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This Quarterly Review *is published by the Research and Statistics Group of the Federal Reserve Bank of New York. Remarks by* E. GERALD CORRIGAN, *President of the Bank, on the role of central banks and the financial system in emerging market economies begin on page 1. Among the staff members who contributed to articles in this issue are* PAUL BENNETT *(on the influence of financial changes on interest rates and monetary policy, page 8);* RICHARD CANTOR *(on effects of leverage on corporate investment and hiring decisions, page 31);* JOHN RYDING *(on housing finance and the transmission of monetary policy, page 42);* BEVERLY HIRTLE *and* JEANETTE KELLEHER *(on financial market evolution and the interest sensitivity of output, page 56); and* RICHARD G. DAVIS *(on intermediate targets and indicators for monetary policy, page 71).*

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The Role of Central Banks and the Financial System in Emerging Market Economies

by E. Gerald Corrigan

Remarks by E. Gerald Corrigan, President of the Federal Reserve Bank of New York, before the Federal Reserve Bank of Kansas City's Fourteenth Annual Economic Symposium on "Central Banking Issues in Emerging Market-Oriented Economies," August 25, 1990, in Jackson Hole, Wyoming.

Good morning, ladies and gentlemen. I am pleased to appear before you today to discuss the role of central banks and the financial system in the specific context of the recent efforts on the part of a number of Eastern European countries and the Soviet Union to shift their economies toward more market-oriented and competitive systems. I am especially pleased to have the opportunity to discuss these issues in the presence of the distinguished group of central bank governors from those nations who are gathered with us today.

For the sake of emphasis, let me begin my remarks by citing several propositions that, in my judgment, are central to the discussion as a whole. These propositions are:

The stability of the banking and financial system is an absolute prerequisite for the growth and stability of the economy at large.

- *First,* the stability of the banking and financial system is an absolute prerequisite for the growth and stability of the economy at large.
- *Second,* of all the elements of structural reform that are necessary in the transition from a centrally planned and controlled economy to a market economy, none is of greater importance than the reform of the banking and financial system.
- *Third,* while the development of capital markets — especially an efficient market and secondary market for national government securities — is clearly important, the highest priority should be placed on the reform and adaptation of the commercial banking system.

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- *Fourth,* successful reform of the commercial banking system presupposes parallel reform in the central banking system. At a minimum, this reform should take central banks out of the business of directly financing government deficits and provide mechanisms through which central banks can increase or decrease liquidity in the economy without allocating credit for specific purposes or functions.
- *Finally,* and most importantly, at the end of the day, commercial banks and central banks have only one asset that really matters, and that asset is public confidence. Accordingly, the task of reform — in all its detail — must be approached with enormous weight given to this overriding consideration. Indeed, the confidence factor will become all the more important over time as the

ownership of banking and financial institutions shifts to private hands. The crucial question is not whether particular reforms will work as a matter of theory or abstraction, nor even whether a particular approach has worked in other countries.

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Rather, the bottom line is the issue of whether specific reforms are likely to work *and* to build confidence in the specific context in which they are applied.

Before discussing these issues in greater detail, I should make two important qualifications: first, my thinking about these very difficult issues is naturally conditioned by my own experience and environment. Thus, much of what I have to say reflects how things have—and have not—worked here in the United States and in other western industrial countries. I say this because I am acutely mindful—in part from my association with reform efforts in developing countries in Latin America and elsewhere—that successful elements of structural economic reform cannot be insensitive to traditions, customs, cultures, and histories in the reforming countries. On the other hand, there are certain basics—even when considered in the light of national histories and cultures—that are essential in virtually any setting.

The second qualification follows from the first: namely, I do not consider myself an expert on the details of the commercial or central banking systems in any of the countries whose officials are gathered here today. But I do know enough about each and enough about reforms already under way to know that much of what I have to say will not apply equally in all cases and in some may apply in only limited ways. However, even where the latter is the case, I am quite convinced that there is value and discipline to be gained in going back to basics.

Against that background, I believe it is fair to say that it is universally recognized that a particularly important function of a banking and financial system in a market economy is to help mobilize a society's savings and to channel those savings rigorously and impartially into the most efficient and effective uses or investments. That process is, of course, the very lifeblood of economic development and rising standards of living. As a corollary, it is also universally recognized that the banking and financial system must provide the vehicles through which payments for goods and services can be made quickly, efficiently, and safely in a context in

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which both the seller and the buyer of such goods and services have confidence that instruments used to make such payments will be honored and accepted by all parties to that transaction and to subsequent transactions. Without that confidence, the system simply cannot work. Stated differently, these crucial economic functions of mobilizing savings and making payments are often taken for granted. In reality, however, it is very difficult to forge a set of legal and institutional arrangements within which these functions are performed that would be consistent with the often conflicting goals of free choice, economic efficiency, and safety and stability.

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Indeed, economic history tells us in wholly unmistakable terms that no society has found it easy to forge its financial institutions in a way that these goals are appropriately balanced. Even today, within and among the most successful industrialized countries of the world, there is great debate as to how best to go about that task. Certainly, that is true here in the United States. The reasons for the inherent difficulties in this area are an almost classic blend of political and economic considerations that have their roots in the crucial functions the banking system must perform in a market economy.

As an illustration, take the example of the typical household. Clearly a society's long-term economic prospects are best served when such households

make the decision to freely save some of their current income. But that is not enough, since there must also be a way in which those savings can be mobilized and put to work in productive investments. That, of course, means that the household must see not only an inducement to save freely but also an inducement to entrust those savings to someone or something else that can directly or indirectly put those savings to work in sound and productive investments. Under any circumstances, the household will see some risk in parting with its savings and it will expect to be compensated accordingly. But, and this is a very large but, under *any* circumstances, *any* household in *any* society will also want to maintain some fraction of its savings in the form of highly liquid assets, including assets which can easily be used to finance day-to-day and week-to-week transactions needs.

A household's willingness to entrust its savings—especially its highly liquid savings—to some institution presupposes that it has confidence in the financial integrity of that institution. If that confidence is not there in the first instance, the society's ability to mobilize its savings will be compromised and its ability to reap the benefits of economic specialization in the production and distribution of goods and services will be undercut.

For that reason a household's willingness to entrust its savings—especially its highly liquid savings—to some institution presupposes that it has confidence in the financial integrity of that institution. If that confidence is not there in the first instance, the society's ability to mobilize its savings will be compromised and its ability to reap the benefits of economic specialization in the production and distribution of goods and services will be undercut. Similarly, if that confidence is lost, households will simply rush to redeploy their savings, raising the spectre of a flight to cash and/or to hard goods with all its implications for inflation and destabilizing runs on banks.

This, of course, is why confidence in banks is so crucial, and this single factor goes a very long way in explaining why banking institutions and banking instruments have evolved in the way that they have over centuries. What this says, of course, is that no matter what the precise legal and institutional financial framework in a particular country, there are certain preconditions that must exist if the financial system is to be able to perform its essential tasks of mobilizing and allocating savings and facilitating day-to-day transactions. Thus, there must be a class of financial institutions and financial instruments that the public views as safe and convenient outlets for their savings, where at least some fraction of those savings are highly liquid and can be used to make payments. The problem, of course, is

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that any institution that provides the public with access to financial instruments having those characteristics must be one that invests the public's savings carefully and prudently, but also invests those savings in a way that promotes economic efficiency and growth.

In virtually all countries, the single dominant class of institution that has emerged to play this crucial role as both the repository of a large fraction of the society's liquid savings and the entity through which payments are made is the commercial bank. Indeed, even in mature industrial countries with highly developed capital markets—such as the United States—the commercial banking system is still the most important single element of the financial system, especially when it is kept in mind that the capital markets rely very heavily on the banking system for day-to-day and standby financing facilities.

But from the earliest days of commercial banking, experience has repeatedly shown that the *combination* of functions typically provided by such institutions carries with it the unique risk that a loss of confidence in

As the broad sweep of history tells us, there are many instances in which the loss of confidence in financial institutions has caused major damage to the real economy. In other words, systemic risk is not an abstraction; it can be quite real.

individual institutions can spread to the system as a whole. This, of course, is the so-called systemic risk phenomenon. And as the broad sweep of history tells us, there are many instances in which the loss of confidence in financial institutions has caused major damage to the real economy. In other words, systemic risk is not an abstraction; it can be quite real.

It has long been recognized by all governments that banking and financial institutions must be subject to at least some form of regulation or official oversight

because the functions they provide are indispensable to economic success, even though these same functions by their very nature introduce potential risks that are capable of undermining the prospects for such economic success. I am fond of pointing out — and I will do it again in this context — that Adam Smith forcefully took this position in *The Wealth of Nations.*

In most countries there is either an explicit or a tacit recognition that one of the crucial functions of the central bank is to help preserve and enhance the stability of the banking and financial system. Indeed, while the primary task of most contemporary central banks is viewed as the conduct of monetary policy, many central banks — certainly including the Federal Reserve — were established largely with a view toward preventing or at least containing financial shocks and disruptions.

My own vision of the role of the contemporary central bank...is one in which the central bank houses a trilogy of functions. At the center of the trilogy is, of course, monetary policy. But there are two other crucial functions of the contemporary central bank that are closely related to monetary policy and constitute a single theme. These other two functions are the broad oversight of the financial system and the oversight of and/or direct participation in selective aspects of the operation of payment systems.

My own vision of the role of the contemporary central bank — framed by a sense of history, by my experience in the United States, and by my utter conviction as to the importance of the efficiency and stability of the financial system — is one in which the central bank houses a trilogy of functions. At the center of the trilogy is, of course, monetary policy. But there are two other crucial functions of the contemporary central bank that are closely related to monetary policy and constitute a single theme. These other two functions are the broad oversight of the financial system and the oversight of and/or direct participation in selective aspects of the operation of payment systems. These are the functions, but the single theme is stability — stability in the purchasing power of the currency of the country and stability in the workings of the financial system, including the payments system. This single theme of stability is a package deal in that each of the parts is dependent on the other parts.

But if it is appropriate to think of the role of the central bank in the context of this trilogy of functions, and if it is fair to suggest that financial stability is a necessary — but not sufficient — condition for economic growth and stability, then it must follow that the structure and workings of the banking system are of great importance to this process as a whole. Looked at in this broad light, the challenge of reforming the banking system is formidable indeed, especially since the paths chosen to effect such reform cannot be viewed in isolation from reforms of the central bank. Neither can they be viewed independently of emerging developments in capital markets, in particular the need to develop mechanisms whereby central governments can more effectively finance budget deficits in a manner that does not constrain the monetary policy process. None of this is easy, but the greatest challenge may lie in forging the individual pieces of the reform effort in such a way that they fit together into a cohesive whole that will serve the dictates of stability, growth, and confidence. From this perspective, it seems clear to me that the first priority is the mobilization of private savings.

The challenge of reforming the banking system is formidable indeed, especially since the paths chosen to effect such reform cannot be viewed in isolation from reforms of the central bank. Neither can they be viewed independently of emerging developments in capital markets, in particular the need to develop mechanisms whereby central governments can more effectively finance budget deficits in a manner that does not constrain the monetary policy process.

This, in turn, brings one's attention immediately to the liability side of the balance sheet of the major financial intermediaries — the commercial banks. Indeed, in the short run, I would argue that the design of the transactions-like and savings-like liability instruments of the banks is more important than the design of the overall structure of the system. And it is not simply the design of the instruments that is important but also the design and workings of the broad infrastructure that goes with such instruments. For example, for transactions-type accounts and especially for interbank movements of funds, efficient, safe, and speedy collection and payments systems are a must if confi-

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dence is to be built and maintained. Indeed, banking instruments and institutions are only as good as the infrastructure that supports them.

The ability of the banking system to mobilize savings by attracting deposits is one thing. But its ability to retain such deposits and to put them to good use is quite another, which of course brings me to the asset side of the balance sheet. The bank's choice of its assets is crucial for two reasons:

> First, if the bank is careless in the credit it extends, it will incur losses and will not be able to honor its obligations to its depositors. If its ability to honor its deposit obligations is in question, the bank will always be subject to the risk of deposit runs. This is the subtle genius of the banking system, for it is a key feature of the banking system that creates the incentive for the bank to extend credit wisely, judiciously, and impartially.
>
> Second, even where capital markets are well developed, the credit decisions of the banking system remain the single most important element determining how the society's savings are deployed. Those credit decisions therefore determine which firms, which farms, and which entrepreneurs will receive the credit and which will not. If the system is working correctly, those who receive credit will be the most efficient, the most competitive, and the most profitable. Therefore, they will be the most capable of producing the stream of goods and services that will permit the economy to grow and standards of living to rise.

It should be clear that the objectivity and impartiality of the credit decision-making process are absolutely indispensable features of an efficient and market-oriented banking system. Partly because of the obvious problems of political pressures, but for other reasons as well, the government or the state is not well equipped to make these decisions.

It should be clear that the objectivity and impartiality of the credit decision-making process are absolutely indispensable features of an efficient and market-oriented banking system. Partly because of the obvious problems of political pressures, but for other reasons as well, the government or the state is not well equipped to make these decisions. To be sure, the state can establish tax or other incentives for certain activities — something we see in all societies — but the decision as to who gets credit and who does not must be left to private initiative in a context in which those making the decisions have a major stake — their own economic livelihood — in the credit decisions they make.

This is also one of the more fundamental reasons that the development of sound and internationally acceptable accounting systems in emerging market economies is so vitally important. Accounting systems serve a variety of purposes, but none is more important than their role in helping creditors make the rigorous decisions as to which enterprises can meet the market test of efficiency, competitiveness, and profitability that will permit those enterprises to meet their obligations and, in turn, permit their creditors to meet their obligations.

Another subject of importance in regard to the structure of banking institutions is the size and composition of the bank's capital account....[The capital base] creates a constituent group of individuals or institutions that has a direct interest in the profitability of the bank, which in turn should strongly reinforce the impartiality of the credit decision-making process.

Another subject of importance in regard to the structure of banking institutions is the size and composition of the bank's capital account. The capital account, representing the ownership interests in the bank, serves two obvious purposes: first, it is a source of permanent funding, and second, it provides a cushion for absorbing losses. But the capital base also serves another, more subtle function: namely, it creates a constituent group of individuals or institutions that has a direct interest in the profitability of the bank, which in turn should strongly reinforce the impartiality of the credit decision-making process.

For these reasons, it should be obvious that private ownership of banks is the preferred arrangement. Having said that, I would add that it is also true that government ownership of commercial banks is quite common in developing nations and, in fact, is also to be found in some major industrial countries. Also, in virtually all countries — the United States included — special purpose banking organizations entailing government ownership, guarantees, or sponsorship are not uncommon. I mention this only because the drive for private ownership of banks may — particularly in the short to intermediate run — have to be tempered with some realism as to what kinds of arrangements are workable. Thus, some or all of the initial capital stock of commercial banks may have to come from the gov-

ernment — an outcome that can be acceptable if three conditions are also met. Those conditions are:

First, the management of the bank is independent of the government such that the government does not direct credit decisions and allocation. In other words, government ownership must not preclude competition.

Second, having provided the initial capital, the government is not responsible for the overall funding of the bank.

Third, the government's ownership interests are structured such that at some later date they can be easily sold to private interests.

While individual countries have considerable latitude with regard to the precise legal and organizational structure of their commercial banking system, the basic functions are common to all countries. And by their very nature, those functions entail risk taking on the part of individual institutions and the system as a whole. In the face of that risk taking and the need to maintain public confidence in the banking system, banking in all countries is subject to a higher degree of official oversight and regulation than is the case for most other forms of private enterprise. As an extension of that, all countries have put in place some form of a so-called safety net that is associated with the operation of the banking and financial system.

In practice, the specific form of the safety net — in both de jure and de facto terms — can differ appreciably from one country to the next. In generic terms, however, the safety net is usually designed to provide the following functions: first, the regulation of the affairs of banking institutions, usually including the inspection and examination of such institutions; second, some form of protection against loss on the part of at least small depositors and investors; third, some form of emergency liquidity facility; and finally, some form of official regulation of or participation in the workings of the payments system.

I would place a particularly high priority on the need to develop a strong program of bank supervision, especially in the early phases of the changing role of the commercial banks....The central bank can also play a highly valuable role in the early development of critical aspects of the payments system such as the interbank deposit market and the emerging markets for government securities.

In virtually all countries, the central bank plays a direct or indirect role in the operation of one or more of these central features of the safety net. For example, the emergency liquidity facility is almost always the discount window of the central bank. In many countries — including the United States — the central bank also plays an important role in both the supervision of banking institutions and in either or both the regulation and the operation of the payments system. Given the concept mentioned earlier of the trilogy of central bank functions, it will come as no surprise when I say that I strongly believe that central banks should play an important role in both of these areas. In this regard, I would place a particularly high priority on the need to develop a strong program of bank supervision, especially in the early phases of the changing role of the commercial banks. Similarly, the central bank can also play a highly valuable role in the early development of critical aspects of the payments system such as the interbank deposit market and the emerging markets for government securities.

Regardless of how broadly or narrowly, how explicitly or implicitly the legal mandate of the central bank is drawn, it seems to me inevitable that the central bank will always have an important role in helping to build and maintain confidence in the underlying stability of the banking and financial system. In turn, that necessarily implies that there must be a high degree of public confidence in the central bank itself. Achieving and maintaining that public confidence is, in the first instance, squarely related to the success the central bank has in the discharge of its monetary policy responsibilities. That is why monetary policy stands at the center of the trilogy of central bank functions. It is also the reason that central banks must have special status within the governments they serve. At the very least, that special status implies that central banks should not be expected to finance the budgetary deficits of governments directly. It also implies that the central bank normally should not be responsible for the direct financing of other types of enterprise. Indeed, such arrangements run the clear risk that the central

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bank's balance sheet can become weighed down with low-quality assets. In such circumstances, confidence in the financial integrity of the central bank can only suffer.

Having said that central banks should not be responsible for the direct financing of government deficits, I should add that it is also true that central banks typically are major holders of government debt. But in the ideal order, a central bank's holdings of such government debt should arise in connection with its orderly efforts to supply liquidity to the economy as a whole through open market operations or other suitable vehicles. This is one of the many reasons that the development of a market for government securities — including a viable secondary market for such securities — is such a high priority. Indeed, a well-functioning government securities market will serve three vital purposes: first, it will provide a more market-oriented way to finance budget deficits; second, it will facilitate a more effective approach to monetary policy and the strengthening of the balance sheet of the central bank; and third, it will provide the foundation upon which other elements of capital markets can be developed. But as with all markets, the development of a smoothly functioning government securities market presupposes that there is a complete infrastructure that will support an emerging secondary market for such securities that, at the least, provides the liquidity whereby such securities can be readily bought and sold by the central bank and other market participants. Without that infrastructure and liquidity, it will be very difficult to design government debt instruments that institutions and individuals will find attractive as investments and it will be equally difficult to free the monetary policy process from the need either to directly finance government deficits or to engage in various forms of credit allocation, or both.

A well-functioning government securities market will serve three vital purposes: first, it will provide a more market-oriented way to finance budget deficits; second, it will facilitate a more effective approach to monetary policy and the strengthening of the balance sheet of the central bank; and third, it will provide the foundation upon which other elements of capital markets can be developed.

I said at the outset that the task of reforming the banking and financial system was one of the most important tasks facing the countries of Eastern Europe and the Soviet Union. It is also one of the most difficult. In part those difficulties are technical, in part they are economic, and in part they are political. But most fundamentally, these difficulties arise from the fact that the reform of the banking system must come to grips with that great intangible — public confidence. It is in this area in particular that the role of the central bank is vitally important not only in the context of its monetary policy responsibilities but also with regard to the inherent responsibility of the central bank to help ensure the essential stability and viability of financial institutions and markets.

The Influence of Financial Changes on Interest Rates and Monetary Policy: A Review of Recent Evidence

by Paul Bennett

Changes in financial regulations, markets, and institutions have been altering the relationships between key interest rates and the effective degree of stimulus or restraint in sectors of the economy. Although the complexity of these developments has made them difficult to monitor, statistical evidence relevant to the topic is becoming available. This article reviews a number of recent studies that directly or indirectly consider the influence of financial changes on the behavior of interest rates and the transmission of monetary policy.

Before surveying the empirical evidence, it is useful to describe at a conceptual level how financial changes might affect interest rates and the transmission of policy. In principle, changes to the financial system may alter both the equilibrium level of interest rates — that is, the level consistent with a full employment noninflationary economy — and the size of interest rate changes consistent with the maintenance of good economic performance in the face of shocks to output and prices. If "nonprice" mechanisms that rationed credit in the past have been reduced, then more of the burden of credit allocation among potential borrowers will fall on interest rates. Without a perfectly elastic supply of savings at given interest rates, or any increase for other reasons in the amount of loanable funds available, the equilibrium level of rates will be higher. Moreover, if it is true that in the past the nonprice mechanisms tended to bind especially forcefully when interest rates were high and less so when rates were lower, then once these mechanisms have ceased to operate, interest rates may have to rise and fall more to exert the same restraining or stimulating effects on the economy.

The core notion that allocational mechanisms other than explicit interest rates figure importantly in credit markets and affect the way monetary policy is transmitted is fairly widely accepted in the economics literature (for example, Brunner and Meltzer 1988, Blinder and Stiglitz 1983, and Bernanke and Blinder 1988[1]). Nevertheless, these mechanisms are not explicitly incorporated in some of the most widely used economic models. A stylized neoclassical framework might emphasize individuals' or firms' saving and borrowing decisions that depend on interest rates, with borrowing and spending negatively related to interest rate levels except in cases where offsetting income or wealth effects arising from interest rate movements are present. Such a framework does not recognize that borrowing is often constrained by other factors, and the resulting "notional" demands for borrowing and spending — that is, the amounts individuals or firms would ideally choose at given interest rates — may not be an adequate description.

Two important categories of constraints on borrowing activity will be cited in the discussion that follows. One type of constraint reflects the possible inability of credit intermediaries to provide all the funds their loan customers demand. An example of such a "funding availability constraint" was the episodic inability of

[1]Full bibliographical information for all sources cited in the text can be found in the reference list at the end of the article.

depository institutions to bid for deposits because of regulatory ceilings on deposit rates. To the extent that potential borrowers depended upon particular intermediaries or classes of intermediaries that were unable to supply all the funds demanded, borrowing — and spending — fell short of the "notional" amounts that would otherwise have occurred at given interest rates. A second type of constraint might be called a "credit qualification constraint." Because of informational asymmetries, differing assessments of the underlying risks, or merely different attitudes toward those risks, a borrower may want to borrow more at the prevailing interest rate than a lender feels it can safely lend to that firm or individual.

Structural changes in financial markets and practices over the past few decades have encouraged reductions in these financing constraints and thereby raised potential borrowers' abilities to realize their notional demands for credit. Deposit rate ceilings have been eliminated, relaxing funding availability constraints since the 1970s and the early 1980s. The entry of foreign banks, the phasing out of interstate banking restrictions, the growth of commercial paper and other alternatives to loans, and the increased competition between depository and nondepository intermediaries have increased potential borrowers' choice of lenders.[2] These developments have reduced the likelihood that a borrower will be limited by an intermediary's own particular funding situation or credit evaluation process. The growth in committed bank lines of credit has made it less likely that difficulties or delays in borrowing will force a business to limit its productive activity. Securitization of assets has provided an important added dimension of funding flexibility for intermediaries, including those with limited scope for raising deposits or other liabilities.[3] Like the removal of deposit rate ceilings, mortgage securitization has helped to eliminate funding availability bottlenecks in the housing market. Similarly, the growth and spread of consumer credit lines, including those backed by home equity, have reduced the likelihood that households will become constrained in their spending by slowness or difficulties in obtaining credit.[4]

Thus some borrowers can borrow more than before, and — for given interest rates and holding other factors equal — aggregate spending on goods and services is stronger than it would have been in the absence of the financial changes. But because the overall productive capacity of an economy is limited and the supply of savings, domestic or international, is not perfectly elastic, the equilibrium level of interest rates is higher following the relaxation of the constraints.

In addition, the sensitivity of aggregate demand to *changes* in interest rates may have been altered. That is, the financial changes may have increased or decreased the size of movements in interest rates consistent with maintaining or restoring a noninflationary economic growth path. Many of the financial changes work in the direction of *increasing* the size of swings in interest rates needed to achieve a given impact on aggregate demand. The nature of funding availability and credit qualification constraints suggests that the degree to which they bind may vary somewhat systematically with the level of interest rates. When deposit ceilings were in effect, they tended to bind more when interest rates rose and to ease up when rates fell. Credit standards automatically tighten when interest rates rise, most obviously because debt service rises relative to current income but also because the resale value of collateral assets drops and expectations of future earnings or cash flows may be revised downward. Financial changes that reduce the likelihood that such constraints bind as interest rates rise (and ease up as rates fall) will tend to increase the size of interest rate movements relative to their effects on expenditures.

Other financial changes, however, may make expenditures more, rather than less, sensitive to interest rate movements. One very important example is the 1980s increase in the level of debt in the household and corporate sectors, itself a medium-term cumulative result of the relaxation of constraints on borrowing. Leveraging leaves borrowers' ability to obtain additional credit more sensitive to interest rates and credit market conditions generally. Another financial change that may increase potential borrowers' sensitivity to interest rates is the trend toward pricing credit more directly and competitively off of short-term market interest rates. While this trend is part of a broader set of changes making credit more widely available, floating rate loan pricing may affect borrowers' decisions more directly, possibly replacing credit rationing with a heightened interest rate sensitivity on the part of borrowers themselves. Thus the ability of monetary policy to affect certain types of borrowers through short-term market rates may be enhanced. Finally, categories of borrowers who were previously at the margin of markets for credit may now have more access. Some of these people and businesses may now rely more on debt than in the past and may therefore be more sensi-

[2]On foreign bank competition, commercial paper, and competition with nonbank competitors, see Estrella (1986); Hook and Alvarez (1986); and Mead and O'Neil (1986). On interstate banking, see King, Tschinkel, and Whitehead (1989).

[3]For a review of economic factors driving securitization of assets, see Cumming (1987).

[4]For a general description of consumer credit lines backed by home equity, see Canner, Fergus, and Luckett (1988).

tive to changes in credit market conditions.

Exchange rates also may be affected by reductions in nonprice credit rationing mechanisms. If the decline of such mechanisms leads to an increase in the domestic effective demand for credit, not only will interest rates increase but also the exchange value of the domestic currency will rise. In turn, imports will be encouraged and exports discouraged. Such an outcome presumes that parallel changes in other economies' financial systems do not lead to equally higher foreign interest rate levels, which would offset effects on exchange rates and require domestic interest rates to rise still more. More generally, domestic financial sector improvements that attract capital from abroad in one period might be imitated in foreign economies in subsequent periods. As financial changes that draw in capital and encourage spending and imports in one economy eventually make themselves felt in other economies, balances of trade will shift as well.

In addition to influencing the general levels of exchange rates, financial changes may also affect the size of swings in exchange rates through time. As noted, a country's own interest rates may be induced to rise or fall to a greater or smaller degree as a result of financial changes. Exchange rate movements might then tend to become correspondingly more or less volatile, reflecting the domestic interest rate changes, other factors equal.

Financial changes that affect the relationship between interest rates and economic activity also may have implications for monetary policy. At least temporarily, the monetary authorities can influence interest rates by adjusting the availability of bank reserves. However, if they were to attempt to hold down the level of interest rates artificially by supplying excessive reserves when macroeconomic equilibrium implied a higher interest rate level, then the result would be too rapid a growth of credit and an acceleration of inflation. More generally, if the authorities attempted to keep interest rates from changing appropriately in response to shifting macroeconomic forces, the result would be less economic stability.

To summarize the conceptual framework, financial changes that reduce constraints on funding availability or on credit qualification allow some businesses and households to spend at higher levels more closely approximating their ideal, notional demands. Such changes strengthen aggregate demand, pushing up interest rates and attracting foreign capital. To the extent that the lifting of financial constraints changes the sensitivity of aggregate demand components to movements in interest rates, the size of the interest rate responses to given demand shocks changes as well. Some developments may have made the marginal effect of rate changes on spending smaller, but there have also been some offsetting increases in sensitivities to interest rate changes.

Evidence of the effects of financial change

This section reviews evidence of shifts in funding availability and credit qualification constraints on intermediation and borrowing. Central questions are whether financial changes have raised the level of interest rates consistent with noninflationary growth and whether a given fluctuation in aggregate demand now requires a different sized adjustment in rates than in the past to maintain macroeconomic equilibrium. This section also considers how the relative incidence of interest rate sensitivities may have shifted, among domestic sectors as well as external trade-sensitive sectors.

At the outset, it is useful to review some basic trends in interest and exchange rates. From a long-run perspective, interest rates have tended to be higher in recent years than in earlier decades. Table 1 shows average levels of short- and long-term interest rates over a series of five-year periods from 1955 to 1989. If one abstracts from the inflationary early 1980s, both short- and long-term rates show upward secular trends. Table 1 also shows the rates as "real rates," adjusted for inflation, and these too have been higher on average during the economic expansion of the 1980s.

Table 2 measures the average size of interest rate swings, calculated here as absolute values of December-to-December rate changes, averaged over five-year periods. It is not as clear from these volatility-type calculations whether interest rate changes have become

Table 1

Average Nominal and Real U.S. Interest Rates

	Long-Term†	Short-Term‡	Real Long-Term§	Real Short-Term‖
1955-59	3.49	2.54	1.84	.89
1960-64	4.01	2.91	2.76	1.66
1965-69	5.37	5.54	1.95	2.13
1970-74	6.81	7.07	.68	.94
1975-79	8.23	7.22	.18	−.83
1980-84	12.39	12.17	4.88	4.66
1985-89	8.75	7.67	5.08	4.00

†Period-average ten-year Treasury.
‡Period-average federal funds rate.
§Period-average ten-year Treasury bond yield minus contemporaneous period-average consumer price index (CPI) inflation rate.
‖Period-average federal funds rate minus the contemporaneous period-average CPI inflation rate.

