The knowledge by financial intermediaries or individual investors that individual firms may also rely, to a degree, on the financial resources of the group is likely to improve their access to external financial resources. Moreover, business groups allow the formation of an internal capital market that supplements the capital allocation function of the external market. Finally, in some countries, groups are organically linked with banks.

In Japan, banks provide a large proportion of a firm's financing, own shares, and sit on the board of directors of industrial firms. In Germany, relationships between banks and firms are also close, through board representation and the control of voting rights for their own shares and for the shares left in bank custody. However, contrary to common belief, bank financing does not represent a large share of corporate financing in the postwar era (see Mayer 1990). Even though

[29] See Fazzari, Hubbard, and Petersen (1995) for a detailed discussion of the Kaplan and Zingales paper, including the econometric reasons that may explain the differences observed in the estimated value of the cash flow coefficient.

formal ties between banks and firms are absent in Italy, banks represent the dominant source of outside finance. Moreover, the dominant large business groups have special informal relationships with national financial institutions. Some of the latter play an important role not only in the financing of enterprises, but also in acting as exclusive clubs where mutual share holdings are organized and strategic decisions on corporate control are taken. Notice that Italian business groups are often organized around a family nucleus, and in most cases the controlling group owns a large stake of total equity. Business groups also play an important role in developing countries like Korea and Indonesia.

Whatever the form, strong ties between banks and certain firms represent a way to reduce information costs.[30] In this sense we would expect firms affiliated to a business group to be less sensitive to cash flow, both because of the mitigation of information problems in accessing external finance (especially if there are bank links) and because of the creation of an internal capital market. The use of affiliation to industrial groups, particularly in situations in which such affiliation is a stable characteristic, is probably less subject to the problems generated by

dispersed share ownership structure. Since a more dispersed ownership is, everything else equal, associated with greater agency problems between management and outside investors, it would be interesting to use the two characteristics simultaneously in partitioning the sample. Finally, Schaller (1993) and Chirinko and Schaller (1995) provide evidence that members of major Canadian conglomerates do not display excess sensitivity to cash flow. Canadian conglomerates often contain distinct enterprises with their own publicly traded shares, and they have points of similarity with business groups in Japan or Italy. However, no suggestion is made in the two papers just mentioned that conglomerates have a special relationship with banks.

On balance, all of these results are consistent with the idea that group membership relaxes financial constraints. How much this is due to the role of banks' ties and how much is due to the creation of an internal capital market is a matter of conjecture, and the answer is likely to differ across countries. Detailed information on both consolidated and unconsolidated balance sheets, and on intra-group loans and equity issues, in theory at least could help in assessing the relative importance of these two effects. While data on these financial flows may be available, it is likely to be difficult to assess intra-group flows of funds achieved through transfer pricing.

So far the discussion has focused on the differences between types of firms within each country, in order to draw inferences on the importance of bank affiliation. Another possible way to assess the importance of financial intermediaries in minimizing the adverse consequences of informational asymmetries can be obtained by analyzing the cross-country differences in the excess sensitivity to cash flow. The empirical study on financing patterns in developed countries by Mayer (1990), based on flow of funds data, suggests that retentions are the dominant source of finance in all countries, and in general banks are more important than market sources of external finance.[32] However, bank finance is particularly important in France, Italy, and Japan, while it is relatively less important in the United Kingdom and the United States. Surprisingly, the proportion of total finance provided by German banks is closer to the U.K. and U.S. figures.

Bond et al. (1995) estimate various versions of the investment equation (in its Euler equation form, flexible accelerator, and so on) on panel data for the United Kingdom, France, Belgium, and Germany. They conclude that the sensitivity to cash flow is greater for the United

[32] All international comparisons are fraught with difficulties, and any conclusions reached must be treated with care. The Bond, Elston, Mairesse, and Mulkay (1995) paper contains a detailed discussion of these issues and of the efforts made to render the international comparisons as meaningful as possible.

Kingdom than for all the other countries. This suggests that the availability of internal finance may be more important in financial systems that are more market-based.[33] However, caution is needed before jumping to this conclusion, because it is also possible that the different roles of cash flow reflect differences in the nature of the data for each country. In particular, while the U.K. data are consolidated accounts, the main data available for the other countries are not. Although the purpose of their study was not an inter-country comparison of cash flow sensitivity, Cummins, Hassett, and Hubbard (1994) find that, out of a set of 14 countries included in the Global Vantage data base, the cash flow coefficient is significant in Q equations only for Japan, Norway, the United Kingdom, and the United States. Obviously, these four countries differ greatly in terms of the market or bank orientation of the system of external finance. Again, the results may be driven by the vastly different composition (and numbers) of the firms included in the data base for each country.

Size of Firms

One criterion frequently used to identify firms that are more likely to be financially constrained has been size, on the presumption that size is highly correlated with the fundamental factors that determine the probability of being constrained. Smaller firms are more likely to suffer from idiosyncratic risk and, insofar as size is positively correlated with age, are less likely to have developed a track record that helps investors to distinguish good firms from bad. Moreover, small firms may have lower collateral relative to their liabilities, and unit bankruptcy costs are likely to decrease with size. Finally, it is likely that transaction costs for new share issues decrease with size. However, size also may be inversely related to concentration of ownership, and concentrated share ownership is likely to mitigate agency problems between managers and outside investors. This last consideration is probably more important when dealing with samples of relatively large quoted companies.

The evidence is indeed mixed. When the size criterion is applied to large data sets that include quoted and unquoted companies and cover a broad spectrum of the size distribution, then the results tend to suggest that smaller firms face significantly higher hurdles in accessing external funds. This is true both for developed countries (see Galeotti, Schiantarelli, and Jaramillo (1994) for Italy, and Johansen (1994b) for Norway) and for developing countries (see Jaramillo, Schiantarelli, and Weiss (1994) using data on Ecuadorian firms, and Harris, Schiantarelli,

[33] Notice that Q is likely to be more informative in countries in which the provision of external finance is (relatively) more market-based.

and Siregar (1994) using panel data for Indonesia). Carpenter, Fazzari, and Petersen (1994) find that the impact of internal finance on inventory investment is greater for small U.S. firms relative to large firms, although internal finance is economically important for large firms. Time series data disaggregated by firm size confirm the greater sensitivity to cash flow (relative to interest payments) of inventory investment in the United States (see Gertler and Gilchrist (1994), using Quarterly Financial Report data); of fixed investment and inventory investment in Italy (see Rondi, Sack, Schiantarelli and Sembenelli 1993); and of investment in Colombia (Tybout 1983).[34] However, Devereux and Schiantarelli (1990), using a sample of relatively large quoted firms, find that large firms are more sensitive than small firms to cash flow fluctuations.[35]

The fact that a firm must be quoted to be included in the sample means that there probably is a selection bias in favor of picking only the best of the small firms. However, it may also be the case that larger firms have more dispersed share ownership (see below). Unfortunately, the U.K. panel does not contain enough information to assess whether this explanation is correct. Results on the role of size for a small sample of U.S. firms listed on the New York Stock Exchange or traded in the over-the-counter market suggest no significant differences between size classes (see Oliner and Rudebusch 1992). Hu and Schiantarelli (1994) find that, everything else equal, size is positively related to the probability of being financially constrained for quoted companies present continuously between 1978 and 1987 in the Compustat Annual Industrial File and in the Over-the-Counter File. The probability of being constrained increases with stock and flow measures of leverage and decreases with the stock of liquid assets. In sum, size seems to be a useful criterion to identify firms that are more likely to be financially constrained, but only when the sample used for estimation includes at least a portion of the lower tail of the size distribution and is not limited to the successful young firms that have survived the competition in the marketplace.

Agency Problems and Concentration of Ownership

The interests of inside shareholders are likely to be aligned more closely to those of outside shareholders when the former have a large

[34] Hall (1992) finds that R&D expenditure by U.S. firms responds significantly to cash flow. Himmelberg and Petersen (1994) provide similar evidence for a panel of smaller firms. The cash flow effect is stronger for their sample than for the sample of larger firms used in Hall's paper.

[35] Athey and Laumas (1994) find that large Indian firms are more sensitive to cash flow than small firms, and they explain their result as a reflection of the Indian government credit policies for promoting small enterprises.

equity stake in the company. Moreover, more efficient monitoring of management will occur when outside shareholding is highly concentrated. In this case, the agency cost premium for equity finance should be smaller. Oliner and Rudebusch (1992) do not find evidence that the structure of shareholding for a small sample of U.S. firms affects the sensitivity of cash flow in Q-type equations. Results for Canada suggest, instead, that cash flow is less important for companies that have more concentrated share ownership and are on average smaller. (See, for example, Schaller (1993); Chirinko and Schaller (1995), using Q models; and Ng and Schaller (1991), using the Euler equation approach.)

Additional evidence on the source of the premium for external finance is contained in Hubbard, Kashyap, and Whited (1995) for the United States. Within the group of low-dividend-payout firms, they separate those in mature industry sectors. These are the firms for which the problems outlined by Jensen and Meckling (1976) and Jensen (1986) should be the most important, yet the test of overidentifying restrictions does not suggest a rejection of the model for this subgroup, while it does for the other low-dividend-paying firms. However, using a similar data set, Vogt (1994) divides the low-dividend-paying firms into four size classes and shows that the cash flow coefficient is greater for larger firms, which presumably are more likely to suffer from this type of agency problem. Summarizing, the evidence is mixed, and more research work is needed in order to identify the relative importance of the various sources of the discrepancy between the costs of internal and external finance.

Variations over Time in the Tightness of Financial Constraints: Asymmetric Cash Flow Effects, Business Cycle Conditions, and Monetary Policy

One implication of the information-based models of investment is that the severity of financial constraints is likely to vary with overall macroeconomic conditions and with the stance of monetary policy, because they influence the value of firms' net worth. Therefore, during recessions or after a monetary tightening, the cost of external finance could be expected to increase and/or the access to it to decrease.

The evidence for time variation in the severity of financial constraints is quite robust for the United States. Gertler and Hubbard (1988) provide empirical evidence for the United States that the cash flow coefficient for firms with low payout ratios, in a Q type of investment equation, is greater in recessions. Kashyap, Lamont, and Stein (1994), using panel data, find that inventories for firms without a bond rating are sensitive to measures of the stock of liquidity during years of recession, but not during the subsequent boom years. They do not detect any excess sensitivity in any period for firms with a bond rating.

Similar results for investment are obtained by Oliner and Rudebusch (1994) using the QFR data set. The interesting twist in their paper is that the cash flow coefficient increases in the four quarters following a monetary contraction, defined either on the basis of the Romer dates (see Romer and Romer 1989 and 1990) or on the basis of the behavior of the spread between the federal funds rate and a long-term government bond rate.

All the contributions mentioned above are based on classifying firms cross-sectionally and temporally, prior to estimation. In the endogenous switching regression approach of Hu and Schiantarelli (1994), macroeconomic conditions affect the probability of a firm being constrained or unconstrained, through both the balance sheet variables (stock and flow measures of indebtedness, stock of liquid assets, and size) and the year dummies included in the switching function. This allows the data to speak about the determinants of the probability of facing constraints and the evolution of such a probability. As a summary measure of the effect of macroeconomic conditions, they use the parameter estimates to calculate the average probability (across firms) of being constrained in each year. This probability varies substantially over time; it reaches its highest value in the recession of 1982 and in its aftermath, and its movements closely follow (with a lag of approximately two years) the behavior of the federal funds rate.[36]

Gross (1994) provides a theoretical and empirical analysis of the dynamics of U.S. firms' investment and financing decisions. In his paper, firms decide about fixed and liquid assets in order to protect themselves against bankruptcy, while assuring themselves of the availability of resources to undertake profitable investment. Rather than assuming exogenously that some firms are constrained, Gross shows that the tightness of financial constraints varies over time, depending upon the amount of internal financial resources. Kernel regression estimates of the policy function for capital and debt suggest that the capital stock is not sensitive to the amount of internal financial resources when the latter are large. When the firm is somewhat constrained, a large portion of each extra dollar of internal funds is invested. When firms are very constrained, they resort to borrowing in order to prevent the capital stock from falling further.