Table 2

Average Absolute Changes in Nominal and Real U.S. Interest Rates

(In Basis Points)

	Long-Term†	Short-Term‡	Real Long-Term§	Real Short-Term‖
1955-59	59	77	126	115
1960-64	32	77	67	87
1965-69	69	138	72	80
1970-74	64	241	214	237
1975-79	104	260	224	102
1980-84	163	334	230	254
1985-89	153	78	112	150

Note: Table shows five-year averages of absolute values of annual December-to-December rate changes.
†Ten-year Treasury bond yield.
‡Federal funds rate.
§Ten-year Treasury bond yield minus the twelve-month lagged CPI inflation rate.
‖Federal funds rate minus the twelve-month lagged CPI inflation rate.

systematically larger or smaller in recent years.[5] The changes in long-term real and nominal rates have been larger since the mid-1970s, but not especially larger since the mid-1980s. The two measures of average short-term rate movements, on the other hand, were moderate during the late 1980s, in the context of relatively stable macroeconomic conditions.

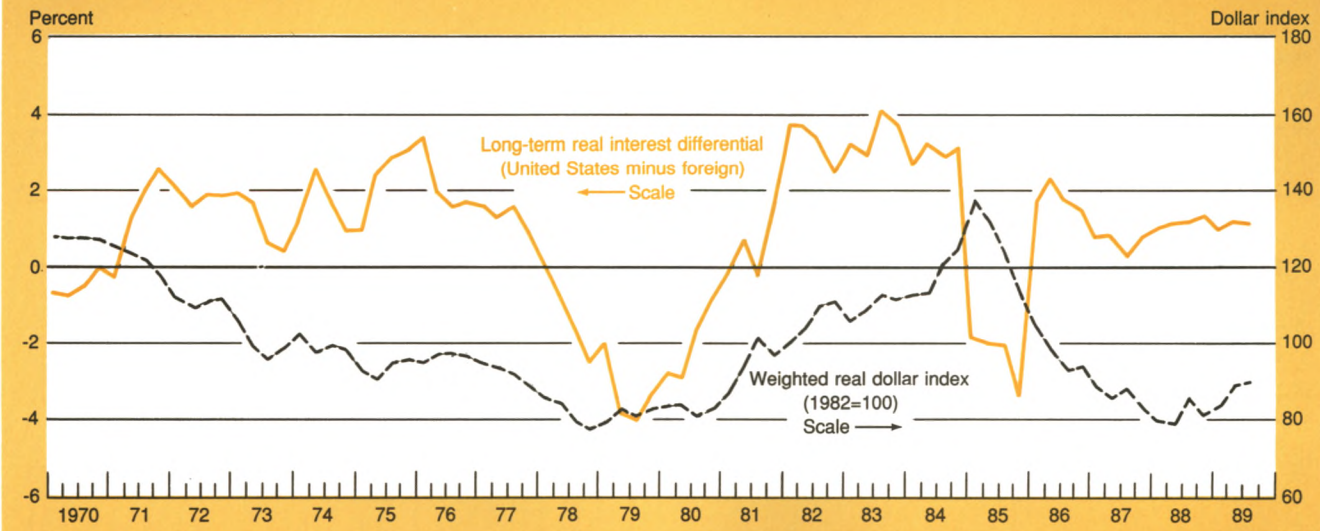
Chart 1 plots the differential between U.S. and foreign long-term interest rates against the weighted average exchange rate, adjusting both interest rates and exchange rates for price-level changes. The trend from the mid-1970s through the late 1980s was for U.S. real rates to rise relative to foreign real rates. The real dollar's strength in the first half of the 1980s and its drop in 1985-86 appear partly attributable to the interest rate differential. As Chart 2 shows, changes in the dollar were relatively large in much of the 1980s, even compared with the changes during the earlier floating rate period of the 1970s.

[5]To check robustness with respect to different choices of volatility measures, monthly and quarterly standard deviations of short- and long-term nominal and real interest rates were also computed, and the pattern was similar to that in Table 2.

Chart 1

Long-Term Real Interest Rate Differential and Real Dollar Exchange Rates

"Foreign Major Five" Countries



Notes: Foreign major five countries are Japan, Germany, the United Kingdom, France, and Canada. Weighted real dollar index is calculated using each country's GNP and GNP deflator relative to the U.S. GNP deflator. Long-term rates are calculated by subtracting inflation (four-quarter lags) from each country's nominal interest rate. The long-term interest rates used are from long-term industrial bonds (Japan), industrial bonds (Germany), twenty-year debentures (United Kingdom), public bonds (France), and industrial bonds (Canada). The AAA corporate bond rate is used for the United States.

The following subsections review the evidence on the effects of financial change on different parts of the U.S. economy, particularly such traditionally interest-sensitive areas as housing, consumer durables expenditures, and business investment. The possibility that exchange rates and international financial market linkages are assuming greater importance in the transmission of monetary policy is also discussed. In addition, attention is given to aggregate-level research that may clarify whether the financial changes are significant from a macroeconomic perspective.

Housing and mortgage markets

Many analysts agree that financial changes have altered the relationships between interest rates and mortgage and homebuilding activity. During the 1960s and 1970s, tight monetary policy on several occasions slowed housing by pushing interest rates on short-term instruments such as Treasury bills above the maximum rate allowed under Regulation Q at depository institutions. As depositors withdrew funds to seek higher market rates — a phenomenon known as "disintermediation" — many thrifts were unable to originate new loans.[6]

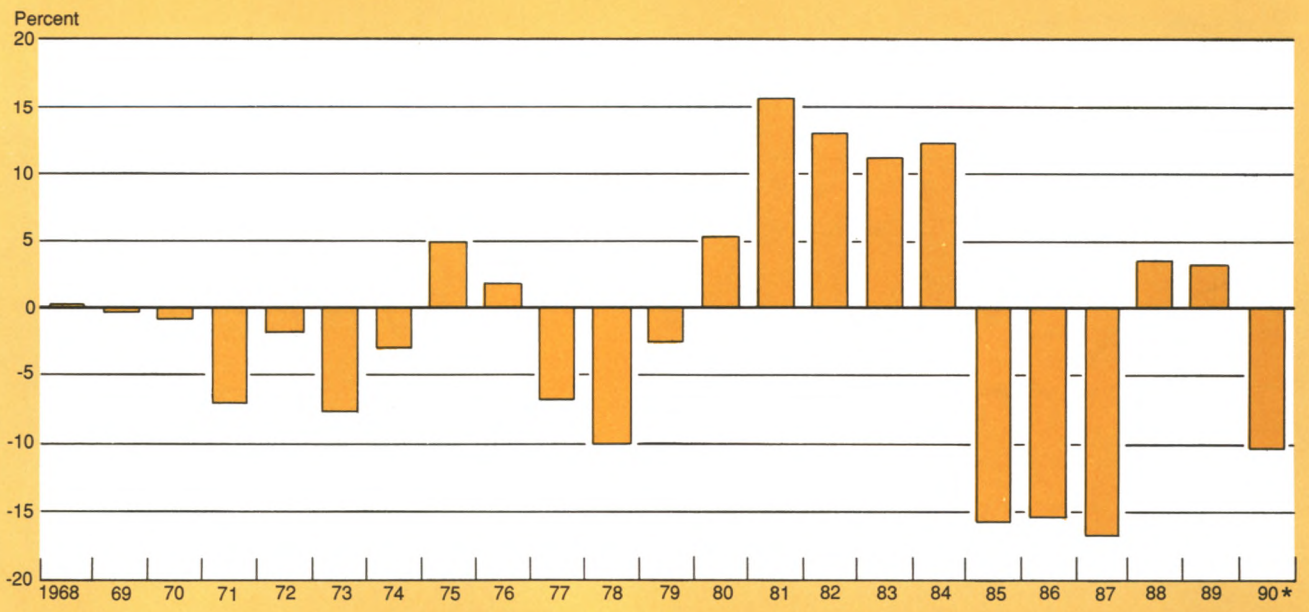
Econometric studies confirm that deposit deregulation increased the availability of funding for housing. Jaffee and Rosen (1979) estimate a model of the housing sector through the end of 1978, when deposit deregulation was just getting underway in the United States. Simulating forward, they find that the post-1978 growth of money market certificates kept housing starts higher than otherwise in the face of sharp interest rate increases. Throop (1986) presents evidence that the severe funding availability constraints under Regulation Q reduced residential construction by up to 12 percent in some quarters and that such effects have now been eliminated. Throop further calculates that financial deregulation since the mid-1970s increased the variability of interest rates, although only to a modest degree. Friedman (1989), using large econometric model estimates, finds that mortgage rates would have

[6]For further discussion of disintermediation effects on housing, see the article by John Ryding in this issue of the *Quarterly Review.*

Chart 2

Change in the Value of the U.S. Dollar

December-to-December Percent Changes



Notes: The value of the U.S. dollar is measured as a trade-weighted rate of exchange against ten foreign currencies. Weights reflect 1972-76 global trade of each of the Group of Ten countries.

* 1990 value is August-to-August change.

to rise approximately 2½ percentage points to generate an impact on housing equivalent to that caused by a decline in mortgage funding availability typical of severe disintermediation episodes. Ryding (1990) presents econometric evidence that even the limited disintermediation taking place in the early 1980s dampened housing activity, although this effect was clearly less pronounced than in earlier periods because deposit ceilings were being phased out. Presumably by the middle 1980s the completion of the Regulation Q ceiling phaseout, together with the growth of secondary mortgage trading, had eliminated this type of disintermediation effect from the monetary transmission mechanism.

Ryding also offers evidence that the growth of secondary mortgage trading has affected the cost of housing finance. In the mid-1980s the sharp rise in the proportion of outstanding single-family mortgages trading in securitized form helped to break the links between particular institutions' ability to attract deposits and individual households' ability to obtain mortgage credit. In addition, the increased competition among originators and among investors in mortgages implied by the secondary market growth, together with the credit enhancement provided by federally sponsored mortgage-backed securities programs, suggests lower all-in funding costs to homebuyers; Ryding shows that lending spreads have indeed been narrower as a result.

In principle, increased mortgage lending competition may also make it easier for some borrowers to qualify for loans because there are more lenders seeking to identify acceptable credits. Also contributing to this increased flexibility in qualifying borrowers for mortgage credit is a series of innovations stimulated by lenders' attempts to accommodate the effects of inflation on cash flows. While high nominal interest rates reflect expectations of general price and wage increases, lending decisions out of prudence must give less than full weight to such projected inflation. Jaffee and Rosen model the demand for housing as depending in part on nominal, rather than only on real, interest rate levels. New types of mortgages reducing cash flow requirements and increasing credit qualification began to be used with the arrival of very high nominal interest rates in the early 1980s.[7] In addition, some mortgage lenders eased their limits on acceptable levels of debt service relative to income.[8] With lower inflation, some of these changes in lending standards may have been reversed, but others persist. Adjustable rate mortgages (ARMs), for example, developed in an inflationary environment but have continued to some extent even with lower rates.

ARMs are a particularly successful innovation because they help intermediaries better manage repricing and prepayment risks, and they also tend to allow lower monthly payments for borrowers. The better risk-management opportunities encourage intermediaries to extend ARM credit, although variable payments raise credit risk for marginal borrowers. Borrowers too must balance the lower starting payments against the greater cash flow uncertainty. Studies have tended to find that adjustable rate lending has had a very modest positive impact on the effective demand for housing.[9]

While ARMs probably make housing credit somewhat more available and affordable, they may also increase the sensitivity of housing to marginal changes in short-term rates, which in turn are most influenced by monetary policy. Ryding shows that, particularly in the last few years, the ARMs share of new mortgage originations has fluctuated closely in line with the spread of fixed rates relative to the ARM rate.[10] That is, people tend to take the lower rate. If tight monetary policy raises short-term rates, some potential home buyers could choose fixed rates instead of adjustable rates. But to the extent that there now exists a component of housing demand that is especially dependent upon the normally lower ARM rates, a rise in short-term rates may have a direct negative impact on some home purchase decisions.[11]

On balance, it appears fairly clear that housing finance is better insulated from periods of major credit stringency than in the past, mainly because of deposit deregulation but also because of the growth of the secondary mortgage market. In addition, the market appears generally more competitive, providing creditworthy borrowers better access. By contrast, it is not as clear how financial changes have affected sensitivity to less dramatic movements in interest rates. It seems at least possible that ARMs may have created a slightly

[7]For example, see Jones (1982) and DeMagistris (1982).

[8]Wojnilower (1985) notes that lenders became markedly enthusiastic (partly also for legal reasons) about taking households' second incomes into account in credit evaluations. See especially p. 354.

[9]For discussions of the theoretical issues and for empirical findings, see Brueckner and Follain (1988); Goodman (1985); Palash and Stoddard (1985); Stutzer and Roberds (1988); Esaki and Wachtenheim (1984-5).

[10]See the accompanying article by Ryding in this issue of the *Quarterly Review*. A different viewpoint emphasizes that having ARMs as an alternative to fixed rate lending may reduce some borrowers' sensitivity to long-term rates, because they can use the floating rate alternative if they believe market interest rates will fall more rapidly than implied by the rates on fixed rate mortgages. See Bosworth (1989, pp. 80, 81).

[11]For some evidence that ARMs borrowers tend to be relatively illiquid, see Goodman, Luckett, and Wilcox (1988).

closer link between housing and short-term rate fluctuations, but this last point is still conjectural.

Consumer expenditures

Relationships between interest rates and household consumption spending may have changed as well. Traditionally, spending on goods other than consumer durables has not been very interest sensitive.[12] One reason is that many households are net lenders of funds and receivers of interest income. For example, many elderly people are spending down their accumulated lifetime savings and could therefore spend more if interest rates were to rise, particularly now that small savings accounts pay variable market rates.[13] This logic extends also to middle-aged people accumulating savings for retirement, especially if their liabilities are locked in at fixed (for example, mortgage) rates.[14] Goodman, Luckett, and Wilcox (1988), however, show that for some younger households, particularly those with ARM loans and relatively few liquid assets, higher rates would squeeze their cash flows and presumably force less spending.

A recent article by Cantor (1989) investigates how the effects of interest rates on household cash flows changed in the 1980s. He takes into account the growth since the 1970s of assets linked to market rates, particularly in the wake of deposit deregulation, in addition to the growth of ARMs and other liabilities. Cantor finds that, on balance, the increases in rate-sensitive assets and liabilities have largely offset each other. Thus they have not caused major changes in the overall sensitivity of household cash flows to interest rates over the last decade, although some modest

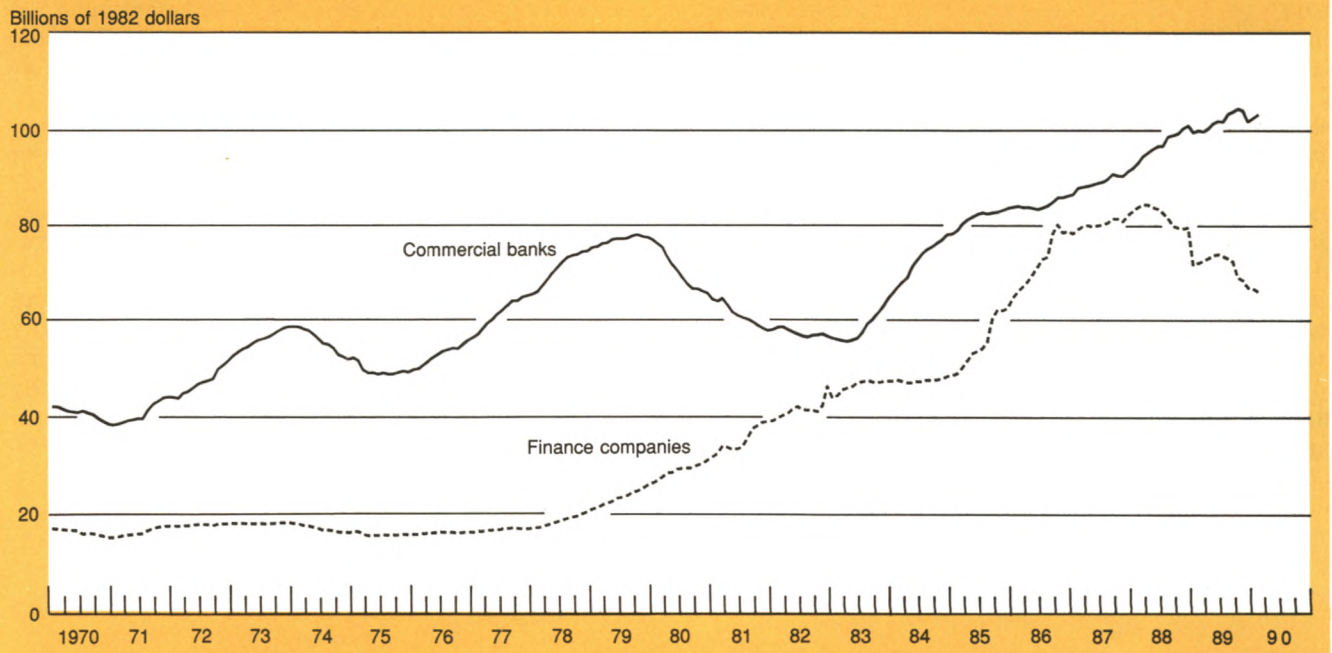
[12]Regarding the relative interest insensitivity of consumption outlays, particularly purchases other than of durable goods, see Hall (1988) and Campbell and Mankiw (1989).

[13]On the savings behavior of the elderly, see Hurd (1987).

[14]The logic here is analogous to the result that higher interest rates increase the net asset value of pension funds, even those invested in fixed-rate assets, because their retirement funding goals or obligations are of still longer duration on average. See, for example, Estrella (1984).

Chart 3

Net Extensions of Auto Credit



Source: Federal Reserve Board.

Note: Chart shows nominal net extensions of auto credit deflated by the consumer price index component for new cars.

increase in sensitivity occurred before 1978. Cantor concludes that any positive impact that higher interest rates might have on consumption because of cash flow effects remains a comparatively minor positive offset to the more generally restraining effects of interest rates on spending.

The mechanisms through which market rate changes influence expenditures on consumer durables have undergone substantial changes. Traditionally, banks' willingness to extend consumers credit has played a significant role in the transmission mechanism. Evidence presented by John Duca (1987), for example, indicates that banks' credit extensions to support consumer durables expenditures have been related to their "willingness to lend," as measured in this case by an index derived from the Federal Reserve Senior Loan Officer Surveys. The banks' willingness to lend in turn has been related to interest rate changes, although Duca's statistical tests reveal little *direct* linkage between rates and consumer outlays once the intermediate willingness-to-lend effect is taken into account.

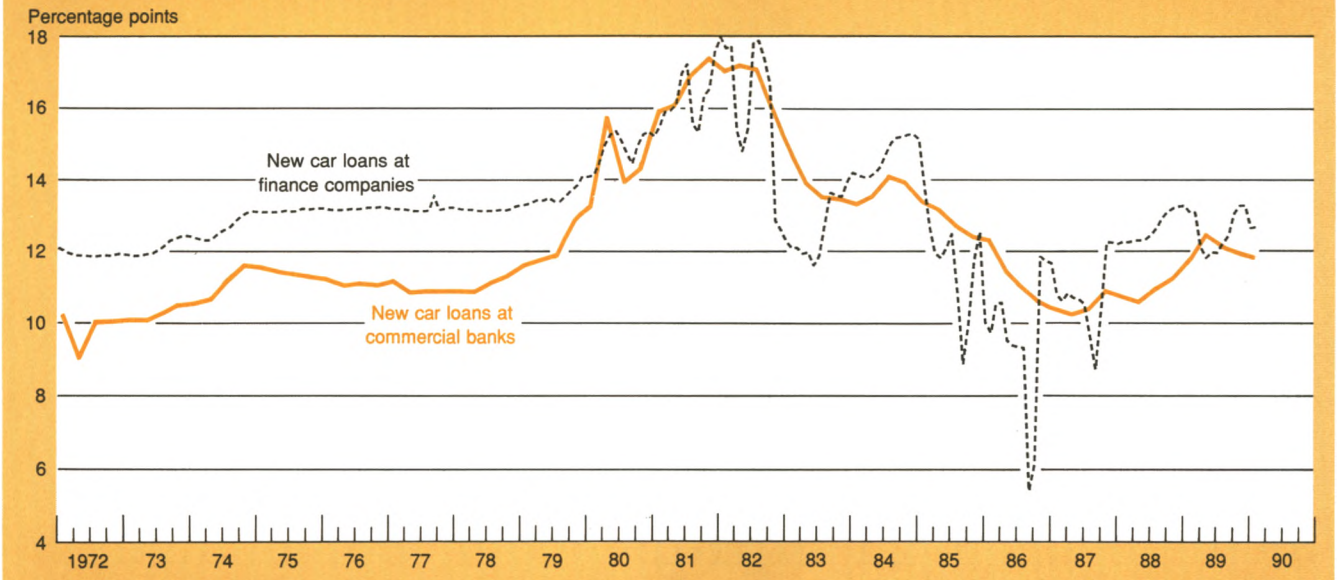
In recent years, however, the banks' role in financing consumer durables expenditures has been firmly challenged by the activities of the automobile finance companies. The share of auto loans made by the finance companies has risen significantly in the 1980s (Chart 3). Previously, auto finance rates were lower at banks, leaving the higher cost lending of the finance companies for the riskier end of the market (Chart 4). But now, with both bank and finance company lenders competing for business, car buyers may be less likely to be constrained in their purchase decisions by funds availability or credit qualification limits. In addition, the growing issuance of securities backed by auto receivables, while minor compared to mortgage securitization, nonetheless works in the same direction. A broader implication of the auto financing shifts appears to be that, at a given level of market interest rates and with the many other factors influencing car sales held constant, the effective demand for autos may be greater than in the past.

Moreover, the recurrent willingness of auto companies to subsidize lending by their financing subsidiaries as a means of combating sales slowdowns may tend to offset market interest rate changes to some extent. Chart 5 illustrates not only the generally strong inverse historical relationships between auto loan rates and auto sales, but also the apparent extension of the inverse relationship to periods of steep discounting of loan rates. If such discounts are systematically used to offset weak sales, market rate increases may not reduce auto loan demand as effectively as they did in

Chart 4

Interest Rates on Auto Credit

Commercial Banks and Finance Companies



Note: The maturity for new car loans at commercial banks was thirty-six months before 1983 and forty-eight months since.

the past.

This pattern of discounting to offset negative sales effects from high market rates would seem to imply that larger market rate increases would have to be associated with given declines in consumer durables outlays. But little clear statistical evidence supports this view. For example, the study by Akhtar and Harris (1986-87) finds no econometric evidence that the sensitivity of consumer durables spending to interest rates has lessened in the 1980s, and the results of other studies have tended to be mixed at best.[15] It is possible that episodes of loan rate discounts have reinforced an interest rate consciousness among car buyers, who have learned to time durables purchases to take better advantage of low rates, whether or not their longer run demand elasticities have changed. It also may be that — partly as a result of market-based loan pricing — market rates on the whole have become better "proxy" measures of the terms, conditions, and credit requirements available to car buyers, a development that would boost the statistical explanatory power of the market rates. In addition, as Bosworth (1989) argues, the phasedown of the tax deductibility of consumer interest payments may have raised the sensitivity of such expenditures to rate movements. Whatever the reason, to date there appears little solid econometric support for the hypothesis that sales of autos, or consumer durables, have become any less sensitive to market interest rates.

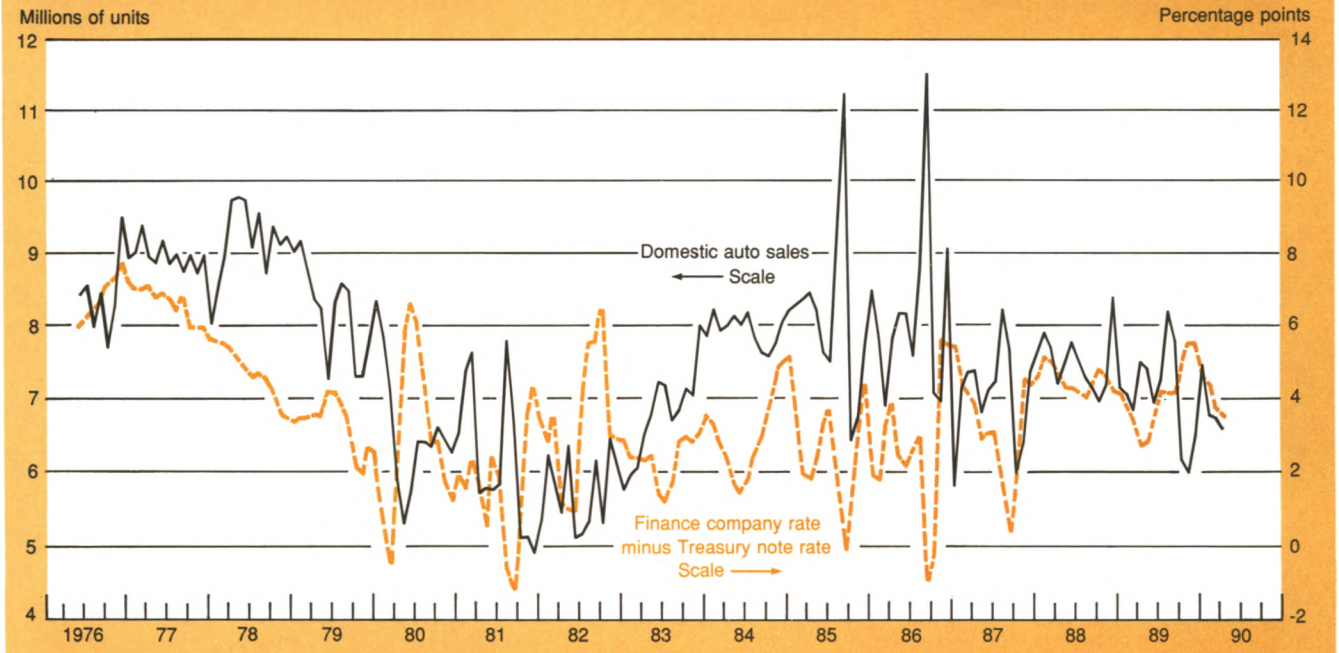
Formal statistical evidence relating more generally to consumption by the household sector is scarce, but there is still reason to believe that more available credit or better opportunities to qualify have increased the effective demand for spending at given levels of interest rates. Paquette's (1986) study of household debt service payments pointed out that the extension of maturities on automobile and other loans was a response to the difficulty of meeting income-to-debt service requirements during the high-inflation, high-interest rate period of the early 1980s. While lending policies have at least partly reverted to more conservative shorter maturities as inflation and nominal interest

[15] Akhtar and Harris obtained this result after controlling for effects of the 1980 credit controls. If the auto finance companies' loan pricing strategies had lessened the sensitivity of auto buyers to market interest rates, this effect should have shown up even after the 1980 credit controls episode was accounted for. Friedman (1989) too finds little support for a reduced sensitivity, although Kahn (1989) does report a reduction in interest sensitivity in his consumption equation.

Chart 5

U.S. Auto Sales and Financing Rates

Domestic Passenger Car Sales and Spread of Auto Finance Company Loan Rates over Two-Year U.S. Treasury Note Rates



rates have eased in the later 1980s, certain of the enhanced credit-qualification practices surely have persisted. Longer run developments such as the spread of credit cards and the related growth of computerized central credit file vendors appear to be part of a secular trend toward improved access to credit by individuals. Moreover, banks and other intermediaries that take advantage of the increased credit information can more aggressively solicit potential loan customers nationwide. In effect, wider competition allows households to choose the lenders doing the most to promote funds availability and easy qualification terms. Better collateralization of credit, in the form of home equity–backed consumer credit lines, represents yet another innovation relaxing credit qualification constraints on household spending.[16] Partly because this innovation was spurred by tax law changes and targeted largely toward households with high net worth, it appears to have initially supported only modest amounts of net new lending, with low utilization of existing lines.[17] More generally, however, the comparatively low ratios of household savings to disposable income in the 1980s (Chart 6) and the buildup of household debt levels (Chart 7) appear symptomatic of a situation in which better funding availability and enhanced credit qualification have allowed consumer spending to remain stronger in the face of high interest rates than would have been possible in the absence of the financial changes.

Business expenditures

Increased funding availability and enhanced ability to qualify for credit have been cumulative trends in the corporate business sector for many years. Nevertheless, the number of empirical statistical studies directly testing or documenting the effects of such changes on business borrowing and spending behavior has been limited. Wojnilower (1980, 1985) points out many of the market and regulatory changes — often stimulated by recurrent funding availability difficulties — that removed obstacles to the smooth intermediation of funds to business corporations. Hester reviews several key innovations in the 1960s and 1970s that reduced constraints on business borrowing activity, including commercial banks' development of markets in federal funds, negotiable certificates of deposit, Eurodollars,

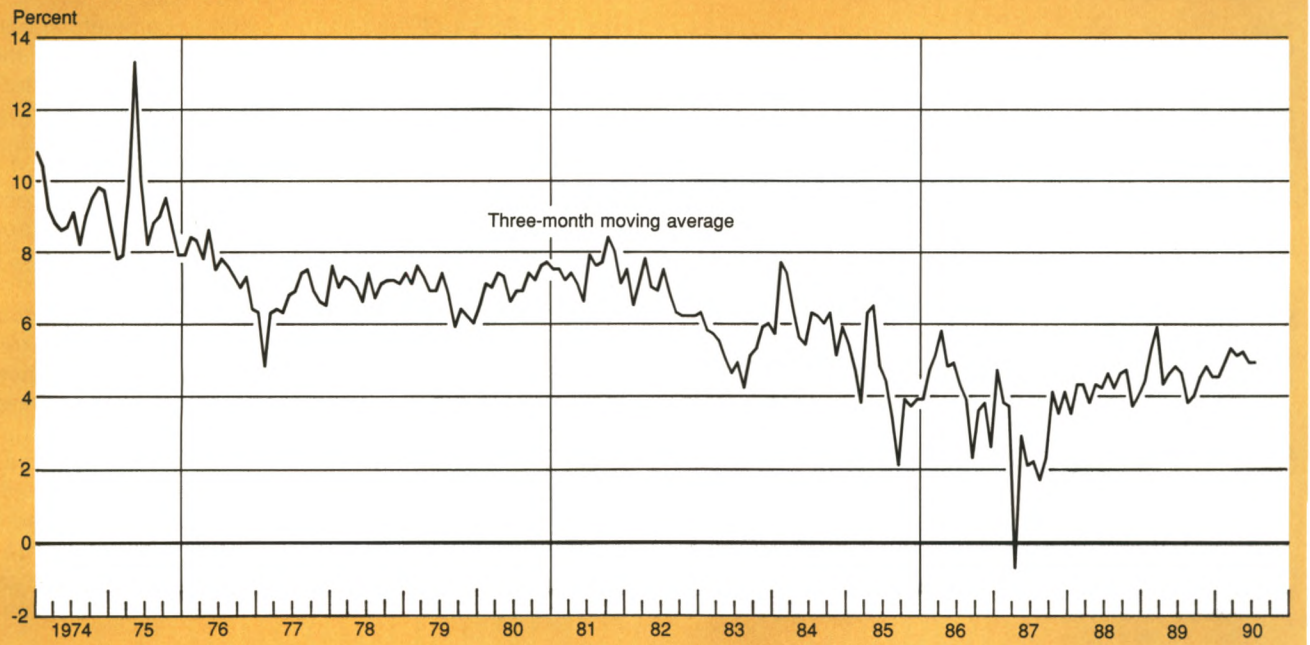
[16]For a description of the market for home equity credit accounts, see Canner, Fergus, and Luckett (1988).