The international evidence on this issue is not as rich. Rondi, Sack, Schiantarelli, and Sembenelli (1993), using annual firm data for Italy aggregated into two size classes (large and small), also find that both fixed and inventory investments at small firms respond more to changes

[36] When the federal funds rate is included directly in the switching function in place of the year dummies, it has a positive and significant impact on the probability of being financially constrained.

in cash flow relative to interest payments in periods following monetary tightening. The same occurs for large firms, although their sensitivity is found to be less than that of smaller firms in all subperiods. Schiantarelli and Sembenelli (1995), using Italian panel data, obtain the result that the effect of cash flow is asymmetric, particularly for firms that are not associated with business groups. They allow the cash flow coefficient to differ depending on whether cash flow increases or decreases, and find that it is greater when cash flow decreases. This means that lack of availability of internal resources causes a decrease in investment, while an increase in such availability has a weaker positive effect. Preliminary results by Guariglia (1994), using U.K. panel data to estimate finished goods inventory equations, also suggest greater sensitivity to cash flow during recessions.

Variations over Time in the Tightness of Financial Constraints: The Effects of Structural Changes in Financial Markets

The tightness of financial constraints over time may vary, not only following changes in business cycle conditions and monetary policy, but also because of structural changes in financial markets. During the 1980s, several developing countries introduced financial reforms to facilitate capital accumulation and growth. These reforms consisted mainly of the removal of administrative controls on the interest rate and the elimination or scaling down of directed credit programs. Barriers to entry in the banking sector were also lowered, and the development of securities markets was stimulated. The main objective of the banking deregulation was to provide higher returns to depositors and to increase the supply of funds for investment, although whether this happens at the economy-wide level is a matter of controversy. It is likely, however, that the amount of saving intermediated by the banking system will increase. To the extent that economies of scale exist in information-gathering and in monitoring, it is possible that banking intermediaries may have an advantage over the curb (informal) market in allocating investment funds, and this may lead to a reduction in the premium of external finance over internal finance. On the other hand, the elimination of subsidized credit programs will increase the financing constraints on those firms that previously benefited from the system of administrative allocation of credit. This means that programs of financial liberalization have distributional conseqences, and whether they relax financing constraints for different categories of firms is ultimately an empirical question.

Evidence about the effects of financial liberalization is provided by Harris, Schiantarelli, and Siregar (1994) for Indonesia, and by Jaramillo, Schiantarelli, and Weiss (1994) for Ecuador. Harris et al. find that cash flow is large and significant in an accelerator type of equation for small firms, but not for large firms. However, the cash flow coefficient

decreases dramatically in the second half of the 1980s, in the post-liberalization period.[37] Moreover, the coefficient on the beginning-of-period degree of leverage, meant to capture the marginal cost of debt, also becomes less negative, suggesting that the cost-of-funds schedule increases less rapidly as a function of leverage. It is interesting that these results still hold if the next period's profits are included in the equation in order to control for the informational role of cash flow. One can therefore conclude that banking deregulation has indeed relaxed financial constraints for small firms in Indonesia. No significant changes are detected for large firms. There is evidence that large firms that had been beneficiaries of subsidized credit have been able to replace directed credit with borrowing on the foreign markets. Note that many large firms are members of conglomerates or are owned by ethnic Chinese with connections to the financial markets in Hong Kong and Singapore.

The results for Ecuador by Jaramillo, Schiantarelli, and Weiss (1994), based on estimating Euler equations for capital that allow for both an interest rate that increases with the degree of leverage and a ceiling on leverage, suggest that small firms face constraints, while large firms do not. However, no changes occurred in the structural coefficients over time. This may be because financial liberalization was less profound in Ecuador than in Indonesia, or because some of the subsidized credit programs benefited small firms in the pre-reform period. Moreover, while financial liberalization is a process that may take time before its effects can be felt, the panels used for estimation are rather short. Additional years of data will be necessary to pass final judgment, particularly on the effect of the introduction of securities markets at the end of the 1980s and the beginning of the 1990s in Ecuador, Indonesia, and other developing countries.

Financial deregulation is not a phenomenon limited to developing countries; it has taken place also in a set of developed countries. The paper by Hoshi, Kashyap, and Scharfstein (1991) provides some evidence on the consequences of financial reforms that increased the financing options for Japanese corporations. The reforms basically involved the repeal of regulations that hampered the issuance of bonds in the domestic and the international markets and the elimination of interest ceilings that reduced the demand for bonds. The analysis focuses on firms that had strong bank ties during the 1977–82 period (the focus of their previous work). It shows that firms that reduced those ties after 1982 show much stronger sensitivity to cash flow than firms that maintained bank ties in the later period. The decrease in the proportion

[37] Note that the decrease in the value of the cash flow coefficient is not likely to be explained by the fact that the economy was more buoyant after banking deregulation. GDP fell steadily, in fact, until it reached the trough in 1987.

of borrowing from banks within the group, relative to total borrowing between 1977 and 1986, is used as a sample-separation criterion.

Their finding is consistent with the idea that benefits result from intermediation, but at the same time it raises the issue of why a firm would choose to weaken its bank ties. Presumably if a firm decides to do so, it is because of net benefits from emancipating itself from the group's main bank. Moreover, it is possible that the correlation between cash flow and unobserved investment opportunities may be greater for firms that have decided to weaken their bank ties. In this case, a greater upward bias would be found on the cash flow coefficient for such firms.[38] Finally, given the nature of the sample-split criterion, which uses future information, an instrumental variable procedure based on lagged values of the regressors would not lead to consistent estimates of the cash flow coefficients. Note that sorting by bank association is probably less of an issue for the estimation period preceding financial deregulation, a period characterized by stable and long-lasting group links. Moreover, while the growth opportunities for group and independent firms in the 1977–82 period do not differ greatly, the group firms that weakened their ties after 1982 are characterized by better investment opportunities.