[17]See Canner and Luckett (1989).

Chart 6

Consumer Savings Rate

Seasonally Adjusted Annual Rate



and repurchase agreements. These innovations helped circumvent Regulation Q ceilings, allowing funds to continue flowing as the level of interest rates rose. Brimmer (1989) recounts how the remaining Regulation Q ceilings on large deposits were lifted to accommodate smooth commercial bank reintermediation of business commercial paper financings in the wake of the Penn Central bankruptcy in June 1970.

The lessening of constraints on bank intermediation to business is reflected also in the changed role of the prime rate, once the rate charged the most creditworthy customers. In a 1983 article, Arak, Englander, and Tang provided statistical evidence that, as banks were increasingly forced to offer more competitive pricing options to large business loan customers, the prime rate itself began to move in a "stickier" fashion, reflecting its applicability mainly to less mobile customers. These authors suggested that as the process continued and the prime rate became applicable to an even smaller set of business borrowers, its pricing would become stickier than ever. In fact, by the mid-1980s, even individuals had become eligible for prime-based loans in the form of home equity loan pricing.[18] This change in the role of the prime rate is indicative of the spread of greater lending competition from the highest rated corporate customers to the household level.

After the middle 1970s, commercial banks' access to money market funding sources was relatively free, particularly in the absence of Regulation Q ceilings on large deposits. At the same time, well-known loan customers were themselves increasingly able to borrow directly from the commercial paper market and other nonbank sources.[19] Moreover, in recent years commercial banks have also increasingly marketed their contingency funding capabilities in the form of committed lines of credit, which often complement or back up business corporations' open market borrowings. Sofianos, Wachtel, and Melnik (1990) provide some statistical support for the assertion that committed bank credit lines protect customers from credit rationing; this implies that the granting of credit is determined more directly by notional credit demands at given interest rates. This conclusion in turn can be interpreted as consistent with the idea that when loan commitments are available, the equilibrium level of interest rates will be higher than in their absence, particularly under periods of relatively tight credit. Morgan (1989) also discusses the role of bank loan commitments, particularly their usefulness when the timing of loan needs is uncertain and default costly, and he too emphasizes that commitments give greater prominence to high interest rates as a means of allocating scarce credit. Berger and Udell (1989) investigate the empirical significance of loan commitments and find, for 1977-88, weak evidence of rationing of credit to commercial borrowers and small effects of loan commitments on the amounts of credit extended during periods when rationing appeared most likely to occur.

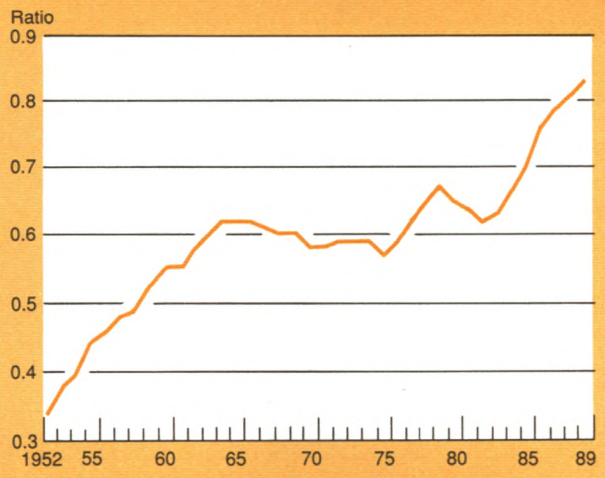
Hirtle (1990) further analyzes the monetary policy consequences of the growth of bank loan commitments. She provides evidence that the growth of commitments has been accompanied by a decreased responsiveness of output to interest rate movements. Hirtle attributes this relationship to a change in the composition of commercial and industrial loan customers. Large corporate borrowers now tend to rely less on bank borrowings, and for many companies, committed bank lines represent only one of several competing sources of funds. These borrowers can apply to a variety of banks, the commercial paper market, or other sources to satisfy their short-term needs for funds. Therefore, the productive activities of such highly rated borrowers are generally well insulated from their current financing needs. Thus the statistical relationship between economic activity and the amount

[18] See Canner, Fergus, and Luckett (1988) and Canner and Luckett (1989).

[19] See, for example, Estrella (1986).

Chart 7

Ratio of Household Debt to Disposable Income



Sources: Board of Governors of the Federal Reserve System, Flow of Funds data; National Income and Product Accounts.

Notes: Debt comprises household mortgage debt and household consumer debt. Income is personal disposable income earned by households.

of bank loans made under commitment is not particularly strong. Conversely, loans not under commitment, which presumably tend to go to borrowers more dependent on their banks, appear to be more closely correlated with output.

Although the ability to borrow is essential for many businesses to be able to modernize or expand, in the 1980s the loosening of the link between borrowing and spending was manifest in the widespread restructuring of corporate balance sheets. The rise in corporate leverage during the 1980s may have been partly the result of expanded financial sector capabilities. Yet leverage itself affects a firm's flexibility to borrow more under various contingencies. Thus, leverage may affect how much a firm's real outlays are influenced by interest rate changes or other factors shifting the firm's demand for and access to funds.

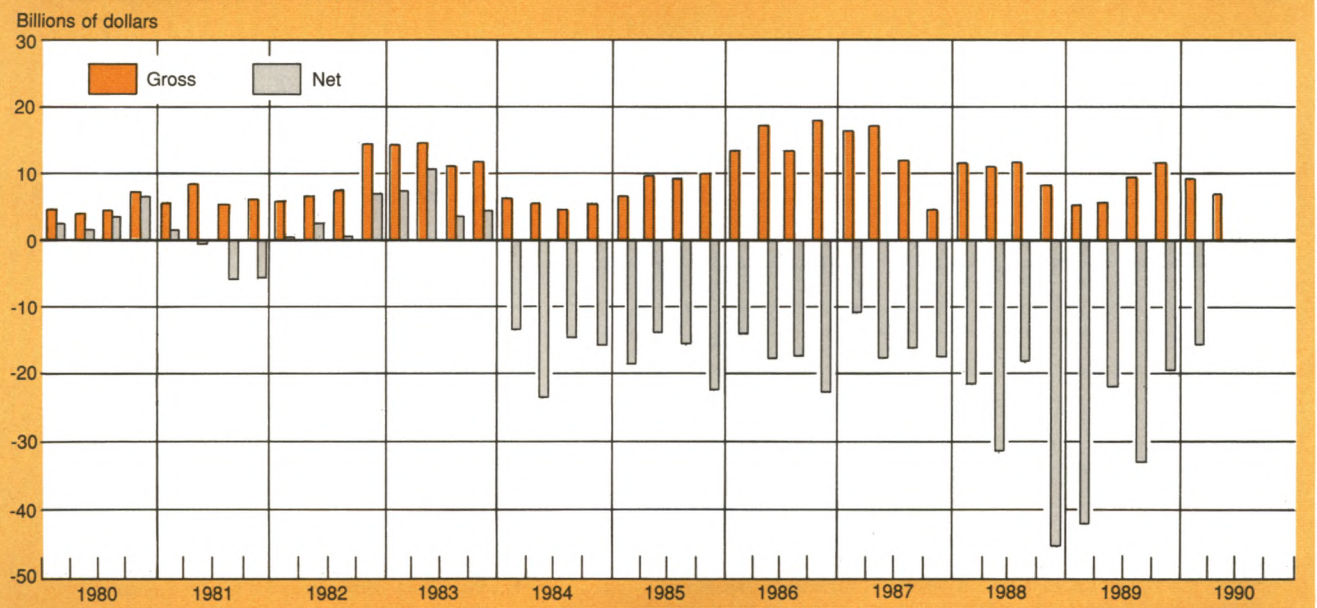
The changing relationship between interest rates and business activity has been the focus of recent articles examining the potential impact of rising corporate leverage on cash flow and on real investment and employment decisions. Bernanke and Campbell (1988) simulate how interest rate and recession shocks such as those of 1973-74 and 1981-82 would have affected a large number of corporations if the shocks had occurred later in the 1980s. They find that in the context of 1986 corporate financial structures, significantly more corporations were vulnerable to cash flow squeezes or insolvencies than was true earlier. Taken alone, however, their results may underestimate the extent of potential corporate financing problems. One reason is that the Bernanke-Campbell sample includes only companies whose stock is publicly traded, thus excluding the many (in some cases large) firms taken private by LBO transactions. Another reason is that their statistical results use 1986 data; as Charts 8 and 9 illustrate, the leveraging trend through the late 1980s continued to erode corporate equity and to raise interest servicing burdens. More recently, Bernanke, Campbell, and Whited (1990) update the earlier study through 1988. Simulating the 1973-74 and 1981-82 experiences with more recent financial structures, they find that the potential impact on corporate financial conditions appears to have worsened. Moreover, their findings also cast doubt on the assertion that the leverage increases have been confined to noncyclical industries.

Lee (1990) further investigates the vulnerability of leveraged corporations to economy-wide developments. Lee notes that leverage not only results from

Chart 8

Gross and Net Corporate Equity Proceeds

Financial and Nonfinancial Quarterly Volume



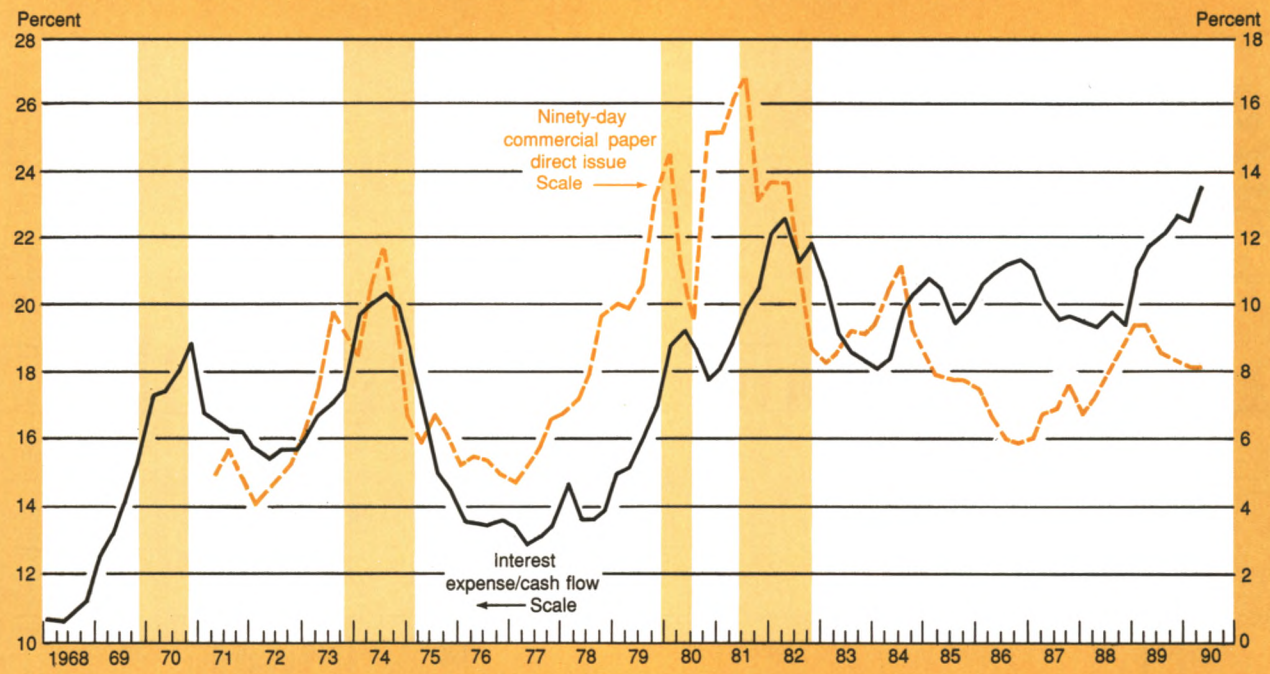
strategic financing decisions but also can reflect cumulative earnings and cashflow results. Combining firm-specific factors with macroeconomic influences, he develops a statistical model isolating the induced changes in leverage associated with changes in cashflow, inflation, and interest rates — as distinct from purposeful leverage changes associated with financial restructuring strategies. Even after explicitly controlling for many of the microeconomic factors affecting leverage, Lee finds that the corporate sector has indeed become more exposed to macroeconomic shocks, as Bernanke and his colleagues found. Moreover, Lee separates cyclical from noncyclical firms and finds that although the earnings of cyclical firms are by definition more vulnerable to business recessions, the noncyclical firms can be quite sensitive to inflationary cost pressures and accompanying high interest rates. Lee concludes that the risks are more symmetrical than might have been supposed, in the sense that leveraged businesses are potentially vulnerable not only to recession but also to macroeconomic overheating and increased input cost pressures.

If the vulnerability of corporate financial structures has risen, what, if anything, does this imply about the potential for cutbacks in real investment and employment should business finances come under stress? An argument can be made that such effects would be limited. When a company is having difficulties, or even in bankruptcy, it is often in the creditors' and other parties' collective interests not to disrupt activities generating gross revenues net of operating expenses. Thus the bankruptcy process itself does not necessarily imply extensive layoffs or plant closings. In addition, some leveraged firms experiencing debt servicing difficulties have been able to renegotiate terms, sell assets, or exchange debt for equity stakes rather than undergo bankruptcy. Indeed, refinancing and asset sales capabilities developed in conjunction with the

Chart 9

The Short-Term Interest Rate and the Interest Coverage Ratio

Ninety-Day Commercial Paper Rate and Ratio of Interest Expense to Cash Flow for U.S. Nonfinancial Corporations



Sources: Federal Reserve System and U.S. Department of Commerce.

Note: The interest coverage ratio is defined as net interest paid divided by the sum of net interest paid, corporate profits before tax, capital consumption allowance with capital consumption allowance adjustment, and inventory valuation adjustment.

buyout and acquisition activity may help protect real business operations from the effects of financial stress. It could also be argued that any inability or unwillingness of a leveraged firm to pursue profitable investment spending opportunities as they arise would be effectively counterbalanced by the activities of better financed competitors, at least to the extent that they were positioned to realize the opportunities.

It may be more realistic, however, to expect that in a macroeconomic scenario with widespread increased interest costs and/or reduced net operating revenues, the abilities of firms to refinance bonds or exchange equity for debt would be hampered. Sales of corporate assets could also be problematic, particularly if attempted by many firms at the same time to compensate for shortfalls in revenues. Manager-owners of leveraged firms under stress could be expected to reduce discretionary outlays — implying job losses and investment spending cutbacks — to avoid losing corporate control and the associated possibility of longer term profitability. And given a general environment of uncertainty, better financed competitors might not be able or willing to pick up the spending slack in the short run.

Several recent studies suggest that companies experiencing financing constraints are more likely to respond to cash flow fluctuations by adjusting their real investment and employment outlays than are firms operating with more financial slack. Fazzari, Hubbard, and Petersen (1988) show that a sample of firms with tighter cash flow availability — quantified in terms of a low dividend payout rate — exhibit a closer correlation between changes in investment outlays and fluctuations in cash flow than do firms with better overall cash availability. In other words, when cash flow is scarce, it seems to matter more for investment, at least in the short run. Gertler and Hubbard (1988) report similar findings, and Whited (1990) presents additional evidence that U.S. firms with low net financial asset positions are constrained in their real investment spending decisions.

Cantor (1990) has extended this broad line of research to focus specifically on leveraged U.S. corporations. Fazzari, Hubbard, and Petersen's division of firms according to dividend retention rates in effect identifies a number of smaller, faster growing companies whose ability to invest is tied to their ability to generate cash earnings. Cantor's classification according to leverage indicators also results in a cash-constrained subsample, but in this case it includes mature, slow-growing firms that are more typical of participants in the 1980s takeover and buyout activity. Cantor shows that the cash flows remaining after debt servicing at leveraged firms are proportionally more variable; that is, leveraging has not only been occurring at firms with unusually stable revenues. Furthermore, he confirms that the leveraged firms' investment spending tends to fluctuate more in line with cash flow than is the case at less leveraged firms. Finally, Cantor presents some evidence that employment at leveraged firms is also more affected by cash flow availability than is employment at better capitalized firms.

Thus the empirical work appears to confirm the basic notion that a more leveraged business sector exhibits an increased sensitivity of spending to interest rate changes and other factors, including variations in revenues. Higher interest charges may lead cash-constrained firms to cut back more aggressively on investment and employment. The implication would appear to be that by increasing leverage, corporations have become more, rather than less, responsive to given changes in interest rates, so that even moderate changes in rates may be capable of restraining or stimulating their expenditures in the face of economic shocks of a given size. A caveat is that, again because of leverage, the economic shocks themselves may be more severe, in the sense that a given slowdown in corporate sales revenues may more quickly multiply into adverse investment and employment decisions. If shocks to leveraged firms were to cumulate in such a manner, sizable adjustments in interest rates might be needed to reestablish equilibrium. Put differently, while leveraged firms may indeed be more sensitive to interest movements, they are correspondingly more sensitive to other influences as well. So the size of interest rate changes required to offset the effects of other shocks may be at least as large as in the past.

In sum, although the reduction of financial constraints has provided more funding options, competitive forces have prompted firms to use these enhanced capabilities to raise leverage, a step that increases firms' vulnerabilities to recession, cost-push inflation, or higher borrowing costs. A rise in interest costs, particularly if caused by a change in interest rates that is unanticipated or outside the range contemplated when leveraging occurred, would squeeze vulnerable firms' cash flows, investment, and employment. The basic notion that greater leverage can create a possibility of larger swings in firm spending and macroeconomic activity is further developed by Bernanke and Gertler (1989). Bernanke pursues a related point in a 1983 article, arguing that the Depression of the 1930s was exacerbated by business failures that disrupted financial intermediation.

External trade and finance

Reduced costs of transportation and communication have encouraged a secular increase in the volume of international transactions, including trade in real goods

and services as well as cross-border financial investment and trading. U.S. imports and exports have risen relative to total U.S. GNP (Chart 10). Shorter term fluctuations in the amount of trade are influenced by exchange rates, and thus by U.S. interest rates and monetary policy. Other factors equal, a high level of U.S. interest rates relative to foreign interest rates attracts capital inflows, tending to raise the exchange value of the dollar, at least in the short run. Thus the monetary restraint of higher domestic interest rates on domestic demand is supplemented by the restraint of a stronger dollar on U.S. net exports. In addition, a strong dollar may also have direct disinflationary effects on import prices and prices of trade-competitive goods.[20] As net exports grow secularly as a proportion of U.S. total GNP, these external channels of monetary policy transmission increase in importance.

Moreover, the propensity of financial capital to flow back and forth across borders in response to shifting risks and relative rates of return is now greater, because of the reduction of foreign capital controls, improved access to information, the increasingly international strategies of institutional investors, and the success of risk management innovations such as interest rate swaps and futures, currency futures, and longer term currency swaps.[21] Chart 11 shows the burst of cross-border buying and selling of bonds and equities since the mid-1980s. Chart 12 demonstrates that with the relaxation of capital controls in many countries, closer arbitrage linkages have emerged between domestic short-term interest rates in different currencies, hedged with forward exchange contracts. Chart 13 illustrates the rapid growth of the interest rate swap market. Combined with currency swaps, the interest rate swaps mean that credit risk on a loan or security can now be at least partly "unbundled" from its repricing and currency risk characteristics. This development has given issuers and investors broader access to competitive international markets, thereby helping to lessen potential constraints on funding availability and credit qualification.

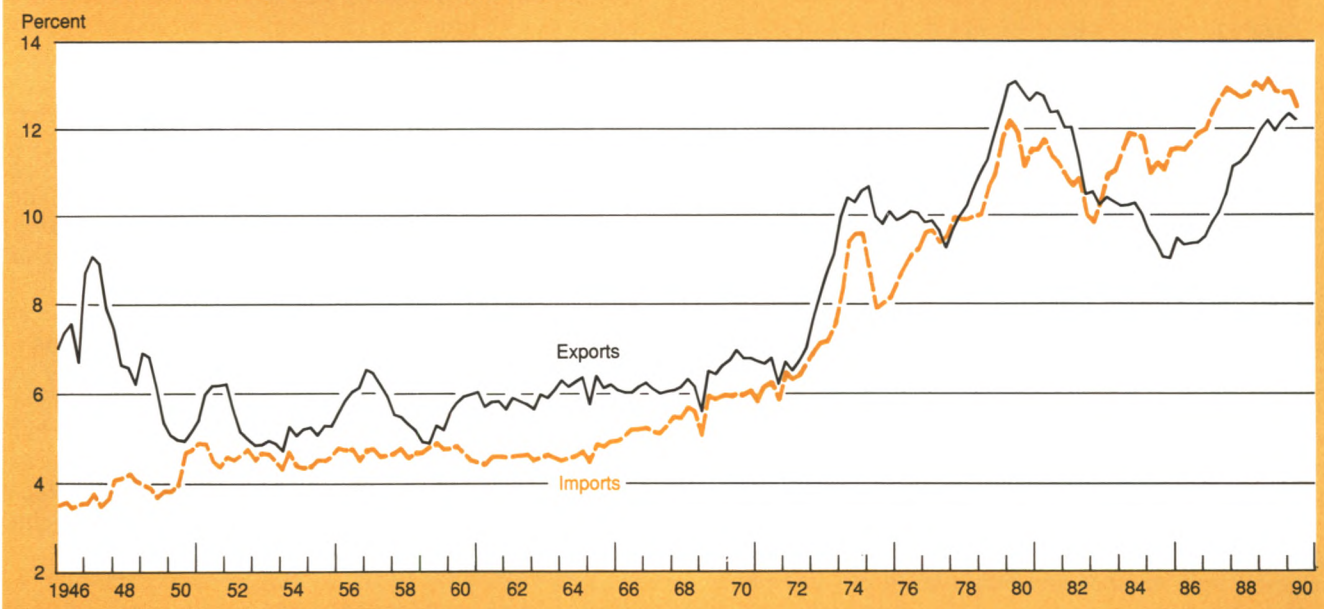
Closer links between financial markets also lead to shared sensitivities — sensitivities not only to liquidity

[20] On the price pass-through effects of exchange rate changes, see, for example, Hooper and Mann (1989), including their discussion of parameter stability on pp. 320-321.

[21] The increasing integration of shorter term interest rate and exchange markets is discussed in Jeffrey A. Frenkel (1989). Another recent piece by Koh and Levitch (1989) discusses such arbitrage in currency futures.

Chart 10

U.S. Imports and Exports as a Percentage of GNP



Source: Bureau of Economic Analysis.

Note: Chart shows nominal imports and exports as a percentage of nominal GNP.

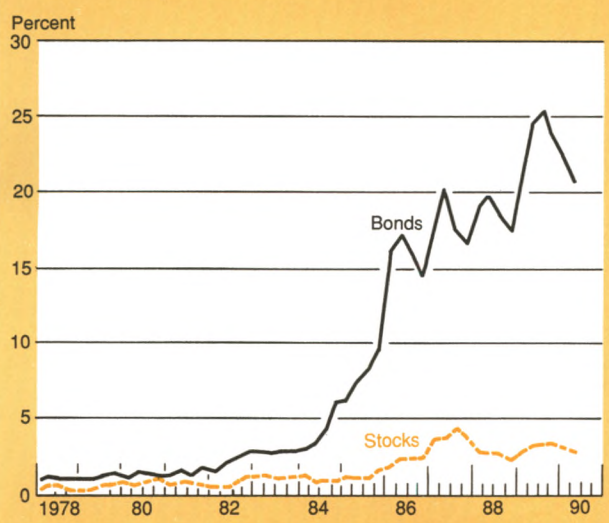
and trading conditions in individual markets but also to economic factors affecting them all. One issue is whether the tightening of linkages creates so much cross-border sensitivity to liquidity conditions that national monetary authorities begin to have less influence over domestic interest rates and securities prices, particularly on longer term instruments. A related question is the extent to which shocks to securities prices, from whatever source, are now more readily transmitted from one market to another. A floating exchange rate regime, such as has been in effect since the mid-1970s for the United States and other industrial countries, ensures the long-term independence of national monetary policies and inflation performances. On a shorter run basis, however, a rise in the responsiveness of globally oriented investors to price movements in various national markets could cause securities returns to become more mutually sensitive and interrelated, even when denominated in different currencies.

Studies exploring whether longer term securities prices or returns are becoming more interrelated through time are still somewhat scarce. With regard to fixed-income securities, Kasman and Pigott (1988) find little evidence that during the 1980s long-term interest rate fluctuations in the United States became more closely aligned with rate movements in other major countries, on a quarterly average basis. Several papers, however, have demonstrated statistically that stock price movements in different countries have become more correlated in recent years — even aside from the highly visible round-the-world "market breaks" in October 1987 and October 1989. Using various approaches, Friedman and Weiller (1987), Bennett and Kelleher (1988), and von Furstenberg and Jeon (1989) find increased similarity of price movements in major stock market indexes, including higher frequency (that is, daily) returns.

Chart 11

Gross Securities Transactions across U.S. Borders

As a Percentage of Nominal U.S. GNP



Sources: Federal Reserve System, U.S. Treasury Department, and U.S. Department of Commerce.

Note: Gross securities transactions consist of sales and purchases of U.S. securities by non-U.S. residents and sales and purchases of non-U.S. securities by U.S. residents.

On balance, while the evidence is still preliminary, globalization has had profound effects on financial markets, although the effects on liquidity and monetary policy are still only partly understood. Credit can now be more readily extended across borders, with appropriate hedges available for unwanted currency and repricing risks that in the past might have discouraged movements of capital even in the absence of regulatory controls. In an environment in which domestic access to credit by households and businesses has been improving, the increased ease with which savings can be drawn in from other countries takes on added significance. While monetary authorities can still conduct independent policies to the extent that exchange rates are allowed to float, tight credit conditions may attract capital inflows from abroad more readily than in the past. Other factors equal, greater competition from foreign lenders and other offshore sources of funds will increase the availability of credit to domestic borrowers, further reducing the odds that credit or funding constraints will be binding. In addition, on a short-term (for example, daily or weekly) basis, disturbances to stock (and possibly bond) prices appear to be transmitted across international markets more than in the past, a development which also carries the potential for complicating the conduct of monetary policy at times.

Aggregative studies

Several studies in the past few years have investigated whether financial changes have altered the relationships between interest rates (and exchange rates) and broader macroeconomic performance. While some look directly at aggregate output, others take a sector-by-sector approach, focusing on areas of the economy traditionally sensitive to interest and exchange rates.

The sector-by-sector studies support the notion that the incidence of interest rate effects has been shifting across different parts of the economy. Akhtar and Harris (1986-87) examine shifts in interest rate effects on real activity, using a set of equations for traditionally

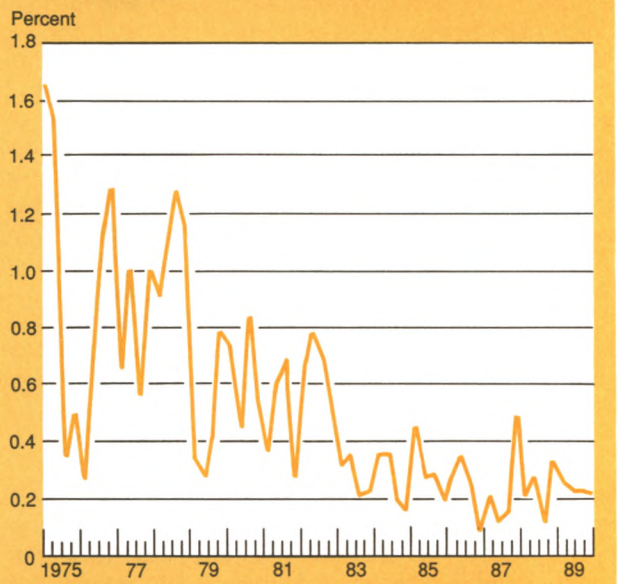
interest-sensitive sectors, including housing, durables consumption, business investment, and net exports. They conclude that the net effects of interest rate changes on the overall economy have not declined through time, although they attribute this result partly to their explicitly controlling for episodes of funding availability problems affecting housing and consumer durables. Friedman (1989), also using sector equations, finds significant changes in the interest sensitivities of sectors, particularly when the reduction of funding availability effects on the housing market is included. Although Friedman concludes that housing has become less interest sensitive, he finds that business investment has become more sensitive, leaving it unclear whether the aggregate responsiveness of the economy to rates has changed. Bosworth (1989) also reviews developments in housing, consumption, business investment, and net exports. He contends that housing has become less interest sensitive, but he points to offsetting increases in sensitivity for net exports and, possibly, consumption. Kahn (1989) estimates sector equations as well, finding decreased interest sensitivity in housing and consumption, increased sensitivity in net exports, and little or no sensitivity of business investment to interest rates. Thus virtually all the sector-by-sector studies support the view that housing has become less interest sensitive, mainly because of deposit deregulation, and a majority find that net exports have become a more important channel of monetary policy, if only because of the rapid growth of traded goods and services. Their findings on consumer durables and business investment, however, are mixed. With respect to business investment, the hypothesis relating increased interest sensitivity to leverage may not be adequately addressed by the aggregative studies, since the main support for that hypothesis is derived from studies using data on individual firms. More generally, the sector-by-sector studies support the notion that the incidence of monetary restraint has changed, most clearly moving away from housing and toward net exports.