In conclusion, the evidence concerning the benefit of bank ties, derived from documenting the consequences of financial deregulation, is less convincing for Japan. More work is needed in order to assess the consequences for financial constraints of moving to a more market-oriented (or less bank-oriented) financial system, including the analysis of deregulation episodes in other developed countries.

Conclusions

The weight of the evidence I have reviewed suggests that, for a substantial subset of firms, informational asymmetries and incentive problems generate significant departures from the model derived under the assumption of perfect capital markets. This conclusion is derived from both Q models and Euler equations for capital. It holds, independent of the specific cross-sectional criteria used in classifying firms, and it is supported by most of the empirical evidence for a number of countries. Moreover, substantial support is also available for the proposition that the severity of financial constraints varies over the business cycle and with the stance of monetary policy. For some developing countries, evidence suggests that financial liberalization and the ensuing process of financial re-intermediation have led to a relaxation of constraints for those firms that had restricted access to finance in the

[38] The econometric results in the paper are obtained using OLS in differences.

pre-reform period. More research is needed on the comparative performance of market-based and bank-based financial systems, as well as on the consequences of those forms of financial deregulation that have led to an increased role for security markets, vis-à-vis banks. Some panel data evidence within individual countries suggests that bank association is beneficial, but the cross-country evidence is still too weak to draw definitive conclusions.

Several other problems remain open at this stage, some of them quite general in nature. Quite a few of the results reviewed here suggest evidence of excess sensitivity to internal funds or of misspecification of the estimated equations, even for firms that are thought a priori not to suffer from severe information problems (for instance, large, mature companies). Moreover, a simple look at the data reveals that retentions are their prevalent source of finance (just as for most other companies). This may be because even large, mature firms cannot costlessly and credibly communicate their real investment opportunities to lenders and investors and consequently suffer from adverse selection problems. Alternatively, the agency problems may be severe between managers and the providers of external finance (both outside shareholders and suppliers of loan capital). The research agenda for the future should include efforts to identify more carefully the nature of the information and agency problems that make external finance more expensive than internal finance. More generally, it would be useful to investigate in depth how managerial preferences and incentives may generate a close association between firms' investment and the availability of internal resources.

Another direction for future research is provided by the desirability of moving away from the standard assumption of convex adjustment costs underlying the model used so far for econometric testing. The evidence of misspecification, including the change in parameters across normalizations and their instability over time (in some studies), may not be wholly explained by capital market imperfections. Other forms of misspecification may also exist, related, perhaps, to the irreversibility of investment and to non-convexities in adjustment costs. The simultaneous treatment of capital market imperfections and of more complex forms of adjustment costs is likely to be very fruitful.

Appendix

The Firm's Optimization Problem

Denote R_{it} by the required rate of return; then the following standard arbitrage condition must hold for a firm's shareholder:

$$R_{it} = \frac{(1 - m_t)D_{it} + (1 - z_t)E_t(V_{i,t+1} - V_{it} - S^n_{it})}{V_{it}}, \tag{A1}$$

where D_t denotes dividends, V_{it} the value of the firm, S^n_{it} the nominal value of new shares, m_t the personal tax rate, z_t the tax rate on capital gains, and E_t the conditional expectations operator. Solving (A1) recursively gives:

$$V_{it} = E_t \sum_{j=0}^{\infty} \beta^j_{it}[\gamma_{t+j}D_{i,t+j} - S^n_{i,t+j}]. \tag{A2}$$

V_{it} is the value of the firm for existing shareholders. Assume this is the objective function that is maximized, subject to the following constraints:

$$\begin{aligned} D_{i,t+j} = (1 - \tau_{t+j})[&p_{i,t+j}(F(K_{i,t+j}, L_{i,t+j}) - G(I_{i,t+j}, K_{i,t+j})) \\ &- w_{t+j}L_{t+j} - (i_{i+j} + A(B_{t+j-1}, p^k_{t+j-1}K_{t+j-1})/B_{t+j-1})B_{t+j-1}] \\ &+ (B_{t+j} - B_{t+j-1}) - p^k_{t+j}I_{t+j} + S^n_{t+j} + C_{i,t+j}, \end{aligned} \tag{A3}$$

$$K_{t+j} = (1 - \delta)K_{t+j-1} + I_{t+j}, \tag{A4}$$

$$D_{t+j} \geq 0, \tag{A5}$$

$$B_{t+j} \geq 0, \tag{A6}$$

$$S^n_{t+j} \geq 0, \tag{A7}$$

$$M_{i,t+j} - \frac{B_{i,t+j}}{p^K_{i,t+j}K_{i,t+j}} \geq 0, \tag{A8}$$

where

$$\beta^j_{i,t} = \prod_{i=0}^{j} (1 + R^*_{i,t+i})^{-1},$$

$$R^*_{i,t+j} = \frac{R_{i,t+j}}{(1 - z_{t+j})},$$

$$\gamma_{i,t+j} = \frac{(1 - m_{t+j})}{(1 - z_{t+j})},$$

τ_{t+j} = corporate tax rate,
$p_{i,t+j}$ = output price,
$K_{i,t+j}$ = capital stock,
$L_{i,t+j}$ = labor,
$I_{i,t+j}$ = investment,
$w_{i,t+j}$ = wage rate,
i_{t+j} = riskless interest rate,
$B_{i,t+j}$ = stock of debt,
$P^k_{i,t+j}$ = price of investment goods,
$C_{i,t+j}$ = tax savings associated with depreciation allowances on existing capital goods, and
δ = depreciation rate.