Complicating the question of incidence are the different lengths of time required in the different sectors of the economy for interest or exchange rate changes to influence the pace of activity. In principle, financial or

Chart 12

Dispersion of Covered Short-Term Interest Rates

Three-Month Money Market Yields in Dollar Terms for the United States, Germany, Japan, Canada, and the United Kingdom

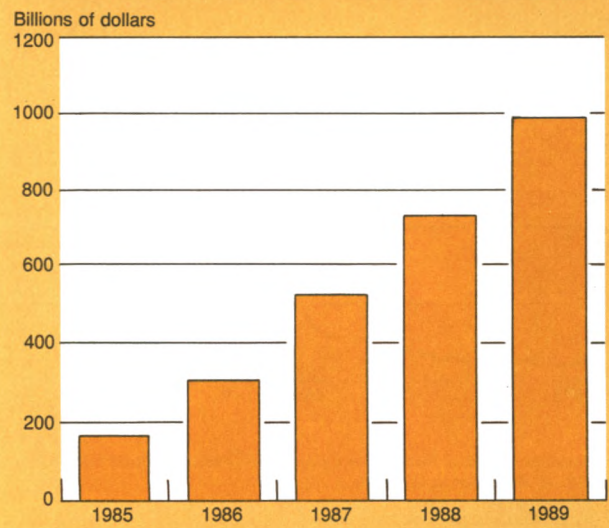


Notes: Chart shows mean absolute deviation of quarterly average short-term yields (converted to dollar terms by the forward exchange rate premia) from the simple average of the five countries. Yields used were U.S. three-month CD rate, West German three-month money market rate, Japanese three-month Gensaki rate, Canadian ninety-day finance company paper rate, and British three-month sterling interbank deposit rate.

Chart 13

Size of Interest Rate Swap Market

Notional Value of Outstanding U.S. Dollar Interest Rate Swaps



Source: International Swap Dealers Association.

other changes could alter the length of these lags in particular sectors, but in practice there is not enough data to detect or accurately measure lag changes. Whether or not sector lags have been changing, the aggregate lag may change if there are sizable differences in lags among sectors whose relative weights in the monetary transmission process are shifting. A key change here is the shift away from domestic interest rate impacts and toward the effects of interest rates on exchange rates, net exports, and trade-sensitive prices. Although policy lags are intrinsically difficult to measure and possibly inherently uncertain, statistical evidence tends to show that the lags in the effects of interest and exchange rates on net exports are longer than lags in the effects of interest rates on domestic sectors. The Federal Reserve's macroeconomic model of the U.S. economy, for example, shows that a change of monetary policy has its greatest impact on the growth rate of GNP within one year.[22] Bryant, Holtham, and Hooper (1988) review a dozen econometric models and find a similar result, on average.[23] In contrast, econometric estimates typically show that the effects of a change in the dollar on real net exports require several years to be substantially realized. This long delay in the effects of exchange rates on U.S. real net exports is illustrated by the experience of the 1980s: the dollar fell sharply in 1985, yet real net exports did not significantly outpace imports until 1987, 1988, and the first part of 1989. Bryant, Holtham, and Hooper also compare the responses of various econometric models to effects of dollar changes on U.S. net exports; on average, the models they review show a lower dollar continuing to have a stimulative impact on the U.S. economy for up to four years.[24]

The picture is further complicated because exchange rate changes also have direct effects on prices in the economies involved, by means of the prices of imports and exports. Although the price effects may occur relatively quickly (in contrast to exchange rate effects on real net exports), they are particularly uncertain in magnitude.[25] For example, the proportionate impact of dollar movements on the U.S. price level may depend on capacity utilization rates, the types of goods and services traded, companies' strategies for market share, profit levels, and perceptions about the permanence of exchange rate changes.[26] As noted earlier, in the comparisons of model simulations performed by Bryant, Holtham, and Hooper a "consensus" simulation showed that an (exogeneous) appreciation in the dollar restrains real U.S. GNP by way of weaker real net exports. Nevertheless, the dispersion of individual model effects around this "consensus" is striking, and the degree of price pass-through is one of the main sources of divergence.[27]

Although the evidence appears to suggest that the effects of monetary policy may now occur with a longer and more uncertain lag because of an increase in the relative importance of net exports, this conclusion may be premature. Because part of the implicit goal of monetary policy is to achieve objectives within some time frame, shifts in the incidence of policy cannot be fully evaluated independently of the relative timing and reliability of effects. The long lags of the effects of dollar changes, combined with the uncertainty regarding the strength of the effects, might make this channel less useful for the conduct of policy. If policy were attempting to, say, restrain aggregate demand, the parts of the economy that react more quickly to policy actions might tend to bear more of the overall restraint.

Conversely, a sector that is in principle sensitive to policy but only with a long lag might turn out to be less influenced during the time frame within which policy is seeking results. For example, a sector such as housing that responds relatively rapidly to interest rates has become less interest sensitive, while net exports appear to have become more sensitive, although only with a substantial time lag. In this example, achieving a given degree of stimulus or restraint within a given time frame may require wider movements in rates since this objective must be largely realized through the housing sector.

The question then becomes how the longer lagged effects on net exports subsequently complicate policy and economic performance. One possibility is that the lagged effects would provide too much further stimulus or restraint after the initial policy effects had already occurred, and thereby risk destabilizing the economy. This particular possibility appears somewhat unlikely. For example, one cause of the apparent lags in exchange rate effects on net exports is the existence

[22]See, for example, Brayton and Mauskopf (1985), especially pp. 180-81 and Table 4.

[23]One of the comparison simulations run by Bryant, Holtham, and Hooper on twelve models was to accelerate U.S. money growth by 2 percent in year one and 4 percent in year two, relative to baseline. The average effect on the level of U.S. real GNP was plus 3/4 percent in year one and plus 1 percent in year two, dissipating thereafter (see Figure 3-10). The standard deviation among the twelve models' real GNP impacts was about 3/4 percent by year two.

[24]See Bryant, Holtham, and Hooper (1988, Figure 3-20).

[25]See Hooper and Mann (1989, pp. 320-21).

[26]For example, see Froot and Klemperer (1989) for a summary of recent theories on the pass-through from exchange rates to import prices; the authors present some evidence that market share considerations and expected future exchange rate changes may have important effects on the degree of pass-through.

[27]See Bryant, Holtham, and Hooper (1988); also see Brayton and Mauskopf (1985), especially Table 4 and pp. 181-82.

of long-term contracts (for example, for made-to-order equipment). A new exchange rate would have to persist at least over the remaining life of a contract to have an effect on the value and volume of trade when the contract finally comes up for renewal. But if the initial monetary policy impacts have already worked their way though the economy, then by the time of renewal the interest and exchange rates would already have readjusted as well, with little effect on the subsequent contracts. Similarly, if businesses have long-term import or export strategies (for market share and so forth), then they may resist altering pricing or sales goals when exchange rate swings are recognized as temporary. This may blunt the exchange rate effects not only on net exports but also on the degree of price pass-through. More generally, except in special (hard-to-identify) cases when activity in the future is strongly affected, not by future exchange rates or by average exchange rates over the intervening horizon but specifically by exchange rate values today, the likelihood of destabilizing delayed effects via lagged exchanged rates appears minor. It follows that the influence of interest rate movements or monetary policy changes will fall on traditionally sensitive domestic sectors, and the net effect may be a decline in the overall interest sensitivity of aggregate demand rather than merely a shift in its incidence across sectors.

Indeed, two recent studies have examined more directly whether overall GNP — rather than particular industries or sectors — has changed in its responsiveness to interest rate changes. Kahn (1989) econometrically compares the effects of changes in the federal funds rate on real GNP in two subperiods, 1955-79 and 1983-89 (skipping the early 1980s). He finds that the effect on real GNP growth of a 1 percent change in the interest rate was substantially larger in the earlier period. More recently, Hirtle and Kelleher (1990) also test for changes in the impact of interest rates on GNP but, rather than break the sample into two parts, they allow a time path for the interest rate coefficient. Notwithstanding the different specification, they find a decline in interest sensitivity qualitatively similar to Kahn's result.[28] Interestingly, however, Hirtle and Kelleher calculate that interest sensitivity declines in the 1950s, 1960s, and 1970s, and then levels off or even increases moderately again in the 1980s. Taken at face value, this finding would suggest that some of the more significant structural changes actually occurred much earlier, for example, with the interbank funding developments discussed by Hester (1981). The elimination of retail deposit interest ceilings and the growth of secondary mortgage markets and other sources of funding flexibility for thrift institutions during the 1970s and 1980s would then appear to have had analogous effects on the sensitivity of the economy to interest rate changes. Although the more recent financial market developments in the 1980s have further reduced the constraints on funding availability and the credit qualification process, it is possible that they have been quantitatively less significant than the changes in earlier decades and, particularly in the latter 1980s, offset by the increase in leverage-related sensitivities.

[28] Akhtar (1983) also reports, in the context of a single equation model, a statistically significant decline after 1977 in interest sensitivity for U.S. and Italian aggregate spending, while for other major economies he finds a rise in sensitivity during that period. Like Hirtle and Kelleher, Akhtar finds that allowing for the parameter shift raises his overall interest elasticity estimate values. Akhtar and Dennis (1984) report qualitatively similar post-1977 declines in interest sensitivity for the United States, Canada, and Italy, but they report increases in sensitivity in Japan, Germany, France, and the United Kingdom in the corresponding time period.

Conclusions

Relationships between interest rates and economic activities are of central importance to the transmission of monetary policy. There is little basis, however, for presuming that these relationships are static or unchanging. On the contrary, a variety of institutional developments and statistical findings confirm the notion that the ways monetary policy and interest rates affect the economy have been evolving. Several factors have contributed to this evolution: changes in structure and competition in financial services industries; regulatory changes; advances in communications, data processing, and information management technology; the geographic enlargement of markets; and the rapid development of new financial instruments or techniques. Financial changes have made credit more widely and competitively available, reducing intermediation costs and eliminating or reducing constraints on funding availability and credit qualification. This development in principle should raise the equilibrium level of interest rates and may help account for the erratic upward movement of nominal and real rates during the past several decades.

The removal of constraints on funding availability and credit qualification also may alter the degree of real stimulus or restraint associated with rate changes. There is some limited statistical support for the view that the interest elasticity of aggregate demand has fallen during the past several decades. More recently, however, leveraging of some businesses and the rise in borrowing by some households may have had an offsetting effect, replacing traditional constraints on borrowing at the margin with new leverage-related credit qualification and cash flow constraints. The rise in leverage should make some components of aggregate spending more, rather than less, sensitive to interest

rate movements. In theory such a development might reduce the size of movements in interest rates required to stabilize spending by leveraged firms and households, barring scenarios in which the leveraging magnifies the force of inflationary or recessionary influences that monetary policy seeks to counteract. In addition, the growth of international goods and services suggests a greater external channel for monetary policy, through the effects of exchange rates on output and prices. A practical limitation on this channel, however, is the long and uncertain lag with which it tends to operate. Finally, the international integration of capital markets not only accentuates the elimination of domestic constraints on funding availability and credit qualification but also implies greater mutual sensitivity and shared liquidity conditions across national markets.

References

Akhtar, M.A. 1983. "Financial Innovations and Their Implications for Monetary Policy: An International Perspective." Bank for International Settlements, Basle.

Akhtar, M.A., and Geoffrey E.J. Dennis. 1984. "Financial Innovations and the Interest Elasticity of Private Expenditures." Federal Reserve Bank of New York, Research Paper no. 8422. October.

Akhtar, M.A., and Ethan S. Harris. 1986-87. "Monetary Policy Influence on the Economy: An Empirical Analysis." Federal Reserve Bank of New York *Quarterly Review,* vol. 11, no. 4 (Winter), pp. 19-31.

Arak, Marcelle, A. Steven Englander, and Eric M.P. Tang. 1983. "Credit Cycles and the Pricing of the Prime Rate." Federal Reserve Bank of New York *Quarterly Review,* vol. 8, no. 2 (Summer), pp. 12-18.

Bennett, Paul, and Jeanette Kelleher. 1988. "The International Transmission of Stock Price Disruption in October 1987." Federal Reserve Bank of New York *Quarterly Review,* vol. 13, no. 2 (Summer), pp. 17-33.

Berger, Allen N., and Gregory F. Udell. 1989. "Some Evidence on the Empirical Significance of Credit Rationing." Board of Governors of the Federal Reserve System, December.

Bernanke, Ben S. 1983. "Nonmonetary Effects of the Financial Crisis in the Propagation of the Great Depression." *American Economic Review,* vol. 73, no. 3 (June), pp. 257-76.

Bernanke, Ben S., and Alan S. Blinder. 1988. "Credit, Money, and Aggregate Demand." *American Economic Review,* May (Papers and Proceedings of the 100th Annual Meeting of the American Economic Association, December 1987), pp. 435-39.

Bernanke, Ben S., and John Y. Campbell. 1988. "Is There a Corporate Debt Crisis?" *Brookings Papers on Economic Activity,* 1, pp. 83-139.

Bernanke, Ben S., John Campbell, and Toni Whited. 1990. "U.S. Corporate Leverage: Developments in 1987 and 1988." *Brookings Papers on Economic Activity,* 1, pp. 225-86.

Bernanke, Ben S., and Mark Gertler. 1989. "Agency Costs, Net Worth, and Business Fluctuations." *American Economic Review,* vol. 79, no. 1 (March), pp. 14-31.

Blinder, Alan S., and Joseph E. Stiglitz. 1983. "Money, Credit Constraints, and Economic Activity." *American Economic Review,* May (Papers and Proceedings of the 95th Annual Meeting of the American Economic Association, December 1982), pp. 297-302.

Bosworth, Barry. 1989. "Institutional Change and the Efficacy of Monetary Policy." *Brookings Papers on Economic Activity,* 1, pp. 77-124.

Brayton, Flint, and Eileen Mauskopf. 1985. "The Federal Reserve Board MPS Quarterly Econometric Model of the U.S. Economy." *Economic Modelling,* July, pp. 170-292.

Brimmer, Andrew. 1989. "Distinguished Lecture on Economics in Government: Central Banking and Systemic Risks in Capital Markets." *Journal of Economic Perspectives,* Spring, pp. 3-16.

Brueckner, Jan, and James R. Follain. 1988. "ARMs and the Demand for Housing." Syracuse University, Department of Economics, Discussion Paper no. 24. November.

Brunner, Karl, and Allan H. Meltzer. 1988. "Money and Credit in the Monetary Transmission Process." *American Economic Review,* May (Papers and Proceedings of the 100th Annual Meeting of the American Economic Association, December 1987), pp. 446-51.

References *(continued)*

Bryant, Ralph C., Gerald Holtham, and Peter Hooper. 1988. "Consensus and Diversity in the Model Simulations." In Bryant, Henderson, Holtham, Hooper, and Symansky, eds., *Empirical Macroeconomics for Interdependent Economies,* chap. 3, pp. 27-62. Washington, D.C.: Brookings Institution.

Campbell, John Y., and N. Gregory Mankiw. 1989. "Consumption, Income, and Interest Rates: Reinterpreting the Evidence." Princeton University, April, mimeo.

Canner, Glen B., James T. Fergus, and Charles A. Luckett. 1988. "Home Equity Lines of Credit." *Federal Reserve Bulletin,* pp. 361-73.

Canner, Glen B., and Charles A. Luckett. 1989. "Home Equity Lending." *Federal Reserve Bulletin,* pp. 333-44.

Cantor, Richard. 1989. "Interest Rates, Household Cash Flow, and Consumer Expenditures." Federal Reserve Bank of New York *Quarterly Review,* vol. 14, no. 2 (Summer), pp. 59-66.

Cantor, Richard. 1990. "A Panel Study of the Effects of Leverage on Investment and Employment." In *Studies on Financial Changes and the Transmission of Monetary Policy.* Federal Reserve Bank of New York. A revised version of this paper appears under the title "Effects of Leverage on Corporate Investment and Hiring Decisions" in this issue of the *Quarterly Review.*

Cumming, Christine. 1987. "The Economics of Securitization." Federal Reserve Bank of New York *Quarterly Review,* vol. 12, no. 3 (Autumn), pp. 11-23.

DeMagistris, Robin. 1982. "Impact of 'Buy Downs' on Affordability and Home Prices." Federal Reserve Bank of New York *Quarterly Review,* vol. 7, no. 2 (Summer), pp. 41-45.

Duca, John V. 1987. "The Effects of Credit Availability on Consumer Durable Expenditures." Board of Governors of the Federal Reserve System, Economic Activity Working Paper Series, no. 80. October.

Esaki, Howard, and J. Wachtenheim. 1984-85. "Explaining the Recent Level of Single-Family Housing Starts." Federal Reserve Bank of New York *Quarterly Review,* vol. 9, no. 4 (Winter), pp. 31-38.

Estrella, Arturo. 1984. "Corporate Use of Pension Overfunding," Federal Reserve Bank of New York *Quarterly Review,* vol. 9, no. 1 (Spring), pp. 17-25.

_____. 1986. "Domestic Banks and Their Competitors in the Prime Commercial Loan Market." *Recent Trends in Commercial Bank Profitability,* pp. 159-77. Federal Reserve Bank of New York, September.

Fazzari, Steve M., R. Glenn Hubbard, and Bruce C. Petersen. 1988. "Financing Constraints and Corporate Investment." *Brookings Papers on Economic Activity,* 1, pp. 141-206.

Frenkel, Jeffrey A. 1989. "International Financial Integration, Relations Among Interest Rates and Exchange Rates, and Monetary Indicators." Paper presented at Colloquium on International Financial Integration and U.S. Monetary Policy, Federal Reserve Bank of New York, October 13, 1989.

Friedman, Benjamin M. 1989. "Changing Effects of Monetary Policy on Real Economic Activity." In *Monetary Policy Issues in the 1990s.* Federal Reserve Bank of Kansas City.

Friedman, Benjamin M., and K. Weiller. 1987. "The Substitutability of United States and Foreign Assets." In *International Integration of Financial Markets and U.S. Monetary Policy,* pp. 159-94. Federal Reserve Bank of New York, December.

Froot, Kenneth A., and Paul D. Klemperer. 1989. "Exchange Rate Pass-Through When Market Share Matters." *American Economic Review,* vol. 79, no. 4 (September), pp. 637-54.

Gertler, Mark, and R. Glenn Hubbard. 1988. "Financial Factors in Business Fluctuations." In *Financial Market Volatility.* Federal Reserve Bank of Kansas City.

Goodman, John L., Jr. 1985. "Adjustable-Rate Home Mortgages and the Demand for Mortgage Credit." Board of Governors of the Federal Reserve System, Working Paper Series, no. 41. January.

Goodman, John L., Jr., Charles A. Luckett, and David W. Wilcox. 1988. "Interest Rates and Household Cash Flow." Board of Governors of the Federal Reserve System, December.

Greenwald, Bruce, Joseph E. Stiglitz, and Andrew Weiss. 1984. "Informational Imperfections in the Capital Market and Macroeconomic Fluctuations." *American Economic Review,* May (Papers and Proceedings of the 96th Annual Meeting of the American Economic Association, December 1983), pp. 194-99.

Hall, Robert E. 1988. "International Substitution in Consumption." *Journal of Political Economy,* vol. 96, no. 2 (April), pp. 339-57.

Hester, Donald D. 1981. "Innovations and Monetary Control." *Brookings Papers on Economic Activity,* 1, pp. 141-99.

References *(continued)*

Hirtle, Beverly. 1990. "Bank Loan Commitments and the Transmission of Monetary Policy." In *Studies on Financial Changes and the Transmission of Monetary Policy.* Federal Reserve Bank of New York, May.

Hirtle, Beverly, and Jeanette Kelleher. 1990. "Financial Market Evolution and the Interest Sensitivity of Output." In *Studies on Financial Changes and the Transmission of Monetary Policy.* Federal Reserve Bank of New York, May. A revised version of this paper appears in this issue of the *Quarterly Review.*

Hook, Andrew T., and M. Alberto Alvarez. 1986. "Competition from Foreign Banks." *Recent Trends in Commercial Bank Profitability,* pp. 179-91. Federal Reserve Bank of New York, September.

Hooper, Peter, and Catherine L. Mann. 1989. "Exchange Rate Pass-through in the 1980s: The Case of U.S. Imports of Manufactures." *Brookings Papers on Economic Activity,* 1, pp. 297-337.

Hoshi, Takeo, Anil Kashyap, and David Scharfstein. 1988. "Corporate Structure, Liquidity, and Investment: Evidence from Japanese Industrial Groups." *Quarterly Journal of Economics,* vol. 109 (September).

Hurd, Michael D. 1987. "Savings of the Elderly and Desired Bequests." *American Economic Review,* vol. 77, no. 3 (June), pp. 298-312.

Jaffee, Dwight, and Kenneth Rosen. 1979. "Mortgage Credit Availability and Residential Construction." *Brookings Papers on Economic Activity,* 2, pp. 333-36.

Jones, Marcos T. 1982. "Mortgage Designs, Inflation, and Real Interest Rates." Federal Reserve Bank of New York *Quarterly Review,* vol. 7, no. 1 (Spring), pp. 20-29.

Kahn, George A. 1989. "The Changing Interest Sensitivity of the U.S. Economy." Federal Reserve Bank of Kansas City *Economic Review,* November, pp. 13-33.

Kasman, Bruce, and Charles Pigott. 1988. "Interest Rate Divergences among the Major Industrial Nations." Federal Reserve Bank of New York *Quarterly Review,* vol. 13, no. 3 (Autumn), pp. 28-44.

King, Frank, Sheila L. Tschinkel, and David D. Whitehead. 1989. "Interstate Banking Developments in the 1980s." Federal Reserve Bank of Atlanta *Economic Review,* May-June, pp. 32-51.

Koh, Annie, and Richard Levitch. 1989. "Synthetic Eurocurrency Interest Rate Futures Contracts." Draft, February.

Lee, William. 1990. "Corporate Leverage and the Consequences of Macroeconomic Instability." In *Studies on Financial Changes and the Transmission of Monetary Policy.* Federal Reserve Bank of New York, May.

Mead, Richard H., and Kathleen A. O'Neil. 1986. "The Performance of the Banks' Competitors." *Recent Trends in Commercial Bank Profitability,* pp. 269-366. Federal Reserve Bank of New York, September.

Morgan, Donald. 1989. "Bank Credit Commitments and Credit Rationing." Federal Reserve Bank of Kansas City, Research Working Paper. March.

Palash, Carl J., and Robert B. Stoddard. 1985. "ARMs: Their Financing Rate and Impact on Housing." Federal Reserve Bank of New York *Quarterly Review,* vol. 10, no. 3 (Autumn), pp. 39-49.

Paquette, Lynn. 1986. "Estimating Household Debt Service Payments." Federal Reserve Bank of New York *Quarterly Review,* vol. 11, no. 2 (Summer), pp. 12-23.

Romer, Christina D., and David H. Romer. 1990. "New Evidence on the Monetary Transmission Mechanism." *Brookings Papers on Economic Activity,* 1, pp. 149-213.

Ryding, John. 1990. "Housing Finance and the Transmission Mechanism of Monetary Policy." In *Studies on Financial Changes and the Transmission of Monetary Policy.* Federal Reserve Bank of New York, May. A revised version of this paper appears in this issue of the *Quarterly Review.*

Sofianos, George, Paul Wachtel, and Arie Melnik. 1990. "Loan Commitments and Monetary Policy." *Journal of Banking and Finance.* Forthcoming.

Stutzer, Michael J., and William Roberds. 1988. "Variable Rate Loans and Financial Activities: The Case of Adjustable Rate Mortgages." *Journal of Urban Economics,* vol. 24, pp. 27-37.

Throop, Adrian W. 1986. "Financial Deregulation, Interest Rates, and the Housing Cycle." Federal Reserve Bank of San Francisco *Economic Review,* Summer, pp. 63-78.

References *(continued)*

von Furstenberg, George M., and Bang Nam Jeon. 1989. "International Stock Price Movements: Links and Messages." *Brookings Papers on Economic Activity,* 1, pp. 125-79.

Whited, Toni M. 1990. "Debt, Liquidity Contraints, and Corporate Investment: Evidence from Panel Data." Board of Governors of the Federal Reserve System, Finance and Economics Discussion Series, no. 114. March.

Wojnilower, Albert M. 1980. "The Central Role of Credit Crunches in Recent Financial History." *Brookings Papers on Economic Activity,* 2, pp. 227-339.

_____. 1985. "Private Credit Demand, Supply, and Crunches — How Different are the 1980s?" American Economic Review, May (Papers and Proceedings of the 97th Annual Meeting of the American Economic Association, December 1984), pp. 351-56.

Effects of Leverage on Corporate Investment and Hiring Decisions

by Richard Cantor

The rising indebtedness of the U.S. business sector raises some issues for macroeconomic stabilization policy.[1] Recent studies have investigated whether this rise in corporate leverage has increased the risk of bankruptcies or liquidations in economic downturns.[2] This article presents evidence that increases in leverage at the firm level are associated with increased volatility in capital expenditures and employment growth rates. Such a relationship implies that an increase in the average level of indebtedness across firms may cause the economy to become more vulnerable to macroeconomic shocks and more sensitive to changes in monetary policy.

The potential effects of leverage are assessed in this article by comparing investment and employment patterns of firms with different average levels of indebtedness. The highly leveraged firms are shown to have experienced greater than average volatility in their expenditures on plant, equipment, and labor. Even after controlling for a variety of other firm characteristics, the empirical analysis shows a positive statistical relationship between leverage and volatility in investment and employment.

The analysis also suggests an explanation for the greater average volatility of highly leveraged firms: a heightened sensitivity to fluctuations in cash flow. Because these firms typically face substantial debt service obligations and have limited ability to borrow additional funds, they may feel extra pressure to maintain a positive cash flow cushion. Thus they will be more likely than their less leveraged counterparts to respond to changes in cost and demand by sharply adjusting their input expenditures. Most notably, when sales drop off, even temporarily, highly leveraged firms may choose to postpone investment or to lay off workers until demand strengthens.[3]

The empirical methodology used in this article to relate leverage to cash flow sensitivities follows that employed in a recent study by Fazzari, Hubbard, and Petersen.[4] These authors show that small, fast-growing firms with low dividend-payout rates tend to have heightened correlations between their investment rates

[1]For documentation of the recent rise in corporate leverage, see Ben Bernanke and John Campbell, "Is There a Corporate Debt Crisis?" *Brookings Papers on Economic Activity,* 1:1988, pp. 83-125; and Richard Kopke, "The Roles of Debt and Equity in Financing Corporate Investments," *New England Economic Review,* July-August 1989, pp. 25-48. For a discussion of the potential effects of leverage on macroeconomic stability and monetary policy transmission, see Benjamin Friedman, "Implications of Corporate Indebtedness for Monetary Policy," unpublished paper, Harvard University, September 1989; and William Lee, "Corporate Leverage and the Consequences of Macroeconomic Instability," in *Studies on Financial Changes and the Transmission of Monetary Policy,* Federal Reserve Bank of New York, 1990, pp. 135-68.

[2]See, for example, Bernanke and Campbell, "Is There a Corporate Debt Crisis?" and David Wyss, Christopher Probyn, and Robert de Angelis, "The *Impact of Recession on High Yield Bonds,*" Alliance for Capital Access, Washington, D.C., July 1989, mimeo.

[3]Bernanke and Campbell state that "the way financial distress distorts decisions may depend on how close to bankruptcy a firm is. The managers of a firm that is doing poorly but is not in immediate danger may become conservative...to avoid potentially fatal mistakes....Once bankruptcy becomes likely, on the other hand, gambling becomes a better strategy for the managers."

[4]Steven Fazzari, R. Glenn Hubbard, and Bruce Petersen, "Financing Constraints and Corporate Investment," *Brookings Papers on Economic Activity,* 1:1988, pp. 141-95.

and fluctuations in their cash flows. The highly leveraged firms examined here are also shown to have investment rates with sharp sensitivities to fluctuations in sales and cash flow. Thus the methodology produces similar results in the two studies although the sample of leveraged firms in this analysis is more heavily weighted toward larger and less rapidly growing companies. This article also extends its analysis to the relationship between cash flow and employment, a topic not covered in the earlier study.

Background

Over the years, economists have shifted their assessment of the effects of cash flows or internally generated funds on firms' capital expenditures. It was traditionally believed that cash flow was important for firms' investment decisions because firm managers regarded internal funds as less expensive than external funds. In the 1950s and 1960s, this view led to numerous empirical assessments of the role of internal funds in firm investment behavior.[5] These studies found strong relationships between cash flow and investment. However, because sales, output, and cash flow have historically been highly correlated in aggregate data, these studies could not isolate the variable that was actually driving investment. Thus the results obtained may also have been consistent with theories of investment that deemphasize internal funds.

The literature's emphasis on the interaction of real and financial variables declined after a theoretical paper by Modigliani and Miller showed that, under certain theoretical conditions (perfect capital markets, no taxes, and no bankruptcy), the market would not consider a firm's capital structure when valuing its assets.[6] By implication, the marginal cost of equity, debt, and internal funds financing would then be equal, and financial policy would be irrelevant to investment and employment decisions. If a firm's internal funds exceeded its real investment needs, this free cash flow would be either returned directly to stockholders through dividends or stock buybacks or invested for them by acquiring income-earning assets.

The theoretical case for the independence of real and financial decisions was reinforced when Jorgenson presented empirical evidence that aggregate cash flow or profits variables provided no additional explanatory power for aggregate investment regressions if sales or output variables were included in the equations.[7] Models that denied a role to internal funds therefore dominated the investment literature until recently, largely because of their theoretical appeal.