Assume that the firm is imperfectly competitive. Denote with μ_t the markup of prices over marginal cost. To simplify notation, set $\beta^0_{i,t+1} = \beta_{i,t+1}$. Assume that the firm always issues a positive amount of debt. The first-order conditions are:

$$(\gamma_t + \lambda^D_t)(1 - \tau_t)[(1 + \mu_t)^{-1}P_{it}(F_K(it) - G_K(it))] - E_t[(\gamma_{t+1} + \lambda^D_{i,t+1})$$

$$(1 - \tau_{t+1})\beta_{t+1}A_K(it)] - \lambda^k_{it} + \lambda^B_t B_{it}/(p^k_{it}K^2_{it}) + E_t[\lambda^k_{i,t+1}\beta_{i,t+1}(1 - \delta)] = 0, \tag{A9}$$

$$(\gamma_i + \lambda^D_{it})[-(1 - \tau_t)p_{it}(1 + \mu_t)^{-1}G_I(it) - (1 - \xi_t)p^k_{it}] + \lambda^k_{it} = 0, \tag{A10}$$

$$(\gamma_t + \lambda^D_{it})(1 - \tau_t)[p_{it}(1 + \mu_t)^{-1}F_L(it) - w_{it}] = 0 \tag{A11}$$

$$(\gamma_t + \lambda^D_{it}) - E_t[\beta_{t+1}(\gamma_{t+1} + \lambda^D_{i,t+1})(1 + (1 - \tau_{t+1})i_{t+1})] \tag{A12}$$

$$- E_t[\beta_{t+1}(\gamma_{t+1} + \lambda^D_{i,t+1})(1 - \tau_{t+1})A_B(it)] - \lambda^B_{it}/(p^k_{it}K_{it}) = 0,$$

$$\gamma_t + \lambda^D_{it} - 1 + \lambda^s_{it} = 0. \tag{A13}$$

where ξ_t is the present value of tax savings associated with depreciation allowances on investment, and λ^k_t, λ^D_t, λ^s_t and λ^B_t are the Lagrange multipliers associated with the capital accumulation equation, with the non-negativity constraint on dividends, new share issues, and the ceiling on the debt to capital ratio. $A(B_{t+j-1}, P^k_{t+j-1}K_{t+j-1})/B_{t+j-1}$ denotes the premium that must be paid over and above the safe interest rate. Equations (A9) through (A13), in addition to the complementary slackness condition (not reported here for brevity's sake) define the firm's optimal plan.

Assume that the gross production and the adjustment cost function are linear homogenous. Assume, moreover, that adjustment costs are quadratic.

$$G(I_{it}, K_{it}) = \frac{b}{2}\left(\frac{I_{it}}{K_{it}} - a - \varepsilon_{it}\right)^2 K_{it}. \tag{A14}$$

When debt is omitted entirely from the problem, and perfect competition is assumed ($\mu_t = 0$), then it is easy to show that (A9), (A10), (A11), and (A12) and the complementary slackness conditions imply:

$$\lambda^k_{it} = \frac{\beta_{it}(V_{it} - H_{it})}{P_{it}(1 - \tau_t)(1 - \delta)K_{i,t-1}} \tag{A15}$$

in the case when dividend payments are strictly positive. H_{it} is the present value of tax savings associated with the depreciation allowances on past investment. Equations (1) and (2) in the main text and variations thereof, follow immediately from (A10) and (A15). To derive the basic Euler equation for the case of no debt, simply omit the $(\lambda^B_{it} B_{it})/(P^k_{it}K^2_{it})$ term

from (A9). Using (A10) to substitute out λ_{it}^{K} and $\lambda_{i,t+1}^{K}$ from (9), one obtains equation (3) in the main text (assuming μ_t is constant). The extensions due to the inclusion of debt can also be easily derived. Note that when the ceiling on debt is exogenous, i.e. $B_{it} \leq \overline{B}_{it}$, $(\lambda_{it}^{B} B_{it})/(P_{it}^{k} K_{it}^{2})$ should be omitted from (A9) and $\lambda_{it}^{B}/(P_{it}^{k} K_{it})$ is replaced by λ_{it}^{B} in (A12).

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Discussion

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This conference considers the question: "Is bank lending important for the transmission of monetary policy?" For the answer to this central policy question to be "Yes," and for the magnitude of lending effects to be empirically significant, fluctuations in bank loans must cause some changes in the real economy. The most obvious place to look for effects of this kind is investment. In business circles, and especially in the business press, it seems to be taken for granted that restrictions in bank lending prevent firms from undertaking investment projects, owing to a lack of finance.

Economists, however, are not necessarily convinced that reduced bank lending constrains firms' investment. In a world of perfect capital markets, the Modigliani-Miller theorem implies, firms could replace bank financing with other sources of funds at low cost. If, for example, tight monetary policy causes bank lending to decline, firms could issue directly marketed debt (like commercial paper or corporate bonds) or sell new equity to raise funds. For bank lending to affect investment, some kind of capital market imperfection must be present that prevents firms from costlessly substituting other sources of finance for bank loans when the supply of loans is restricted.

In the past decade, much new research has tested for the existence of such capital market imperfections that affect investment. The findings reported in this work, in most cases, support the presence of economically significant financial constraints on investment. Fabio Schiantarelli has put together an extensive and insightful survey of this literature, to

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which he has contributed many important papers. With a variety of co-authors, I have also participated in this research. It is, therefore, not surprising that I agree with Schiantarelli about the importance of this work, and I also broadly agree with the conclusions he reaches. I will, however, expand on a few of the points made in the paper and offer some different interpretations of the findings.

Schiantarelli's paper focuses primarily on the empirical literature linking financial factors and investment. The theoretical issues are surveyed only briefly. I begin this comment by expanding on some of the conceptual issues involved in understanding how finance, and ultimately monetary policy, affect investment. In particular, I identify three distinct channels through which financial effects operate—the collateral, bank lending, and internal finance channels. I will then consider some of the empirical issues at the core of Schiantarelli's paper and conclude with a comment on the directions that research in this area might take in the future.