Newly developed formal models, however, challenge the assumptions underlying the so-called Modigliani-Miller theorem and argue that a firm's investment and employment decisions do depend on the availability of internal finance. The theoretical arguments supporting these models generally describe how the existence of informational asymmetries between firm managers and lenders can raise the cost of external funds over the cost of internal funds.[8] The main argument is that because managers can only be imperfectly monitored by investors, lenders will require a higher rate of return to be compensated for the possibility that the manager is wasting resources. The increased availability of internally generated funds lowers the cost of capital and thus affects real economic decisions by inducing more investment than would occur if managers had to seek external finance. Internally generated funds are therefore cheaper at the margin than external funding. It follows that firms with plenty of internally generated cash may tend to invest more, other factors equal.

This argument has implications for the relative responsiveness of different types of firms to fluctuations in their cash flows. A firm with a large average cash flow typically accumulates a substantial reserve of internal funds that can be drawn upon to maintain an investment program when cash flow drops off in a particular year. By contrast, a highly leveraged firm with a small average cash flow does not have such a reserve and may need to cut investments back sharply in response to a decline in cash flow. When revenues and internal funds pick up, the leveraged firm is more apt to increase its capital expenditures. Overall, the leveraged firm is therefore likely to exhibit greater variability in its investments over time.

The recent availability of quality historical data on individual firms and the increasing popularity of these asymmetric-information models of the firm's capital structure have renewed interest in the empirical estimation of the interaction between financial variables and firm investment.[9] Articles exploring this relation-

[5]See, for example, the joint work of Edwin Kuh and John Meyer, *The Investment Decision* (Cambridge: Harvard University Press, 1957); and "Investment, Liquidity and Monetary Policy," in *Commission on Money and Credit: Impacts of Monetary Policy* (Englewood Cliffs, N.J.: Prentice Hall, 1963).

[6]Franco Modigliani and Merton Miller, "The Cost of Capital, Corporate Finance, and the Theory of Investment," *American Economic Review*, vol. 48 (June 1958), pp. 261-97.

[7]Dale Jorgenson, "Econometric Studies of Investment Behavior," *Journal of Economic Literature*, vol. 9 (1971), pp. 1111-47.

[8]This recent literature is surveyed by Mark Gertler and R. Glenn Hubbard, "Financial Factors in Business Fluctuations," in *Financial Market Volatility*, Federal Reserve Bank of Kansas City, 1988.

[9]An article by Steven Fazzari and Michael Athey, "Asymmetric Information, Financing Constraints and Investment," *Review of Economics and Statistics*, August 1989, pp. 481-87, uses Compustat data to show that if one adds internal finance (after-tax profits plus

ship confirm that fluctuations in internal funds are important determinants of investment.

Fazzari, Hubbard, and Petersen show that internal funds are more important for explaining the investment of certain cash-constrained firms (specifically, those that have low average dividend-payout rates) than the investment of other firms. In the authors' data set, these firms are smaller, faster growing, and more subject to sales volatility than the rest of the sample. These characteristics, combined with the firms' practice of using most of their earnings for investment, make the firms more likely to face a large differential cost between internal and external funds. The novelty of the Fazzari, Hubbard, and Petersen approach lies in demonstrating that the behavior of certain classes of firms depends on capital market imperfections and the availability of internal funds while other firms behave as if they face relatively perfect capital markets.[10]

The analysis that follows uses the logic and methodology of the Fazzari, Hubbard, and Petersen study to investigate whether highly leveraged firms — firms that are cash-constrained because of debt service obligations — exhibit increased sensitivity to cash flow. These firms, like the small, rapidly growing firms studied by Fazzari and his colleagues, are likely to face higher borrowing costs than less leveraged firms. In addition, the analysis tests whether leveraged firms have heightened sensitivities to current demand conditions when cash flow is held constant. Particularly when high leverage encourages a risk-averse attitude on the part of management, a drop in current sales may lead firms to postpone investment and strenuously avoid inventory buildup, even if they are experiencing offsetting improvements in interest or other expenses. Since the maintenance of employment in a downturn can be viewed as an investment by firms, these effects may also be present in the employment patterns of leveraged firms. In sum, the statistical analysis presented below is designed to assess the effect of leverage on overall cyclical variability by studying the interaction of financial and real variables for both firm employment and investment in plant and equipment.

Characteristics of the data

The basic data source for this article is the Compustat annual financial data tapes, which contain information on firms between 1968 and 1987.[11] Only 778 nonfinancial firms have complete data sets for all variables (including necessary lags) used in this study. Firms that had large acquisitions over this period were eliminated from the sample because the statistical procedures (the model's lag structure and the estimation of the fixed firm effects) employed in the study required that the general characteristics of the firms be constant over time.[12]

Of the remaining 586 firms, a surprisingly large number, 176, had lower sales revenue (in 1982 dollars) in 1987 than in 1971. These negative-growth firms were not dropped from the sample (as they were in the Fazzari, Hubbard, and Petersen analysis) because this study is particularly concerned with the ways in which firms respond to adverse shocks. Nevertheless, many of the regressions reported below for the sample of 586 firms were also run on a sample limited to the 410 firms that showed positive growth, and the results

Footnote 9 continued
depreciation less dividends) and interest expense variables to a sales accelerator model with fixed firm effects, internal finance is positively, and interest expense negatively, related to investment.

Using Value Line data and somewhat different econometric techniques, Steven Fazzari and Tracy Mott ("The Investment Theories of Kalecki and Keynes: An Empirical Study of Firm Data, 1970-1982," *Journal of Post Keynesian Economics*, Winter 1987-88, pp. 171-87) show that these financial variables are also important in CAPM-based models, neoclassical models of investment, and sales accelerator models.

[10]A related article by Takeo Hoshi, Anil Kashyap, and David Scharfstein, "Corporate Structure, Liquidity and Investment: Evidence from Japanese Industrial Groups," *Quarterly Journal of Economics*, vol. 109 (September 1988), identifies a group of Japanese firms that face relatively small differentials between their costs of internal and external finance because they have close ties to individual banks. The authors find that firms without such relationships alter their capital expenditures much more in response to cash flow and liquid asset fluctuations than do those firms with special banking relationships.

In an unpublished paper, "Debt, Liquidity Constraints, and Corporate Investment: Evidence from Panel Data," Princeton University, 1989, Toni Whited adopts an Euler equation estimation approach and shows that for most firms the neoclassical model is not rejected by the Compustat data while for firms that are classified a priori as experiencing "financial distress," the model needs to be amended to incorporate a potentially binding financing constraint. The financially constrained or distressed firms, like the low dividend-payout firms identified by Fazzari, Hubbard, and Petersen, are smaller and faster growing than the rest of the sample.

These three papers do not reveal, however, whether firms that have increased their leverage in recent years are likely to change their behavior as a result of their restructuring. Many of the recent leveraged buyouts have involved large, mature firms in noncyclical, stable industries such as medical services, retailing, and entertainment. Fazzari, Hubbard, and Petersen did not report the leverage ratios of their low dividend-payout firms, but the recent leveraged buyouts have typically involved firms that have very different characteristics than the low dividend-payout firms examined by these authors.

[11]The general quality of the Compustat data and its merits relative to the Value Line data have been discussed in an unpublished paper by Terry Zivney and Richard Marcus, "A Comparative Analysis of Compustat and Value Line Financial Data Tapes," University of Tennessee, February 1989.

[12]Firms were dropped if they had a capital stock acquisition in one year exceeding 15 percent of their existing capital stock. Fazzari, Hubbard, and Petersen used a slightly different rule, eliminating firms that had asset acquisitions exceeding 10 percent of existing assets. Whited, in "Debt, Liquidity Constraints, and Corporate Investment," eliminated firms that had asset acquisitions exceeding 15 percent of existing assets. Various rules were tried and appeared to have little effect on the main results of this paper.

changed very little.[13]

The definition of cash flow used in this paper is net income (earnings after interest and taxes) plus depreciation and amortization.[14] Investment is defined as capital expenditures other than those obtained through acquisitions of other firms. Compustat's employment data are usually measured at the end of the year, but some firms may report midyear or year-average data. The rest of the data are reported on a fiscal-year basis; the median reporting date among firms is December 31, but there is wide dispersion.

The market value of the end-of-year capital stock is calculated in the same manner as in Fazzari, Hubbard, and Petersen. Physical depreciation rates are estimated for each firm from its reported depreciation and gross book value of capital. As a benchmark starting value, the reported book value of the net capital stock is assumed to be an accurate measure of the market value of the stock in 1968. Subsequent capital stocks are calculated by adding capital expenditures (investment and net capital acquisitions), subtracting estimated physical depreciation, and adjusting the total by changes in the aggregate price of capital goods.[15]

Summary statistics describing the more and less leveraged firms

The 586 firms are split into two groups according to their average degree of leverage over the sample. Associated with each firm is a single debt-to-asset ratio that equals its median book value debt-to-asset ratio over the seventeen years between 1971 and 1987. The firms are ranked on the basis of this ratio: the most leveraged 20 percent, 118 firms, are placed in the highly leveraged "group H," and the remaining 80 percent, 456 firms, are assigned to the less leveraged "group L."[16] Other methods of splitting the sample were considered, and one method based on interest coverage ratios is discussed below, but this article focuses primarily on the book-value debt-to-asset ratio grouping.[17]

Table 1 shows that the firms' debt-to-asset ratios range between 0.32 and 0.69 for group H and between 0.00 and 0.32 for group L. Splitting the sample into groups on a year-by-year basis would lead to some switching of firms in and out of the two groups, but

[13]A noticeable difference did occur when the sample was split, as in Fazzari, Hubbard, and Petersen, into two groups: firms with low dividend-payout rates and firms with high dividend-payout rates. In the sample of 410 firms, the high retention rate firms are, on average, smaller and faster growing than other firms, and their investment rates are more sensitive to cash flow variations. The firms in the high-leverage group do not have higher than average retention rates.

[14]Some experimentation suggested that the results presented here are not sensitive to modifications of the definition of cash flow — such as excluding preferred or ordinary dividends or including taxes.

[15]Unlike other authors, I add to the previous year's capital stock the physical capital obtained through acquisitions of other firms.

[16]Firms ranked in the "top 20 percent" by their dividend-payout ratios were also singled out for study by Fazzari, Hubbard, and Petersen, but this percentage is essentially an arbitrary cutoff point. The effect of splitting the top 20 percent into the top 10 percent and the next 10 percent is discussed below.

[17]The debt-to-asset ratio is intended to measure a firm's capacity to respond to investment opportunities and its ability to absorb shocks. The choice of book value over market value is somewhat arbitrary, but it is based in part on the relative ease of the former's calculation. Market value and book value measures of debts and assets may not accurately reflect a liquidation value or capacity to borrow. Bernanke and Campbell, "Is There a Corporate Debt Crisis?" and Kopke, "The Role of Debt and Liquidity," compare trends in book value debt to market value debt for Compustat firms.

Table 1

Sample Statistics for the Highly Leveraged (Group H) and Less Leveraged (Group L) Firms

(Median, Means, and Standard Deviations Calculated for Individual Firms over Seventeen Years: 1971-87)

	Group H	Group L
Number of firms	118	468
Median debt/asset ratio — highest in group	0.69	0.32
Median debt/asset ratio — lowest in group	0.32	0.00
Median Values in Each Group		
Median debt-to-asset ratio	0.39	0.20
Debt-to-asset ratio in 1971	0.40	0.21
Debt-to-asset ratio in 1987	0.38	0.21
Assets in 1971 (in millions of 1982 dollars)	262	263
Assets in 1987 (in millions of 1982 dollars)	371	481
Median cash flow†–to–interest coverage	2.95	6.84
Mean annual real sales growth rates	0.033	0.035
Mean annual employment growth rates	0.008	0.011
Mean annual investment-to-capital ratios	0.13	0.14
Mean annual real cash flows‡ (in millions of 1982 dollars)	21.2	37.3
Standard deviations of annual investment-to-capital ratios	0.095	0.071
Standard deviations of annual employment growth rates	0.142	0.114
Standard deviations of real sales growth rates	0.153	0.122
Standard deviations of annual real cash flows‡ (in millions of 1982 dollars)	15.4	15.4
Mean Values in Each Group		
Standard deviations of annual investment-to-capital ratios	0.126	0.085
Standard deviations of mean employment growth rates	0.191	0.136

†Cash flow = net income + interest expense + depreciation + amortization.
‡Cash flow = net income + depreciation + amortization.

overall the relative indebtedness of the firms in the two groups is fairly stable. The median debt-to-asset ratio of group H firms is almost twice that of group L firms in both 1971 and 1987.

This median debt-to-asset ratio is a "stock" measure of leverage, but it has a natural "flow" counterpart, the firm's median cash flow–to–interest coverage ratio over the 1971 to 1987 period. The average values of this ratio among firms in groups H and L are 2.95 and 6.84, respectively, indicating that the group H firms are more highly leveraged in this flow sense as well.[18] These measures also indicate, however, that the differences in leverage are moderate compared to the debt-to-asset and interest-coverage ratios of many of the firms that underwent financial restructurings through leveraged buyouts in 1980s.[19]

The typical firms of groups H and L are similar in asset size. The average group H firm had assets (in current dollars) in 1971 and 1987 of about $262 million and $371 million, respectively, and the corresponding group L averages were $263 million and $481 million. In line with their somewhat faster asset growth, the group L firms had slightly higher sales growth, employment growth, and investment rates. The group H firms had significantly lower average cash flow (net income plus depreciation and amortization), a finding which reflects their higher leverage.

The most interesting difference between the two groups for the purposes of this study is that the highly leveraged firms experienced more volatility (that is, greater seventeen-year standard deviations) in their investment and employment rates. These firms also had higher sales volatility, because of more variable demand and/or more variable production.[20] The two groups experienced similar volatility in their cash flows. Differences in leverage for this sample, therefore, cannot readily be explained or justified by arguing that firms with less volatile cash flows or revenues can "afford" higher leverage without increased risk of bankruptcy.

These summary statistics are consistent with the view that highly leveraged firms experience greater volatility, both in sales and input expenditures. The following two sections study reduced form relationships that may clarify the source of these different characteristics. Since the group H firms were neither particularly small nor rapidly growing, the results of this study may be relevant for understanding the impact of the recent trend toward increased leverage among large, mature firms.

Explaining differences in investment and employment volatilities across firms

This section provides evidence that the differences in investment and employment volatilities may in fact be due to differences in leverage rather than firm-specific or industry characteristics that happen to be correlated with leverage. The regressions presented attempt to explain the differences across firms with respect to their investment rate (investment divided by the prior year-end capital stock) and employment growth rate volatilities, where volatilities are measured by standard deviations calculated over seventeen years.

Table 2 displays the main results. The dependent variables in the two regressions are cross sections of the standard deviations of firms' investment rates and employment growth rates. Some industries may have systematically higher leverage ratios[21] and greater investment and employment volatilities. All cross-sectional regressions therefore include industry dummies (coefficient estimates not reported) to ensure that the measured correlation between leverage and volatility is not simply capturing special industry effects.[22]

Because previous studies have shown that small and rapidly growing firms tend to experience greater volatility, variables for growth and size are included as controls in all the regressions as well. Firm size is measured by the dollar value of assets in 1979, the midpoint of the sample. The estimated coefficient on firm size is indeed negative, as expected, and statistically significant. Firm growth is measured by average investment and average employment growth rates in the investment and employment volatility regressions, respectively. The estimated coefficient is positive, as expected, and statistically highly significant.

Sales and cash flow volatility measures are also included in the regressions to control for variability of demand, input costs, and interest payments facing each firm. The explanatory variables used are the standard deviations of each firm's real sales and real cash

[18]For the calculation of this particular ratio, interest expenses are included (added back) to cash flow. Of the 118 firms that make up the top 20 percent of firms with respect to their debt-to-asset ratios, 79 are among the 118 firms that make up the bottom 20 percent with respect to interest coverage.

[19]The Compustat database excludes firms that are not publicly traded, such as those that have become highly indebted as a result of leveraged buyouts.

[20]Input cost variations might induce production changes even if the demand curve facing the firm were constant.

[21]The determinants of differences in leverage across industries are discussed by Robert Bowen, Lane Daley, and Charles Huber in "Evidence on the Existence and Determinants of Inter-Industry Differences in Leverage," *Financial Management*, Winter 1982, pp. 10-20.

[22]Industries were classified at the two-digit standard industry classification level. The dummies were always significant as a group; however, dropping them had little effect on the other estimated coefficients.

flows (divided by the real capital stock in the investment regressions and divided by the number of employees in the employment regressions). As expected, these two variables have positive coefficient estimates in both sets of regressions. Firm investment and employment volatilities appear somewhat more correlated with the variability of sales than with the variability of cash flow.

The most important regression results concern the estimated coefficients on the so-called dummy variables. These variables allow for marginal, constant-term effects on volatility for members of group H. The estimated coefficients on the dummy variables measure the extent to which volatility differences across firms are explained by the leverage grouping alone rather than industry- or firm-specific differences captured by the other included variables.

Table 2

The Marginal Effects of Leverage on Investment and Employment Volatilities: Basic Regressions

	Dependent Variables	
Explanatory Variables	Volatility of Firms' Investment Rates	Volatility of Firms' Employment Growth Rates
Firm size	−1.543	−2.442
	(2.2)	(2.2)
Average growth rate	0.979	1.975
	(17.3)	(12.0)
Sales volatility	0.009	0.002
	(8.0)	(8.8)
Cash flow volatility	0.047	−0.000
	(2.4)	(0.2)
	Group H Dummy for the Constant Term	
Group H dummy variable	0.033	0.058
	(3.8)	(4.4)
R^2	0.79	0.76

Notes: Sample consists of 586 observations (firms). Means and standard deviations are calculated over the period 1971-87. All regressions include industry dummies (estimates not reported). Absolute t-statistics are shown in parentheses beneath coefficients.

Explanation of variables:

Volatility of firms' investment rates: standard deviations of investment-to-capital ratios.

Volatility of firms' employment growth rates: standard deviations of firms' employment growth rates.

Firm size: the firms' dollar value of assets in 1979.

Average growth rates: mean investment rates and mean employment growth rates in the investment and employment volatility equations, respectively.

Sales volatility: standard deviation of firms' real sales–to–real capital or real sales–to–employment ratios in the investment and employment volatility equations, respectively.

Cash flow volatility: standard deviation of firms' real cash flow–to–real capital or real cash flow–to–employment ratios in the investment and employment volatility equations, respectively.

The estimate of the marginal group H effect in the investment volatility regression is 0.033 — not very different from the difference (0.041) between the mean standard deviations of investment rates for groups H and L, shown in Table 1. This finding suggests that the difference in average investment volatility is not due to special industry factors, differences in firm growth rates, or differences in firm sizes.

Similar results hold for the employment volatility regression. The estimate of the marginal group H effect in the first employment volatility regression is 0.058 — very similar to the difference (0.055) between the mean standard deviations of employment growth rates for groups H and L shown in Table 1. This suggests that the difference in employment volatilities across the two groups is not due to special industry factors, differences in firm growth rates, or differences in firm sizes.

Table 3 presents regressions that probe somewhat deeper into the ways in which higher leverage may lead to greater volatility. To the basic investment and employment volatility specifications in Table 2, the regressions in Table 3 add marginal sales and cash flow volatility effects. These specifications allow the coefficients on the sales and cash volatility variables to vary between group H firms and the rest of sample.

For example, the left-most columns of Tables 2 and 3 report specifications that are identical except for the inclusion of the "group H sales volatility" dummy variable in the Table 3 regression. This variable consists of sales volatilities for group H firms and zeros for group L firms.[23] The effect of sales volatility on investment volatility for group L firms is measured simply by the sales volatility coefficient, 0.001, reported in the second row of Table 3. For group H firms, the total effect is 0.022, that is, the sum of 0.001 and 0.021, the group H sales volatility coefficient shown in the fifth row of Table 3.

The results suggest that the greater volatility of group H firms is not simply exogenous, separate from the other observable forces affecting the firms; rather, the volatility of group H firms seems to arise from their greater sensitivity to sales and cash volatilities. In the specifications of Table 3, the significance of the group H dummy for the constant term is greatly reduced. This result is consistent with findings, reported in the next section, that increased leverage heightens the sensitivity of investment and employment to sales and cash flow shocks.

The evidence presented in this section argues that

[23] This variable can be thought of as the product of a group H dummy variable (unity if a firm is a group H member, zero otherwise) times the firms' sales volatilities.

Table 3

The Marginal Effects of Leverage on Investment and Employment Volatilities: Robustness Tests

	Dependent Variables					
	Volatility of Firms' Investment Rates			Volatility of Firms' Employment Growth Rates		
Explanatory Variables	(1)	(2)	(3)	(4)	(5)	(6)
Firm size	−1.760	−1.741	−1.756	−2.202	−2.454	−2.312
	(3.0)	(3.0)	(3.0)	(2.1)	(2.3)	(2.2)
Average growth rate	0.813	0.798	0.802	0.925	0.964	0.916
	(17.2)	(16.8)	(16.9)	(10.3)	(10.9)	(10.3)
Sales volatility	0.001	0.002	0.001	0.001	0.001	0.001
	(1.3)	(2.0)	(1.4)	(2.1)	(2.3)	(2.2)
Cash flow volatility	0.062	0.053	0.058	0.000	−0.001	−0.001
	(4.0)	(3.4)	(3.7)	(0.7)	(2.4)	(1.9)
	Group H Dummies for the Constant Term and the Slope Coefficients					
Constant term	−0.018	−0.032	−0.017	0.012	0.029	0.013
	(0.2)	(3.9)	(1.8)	(0.8)	(2.2)	(0.9)
Sales volatility	0.021		0.012	0.002		0.001
	(16.3)		(2.8)	(6.2)		(2.8)
Cash flow volatility		0.486	0.231		0.005	0.003
		(16.2)	(2.4)		(6.4)	(3.3)
R^2	0.86	0.86	0.86	0.77	0.77	0.78

Notes: Columns 1-3 present alternative specifications for the investment regression; columns 4-6 present alternative specifications for the employment regression. Variables and sample are defined in Table 2. Group H dummies are marginal constant terms or slope coefficients. All regressions include industry dummies (estimates not reported). Absolute t-statistics are shown in parentheses beneath coefficients.

Table 4

The Cash Flow Sensitivities of Firms' Investment and Employment Demands: Variations across Leverage Groups

	Dependent Variables			
Explanatory Variables	Firm Investment	Firm Investment	Firm Employment Growth	Firm Employment Growth
Current sales	1.1	1.5	32.4	29.8
	(16.7)	(18.1)	(40.7)	(35.4)
Sales lagged one year	−1.0	−0.4	−24.5	−24.5
	(12.3)	(4.9)	(22.2)	(22.8)
Sales lagged two years	0.2	−0.4	5.8	5.5
	(2.1)	(4.2)	(5.8)	(5.7)
Sales lagged three years	−0.2	0.3	0.3	−1.1
	(3.0)	(4.0)	(0.4)	(1.7)
Cash flow	6.8		−8.1	
	(11.1)	*	(4.4)	*
	Group H Dummy on the Cash Flow Slope Coefficient			
Cash flow (group H effect)	45.2	20.0	37.8	18.0
	(29.0)	(10.1)	(13.1)	(5.6)
R^2	0.40	0.46	0.23	0.29

Notes: All regressions are based on a sample of 586 firms over seventeen years and include fixed-firm and year effects (not reported). All estimated coefficients in the investment and employment equations have been multiplied by 100 and 10,000, respectively. Absolute t-statistics are shown in parentheses beneath the estimated coefficients. The dependent and explanatory variables in the investment and employment equations are deflated by the lagged capital stock (divided by the capital goods deflator) and employment level, respectively. Sales and cash flows are divided by the GNP deflator.

*These regressions include marginal coefficients on cash flow estimated separately for each industry (not reported). These coefficients render a unique overall slope coefficient unidentifiable.

the more leveraged firms experience more investment and employment volatility and that the differences cannot be attributed to industry, firm-size, or firm-growth-rate effects. Furthermore, differences in standard deviations of investment and employment among group H firms are strongly correlated with differences in their sales and cash flow variability. Although it is not surprising that the firms with high (low) sales and cash volatility have tended toward high (low) investment and employment volatility as well, it is significant that this relationship is more pronounced for group H than for group L firms.

The effects of leverage on the sensitivities of firms' investment and employment demand to changes in sales and cash flows

This section presents estimates of simple models of firm investment and employment demands. The basic specifications relate capital expenditures and employment growth to current and lagged values of sales and current cash flow. The main result is that, when the specifications permit different coefficients on cash flow for the two groups, the highly leveraged firms exhibit significantly greater responsiveness of both investment and employment to cash flow.

The rest of the section presents regression estimates demonstrating that these findings are robust to the following changes in model specification: (1) allowing the cash flow coefficient to vary systematically by industry, (2) splitting the highly leveraged group into two subgroups, (3) using an alternative interest-coverage measure to identify the highly leveraged group, (4) making the cash flow coefficient a smooth function of firms' average leverage ratios, and (5) replacing current cash flow by lagged cash flow as an explanatory variable.

The dependent variables are real investment and changes in employment, and the explanatory variables are current real cash flow, current real sales, and three lags of real sales.[24] The estimation procedure used removes from the data any part of a firm's investment or employment demand that is correlated with changing

[24] In all the regressions, the data for the investment and employment equations are deflated by the lagged real capital stock and employment, respectively, in order to obtain homoscedastic residuals. Real sales and cash flows are obtained by deflating current dollar values by the GNP deflator. Real investment and capital stocks are obtained by deflating current dollar values by the GNP capital goods deflator.

Table 5

The Cash Flow Sensitivities of Firms' Investment and Employment Demands: Variations across Leverage and Interest Coverage Groups

	Dependent Variables			
Explanatory Variables	Firm Investment	Firm Investment	Firm Employment Growth	Firm Employment Growth
Current sales	1.1	1.4	32.4	32.4
	(15.7)	(21.8)	(40.6)	(40.7)
Sales lagged one year	−0.9	−1.4	−24.5	−24.5
	(10.8)	(19.4)	(22.2)	(22.2)
Sales lagged two years	0.1	0.6	5.8	5.8
	(1.7)	(6.7)	(5.8)	(5.8)
Sales lagged three years	0.2	−0.4	0.3	0.3
	(2.8)	(4.8)	(0.4)	(0.4)
Cash flow	6.9	5.9	−8.1	−8.1
	(11.2)	(9.3)	(4.4)	(4.4)
	Dummies for H1, H2, and Low Interest Coverage Groups on the Cash Flow Coefficients			
Cash flow (group H1 effect)	39.3		37.6	
	(12.9)		(12.8)	
Cash flow (group H2 effect)	47.1		41.3	
	(26.6)		(3.6)	
Cash flow (low interest coverage effect)		30.2		37.8
		(22.2)		(13.1)
R^2	0.40	0.38	0.23	0.23

Notes: All regressions are based on a sample of 586 firms over seventeen years and include fixed-firm and year effects (not reported). All estimated coefficients in the investment and employment equations have been multiplied by 100 and 10,000, respectively. Absolute t-statistics are shown in parentheses beneath the estimated coefficients. The dependent and explanatory variables in the investment and employment equations are deflated by the lagged capital stock (divided by the capital goods deflator) and employment level, respectively. Sales and cash flows are divided by the GNP deflator.

macroeconomic conditions or with the relatively fixed characteristics of a firm such as size, leverage, or industry.[25]

The first and third regressions reported in Table 4 present the main results of this section. The models for investment and employment are estimated using the full sample of 586 firms over seventeen years. The cash flow coefficient is allowed to vary between the high-leverage firms and the rest of the sample.[26] The responsiveness of the investment or employment growth rates to changes in cash flow for group L firms is given in the coefficient estimates of the fourth row of the table. The responsiveness of group H firms is given by the sum of the fourth and fifth rows in that table. The "group H effect" marginal coefficients of the fifth row indicate that the highly leveraged firms have greater sensitivities to cash flow.

These results are quantitatively as well as statistically significant. The regression in the first column indicates that, when other variables are held constant, each extra dollar of cash flow (in 1982 dollars) generates about 45 cents more investment for group H than for group L firms. The regression in the third column indicates that, when other variables are held constant, each increase of 1 percentage point in the cash flow–to–employment ratio causes the employment growth rate to rise four-tenths of 1 percent (37.8 divided by 10,000) more at the highly leveraged firms than at the less leveraged firms.

The second and fourth regressions reported in Table 4 follow the same specification as the other two equations except that a marginal cash flow coefficient is estimated for each industry (estimates not reported) as well as for group H. The extra sensitivity that is found for group H firms in the first and third regressions is still present, though somewhat reduced, under this specification.

The regressions reported in Table 5 examine the robustness of these results. In the first and third regressions, group H is split in half into groups H1 and H2. Group H1 contains the most leveraged firms (the most indebted 10 percent of the sample). A marginal coefficient on cash flow is estimated for both of these subgroups. Somewhat unexpectedly, the estimates indicate that group H2 is slightly more sensitive to cash variations than group H1. This evidence suggests that cash flow sensitivity is not a simple monotonic function of the degree of leverage.

The second and fourth regressions presented in Table 5 allow the cash flow coefficients to vary across firms grouped according to another measure of financial distress. Here, firms are ranked by their median interest coverage ratios over the 1971 to 1987 period; that is, firms are ranked by their average levels of interest coverage. The bottom 20 percent are separated from the total and labeled the "low-coverage group." The large estimates of the marginal coefficient on cash flow for the low-coverage firms suggest that the increased sensitivities to cash flow variations found in Table 4 are robust to alternative measures of financial strain.

Table 6

The Cash Flow Sensitivities of Firms' Investment and Employment Demands: Variations Proportional to Firms' Leverage Ratios

	Dependent Variables	
Explanatory Variables	Firm Investment	Firm Employment Growth
Current sales	1.5	31.3
	(24.1)	(39.2)
Sales lagged one year	−1.0	−24.2
	(13.1)	(22.1)
Sales lagged two years	0.2	5.8
	(2.0)	(5.8)
Sales lagged three years	−0.1	0.3
	(1.8)	(0.5)
Cash flow	−7.7	−12.0
	(9.8)	(6.3)
	Marginal Effect of Leverage on the Cash Flow Coefficient	
Cash flow multiplied by each firm's median debt-to-asset ratio	139.5	99.1
	(33.1)	(15.2)
R^2	0.41	0.24

Notes: All regressions are based on a sample of 586 firms over seventeen years and include fixed-firm and year effects (not reported). All estimated coefficients in the investment and employment equations have been multiplied by 100 and 10,000, respectively. Absolute t-statistics are shown in parentheses beneath the estimated coefficients. The dependent and explanatory variables in the investment and employment equations are deflated by the lagged capital stock (divided by the capital goods deflator) and employment level, respectively. Sales and cash flows are divided by the GNP deflator.