Channels of Financial Influence: Collateral, Bank Lending, and Internal Finance

Most modern research studies on financing constraints start from one of three complementary channels through which financial factors affect real economic activity. All the approaches have historical roots that date back, for example, to the work of Fisher (1916) and Mitchell (1951). The "bank lending channel" is the premise for the title of this conference. Schiantarelli's paper, however, motivates the empirical research in this area by referring to what has been called the "collateral channel" in some of the recent literature. In addition, a distinct "internal finance channel" also has historical roots and has potential importance for monetary policy transmission. In this section, I summarize each channel and discuss how the differences between them are relevant for understanding investment and the transmission of monetary policy.[1]

The collateral view (the primary channel discussed by Schiantarelli) begins from the hypothesis that asymmetric information creates imperfections in capital markets. Asymmetric information causes moral hazard and adverse selection problems that raise the cost of debt above the risk-free rate of interest. Firms can reduce the premium they pay for new debt, however, if they can offer collateral for loans. In this context, collateral is thought of in very broad terms. It includes not only tangible assets, but also the expected present value of future cash flows that will

[1] See Carpenter, Fazzari, and Petersen (1995) for a discussion of these three channels and empirical research that compares the ability of each approach to explain various facts about inventory investment.

be available to service debt. With this definition of collateral, suppose that tight money raises interest rates. The present value of future cash flows will fall and the value of collateral will decline, reducing firms' access to debt and lowering investment.[2]

The bank lending channel has particular relevance for monetary policy. Again, its starting point is asymmetric information and the associated moral hazard and adverse selection problems in financial markets. But the bank lending channel emphasizes the special role played by banks in overcoming these problems through intermediation. Firms that face severe asymmetric information problems may depend on banks for access to debt. The intermediation service banks offer is special, and the cost of providing this service depends on the stance of monetary policy. Tight money reduces bank reserves and forces banks to shrink the asset side of their balance sheets. The result is less bank lending. But, because of capital market imperfections, bank-dependent firms cannot simply replace bank loans with direct open market borrowing. For example, the small start-up company will not be able to issue commercial paper if its bank decides to reduce its credit line. As a result, less bank lending reduces investment for bank-dependent firms.

The third channel for financial influence, the internal finance channel, is perhaps the most straightforward. It also relies on the idea that capital market imperfections increase the cost of external finance, including both new debt and new share issues. Then, the opportunity cost of internal funds as a source of finance will be less than the cost of external funds. When the supply of internal finance goes up, say because a firm's profits or cash flows increase, the firm will have more low-cost finance available and investment will rise. This view has a long history in the literature. It was invoked as the "cash flow model" in some of the early empirical work on investment.[3]

All three of the financial channels can generate what Schiantarelli calls a "financial accelerator" for policy. That is, these financial mechanisms will magnify the real effect of monetary shocks on investment. But the relative empirical strength of the different financial channels matters for evaluating the importance of the financing constraint literature for policy. The bank lending view focuses on how changes in the reserve base and capital requirements affect the ability of banks to make loans. The collateral view, in contrast, emphasizes the financial position of firms, that is, borrowers rather than lenders. Policy analysis links monetary shocks to changes in firms' "balance sheets." For example, as

[2] See Gilchrist and Zakrajšek (1995) in this volume for further discussion.
[3] See, for example, Meyer and Kuh (1957) and Minsky (1975).

mentioned above, increases in interest rates could erode firms' collateral position and increase the cost of borrowing.

The internal finance view, like the collateral approach, focuses on the financial condition of firms. But, in contrast with both the collateral and bank lending views, the key financial variable is the flow of internal as opposed to external finance. Monetary effects are magnified through this channel in ways analogous to the standard Keynesian multiplier. Suppose that monetary tightening caused a decline in spending for interest-sensitive sectors of the economy. Firms producing in these sectors would experience a decline of internal cash flow. This effect is magnified by the empirical fact that a large portion of firm costs are fixed in the short run. Relatively small shocks to demand, sales, and revenue translate into large shocks to profits and cash flow.[4] Low cash flow reduces the supply of low-cost internal finance and causes affected firms to cut back on investment in all assets, including both fixed investment and inventories. This fall in investment further magnifies the effect of the initial monetary shock and causes the internal finance shortage to propagate further through the economy.

In summary, the financial mechanisms linking monetary policy to investment are quite diverse. This diversity is not reflected to a large degree in Schiantarelli's paper. Yet, recognition of the diversity of financial channels is important for the topics considered by this conference. As this discussion shows, the bank lending channel is not the only way that the empirical work surveyed in Schiantarelli's paper is relevant for understanding the impact of monetary policy on the real economy.

Empirical Identification of Financial Effects

As a veteran of many empirical studies on the finance-investment link, I agree with Schiantarelli that the main challenge for empirical work that tests the importance of these channels is to separate the financial influence of variables on investment from their role as signals of future profits, signals that matter for investment whether or not financial channels operate. One way to address this problem, widely used in the research Schiantarelli reviews, is to exploit heterogeneity in disaggregated data. Researchers split their data according to criteria that they believe affect access to finance. They then test to determine if the investment of groups of firms considered a priori more likely to face financial constraints is more sensitive to financial variables such as cash flow, debt leverage, interest coverage, and the like. The maintained hypothesis is that if financial variables signal future profits, this signal-

[4] This point is emphasized in Carpenter, Fazzari, and Petersen (1994).

ing will not differ systematically across groups of firms. Therefore, the heterogeneity of estimated financial effects across firms with different access to finance indicates the importance of financial constraints.

Schiantarelli discusses concerns, however, that the variables used to split samples of micro data might themselves be endogenous, and that this might cause misleading results in tests for firm heterogeneity. I believe Schiantarelli's point is correct. It is useful, however, to push the point further to consider the direction of the bias induced. Recognizing this bias might actually strengthen the evidence presented in the financing constraints literature.

The easiest example to consider is a test based on the size of firms, although similar logic likely applies to other sample-splitting criteria used in the literature (dividend payout and bond ratings, for example). Suppose that a firm gets a positive investment shock over the sample period of a research study. This firm will be larger as a result, and it will more likely be classified in the large-firm segment of the sample. Symmetrically, firms with negative investment shocks are more likely to be classified into the small-firm category. Now, suppose that the expected value of size is a true signal of firms' access to finance. The endogeneity described here suggests that some financially constrained firms are misclassified as large firms and some unconstrained firms are put into the small-firm category. This misclassification will likely blur the difference in regression coefficients on financial variables estimated for big and small firms. The endogeneity, in this case, works *against* tests that look for heterogeneity between groups of firms expected to experience different financial effects on their investment.

Another problem that Schiantarelli examines in his paper is that firms may switch groups during the sample period, which could bias estimates of regressions based on fixed sample splits. One approach to this problem is econometric: The classification into constrained and unconstrained groups can be modeled endogenously in a switching regression. This approach has the advantage that it provides a data-determined estimate of what puts firms into different regimes. Hu and Schiantarelli (1994) present interesting results along these lines.

Another approach to mitigating the problem of firms that switch groups over time is to work with short time periods, over which relatively few switches occur. This may not be possible with the annual data used in most studies in this literature because of the limited number of degrees of freedom available in the time dimension. Carpenter, Fazzari, and Petersen (1994), however, had success working with short panels of high-frequency quarterly data from Compustat to study financial effects on inventory investment. The use of quarterly data and short panels also permits comparisons of results across time periods with different macroeconomic conditions or monetary policy regimes.

Schiantarelli also discusses how different econometric specifications

can be used to identify financial effects on investment. In particular, he discusses the relationship between typical "reduced-form" investment regressions and research based on "Euler equations." In the reduced-form approach, firm investment is regressed on a variety of variables, including some that capture financial effects. Euler equations are derived directly from the firm's first-order conditions for optimization, and then the parameters of these conditions are estimated.

As Schiantarelli indicates, the variables available to control for investment opportunities in reduced-form regressions are certainly not perfect. The most widely used variable, some form of the Brainard-Tobin Q, is associated with a variety of measurement problems. Therefore, potential problems arise with testing the importance of financial variables in a reduced-form investment regression, because financial variables may proxy for investment fundamentals that are not adequately captured by Q or other controls.

The Euler equation approach does not require a control for investment opportunities directly and, therefore, as Schiantarelli points out, it sidesteps this problem. But the Euler equation approach has other problems, as Schiantarelli also recognizes. In its simplest form, the Euler equation method leads to a hypothesis test. One specifies the first-order condition that would hold for the optimal intertemporal allocation of capital under perfect capital markets and then checks to see if the condition is consistent with the data. Most of the literature looks to see if the condition is rejected for groups of firms that are most likely to face financial constraints. But to construct an Euler equation, one must impose a lot of structure on the problem. A rejection of the perfect capital markets hypothesis may occur for reasons that have nothing to do with capital market imperfections. For example, rejections could occur because the technology or expectations process was misspecified or unstable.[5]

Furthermore, rejection of the perfect capital markets null hypothesis does not tell us anything about the economic magnitude of financial constraints. Progress has been made in estimating this economic significance by setting parameters for Euler equations with financial variables. The results are interesting, but this approach must also face the criticism that financial variables may be correlated with measurement or misspecification errors in the Euler equation.

This is not to say that we cannot learn important things from research on financial constraints based on Euler equations. My claim is more modest. I believe that the Euler equation and reduced-form research on financial constraints are complements. While potential problems exist with both approaches, I agree with Schiantarelli that strong

[5] Oliner, Rudebusch, and Sichel (1992) find evidence of instability in Euler equations.

support for the existence of significant capital market imperfections, and their effect on investment, comes from the fact that extensive research using these two very different methods reaches the same conclusion in most cases.

Future Research

I will conclude with one brief comment on future directions for research in this area. I agree with Schiantarelli that one intriguing question that deserves more attention is the importance of capital market imperfections and financial constraints for large, mature firms. While financial variables have larger and more significant effects for small, young firms, many researchers find non-negligible effects for big firms. Recent stories in the financial press have provided anecdotal evidence for financial constraints on large firms. Mammoth auto companies such as Toyota and Chrysler claim the need to hold on to huge stocks of cash to buffer their investment and R&D activities against declining cash flow in coming recessions.

The source of these effects is an interesting question. They might come from agency problems that give managers the ability to divert firm resources to serve their own private interests. Or, perhaps the frictions in capital markets are so severe that even well-established firms must pay a premium for external funds and therefore choose to rely on internal finance. When a downturn comes, and internal cash flow falls, these firms may be reluctant to cut dividends, so in the absence of large buffer stocks of cash, they may cut back on investment activities.

This issue has importance for macroeconomics and policy analysis because, while small firms constitute a significant part of the aggregate economy, much of the employment, investment, and R&D is carried out by large firms. It will therefore be interesting to explore how financial channels are relevant, if at all, for the investment of larger, more mature companies in the U.S. economy.

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Discussion

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Fabio Schiantarelli's paper is a comprehensive survey of a very large literature, one that includes many of his own papers and those of others at this conference. Because he does such a good job, I find my position as second-order discussant unenviable. He reports results for many countries, but his emphasis is on differences in modeling techniques rather than international comparisons.

At the outset he states: "The tests for the presence of financing constraints have consisted mainly of adding proxies for the availability of internal funds and/or firms' net worth to the model derived under the assumption of perfect capital markets, and investigating whether these proxies are significant for the firms thought most likely to face information and incentive problems" (p. 178). I will argue that a big difference exists between these tests and deciding the importance of bank lending for the transmission of monetary policy.

Schiantarelli reports that two principal results emerge from this literature: (i) "unless the loans are fully collateralized, external finance is more costly than internal finance" and (ii) "the premium on external finance is an inverse function of a borrower's net worth (liquid assets plus the collateral value of illiquid assets)" (p. 180). I have no difficulty accepting the first, but the second is a confusing and unhelpful construction that apparently first appeared in a paper by Bernanke and Gertler (1989). Net worth is an accounting concept that suffers enough from being the difference between sums of arbitrarily valued assets and liabilities.

The collateralizable value of illiquid assets is not well defined, nor

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does it capture the notion of a firm's access to credit. A firm partly controls its collateralizable value when it chooses to expand inventories or accounts receivable. As Schiantarelli persuasively argues in a later section of his paper, a firm that belongs to formal or informal groups has access to credit, irrespective of its own balance sheet. Furthermore, banks and other creditors are not so witless as to ignore the *promise* of future returns from loan applicants, and they recognize, as did Bulow and Shoven (1978), that potentially valuable options are on the table when a borrower gets in trouble.