[25] That is, in accordance with the standard convention for this type of regression analysis (panel data studies), annual and company dummies are included in all the models (coefficient estimates not reported). The inclusion of the annual dummies provides more accurate estimates of the relationships between firms' rates of investment and hiring and firms' sales and cash flows. Moreover, this approach ensures that the relationships uncovered are, in fact, structural. The procedure does not reduce the macroeconomic significance of the results.

[26] This is accomplished by using all the observations on cash flow as *one regressor and using all the group H observations on cash flow* (with zeros for the group L firms) as another regressor.

Table 7

The Lagged Cash Flow Sensitivities of Firms' Investment and Employment Demands: Variations across Leverage Groups and Variations Proportional to Firms' Leverage Ratios

	Dependent Variables			
Explanatory Variables	Firm Investment	Firm Investment	Firm Employment Growth	Firm Employment Growth
Current sales	2.3	2.3	32.9	32.6
	(41.4)	(42.1)	(42.4)	(42.0)
Sales lagged one year	−2.9	−2.7	−25.7	−25.9
	(41.4)	(37.4)	(22.8)	(23.0)
Sales lagged two years	1.4	−1.4	7.5	7.5
	(17.2)	(16.9)	(7.5)	(7.7)
Sales lagged three years	−0.5	−0.6	−1.5	−1.4
	(7.3)	(7.8)	(2.3)	(2.2)
Cash flow lagged one year	10.2	4.7	4.0	−2.0
	(13.9)	(4.9)	(2.4)	(1.2)
	Group H Dummy on the Lagged Cash Flow Coefficient and the Marginal Effect of Leverage on the Lagged Cash Flow Coefficient			
Cash flow lagged one year (group H effect)	−1.5		11.5	
	(1.2)		(3.0)	
Cash flow lagged one year multiplied by each firm's median debt-to-asset ratio		27.2		36.9
		(6.9)		(5.7)
R^2	0.35	0.35	0.22	0.22

Notes: All regressions are based on a sample of 586 firms over seventeen years and include fixed-firm and year effects (not reported). All estimated coefficients in the investment and employment equations have been multiplied by 100 and 10,000, respectively. Absolute t-statistics are shown in parentheses beneath the estimated coefficients. The dependent and explanatory variables in the investment and employment equations are deflated by the lagged capital stock (divided by the capital goods deflator) and employment level, respectively. Sales and cash flows are divided by the GNP deflator.

Table 8

Separate Estimates of Firm Investment and Employment Demands by Leverage Groups

	Dependent Variables			
Explanatory Variables	Firm Investment (Group H)	Firm Investment (Group L)	Firm Employment Growth (Group H)	Firm Employment Growth (Group L)
Current sales	3.3	0.6	68.1	25.0
	(12.1)	(8.4)	(26.8)	(32.2)
Sales lagged one year	−1.3	−0.2	−51.2	−20.8
	(4.7)	(2.1)	(14.1)	(19.5)
Sales lagged two years	−1.2	−0.3	8.2	5.9
	(3.5)	(3.4)	(2.8)	(5.9)
Sales lagged three years	0.7	−0.1	0.3	−1.5
	(2.7)	(1.9)	(0.2)	(2.3)
Cash flow	23.6	8.7	3.9	−2.1
	(8.2)	(14.7)	(1.1)	(1.3)
R^2	0.70	0.10	0.43	0.17

Notes: All regressions are based on a sample of 586 firms over seventeen years and include fixed-firm and year effects (not reported). All estimated coefficients in the investment and employment equations have been multiplied by 100 and 10,000, respectively. Absolute t-statistics are shown in parentheses beneath the estimated coefficients. The dependent and explanatory variables in the investment and employment equations are deflated by the lagged capital stock (divided by the capital goods deflator) and employment level, respectively. Sales and cash flows are divided by the GNP deflator.

Further evidence of the effects of leverage on the sensitivities of firm investment and employment to cash flow variations is presented in Table 6. Here, the coefficients on cash flow are allowed to vary linearly with firms' median debt-to-asset ratios; that is, the explanatory variable is the multiplicative product of firms' average leverage ratios and their cash flows. This specification leads to an estimate of one cash flow–related coefficient for all firms, but the implied responsiveness of each individual firm to its cash flow equals the product of this coefficient estimate and that firm's debt-to-asset ratio.

For example, in the investment equation, the estimated coefficient on the leverage/cash flow interaction term is 139.5. This implies that, on average, a firm with a 50 percent debt-to-asset ratio spends about 70 cents of each extra dollar of cash flow on new investment; a firm with a 25 percent debt-to-asset ratio spends about 35 cents. The interaction effects of cash flow and leverage on employment are similar.

The evidence presented so far considers the effects of leverage on the sensitivity of employment and investment to cash flow changes in the same year. Table 7 presents estimates of the effects of lagged cash flow on these variables. When the lagged cash flow coefficient is allowed to vary between groups, the group H coefficient is significantly larger in the employment equation but is insignificantly different from zero in the investment equation. When the lagged cash flow coefficient is specified as a linear function of firms' debt-to-asset ratios, however, the previous result that sensitivity to cash flow rises with leverage is shown to hold for both dependent variables.

Experimentation reveals that leveraged firms' heightened sensitivity to cash flow is robust to other specification changes as well. When the sensitivity of investment and employment to sales is also allowed to vary across groups, however, some of the increased cash flow sensitivity of group H firms is apparently "transferred" to increased sensitivity to sales.

This transferral of explanatory power from cash flow to sales is apparent in Table 8, which displays simple investment and employment demand models based on lagged sales and current cash flow. In these regressions, however, the equations are estimated separately for the group H and group L firms. In both the investment and employment models, the more leveraged firms exhibit a stronger positive response to cash flow variations, but their heightened sensitivities to current sales fluctuations are even more dramatic. Perhaps one cannot clearly distinguish the relative importance of leveraged firms' heightened sensitivities to sales or to cash flow shocks because the two variables are highly correlated. It is possible that some of the heightened sensitivity to cash flow might find its way to the sales coefficient because sales revenue is probably the most accurately measured part of cash flow, which also includes various noncash expenses such as deferred taxes and deferred interest.

The regressions presented in this section demonstrate that firms with higher leverage vary their investment and employment more in response to cash flow (and perhaps sales) variations than do firms with less leverage. This conclusion appears robust to a variety of specifications and holds for a measure of leverage based on interest coverage, as well as one based on the debt-asset ratio. These heightened sensitivities are shown to be more than industry effects masquerading as leverage effects.

Conclusions

The firm-level analysis presented in this article shows that an increase in leverage may be associated with increased cyclical variability of investment and employment. The greater volatility of highly leveraged firms appears to arise from a greater responsiveness of investment and employment demands to fluctuations in internally generated funds.

One way in which monetary policy can influence aggregate investment and employment is by affecting firms' sales and interest expenses and hence firms' cash flows. The recent rise in corporate leverage may, therefore, signal an increased sensitivity of employment and investment to monetary policy, at least among corporations that have substantially raised their leverage.

It is conceivable that the microeconomic effects of leverage reported here may not hold as strongly in the aggregate. In particular, even if one highly leveraged firm cuts back sharply on employment in response to a downturn in sales or cash flow, perhaps a less leveraged firm will pick up some of the slack; that is, an industry's output might not be affected by the degree of indebtedness of individual firms. A sizable degree of such "canceling out" of the effects of leverage at the industry level seems plausible, however, only in the medium and long run. Therefore, when leverage increases are fairly widespread, the corporate sector is likely to become more volatile and more responsive to sales and cash flow fluctuations, including those that arise from interactions between the economy and monetary policy.

Housing Finance and the Transmission of Monetary Policy

by John Ryding

Since the 1970s, the system of mortgage financing in the United States has undergone tremendous change. The elimination of ceilings on interest rates payable on time deposits and of state-imposed usury ceilings on interest rates chargeable on mortgages has ended bouts of mortgage rationing. Accompanying this process of deregulation has been a surge in financial innovation. The widespread issuance of the adjustable rate mortgage as an alternative to the fixed rate mortgage in the 1980s has helped thrifts and some other mortgage lenders better manage their exposure to varying interest rates. Also over the last decade, the mortgage-backed securities market has grown to become one of the largest fixed-income markets in the United States, increasing the integration of the mortgage market with other capital markets.

In transforming the system of mortgage finance, deregulation and financial innovation have altered the way monetary policy influences the cost and availability of mortgages and, ultimately, residential investment. In the past, one of the powerful channels through which monetary policy affected economic activity was mortgage rationing. Whenever a tightening in monetary policy pushed market interest rates above the interest rate ceilings on time deposits, banks and thrifts experienced an outflow of retail funds that forced these institutions to restrict new credit. Now, however, credit rationing in the mortgage market resulting from the interaction of market interest rates and these ceilings has been eliminated. Consequently, movements in interest rates play a more direct role in allocating funds to mortgage lending.

This article investigates the extent to which deregulation and innovation have changed the responsiveness of housing investment to monetary policy shifts. It gives particular attention to the effects of changes in the federal funds rate, one indicator of the relative ease or restraint of monetary policy. The article concludes that housing investment has become much less sensitive to a rise in the federal funds rate and attributes this development largely to the elimination of deposit rate ceilings. Although other financial innovations have had important effects on the system of housing finance, little evidence is found that they have had a significant effect on the way residential investment responds to monetary policy.

The first section of the article reviews the elimination of interest rate ceilings on both deposits and mortgages, the introduction of adjustable rate mortgages, the growth of securitization of mortgages, and the increase in competition between the thrifts and other mortgage lenders. Empirical evidence on the determination of mortgage interest rates and housing investment is then explored, and a small statistical model of residential investment and mortgage interest rates is presented to examine the changing sensitivity of housing investment to variations in interest rates. A concluding section summarizes the main analytical and empirical results of the article.

Innovation in and deregulation of housing finance

Interest rate ceilings

Interest rate ceilings of one form or another played important roles in the allocation of funds between the mortgage and other financial markets prior to deregulation in the early 1980s. The Federal Reserve's Regula-

tion Q, which had restricted the maximum interest rates that banks could pay on time deposits since 1933, was extended to thrifts in September 1966 during a period of sharply rising short-term interest rates. Furthermore, many states over time passed usury laws that controlled, among other things, the maximum interest rate that lenders could charge on mortgages.[1]

Whenever interest rates on short-term market instruments such as Treasury bills rose significantly above the Regulation Q ceilings (Chart 1), there was a sharp outflow of funds from depository institutions as customers withdrew savings to invest in higher yielding instruments. This diversion of funds, or "deposit disintermediation," created a funding problem for both banks and thrifts. It was particularly severe for the latter group of institutions because of their limited access to alternative sources of funds. During these periods, often referred to as "credit crunches," depository institutions were forced to reduce mortgage lending sharply (Chart 2).

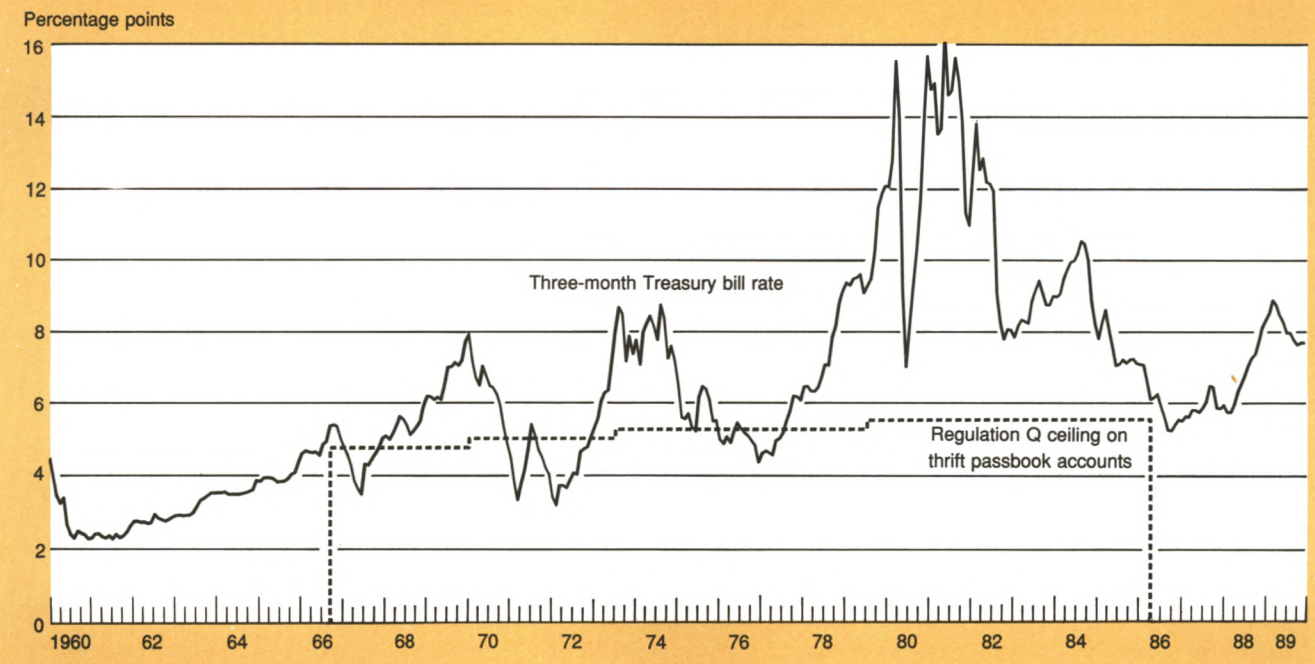
[1]New York, for example, in 1980 still had an 8½ percent ceiling on the rate that could be charged on mortgage lending.

Nevertheless, the interaction of deposit ceilings and high market interest rates stimulated financial innovation that may in fact have reduced the ability of these ceilings to restrain mortgage lending during periods of monetary tightening. Market interest rates remained above rates that thrifts and banks could offer on retail deposits for significant periods of time, producing a growing unsatisfied demand for mortgages at market interest rates then prevailing. This unsatisfied demand in turn encouraged the development of other sources of funding (such as wholesale funding markets or securitization of mortgage assets) and may have induced other financial institutions, not subject to these ceilings, to enter the mortgage market. Thus one might expect the effect of Regulation Q ceilings on mortgage lending to have declined somewhat over time, as the mortgage market evolved in response to disintermediation pressures. This inference is tested by the empirical analysis below, which assesses the extent to which the effectiveness of Regulation Q ceilings in restraining mortgage lending during periods of monetary stringency declined over time.

Partly in recognition of the pressures that periods of

Chart 1

Three-Month Treasury Bill Rate and the Regulation Q Ceiling



Source: Federal Reserve Bank of New York.

disintermediation placed on the ability of depository institutions to raise funds, the authorities increased the minimum denomination of Treasury bills from $1,000 to $10,000 in 1970. Nevertheless, the incentives created by high and rising interest rates in the late 1960s and 1970s spurred the development of alternative deposit-like savings vehicles. For example, money market mutual funds (MMMFs) were introduced in 1972, and by the late 1970s they had become serious competitors with depository institutions (Chart 3).

The process of dismantling Regulation Q ceilings on retail deposits began in June 1978, when depository institutions were allowed to issue six-month money market certificates (MMCs) in denominations of $10,000 or more.[2] The MMCs offered interest rates tied to those available on Treasury bills. The Depository Institutions Deregulation and Monetary Control Act of March 1980 stipulated that Regulation Q ceilings be phased out on time and savings deposits and permitted thrifts and banks to offer individuals interest-bearing negotiable order of withdrawal (NOW) accounts, essentially checking accounts that were not subject to the interest prohibition applying to demand deposits. These relaxations of Regulation Q eased the funding problems during the period of high nominal interest rates at the turn of the decade.

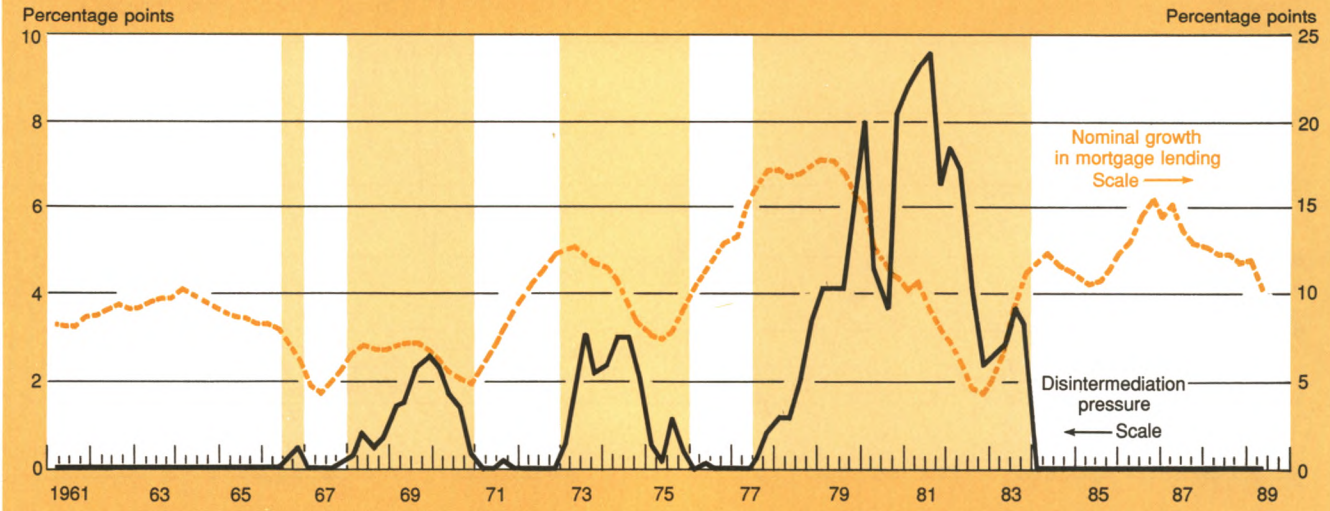
The Garn-St Germain Depository Institutions Act, passed in October 1982, further expanded funding alternatives for banks and thrifts.[3] The act authorized two new types of accounts: money market deposit accounts (MMDAs) — designed to be competitive with MMMFs — and Super-NOW accounts. Both accounts had minimum balances of $2,500, and both were free from interest rate ceilings. MMDAs were permitted beginning in December 1982 and Super-NOW accounts in January 1983. By early 1983, these new accounts effectively eliminated Regulation Q as a significant constraint on banks' and thrifts' ability to raise retail funds, although disintermediation pressures had been lessening for some months before then as a result of a marked reduction in interest rates.

[2]Interest rate ceilings on large certificates of deposit were removed in 1973.

[3]For discussions of the state of the financial health of thrifts during this period, see, for example, R. Dan Brumbaugh, *Thrifts Under Siege* (Cambridge, Mass.: Ballinger, 1988), chap. 2; and Patrick I. Mahoney and Alice P. White, "The Thrift Industry in Transition," *Federal Reserve Bulletin*, March 1985, pp. 137-56. For details on the Garn-St Germain Act and its effects, see Federal Reserve Bank of Chicago *Economic Perspectives*, March-April 1983; and Michael C. Keeley and Gary C. Zimmerman, "Competition for Money Market Deposit Accounts," Federal Reserve Bank of San Francisco *Economic Review*, Spring 1985, pp. 5-27.

Chart 2

Nominal Growth in Mortgage Lending and Disintermediation Pressure



Sources: Board of Governors of the Federal Reserve System, Flow of Funds data; Federal Reserve Bank of New York.

Notes: Before 1984, disintermediation pressure is measured as the three-month Treasury bill rate less the Regulation Q ceiling on thrift passbook accounts when this difference is positive; disintermediation pressure is calculated as zero when the difference is negative. From 1984 on, the value is zero. The shaded areas represent periods when the disintermediation spread is significantly greater than zero.

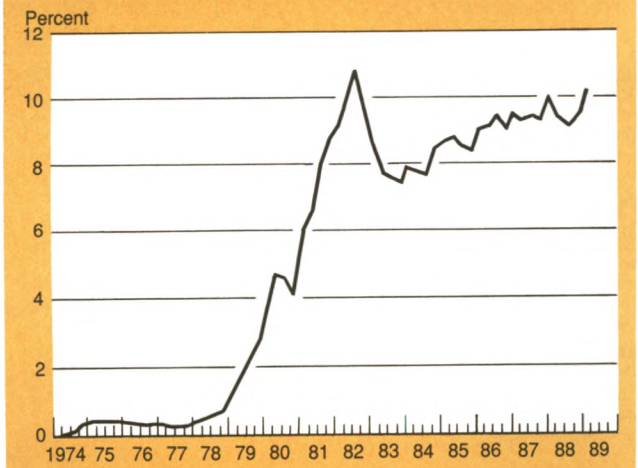
Also important in the allocation of funds for mortgage lending were state-imposed usury ceilings on mortgage interest rates. These ceilings differed substantially from state to state, and studies of the impact of usury ceilings have been very limited in scope. Nevertheless, some research indicates that usury ceilings limited the flow of funds into mortgage lending.[4]

It was argued above that deposit rate ceilings, when binding, acted to reduce new mortgage lending more sharply in response to an increase in market interest rates than would otherwise have occurred. Absent ceilings on mortgage interest rates, such a reduction in mortgage lending could have sharply raised mortgage interest rates, choking off the demand for new mortgages until it matched the smaller volume of funds available. To the extent that mortgage interest rate ceilings prevented mortgage rates from increasing sufficiently to bring demand into line with supply, however, lending would have had to be rationed in other ways (for example, lower loan-to-value ratios). The existence of usury ceilings, therefore, prevents one from deducing whether the change in mortgage interest rates caused by an increase in market rates would be greater or smaller in the regulated environment than in the deregulated environment. The behavior of mortgage interest rates in response to a monetary tightening is investigated empirically below.

[4]For references and a more complete discussion, see Harold C. Nathan, "Economic Analysis of Usury Laws," *Journal of Bank Research*, Winter 1980, pp. 200-211.

Chart 3

Share of Household Liquid Assets Held in Money Market Mutual Funds



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

Growth of securitization

The secondary mortgage market originated in the depression period with the foundation of the Federal Housing Administration (FHA) in 1934 and the Federal National Mortgage Association (Fannie Mae or FNMA) in 1938. The FHA insured long-term, fixed-rate mortgages, and FNMA was formed to provide a secondary market for FHA-insured loans. Government participation in the mortgage market was further expanded at the end of World War II with the creation of the Veterans Administration (VA) program. FNMA began purchasing VA mortgages in 1948.

The next major institutional development in the secondary market occurred in 1968, when Congress restructured FNMA as a government-chartered private corporation and created the Government National Mortgage Association (Ginnie Mae or GNMA) to assume some of FNMA's functions. Perhaps the most significant development at this time was that GNMA was empowered to guarantee, with the "full faith and credit" of the U.S. Treasury, the timely payment of both principal and interest on its securities backed by FHA-insured or VA-guaranteed loans. GNMA guaranteed its first mortgage-backed security (MBS) issue in February of 1970. Also in 1970, the Federal Home Loan Mortgage Corporation (Freddie Mac or FHLMC) was chartered to develop the secondary market in conventional mortgages (that is, mortgages not guaranteed by the FHA or VA). In the following year, FHLMC issued its first MBS backed by conventional mortgages. FNMA, however, did not begin issuing MBSs until 1981.

The first type of MBSs issued were mortgage pass-through securities. Essentially, these provided an ownership interest in the underlying pool of mortgages that backed the certificates, and all payments of interest and principal (less a servicing fee) were passed through to the holders of the certificates. However, the risk of default on MBSs was substantially lower than the risk of default on whole mortgages because of the agency guarantees.

An important product innovation was launched by FHLMC in 1983, when it issued the first collateralized mortgage obligation (CMO). A CMO is a multiple-class security, each class having a different maturity. The early CMO issues were structured so that, as payments of principal were received (including prepayments), the shorter maturity tranches were completely retired before any payments of principal were made to the holders of the longer maturity tranches. The attractiveness of issuing structured MBSs was greatly enhanced by the Tax Reform Act of 1986, which permitted multi-

ple-class securities to be issued in the form of real estate mortgage investment conduits (REMICs).[5] Since 1986, multiple-class securities have become more complex in structure, with the introduction of interest-only (IO) and principal-only (PO) strips and Planned and Targeted Amortization Classes (PACs and TACS).[6] Chart 4 illustrates the rapid growth in the securitization of the stock of residential mortgages in recent years.

The MBS market encourages a separation of the various functions of mortgage lending, in particular the separation of the origination and servicing functions from the decision to hold mortgages as a portfolio investment. This feature in turn permits institutions that have a comparative advantage in originating and servicing mortgages to expand their activities without the need to raise funds to invest long term in these mortgages. As indicated below, this may have been a significant factor in the expansion of mortgage banks' activities in originating loans in the 1980s. Furthermore, the ability to invest in mortgages without having to originate or service them substantially increases the attractiveness of mortgages as an investment vehicle for institutional investors such as pension funds and fixed income mutual funds.

The development of structured securities such as CMOs and REMICs has also made possible a more efficient distribution across investors of the risk associated with investing in mortgages. Mortgages are subject to prepayment risk. As interest rates fall, mortgagors have an incentive to refinance their mortgages, prepaying the old mortgages. Consequently, investors are left to reinvest these prepayments in the lower interest rate environment, realizing a reduced yield on their original investment. Dividing up the cash flows from the underlying mortgages into tranches with different yields and maturities, and therefore different degrees of prepayment risk, permits a better matching of investor preferences to the risks inherent in mortgage cash flows and potentially increases the number of investors willing to hold some form of mortgage or mortgage security in their portfolios.

Because MBSs are easily tradable in the secondary market, they are much more liquid than mortgages. Hence they can be held as a short-term investment vehicle, an advantage which further widens the potential investor base for mortgages. By attracting a greater pool of investors, MBSs make possible a more efficient pricing of prepayment risks. Furthermore, because MBSs generally have some form of government or agency guarantee, they carry a default risk below that of the mortgages that back them. Taken together, these arguments strongly suggest that the development of the MBS market should have lowered the interest rate spreads between mortgages and other long-term investments, such as Treasury bonds. The extent to which the expansion of the MBS market may have reduced mortgage spreads is investigated below.

The MBS market also helped to alleviate funding pressures during the period of heavy disintermediation in the early 1980s. The secondary market enabled thrifts to sell mortgages or MBSs and to use the proceeds to originate new mortgages. Nevertheless, an argument can be made that such effects were probably not large. For much of the time when deposit rate ceilings were in force, the size of the MBS market was fairly small relative to the total mortgage market (Chart 4). Further, since disintermediation occurred at a time of rising interest rates, many existing mortgages or MBSs were "under water," that is, they had a market price less than the book value of the mortgage or security. Consequently, selling underwater mortgages or MBSs would have resulted in a loss of stated capital at a time when average lending margins were probably coming under pressure (particularly in the 1981-82 period).[7]

Adjustable rate mortgages

Although a few adjustable rate mortgages[8] (ARMs) were originated in the 1970s, widespread issuance of ARMs did not begin until the early 1980s.[9] The high

[5]The 1986 Tax Reform Act enabled the issuer of the security to sell the residual interest — that is, the difference between the cash flows from the mortgages and the payments to the holders of the REMIC — without incurring double taxation on the pass-through of these payments.

[6]PACs and TACs are REMIC classes whose principal paydown follows a set schedule unless the prepayment rate on the underlying mortgages moves outside a certain range. For more details, see Richard Roll, "Stripped Mortgage Backed Securities," *Goldman Sachs*, October 1986; and Richard Roll, "Recent Innovations in Collateralized Mortgage Obligations," *Goldman Sachs*, January 1987.

[7]This disincentive was sharply reduced for thrifts by the Federal Home Loan Bank Board's October 1981 change to thrift accounting procedures. These procedures permitted losses on the sale of assets with below-market coupons to be deferred for accounting purposes but realized in the current year for tax purposes. For more details, see William W. Bartlett, *Mortgage-Backed Securities* (New York: New York Institute of Finance, 1989), pp. 25-27.

[8]Most ARMs include interest rate or payment caps to limit the interest rate risk borne by the borrower. These caps limit the maximum amount by which the interest rate or payments on the mortgage can be adjusted each year. The cap most commonly set is 2 percentage points per year or, over the lifetime of the loan, typically between 5 and 6 percentage points. Subject to these caps, the ARM rate is tied to an index plus a margin (such as the one-year constant maturity Treasury bill rate). In addition, many ARMs have at various times carried initial rates substantially below current market levels (so-called teaser rates).

[9]ARMs are very common in many overseas countries. For example, in the United Kingdom mortgages are typically twenty-five-year variable rate mortgages; the predominant form of mortgage finance in Canada is the rollover mortgage, which needs to be refinanced every one to five years.

and volatile interest rates of the late 1970s and early 1980s, combined with the gradual phaseout of Regulation Q, made it increasingly attractive for depository institutions to manage their interest rate risk carefully. In 1981 the Federal Home Loan Bank Board (FHLBB) authorized federally chartered thrifts to issue or purchase ARMs. Impetus was added to the development of the ARMs origination market with the introduction of FNMA's ARM purchase program in that year and FHLMC's program in the following year. The introduction of the FHLBB's new net worth accounting regulations in October 1981 reduced the disincentive to sell existing mortgages and thereby encouraged thrifts to restructure their balance sheets to match more closely the interest sensitivity of the returns on their assets to the interest sensitivity of their liabilities.

The growth of the ARMs market is illustrated in Chart 5, which shows the share of new originations that are in the form of ARMs. As the chart illustrates, the share of ARMs is closely correlated with the spread between the average interest rate on new fixed rate mortgages and that on new ARMs.

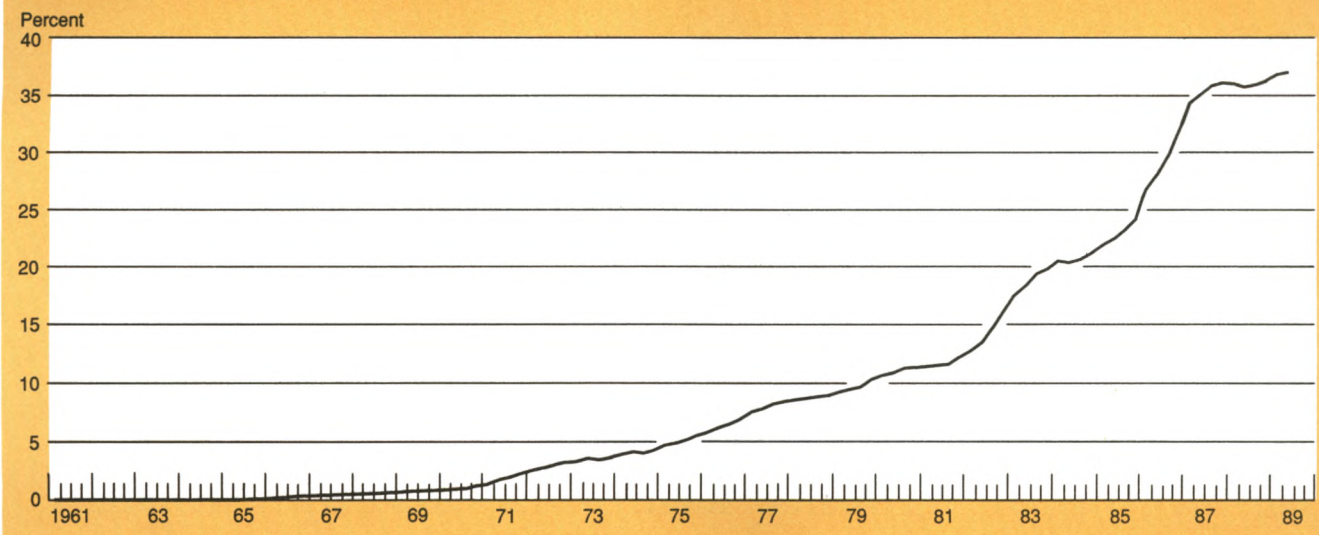
The introduction of the ARM has helped broaden the spectrum of financial instruments, bringing potential benefits to both borrowers and lenders. From the borrower's perspective, an ARM is attractive because it usually carries a lower interest cost than a fixed rate mortgage, although that rate may increase later in the life of the loan. This lower interest rate reflects the customary upward slope of the Treasury yield curve, the transfer of some of the interest rate risk from the lender to the borrower, and the pricing of the prepayment option in the fixed rate mortgage. The availability of ARMs has allowed some borrowers who cannot qualify at the higher fixed interest rate to obtain a mortgage, although they must be willing to bear the interest rate risk.[10] Consequently, ARMs may have increased the demand for housing at a given level of mortgage interest rates. At the same time, however, the demand for housing may have become more sensitive to mortgage interest rate *changes* as a result of the introduction of ARMs. This greater sensitivity could arise because some potential ARMs borrowers may be on the margin of qualifying for an ARM.[11] Still, one would

[10]This mortgage qualification effect might have been more pronounced at times when ARMs carried initial teaser rates. Nevertheless, John L. Goodman, Jr., and Stuart A. Gabriel ("Forecasting Housing Construction: Lessons and Puzzles from Recent Years," Federal Reserve Board, Working Paper no. 69, January 1987) present evidence to suggest that the effects of qualifying at these teaser rates may not have been large. They note, for example, that stricter qualification guidelines for ARMs were introduced in 1984.

[11]Evidence suggests that many ARM debtors have relatively few liquid assets and that their cash flows are vulnerable to being squeezed by rising interest rates. Such evidence is consistent with the view that

Chart 4

Share of Securitized Mortgages Outstanding



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

Note: The share of securitized mortgages is approximated by pooled mortgages over total mortgages on one- to four-family homes.

expect the degree of this extra sensitivity to be small relative to the reduced sensitivity stemming from the phaseout of Regulation Q.

It may be misleading, however, to consider only the demand effect of ARMs when evaluating the potential impact of this type of mortgage on housing activity. From the lender's perspective, issuing ARMs provides a way of reducing the exposure of its balance sheet to varying interest rates by passing on some of the interest rate risk to borrowers, albeit at the risk of raising the default rate on its loan portfolio. If deposit deregulation had occurred without the parallel development of the ARMs market, it is conceivable that deposit intermediaries, some of whom experienced negative spreads between the average effective interest rate they received on their mortgage portfolios and the average rate of interest paid on deposits in 1981 and 1982, might have been less willing to bid for deposits and originate fixed rate mortgages in the newly deregulated environment. Such an outcome in turn might have limited the available supply of mortgage finance unless other lenders were willing to bear the risk. If the absence of ARMs had reduced the supply of mortgage lending, then either mortgage rates would have been higher than was observed, reflecting the greater scarcity of mortgage funds, or mortgage lending would have been restricted in some other way. Therefore, studies showing that investment in housing during the period 1982-84 can be explained by the level of fixed mortgage rates and concluding on this basis that the introduction of ARMs had little or no impact on housing activity[12] leave open the question whether the introduction of ARMs lowered fixed mortgage rates below what they would have been otherwise.

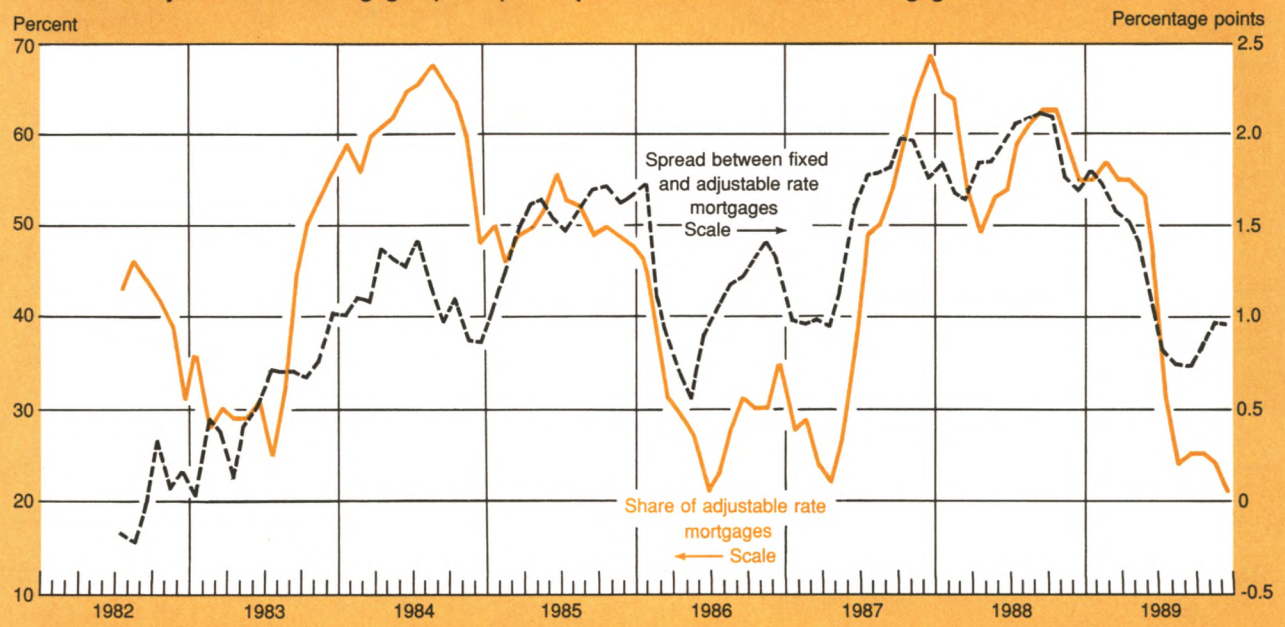
Many analyses of the impact of ARMs on housing demand find some theoretical support for the argument that the availability of ARMs increases the demand for housing. Nevertheless, such effects might be small;

Footnote 11 continued
prospective ARMs borrowers may be more financially constrained than other mortgagors. See John L. Goodman, Jr., Charles A. Luckett, and David W. Wilcox, "Interest Rates and Household Cash Flow," Board of Governors of the Federal Reserve System, December 1988.

[12]These studies include Howard Esaki and Judy Wachtenheim, "Explaining the Recent Level of Single-Family Housing Starts," Federal Reserve Bank of New York *Quarterly Review*, Winter 1984-85, pp. 31-38; and Michael J. Stutzer and William Roberds, "Adjustable-Rate Mortgages: Increasing Efficiency More than Housing Activity," Federal Reserve Bank of Minneapolis *Quarterly Review*, Summer 1985, pp. 10-20.

Chart 5

Share of Adjustable Rate Mortgages (ARMs) and Spread between Fixed Rate Mortgages and ARMs



Source: Department of the Treasury, Office of Thrift Supervision.

there is little empirical evidence to suggest otherwise. Since ARMs have only been available for a limited time and their introduction coincided with other innovations in the mortgage market, the evidence on the impact of ARMs is tentative and the subject merits further investigation as more data accumulate.

Increasing competition in the mortgage market

The market for mortgage originations became much more competitive in the 1980s. With the phasing out of Regulation Q ceilings, thrifts could compete with one another for deposits by raising their interest rates. Furthermore, a number of thrifts attempted to grow quickly, in part by originating new mortgages.[13]

Competitive pressure also was growing from outside the industry, particularly from the mortgage banking industry. Table 1 shows the share of mortgage originations by four broad sectors and clearly illustrates the rise in the share of the mortgage banking industry in the 1980s at the expense of the thrifts. This larger role for the mortgage banks — which specialize in originating loans complying with the requirements for sale or conversion to MBSs issued by FNMA or FHLMC — came at the same time as these agencies were markedly expanding their role in the secondary mortgage market. According to one analyst, Patric Hendershott, the securitized share of new conventional fixed rate loans conforming to FHLMC and FNMA standards rose from 4 percent in the late 1970s to more than 50 percent by the middle of the 1980s.[14] Hendershott argues that this expansion has narrowed the spreads on mortgage rates relative to long-term bonds. Evidence of the potential impact of these developments on mortgage rates is presented in the next section.

[13]For a discussion of this development, see, for example, Andrew S. Carron, "The Thrift Industry Crisis of the 1980s: What Went Wrong?" in *The Future of the Thrift Industry,* Federal Home Loan Bank of San Francisco, December 1988; and Jack M. Guttentag, "Recent Changes in the Primary Mortgage Market," *Housing Finance Review,* July 1984, pp. 221-54.

[14]Patric H. Hendershott, "The Future of Thrifts as Home Portfolio Lenders," in *The Future of the Thrift Industry.*

Table 1

Share of Mortgage Originations by Financial Institutions

Date	Commercial Banks	Mortgage Banks	Thrifts	Other
1971 to 1975	22.9	19.9	52.5	4.6
1976 to 1980	21.7	18.1	56.1	4.1
1981 to 1985	22.5	25.6	47.1	4.7
1986 to 1988	25.8	25.5	47.1	1.7

Source: Department of Housing and Urban Development.

A model of single-family housing investment

This section develops a statistical model of single-family housing investment and mortgage interest rates to investigate the changing relationship between residential investment and interest rates.[15] The section opens with a brief summary of the "stylized facts" and open questions that can be drawn from previous empirical research. The presentation of the model follows, ending with a brief illustration of the model's ability to track historical variations in housing investment. Finally, the effects of a tightening of monetary policy in different subperiods are simulated in order to assess the changing responsiveness of housing investment to changes in interest rates.

Previous work

Although researchers who have examined the determination of residential investment have sometimes reached diverse conclusions, one might summarize their findings as follows:[16]

(i) housing activity was influenced by disintermediation pressures fostered by Regulation Q ceilings, although there is no consensus on the overall strength of this effect;

(ii) the effects of disintermediation were markedly reduced by the late 1970s, and in the period 1978-82 it is not clear that this process significantly reduced housing activity;

(iii) apart from the effects of deposit disintermediation, there is no evidence that housing investment was less responsive to interest rates in the 1980s than in either the 1970s or 1960s;

[15]A more detailed discussion of the derivation of the relationships presented here can be found in John Ryding, "Housing Finance and the Transmission Mechanism of Monetary Policy," in *Studies on Financial Changes and the Transmission of Monetary Policy,* Federal Reserve Bank of New York, May 1990.

[16]Work on modeling residential investment includes: Dwight M. Jaffee and Kenneth T. Rosen, "Mortgage Credit Availability and Residential Construction," *Brookings Papers on Economic Activity,* 2:1979, pp. 333-76; Esaki and Wachtenheim, "Explaining the Recent Level of Single-Family Housing Starts"; M. A. Akhtar and Ethan S. Harris, "Monetary Policy Influence on the Economy — An Empirical Analysis," Federal Reserve Bank of New York *Quarterly Review,* Winter 1986-87, pp. 19-34; Adrian Throop, "Financial Deregulation, Interest Rates, and the Housing Cycle," Federal Reserve Bank of San Francisco *Economic Review,* Summer 1986, pp. 63-78; George A. Kahn, "The Changing Interest Sensitivity of the U.S. Economy," Federal Reserve Bank of Kansas City *Economic Review,* November 1989, pp. 13-34; and Randall J. Pozdena, "Do Interest Rates Still Affect Housing?" Federal Reserve Bank of San Francisco *Economic Review,* Summer 1990, pp. 3-14. These papers, with the exception of that by Pozdena, are briefly critiqued in Ryding, "Housing Finance and the Transmission Mechanism."

(iv) on the basis of tests conducted over a relatively short sample period, financial innovations such as securitization and ARMs have not been found to have a noticeable impact on housing activity.[17]

The model developed here makes it possible to reexamine these assertions.

Structure and testing of the model

The general structure of the model can be explained in simple terms. At its core are two equations, one determining mortgage interest rates and the other housing investment. The first equation relates the average effective mortgage rate on all loans closed (both fixed and adjustable) to Treasury rates, with the spread between these rates depending on a number of variables, as explained below. The second equation relates new single-family housing investment — the measure of housing investment used in this study — to real incomes and mortgage interest rates; in this equation disintermediation pressures affect the cyclical response of housing to interest rates. Since the model is estimated on quarterly data, time series econometric methods, outlined in the Box, are used to determine the time profile of the response of one variable (say, housing investment) to another (say, mortgage rates). Let us examine the individual equations in more detail.

The mortgage rate relationship begins with a long-run relationship linking the mortgage rate and the variables that it may depend on (Table 2, column 1). The selection of variables was guided by the research of other economists and the arguments put forward in earlier sections of this article. The most significant variable (judged by the t-statistics given in parentheses)[18] is the average level of market interest rates, which is a weighted average of the ten-year constant maturity Treasury rate and the three-month Treasury bill rate, where the weights depend on the share of ARMs in new loans closed. As one might expect, this variable has a coefficient close to one, suggesting that a 1 percentage point rise in market rates would eventually lead to a 1 percentage point rise in mortgage rates. Since this coefficient is virtually one, all other variables can be thought of as explaining the spread on mort-

[17]But Barry Bosworth, in "Institutional Change and the Efficacy of Monetary Policy," *Brookings Papers on Economic Activity* 1:1989, pp. 77-110, uses evidence on Canadian housing investment to argue that ARMs have reduced the interest sensitivity of housing in the United States. Alan Blinder and David Romer, in the same volume, cast some doubt on his interpretation of the results, arguing that the most significant change to the transmission mechanism has come from the elimination of disintermediation.

[18]It should be noted, however, that the standard errors and hence t-values from this equation are biased. See James H. Stock, "Asymptotic Properties of Least Squares Estimators of Cointegrating Vectors," *Econometrica*, 1987, pp. 1035-56.

Box: Explanation of Econometric Techniques

The estimation techniques used in this article follow much recent work in time series econometrics. The equation for mortgage interest rates is derived using the Engle-Granger two-step method of cointegration modeling.† This approach involves estimating a first-stage regression between the level of the variable to be explained and other variables on which long-run movements in this variable are thought to depend. Testing whether the variables are cointegrated is done using the Dickey-Fuller test. For example, if Y is thought to depend on X and Z, the first-stage regression is:

$$(1) \quad Y_t = \beta_0 + \beta_1 X_t + \beta_2 Z_t + u_t.$$

If the Dickey-Fuller test suggests that u_t is generated by a stationary process, the estimated residuals, $\hat{u}_t$, from this equation are used as an error correction variable in a dynamic regression of the general form:

$$(2) \quad \Delta Y_t = \sum_{i=0}^{i=I} \alpha_i \Delta X_{t-i} + \sum_{j=0}^{j=J} \delta_j \Delta Z_{t-j} + \sum_{k=1}^{k=K} \gamma_k \Delta Y_{t-k} + \gamma \hat{u}_{t-1} + \varepsilon_t.$$

The selection of the lag lengths I, J, and K depends on the statistical significance of the variables and on whether ε_t appears to be serially uncorrelated (using the Lagrange multiplier test for serial correlation‡) and to have a constant variance (using the test for autoregressive conditional heteroscedasticity, or ARCH, errors§).

The other equations in the article are modeled using a general-to-specific modeling strategy.‖ Illustrating this strategy with our three-variable example, we have a general model of the form:

$$(3) \quad Y_t = \beta_0 + \sum_{i=0}^{i=I} \alpha_i X_{t-i} + \sum_{j=0}^{j=J} \delta_j Z_{t-j} + \sum_{k=1}^{k=K} \gamma_k Y_{t-k} + \varepsilon_t,$$

where the maximum lag lengths I, J, and K are chosen on the basis of the properties of the residuals. The equation can then be restricted in various ways, using F- or t-tests to assess the validity of the restrictions.

†See Robert F. Engle and C.W.J. Granger, "Co-integration and Error Correction: Representation, Estimation, and Testing," *Econometrica*, March 1987, pp. 251-76.

‡See Trevor S. Breusch, "Testing for Autocorrelation in Dynamic Linear Models," *Australian Economic Papers*, 1978, pp. 334-55.

§See Robert F. Engle, "Autoregressive Conditional Heteroscedasticity with Estimates of the Variance of U.K. Inflation," *Econometrica*, 1982, pp. 987-1007.

‖For more details see, for example, David F. Hendry, Adrian R. Pagan, and J. Denis Sargan, "Dynamic Specification," in Zvi Griliches and Michael D. Intriligator, eds., *Handbook of Econometrics* (Amsterdam: North Holland, 1983).

Table 2

Equations for the Average Effective Mortgage Interest Rate (1965-I to 1988-IV)

Equation for the Level of the Mortgage Interest Rate†		Equation for the Change in the Mortgage Interest Rate†	
Explanatory Variable	Coefficient	Explanatory Variable	Coefficient
Constant term	1.284 (4.50)	Change in yield on ten-year Treasury bonds	
Weighted average interest rate on Treasury securities‡	0.9931 (40.77)	Current quarter	0.1720 (3.92)
		One-quarter lag	0.0944 (1.84)
Yield spread on AAA corporate bonds to ten-year Treasury bonds	0.8260 (5.71)	Change in interest rate on three-month Treasury bills	
		One-quarter lag	0.1853 (6.61)
Share of mortgage stock securitized	−3.492 (3.31)	Two-quarter lag	0.1062 (3.33)
		Change in mortgage interest rate	
Rate on Treasury bonds before abolition of usury ceilings	−0.0441 (1.98)	One-quarter lag	−0.2122 (2.35)
		Two-quarter lag	0.3091 (5.11)
Dummy variable to control for introduction of adjustable rate mortgages	1.351 (5.10)	Three-quarter lag	0.2611 (3.86)
		Change in yield spread on AAA corporate bonds to ten-year Treasury bonds	0.2280 (1.86)
		Lagged deviation in mortgage rate from its long-run level§	−0.1631 (3.44)
Statistics			
R-Bar²	0.965	R-Bar²	0.797
Durbin-Watson	0.82	Durbin-Watson	2.01
Dickey-Fuller test for cointegration	−4.86	LM test for up to four-period residual autocorrelation	4.54
		Test for up to two-period autoregressive conditional heteroscedasticity	0.64

Note: Figures in parentheses are t-values.
†Average effective rate on all conventional home mortgages closed.
‡The average of the interest rate on three-month Treasury bills and ten-year Treasury bonds. The bill rate is given the weight of ARMs in new mortgages closed (0 before 1982).
§The long-run level of mortgage rates is given by the predicted value from the regression reported in column 1 of this table.

gage interest rates over Treasury rates. Two possible determinants of the spread that were discussed earlier are the growth of the MBS market and the operation of usury ceilings. The coefficient on the MBS term suggests that for each percent of the mortgage stock that has been securitized, the spread on mortgages over Treasury rates has fallen by 3.5 basis points, although considerable statistical uncertainty is attached to this estimate. The proxy variable for the operation of usury ceilings (measured by the level of Treasury bond rates before the abolition of usury ceilings and zero thereafter) suggests that, on average, a rise of 100 basis points in interest rates when usury ceilings were in effect would lead to a decline of about 4 basis points in the spread on mortgages.[19] The spread on mortgages is also modeled as depending on the spread of AAA corporate bonds over Treasuries. One might expect these spreads to be correlated for two reasons. First, because the spread on corporate bonds over Treasuries tends to widen when the economy turns down, it may act as a proxy for the risk of default on mortgages, a risk which is related to the cyclical state of the economy. Second, many corporate bonds are callable, a feature that is similar to the prepayment option embedded in a mortgage, and this spread might therefore be correlated with the incentives to prepay. The coefficient on this variable suggests that, on average, when the spread on corporate bonds widened by 100 basis points, the mortgage spread widened by around 80 basis points. Although this equation explains the trend movements in mortgage rates, it does not explain the shorter run movements closely. The statistical technique used to track short-term rate movements regresses the change in mortgage interest rates on the deviation of mortgage rates from their trend level, as determined by the previous equation, and on changes (current and lagged) of various interest rates (Table 2, column 2).

Housing investment in the model is measured by a proxy for the growth in the stock of single-family housing. Like equations for housing investment obtained by many other researchers, this equation is derived from a stock adjustment equation that links the demand for the stock of housing to real incomes and real post-tax mortgage interest rates.[20] Hence, one would expect the

[19]Preferably, one would want some measure of the average usury ceiling across the country and would only include this term when market rates exceeded this ceiling. Such data are not available, however, and therefore this effect has to be considered fairly tentative.

[20]Some researchers have used a user cost rather than a post-tax real interest rate. The only essential difference between the two measures is that the latter measure adjusts the real post-tax rate for the movement in house prices relative to other prices.

stock of housing to grow as real incomes rise or real mortgage rates fall. Movements in housing investment have been very cyclical, however, and modeling these movements requires a statistical approach that allows for complex lag structures between housing investment and mortgage rates, real incomes, and disintermediation pressures.

The housing investment equation relates the growth in the stock of single-family housing to the growth in real personal disposable income and a number of variables designed to capture the effects of mortgage interest rates and disintermediation (Table 3). The interest rate variables include the level of the real mortgage interest rate and the change in a nominal interest rate, the latter variable perhaps reflecting a short-term cash flow effect.[21] To capture the effects of disintermediation in the housing equation, the spread (when positive) between the three-month Treasury bill rate and the Regulation Q ceiling on savings accounts at thrifts was included. To examine the possibility that the effectiveness of these ceilings in restraining mortgage growth was declining over time, the coefficient on the disintermediation variable was allowed to differ in each of the historical periods when Treasury bill rates exceeded the ceiling. The declining values of these coefficients

[21] In the specification search for the housing investment equation, both real and nominal mortgage rates (current and lagged several quarters) were included as explanatory variables. Statistical tests rejected the hypothesis that the real interest rate should enter in difference form only.

Table 3

Equation for Single-Family Housing Investment (1965-I to 1988-IV)

Explanatory Variable	Coefficient
Constant term	0.00177
	(5.66)
Housing investment	
One-quarter lag	1.347
	(14.23)
Two-quarter lag	−0.6293
	(4.39)
Three-quarter lag	0.0958
	(1.18)
Growth in real personal disposable income†	0.00695
	(2.18)
Change in mortgage rate	−0.00027
	(2.20)
Change in real post-tax mortgage rate	−0.00013
	(2.06)
Level of real post-tax mortgage rate lagged one quarter	−0.000064
	(3.37)
Spread between interest rate on three-month Treasury bills and Regulation Q ceilings	
1966-67	−0.00227
	(3.82)
1969-71	−0.00027
	(3.77)
1973-76	−0.00031
	(4.68)
1978-82	−0.000094
	(4.72)
Statistics	
R-Bar²	0.969
Durbin-Watson	2.06
LM test for up to four-period residual autocorrelation	0.72
Test for up to two-period autoregressive conditional heteroscedasticity	1.09

Note: Housing investment is measured as a percent (over 100) of the previous quarter's stock of single-family homes. Figures in parentheses are t-values.
†Measured as the change in the natural log of real personal disposable income.

Table 4

Equations for Interest Rates on Treasury Bills and Bonds (1965-I to 1988-IV)

Equation for the Interest Rate on Three-Month Treasury Bills		Equation for the Interest Rate on the Ten-Year Constant Maturity Treasury	
Explanatory Variable	Coefficient	Explanatory Variable	Coefficient
Constant	0.1994	Constant	0.1248
	(1.76)		(0.99)
Federal funds rate		Treasury bill rate	
Current quarter	0.7404	Current quarter	0.6727
	(23.41)		(7.07)
One-quarter lag	−0.4924	One-quarter lag	−0.5354
	(7.72)		(5.47)
Treasury bill rate		Change in federal funds rate	−0.1873
One-quarter lag	0.6075		(2.59)
	(7.14)	Yield on ten-year constant maturity Treasury lagged one quarter	0.8722
Two-quarter lag	0.0879		(22.49)
	(2.18)		
Statistics			
R-Bar²	0.981		0.980
Durbin-Watson	2.09		1.72
LM test for up to four-period residual autocorrelation	3.03		2.91
Test for up to two-period autoregressive conditional hetero-scedasticity	9.29		0.13

Note: Figures in parentheses are t-values.

suggest that such a change was in fact taking place, a finding discussed further below. Note that the statistically significant coefficient on this term for the period 1978-82 provides evidence that disintermediation continued to play an important role in the contraction of housing investment during that period, even after the introduction of MMCs.

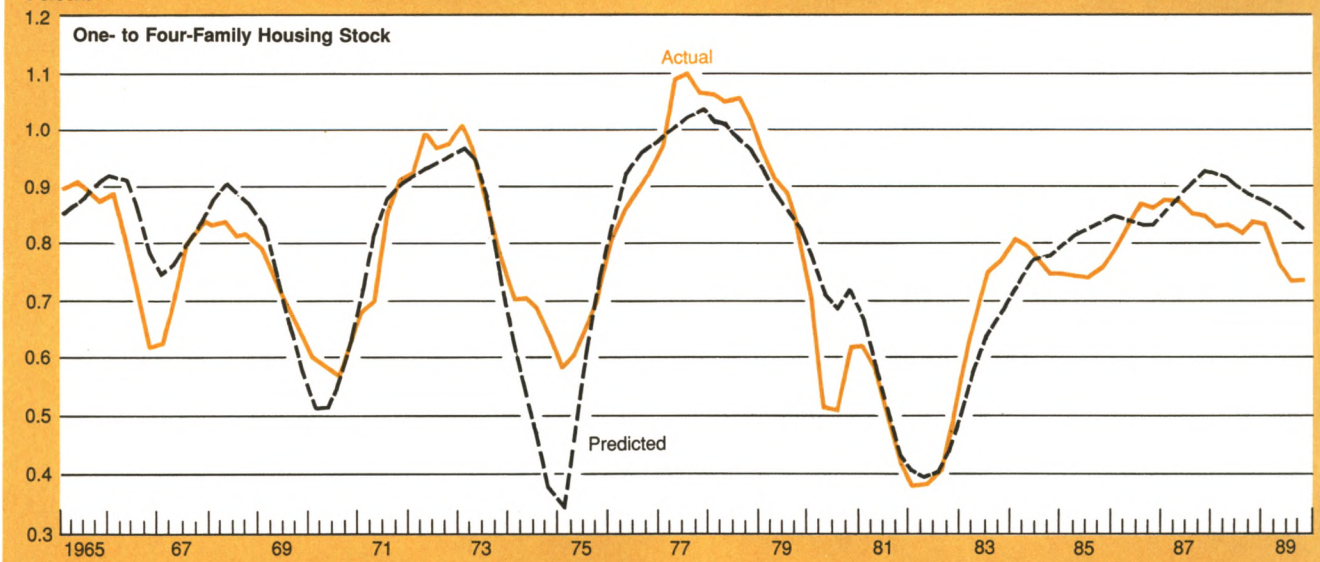
A number of different specifications of the housing equation were examined, and some of the results obtained are worth noting. For example, there was no evidence that housing investment has become significantly more or less sensitive to movements in the average level of mortgage interest rates. However, the widespread use of ARMs opens up the possibility of some additional short-run sensitivity to market interest rates, since an increase in the federal funds rate is typically associated, at least initially, with a sharper rise in short-term interest rates than in long-term interest rates. Consequently, the ARMs rate will rise more quickly than the interest rate on fixed rate mortgages during the initial phase of a monetary tightening. The size of this potential additional sensitivity to interest rates, however, is extremely small relative to the reduction in sensitivity arising from the elimination of disintermediation. Furthermore, even though the average level of mortgage rates may be more responsive, in the short run, to market interest rates, there is no strong evidence that this will affect housing investment. Indeed, when the housing equation was reestimated using the interest rate on fixed rate mortgages alone (rather than the weighted average interest rate), results virtually identical with those presented in Table 3 were obtained. Furthermore, specifications that included the rate on fixed rate mortgages typically showed no significant separate role for the interest rate on ARMs.

To examine the response of housing investment to a tightening in monetary policy, the model includes equations that link the three-month Treasury bill and ten-year constant maturity Treasury interest rates to the federal funds rate. These equations, presented in Table 4, capture the average historical response of these Treasury rates to movements in the federal funds rate. For example, the equations suggest that a 100 basis point rise in the funds rate sustained for one year would raise the three-month Treasury bill rate about 75 basis points by the end of that period, and the yield on ten-year Treasury bonds about 50 basis points.