I certainly agree that firms' access to banks and other lenders may vanish when real interest rates soar, when prices in goods markets collapse, or when substantial amounts of idle capacity, unemployment, and vacant buildings appear. Further, a little of any of these changes is likely to lead to a little less access to credit. However, I doubt that a well-behaved function exists that maps small changes in access, and surely none that could be estimated using conventional balance sheets of firms, which do not mark assets to market.

Moreover, firm-level data are seriously incomplete for interpreting macroeconomic relations. Firms with shaky balance sheets can and increasingly do lease equipment and structures. Companies that provide equipment through leases can invest, even if their clients cannot. Also, a merger between a capital-starved firm and another with access to credit gets around the problem at a "macroeconomic" level. Finally, as the example of Barings amply testifies, firms are not eternal. Such crises are resolved through involuntary mergers and successor firms have or soon regain access to capital markets.

Schiantarelli's useful survey observes that most empirical work can be viewed as employing variations of either Q or Euler-equation models; this is also my interpretation of this literature. Both models are designed to represent a borrowing firm in a world with perfect capital markets. He provides a very valuable discussion of essential assumptions and how different specifications qualify conclusions, especially techniques that dichotomize firms according to whether they are credit-constrained or not. The test then is whether firms scored as credit-constrained deviate predictably from unconstrained firms. The section of his paper on "International Evidence" indicates that many departures from perfect markets are detected, and not a few indicate that supposedly capital-starved firms act as if they are *not* especially credit rationed.

I agree with Schiantarelli that firms vary in their ability to borrow, but would like to suggest a different interpretation. Firms are extremely heterogeneous in what they make, in their style of management and aversion toward risk, in their histories of financial flows, and in the promise of their prospective product lines. It requires an extraordinary leap of faith to believe that this heterogeneity can be represented by independent and identically distributed shocks that are not correlated

with various surrogates for credit constraint. Therefore, while I can readily accept Schiantarelli's conclusion that "the overall evidence suggests significant departures from the perfect capital market paradigm" (p. 189), what is missing in his paper is a model of firm investment decision-making. He candidly acknowledges this in his footnote 13. Much of his discussion in the section "Sample Separation Criteria" seems to skirt this question, but he gets the cart before the horse when he focuses on estimation rather than identification. Suppliers and demanders in imperfect capital markets are both active players; the strategy of neither can be inferred (or identified) from the Q or the Euler-equation approaches without more structural assumptions.

This is not the place to provide an analytical framework for describing the bargaining between potential borrowers and lenders in imperfectly competitive markets. Such a framework would need to be dynamic and to incorporate learning and intertemporal optimization. Because of continuing financial and organizational innovations, Euler-equation techniques are not likely to be illuminating. I refer to the recent rapid growth of foreign bank commercial and industrial (C&I) lending, medium-term notes, new forms of commercial paper, just-in-time production technologies, and especially the changing structure of industrial organization. I was persuaded of the importance of endogenizing working capital by a recent paper by Fazzari and Petersen (1993). However, once that step is taken, the validity of cross-sectional or panel studies is called into question, because firms interact strategically and cannot be viewed as independent draws from an urn.

Changes in the stock of inventories nicely illustrate why I believe that failure to identify demand and supply functions prevents inferences about the role of bank lending in transmitting monetary policy. It has repeatedly been noticed—see, for example, Hester (1994)—that a strong positive correlation exists between changes in inventories and changes in C&I loans. Correlation, of course, does not imply causation. The stock of inventories as a percentage of GDP fell monotonically from 22.4 percent to 16.6 percent between 1985 and 1993; inventories as a fraction of domestic wealth fell irregularly from 6.3 percent to 5.9 percent in the same period.[1] The steady decline in the ratio of the stock of inventories to GDP occurred during a period when interest rates and C&I loans as a percentage of bank assets were both trending downward. It seems difficult to characterize firms in such an environment as being credit constrained. When both quantity and price are falling, a more plausible

[1] Sources: Board of Governors of the Federal Reserve System, "Balance Sheets for the U.S. Economy 1945–93," September 20, 1994; *Economic Report of the President*, February 1995.

interpretation is that demand for credit was shifting down relative to loan supply.

Schiantarelli's summary of empirical results in the section "International Evidence on the Effects of Financial Constraints: Cross-Section and Time Series Variations" confirms that there is little linkage between rejecting the perfect market paradigm and finding evidence of binding financial constraints, when studying dividend payouts, size, and concentration of ownership. His discussion of the results of association with business groups and banks is very interesting and suggests that group membership mitigates financial constraints. These relationships should be a hot topic for future research.

His interpretation in his section "International Evidence" of the time variation of tightness of financial constraints and structural changes in financial markets seems particularly vulnerable to the identification question I raise above. Therefore, I cannot accept his conclusion that "substantial support also is available for the proposition that the severity of financial constraints varies over the business cycle and with the stance of monetary policy" (p. 206).

Surely, rising real interest rates reduce the attractiveness of investment projects and the value of existing assets. Both borrowers and lenders will respond accordingly and less investment will occur. Short-maturity bank loans secured by inventories and accounts receivable are not likely to be affected as much as new issues of securities. One does not require cyclically sensitive credit rationing by short-term lenders to understand why monetary policy works.

Finally, firms with weak credit ratings offer commercial banks far more in the way of profit potential than large firms with access to commercial paper and medium-term note markets. It is hard to believe that banks would bite the hand that feeds them. Rather, they will nurture and provide for promising dependent enterprises, just as ants look after aphids and shepherds tend their flocks.

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EGON ZAKRAJŠEK is an economist in Domestic Research at the Federal Reserve Bank of New York. He was an undergraduate at the University of California, Santa Cruz, and received his Ph.D. from New York University. He has been a Graduate Intern at the Board of Governors of the Federal Reserve System, where he carried on research using the Census Bureau's Quarterly Financial Report (QFR) data base. His dissertion is entitled "Econometric Analysis of the Interaction of Real and Financial Decisions Using Firm-Level Quarterly Financial Report (QFR) Data."

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Deborah Allison, *Wellington Management Company*

Lincoln Anderson, *Fidelity Investments*

David Apgar, *Office of the Comptroller of the Currency*

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