The ability of a model to track historical developments is one indicator of that model's usefulness. Chart 6 compares the predicted values for quarterly

Chart 6

Housing Investment: Historic Dynamic Tracking



Sources: Federal Reserve Board and model simulation.

housing investment from 1965 to 1988 with the actual values derived from the complete model. The model is solved dynamically, that is, one period's solution for investment or interest rates feeds into that for the next period and provides a strong indication of model adequacy. As the chart suggests, the model appears to follow historical movements in housing investment reasonably closely.

Response of housing activity to monetary policy

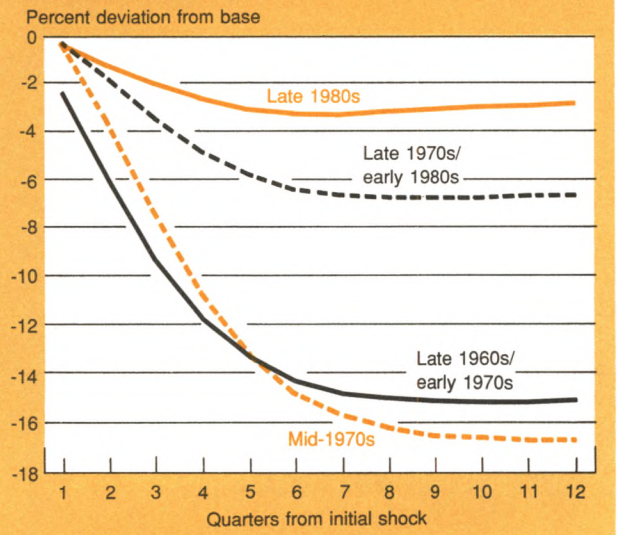
This subsection uses the model presented above to consider the partial response of housing to a monetary policy tightening. The response is partial in the sense that consumer prices and real incomes are held unchanged in the simulation. However, since we are interested in the direct response of housing investment to monetary tightening, this approach would seem appropriate.

Two experiments were constructed to examine the changing response of housing expenditures to a tightening of policy. The first examined the response of the model to a permanent increase in the federal funds rate of 1 percentage point. Four simulations were carried out. The first raised the funds rate alone, with no disintermediation effects. This simulation is labeled "the late 1980s" in Chart 7. In each of the other three simulations, one of the disintermediation spreads[22] was allowed to respond by the increase in the three-month Treasury bill rate (at its peak, this response was about four-fifths of the movement in the funds rate). The chart shows that after three years housing investment would be depressed by over 15 percent if the response were similar to that observed in monetary contractions of the late 1960s or mid-1970s (although the effects of disintermediation appeared to take a little longer to pass through in the mid-1970s). However, if the response were like that exhibited between 1978 and 1982, housing activity would be much less depressed, falling by only about 6 percent. Without disintermediation, the response of housing investment is much smaller (around 2 percent), as shown by the "late 1980s" line. This last result suggests that, contrary to the findings of Throop, much of the response of housing investment in the 1960s and 1970s to periods of monetary tightening was due to the effects of disintermediation (since the model indicates that without disintermediation,

[22]The disintermediation variable for 1966-67 was not shocked because this period of credit rationing was very short and generated very large effects on mortgage lending and housing activity. The strength of these effects may have reflected, to a large extent, the fact that Regulation Q ceilings had only just been extended to thrifts and were biting for the first time.

Chart 7

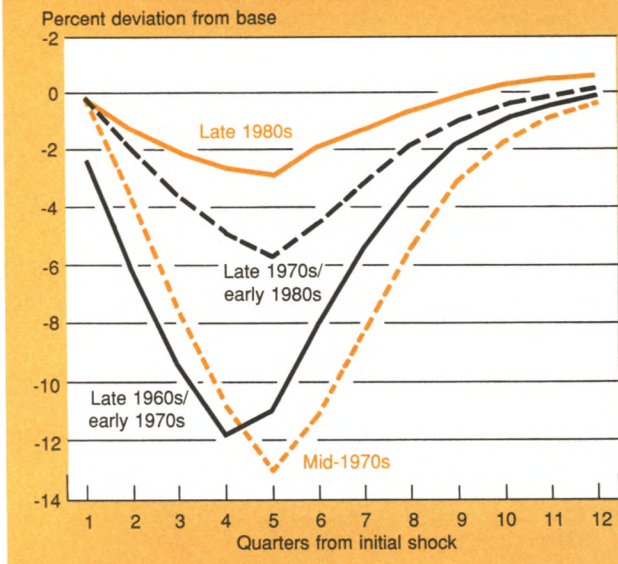
Housing Investment: Response to a Permanent Monetary Tightening



Note: The federal funds rate is raised by 1 percentage point throughout the simulation period.

Chart 8

Housing Investment: Response to a Temporary Monetary Tightening



Note: The federal funds rate is raised by 1 percentage point for one year.

housing investment would have responded rather like the late 1980s line to a monetary tightening), and not due to the interest sensitivity of housing investment per se. This finding accords much more with the results obtained by Benjamin Friedman[23] in simulations carried out on the Federal Reserve Board's model.

It can be argued that the above experiment is somewhat artificial in assuming such a prolonged period of tightening without any response of real growth or inflation. For this reason, a second experiment was conducted in which the funds rate was raised for only one year. The results, presented in Chart 8, echo the general findings from the first experiment.

On the basis of these experiments, one can conclude the following:

(i) the responsiveness of housing investment to a tightening in monetary policy, now that Regulation Q ceilings are no longer in effect, is significantly smaller than in the 1960s or 1970s, notwithstanding the direct effects of short-term rates on ARMs;

(ii) the effectiveness of Regulation Q ceilings in restraining mortgage lending during periods of monetary tightening apparently diminished over time;

(iii) although the response of housing investment was less than previous experience might have suggested, Regulation Q ceilings and disintermediation played an important role in the 1978-82 contraction;

(iv) the effects of a given increase in interest rates on housing investment would be rather smaller now than in 1978-82.

The first two conclusions are generally in agreement with existing work. What had not been established in earlier research, however, is that the process of deposit rate disintermediation resulting from the operation of Regulation Q ceilings appears to have played an important role in the contraction of housing investment in the period between 1978 and 1982.

From the macroeconomic perspective adopted in the statistical part of this study, there is not much evidence that developments in housing finance other than the elimination of Regulation Q ceilings have had a substantial impact on the relationship between housing investment and monetary policy. One development, the growth in the securitization of the stock of mortgage debt, appears to have had the effect of decreasing the spreads between mortgages and other interest rates. But although lower mortgage spreads may make housing more affordable over time, the smaller spreads themselves do not imply an additional change in the response of mortgage rates to a rise in other interest rates. Hence the growth in securitization appears to have had little effect on how housing investment has responded to a tightening in policy.

Conclusion

There have been tremendous innovations in the housing finance market, driven partly by the interaction of the inflationary environment of the late 1970s with the system of regulating deposit rates and partly by federal attempts to promote housing finance with initiatives such as the development of the secondary mortgage market. In analyzing the impact of these innovations, this article confirmed the findings of previous researchers that housing demand should now be considerably less responsive to monetary tightening than in the past. Model simulations showed that deposit disintermediation, induced when market interest rates exceeded Regulation Q ceilings, was the major driving force of the contractions in housing activity in 1966-67, 1969-71, 1974-75, and to a lesser extent, 1978-82. The process of deposit rate deregulation has, therefore, increased the role that mortgage interest rates play in allocating mortgage finance and has eliminated bouts of rationing. In addition, this article provides some evidence that the growth of securitization may have reduced mortgage interest rates relative to other interest rates.

[23]Benjamin M. Friedman, "Effects of Monetary Policy on Real Economic Activity," in *Monetary Policy Issues in the 1990s*, Federal Reserve Bank of Kansas City, 1989.

Financial Market Evolution and the Interest Sensitivity of Output

by Beverly Hirtle and Jeanette Kelleher

Financial markets in the United States have undergone extensive changes in the past three decades. Financial deregulation, increased access to debt and equity markets for large classes of borrowers and investors, a substantially greater degree of internationalization, and innovations in the banking, securities, and financial derivative sectors have all altered the way in which financial markets operate and affect the rest of the economy. One important question emerging from these developments is whether the evolution of the financial sector has altered how monetary policy is transmitted, that is, the ways in which the Federal Reserve's policy initiatives work through various sectors of the economy to affect aggregate output and growth.

This article examines one aspect of the policy transmission mechanism, the relationship between interest rates and the growth of output, and attempts to quantify changes in that relationship over the period of recent financial market evolution. Using a simple empirical technique, we examine the sensitivity of the economy to movements in interest rates, that is, the degree to which changes in the level of interest rates ultimately affect economic activity. The basic goal of the analysis is to identify the direction of any systematic changes in the interest sensitivity of the economy over this time.

Our primary finding suggests that aggregate real gross national product may have become less sensitive to movements in short-term interest rates during the last three decades. According to our estimates, however, the rate of this decline has not been uniform over the entire period. Instead, our results imply that the interest sensitivity of output decreased during the 1950s, 1960s, and 1970s, and then leveled off and possibly rose again during the 1980s. This pattern emerges consistently in our analysis, even following modifications of the basic empirical specification such as controlling for other macroeconomic variables and allowing the degree of interest sensitivity to be affected by both inflation and changes in Federal Reserve regime.

Financial deregulation and interest sensitivity

The theoretical effect of financial deregulation on the interest sensitivity of the economy is ambiguous. On the one hand, certain types of financial deregulation have removed or limited the impact of quantity credit rationing, forcing monetary policy to work more exclusively through the direct effects of interest rates on business and household spending decisions and tending to reduce the measured impact of interest rate movements on real economic activity. On the other hand, secular changes in financial markets and in the degree of access to interest-sensitive financial assets and liabilities may have exposed a broader range of economic agents more directly to interest rate fluctuations. To the extent that a larger segment of borrowers and lenders may now be directly affected by interest rate variations, aggregate economic output will appear to be more interest sensitive. The net impact of these changes on various sectors of the economy can only be assessed empirically.[1]

[1]See Paul Bennett, "The Influence of Financial Changes on Interest Rates and Monetary Policy: A Review of Recent Evidence," in this issue of the *Quarterly Review* for another discussion of the effect of financial market evolution on the interest sensitivity of output.

The factors tending to lead to a decrease in the sensitivity of economic activity to interest rate movements have for the most part acted by curbing or eliminating some form of quantity credit rationing as a channel for monetary policy. For instance, innovations in commercial bank funding practices during the 1960s and 1970s — including the development of the market for negotiable certificates of deposit, the increased prevalence of one-bank holding companies and foreign branches, and the general relaxation of deposit rate ceilings — have increased the ability of commercial banks to fund themselves during periods of tight monetary policy and may have reduced the need for banks to engage in quantity credit rationing.[2] Parallel with developments in the commercial banking sector, the repeal of the Regulation Q ceilings and the deregulation of the thrift industry since the 1970s have greatly reduced thrift disintermediation as a source of restraint on the housing market.[3] Taken as a whole, these innovations in the funding practices of financial institutions have tended to limit the extent to which credit is rationed during periods of monetary tightness.

The impact of bank loan rationing may also have been reduced by the growth of alternative credit markets such as the commercial paper market and by the generally greater access to all debt markets for a large number of corporate borrowers. Mirroring this increased funding availability, the loan commitment market has given a growing share of corporate borrowers protection against bank credit rationing (at least in the near term) and therefore may have contributed to the diminished importance of bank loan rationing as a monetary policy transmission channel.[4] Both of these developments have tended to reduce the extent to which bank loans represent a "special" source of credit under the indirect influence of the Federal Reserve.

While the effects of financial changes in some sectors have probably tended to reduce the interest sensitivity of output, other financial market developments may have acted in the opposite direction. The interest sensitivity of the economy may have been increased by the growing exposure of certain sectors of the economy to fluctuations in interest rates. For instance, higher leverage in the corporate sector may make business output and investment decisions more susceptible to increases in interest rates.[5] In addition, the greater international integration of both financial and real sectors of the economy may mean that the channels of monetary policy acting through exchange rates and capital markets are now stronger.

Given these offsetting financial market developments, an empirical approach is necessary to determine the net effect on the interest sensitivity of output. It is quite possible that the impact of these developments has varied not only across different sectors of the economy, but also over time, as the role played by particular financial market developments has grown or diminished in importance. For this reason, it seems important to examine the interest sensitivity of the economy in a framework that allows for differential effects over time.

Previous empirical work

A number of recent papers have attempted to measure the interest sensitivity of various sectors of the economy and to determine how these sensitivities have changed over time. Relying on a variety of empirical techniques and reaching somewhat disparate conclusions, these papers have assessed the effects of financial market developments on the interest sensitivity of particular economic sectors and then used these sectoral results to make an inference about the overall interest sensitivity of the economy.

Akhtar and Harris, for instance, estimate sectoral equations with specially constructed interest rate measures and, controlling for periods of credit rationing, find an increased interest sensitivity in the producers' durable equipment and consumer durables sectors but a decreased sensitivity of housing activity to changes in interest rates.[6] On the basis of these findings, Akhtar and Harris conclude that the link between monetary policy variables (including exchange rates) and aggregate output is probably stronger now than in the period from 1960 to the mid-1970s.

Using modifications of equations from the Federal Reserve Board's MPS model, Benjamin Friedman examines the response of four economic sectors to movements in real interest rates and evaluates the

[2]For a more complete discussion of these developments, see Donald D. Hester, "Innovations and Monetary Control," *Brookings Papers on Economic Activity,* 1:1981, pp. 141-89; and Albert M. Wojnilower, "The Central Role of Credit Crunches in Recent Financial History," *Brookings Papers on Economic Activity,* 2:1980, pp. 277-326.

[3]See John Ryding, "Housing Finance and the Transmission Mechanism of Monetary Policy," in this issue of the *Quarterly Review* for a detailed analysis of the effects of financial market evolution and housing finance deregulation on the sensitivity of the housing sector to monetary initiatives.

[4]See Beverly Hirtle, "Loan Commitments and the Transmission of Monetary Policy," in *Studies on Financial Changes and the Transmission of Monetary Policy,* Federal Reserve Bank of New York, May 1990, pp. 98-117, for a more detailed discussion of the loan commitment market and its impact on monetary policy transmission.

[5]See Richard Cantor, "A Panel Study of the Effects of Leverage on Investment and Employment" in this issue of the *Quarterly Review* for a discussion of the role of corporate leverage on firms' investment, employment, and production decisions.

[6]M. A. Akhtar and Ethan S. Harris, "Monetary Policy Influence on the Economy: An Empirical Analysis," Federal Reserve Bank of New York *Quarterly Review,* Winter 1987, pp. 19-31.

change in this response since the mid-1970s.[7] He finds that the elimination of credit rationing in the housing finance market has reduced the impact of a monetary policy tightening on activity in that sector, although there is no evidence of a change in the sector's interest sensitivity in periods of no credit rationing. In addition, Friedman's results suggest an increase in interest sensitivity in business fixed investment and a decline in the interest sensitivity of consumer spending as well as imports and exports. On the basis of the findings for these individual sectors, Friedman concludes that the net impact of real interest rates on aggregate output has been unchanged by financial market deregulation.

George Kahn uses vector autoregressions to examine changes in the impact of nominal interest rates on aggregate GNP and various sectors.[8] His approach differs from that of Friedman and of Akhtar and Harris in that he does not control for periods of credit rationing. Estimating his equations over two periods, Kahn finds that both residential investment and consumption are less interest sensitive in the 1980s than in the period from 1955 to 1979, while the impact of an increase in interest rates on net exports has strengthened and changed direction, switching from a small positive effect to a large negative one. His results on business fixed investment are inconclusive. On the basis of this evidence and a direct estimate of his equation on aggregate GNP, Kahn concludes that the interest sensitivity of output in the 1980s has declined since the period from 1955 to 1979.

Barry Bosworth reaches a similar conclusion using a substantially different approach.[9] Noting that adjustable rate mortgages (ARMs) have been prevalent in Canada for a number of years and that Canadian housing investment is less sensitive to movements in interest rates than U.S. residential investment, Bosworth argues that the housing sector in the United States is likely to become less interest sensitive as ARMs become more common. Combining this analysis with an examination of business investment and foreign trade, Bosworth concludes that monetary policy lags have lengthened and become more uncertain as a result of institutional changes in financial and product markets.

As this brief review suggests, there is no clear-cut consensus about the impact of financial market developments on the overall interest sensitivity of the economy. This lack of consensus may in part be explained by the different interest rate measures employed by the authors in their empirical analyses. Friedman examines the sensitivity of output in various sectors to changes in real interest rates, while the bulk of the analysis in Akhtar and Harris and in Bosworth focuses on nominal interest rate movements. Kahn uses the nominal federal funds rate as a measure of interest rates in his estimates.

More probably, however, the differing conclusions about the overall interest sensitivity of the economy derive from the relatively informal way in which most of these papers combine the results from individual sectors to reach a conclusion about aggregate GNP. Of the four papers, only Kahn's makes a direct empirical examination of the effect of interest rates on aggregate output. Although the disaggregate approach taken by Friedman, Bosworth, and Akhtar and Harris has the advantage of providing insight into the differential effects of monetary policy across sectors, it is less well suited to assessing the net change in interest sensitivity for the economy as a whole.

Empirical approach

In this section we adopt a fairly general approach to measuring changes in the sensitivity of output to interest rate fluctuations. Specifically, we estimate an equation relating the growth of real GNP to the level of nominal interest rates and the stance of fiscal policy. This equation has the general form:

$$\log(GNP_t/GNP_{t-1}) = \alpha_0 + \alpha_1 \log(GNP_{t-1}/GNP_{t-2}) + \alpha_2 FISCAL_t + \alpha_3 r_t + \epsilon_t,$$

where GNP_t is real gross national product, $FISCAL_t$ is a measure of the stance of fiscal policy (higher values of FISCAL represent tighter fiscal policy),[10] and r_t is the three-month Treasury bill rate (see Box). The equations are estimated on quarterly data from 1957 to 1989.[11]

[7]Benjamin Friedman, "Changing Effects of Monetary Policy on Real Economic Activity," in *Monetary Policy in the 1990s*, Federal Reserve Bank of Kansas City, 1989.

[8]George A. Kahn, "The Changing Interest Sensitivity of the U.S. Economy," Federal Reserve Bank of Kansas City *Economic Review*, November 1989, pp. 13-34.

[9]Barry Bosworth, "Institutional Change and the Efficacy of Monetary Policy," *Brookings Papers on Economic Activity*, 1:1989, pp. 77-110.

[10]$FISCAL_t$ is the eight-quarter change in the ratio of the full employment government budget surplus or deficit to nominal GNP. We use the midexpansion trend measure of the federal government budget surplus or deficit, calculated by the Bureau of Economic Analysis (BEA), to represent the full employment budget position. This measure was available from 1955 to 1988, when it was discontinued by the BEA. Beginning in 1970, the BEA calculated an alternative full employment budget deficit series based on a 6 percent unemployment rate trend GNP measure. Although the levels of the two series are different, the changes are very similar, so the changes in the 6 percent unemployment rate series are appended to the midexpansion trend level to extend the series into 1989.

[11]All equations are estimated by two-stage least squares using the first lag of the interest rate variable as an instrument for its contemporaneous value to account for possible simultaneity bias.

Box: Selection of the Interest Rate Measure

The interest rate variable used in our estimates is the nominal three-month Treasury bill yield. In making this selection, we considered whether a nominal or real interest rate was the appropriate variable to use in examining the impact of financial market evolution on the interest sensitivity of real output. On the one hand, it is usually assumed that real interest rates affect the production, investment, savings, and spending decisions of firms and individuals in the economy, making real interest rates the correct choice for the equation. On the other hand, nominal interest rates may be more appropriate because they are pivotal in many of the monetary transmission channels affected by financial market evolution. For instance, the Regulation Q ceilings, which triggered rationing in the housing finance market, were expressed in nominal terms. In addition, most interest-sensitive household and corporate assets and liabilities are denominated in nominal terms, implying that household and corporate cash flows vary with movements in nominal rates.

Because these and other monetary policy channels work through movements in nominal interest rates, it seemed reasonable to use nominal rates in attempting to measure changes in interest sensitivity. As a test of this assumption, we reestimated the basic and time-varying forms of the equation using real instead of nominal interest rates. These results are reported in the table. For this purpose, real interest rates were calculated as the nominal rate minus expected inflation, where expected inflation was measured as the percent change in the consumer price index (CPI) over the most

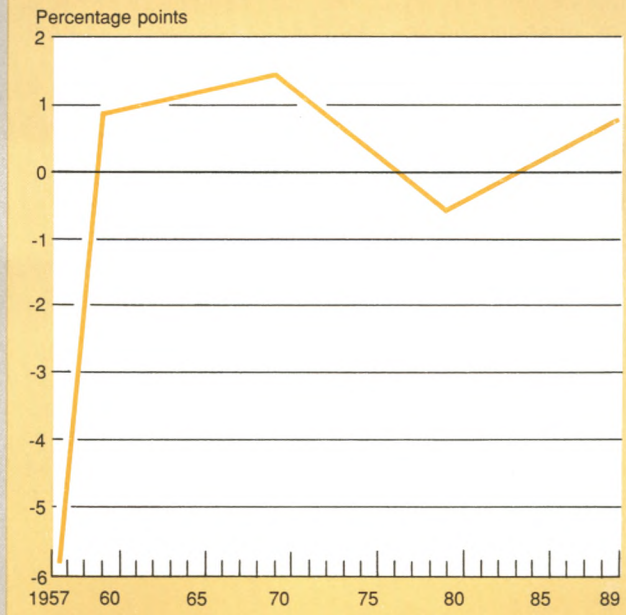
Interest Sensitivity of Real GNP: Real Interest Rates

$$\%GNP_t = \alpha_0 + \alpha_1 \%GNP_{t-1} + \alpha_2 FISCAL_t + \alpha_3 r_t + \epsilon_t$$

	Basic Equation	Time-varying Equation	
	α_3 = Constant	$\alpha_3 = D_{50}(\beta_{50}+\gamma_{50}t) + D_{60}(\beta_{60}+\gamma_{60}t) + D_{70}(\beta_{70}+\gamma_{70}t) + D_{80}(\beta_{80}+\gamma_{80}t)$	
Constant	1.957 (.456)	1.392 (.702)	
Lagged dependent	.274 (.085)	.278 (.130)	
Fiscal policy	−58.970 (26.398)	−64.290 (29.413)	
Interest rate			
Constant	.040 (.171)	β	γ
1957-59		−8.157 (12.909)	.439 (.670)
1960-69		.407 (1.390)	.011 (.031)
1970-70		3.237 (1.928)	−.037 (.021)
1980-89		−2.801 (2.138)	.024 (.018)
Significance level of F-test for exclusion of time-varying coefficients		.309	

Notes: The variable $\%GNP_t$ equals $400*(GNP_t/GNP_{t-1})$, where GNP is real gross national product. The variable r_t is the average three-month Treasury bill rate during the quarter minus the four-quarter CPI inflation rate. $FISCAL_t$ is the eight-quarter change in the ratio of the full employment government budget surplus or deficit to nominal GNP. The variables D_{50}, D_{60}, D_{70}, and D_{80} are dummies for the years 1957-59, 1960-69, 1970-79, and 1980-89, respectively. The equations are estimated from 1957-I to 1989-IV by two-stage least squares using the first lag of the interest rate variable as an instrument for its contemporaneous value. The numbers in parentheses are standard errors.

Interest Sensitivity of Aggregate Real GNP: Piecewise Linear Specification Using Real Interest Rates



Note: Line plotted shows response of long-run real GNP growth to a permanent 1 percentage point increase in the real three-month Treasury bill rate.

Box: Selection of the Interest Rate Measure *(continued)*

recent four quarters.†

Clearly, real interest rates do not perform well in these equations. In the basic form of the equation (column 1 of the table), the interest rate coefficient has the wrong sign and is not a significant determinant of GNP growth. When the coefficient on interest rates is allowed to vary over time, the implied pattern of interest sensitivity varies from positive to negative (see chart) and the coefficients are not statistically significant. Overall, then, it does not appear that real interest rates are the correct interest rate measure for this specification of the equation.

†We also tried estimates using a forecast of inflation over the next quarter constructed from a single equation autoregressive model; substantially similar results were obtained.

This specification is very general in the sense that no attempt is made to control for the structural factors that might influence the relationship between real GNP and nominal interest rates. This lack of structure is deliberate, since the aim of this exercise is to measure the *net* effect of financial market evolution on the interest sensitivity of output. The notion is that by limiting the set of additional explanatory variables, the coefficient estimate on the interest rate measure, r_t, will capture the aggregate effect of the various channels of monetary policy on output. We include a measure of fiscal policy tightness, however, to control for the impact of fiscal policy changes on the relationship between interest rates and real output.

The equation specified above is appropriate only if the economic regime is stable throughout the entire sample period. The primary hypothesis of this work, however, is that the relationship between real economic activity and interest rates has evolved over time. In order to capture these effects, we estimate various alternative forms of the equation that allow the interest rate coefficient, α_3, to vary over time.

The most general of these specifications is a piecewise linear structure designed to allow the growth path of the interest rate coefficient to shift at the end of each calendar decade in the sample. That is, the interest rate coefficient is allowed to move along a linear path over time, but the slope of the path shifts at the end of each decade. This specification can be expressed as:

$$\alpha_3 = D_{50}(\beta_{50} + \gamma_{50}t) + D_{60}(\beta_{60} + \gamma_{60}t) + D_{70}(\beta_{70} + \gamma_{70}t) + D_{80}(\beta_{80} + \gamma_{80}t),$$

where D_{50}, D_{60}, D_{70}, and D_{80} are dummy variables for the years 1957-59, 1960-69, 1970-79, and 1980-89, respectively; t is a time trend; and the β and γ coefficients are the intercept and slope coefficients of the linear growth paths for each of the four decades.[12] Although this specification restricts the growth path of α_3 to be linear *within* any calendar decade, it provides a straightforward means of testing for changes in the growth path *between* decades.

In addition to this piecewise linear structure, some alternative time-varying specifications are estimated. These specifications include linear, quadratic, and logarithmic growth paths:

Linear: $\alpha_3 = \beta_0 + \beta_1 t$

Quadratic: $\alpha_3 = \beta_0 + \beta_1 t + \beta_2 t^2$

Logarithmic: $\alpha_3 = \beta_0 + \beta_1 \log(t)$.

These specifications are more restricted than the piecewise linear specification in that they place more structure on the type of curvature allowed in the growth path of α_3. Nevertheless, the quadratic form in particular represents an interesting base of comparison since its inflection point is unrestricted and can be compared with the arbitrary turning points selected for the piecewise linear specification.

Estimation results: the basic GNP equation

As a first step in examining the interest sensitivity of economic activity, we estimated a basic form of the GNP equation in which the interest effect is assumed to be constant over time. These estimates are con-

Footnote 11 continued

Hausman specification tests on the basic form of the model strongly reject the exogeneity of the three-month Treasury rate, making instrumental variables the appropriate technique. The estimates were also performed using the first two lags and the second through sixth lags of the interest rate measure as instruments without significantly affecting the results. In the various time-varying specifications, the lagged interest rates are interacted with the appropriate time trend variables to create a set of instrumental variables.

[12]The actual estimation procedure is constrained so that the piecewise linear structure is continuous at the three breakpoints between the decades. This constraint means that only one intercept parameter and the four slope parameters are actually estimated; the remaining intercept parameters can be derived from these estimates.

tained in the first column of Table 1. Overall, the results are consistent with our expectations about the effects of the explanatory variables on GNP growth. The coefficient on lagged GNP growth is positive and statistically significant, and indicates that approximately 24 percent of any shock to GNP growth persists from quarter to quarter. The negative parameter estimate on the fiscal policy variable is consistent with the idea that tighter fiscal policy leads to slower GNP growth, although the coefficient is only marginally significant. Most important for this exercise, the coefficient on the interest rate variable is negative and statistically different from zero. The parameter estimate implies that a 1 percentage point increase in the three-month Treasury bill rate would decrease real GNP growth by nearly 1/2 of 1 percentage point (for example, from 2.0 to 1.5 percent).[13]

Table 1

Interest Sensitivity of Real GNP

$$\%GNP_t = \alpha_0 + \alpha_1 \%GNP_{t-1} + \alpha_2 FISCAL_t + \alpha_3 r_t + \epsilon_t$$

	Basic Equation	Time-varying Equation	
	α_3 = Constant	$\alpha_3 = D_{50}(\beta_{50}+\gamma_{50}t) + D_{60}(\beta_{60}+\gamma_{60}t) + D_{70}(\beta_{70}+\gamma_{70}t) + D_{80}(\beta_{80}+\gamma_{80}t)$	
Constant	4.338 (.884)	9.482 (1.841)	
Lagged dependent	.244 (.083)	.233 (.087)	
Fiscal policy	−50.363 (26.270)	−31.101 (28.712)	
Interest rate			
Constant	−.365 (.122)	β	γ
1957-59		−5.442 (1.455)	.162 (.073)
1960-69		−2.571 (.937)	.019 (.012)
1970-79		−2.321 (.746)	.015 (.007)
1980-89		−.427 (.602)	−.0038 (.0025)
Significance level of F-test for exclusion of time-varying coefficients		.003	

Notes: The variable $\%GNP_t$ equals $400*(GNP_t/GNP_{t-1})$, where GNP is real gross national product. The variable r_t is the average three-month Treasury bill rate during the quarter. $FISCAL_t$ is the eight-quarter change in the ratio of the full employment government budget surplus or deficit to nominal GNP. The variables D_{50}, D_{60}, D_{70}, and D_{80} are dummies for the years 1957-59, 1960-69, 1970-79, and 1980-89, respectively. The equations are estimated from 1957-I to 1989-IV by two-stage least squares using the first lag of the interest rate variable as an instrument for its contemporaneous value. The numbers in parentheses are standard errors.

In this specification of the GNP growth equation, the interest rate effect is forced to be constant for the entire sample period. If financial market developments have caused the interest sensitivity of output to change over time, however, then this specification is inappropriate. The second column of Table 1 contains estimates of an alternative version of the model in which the interest rate parameter is allowed to follow a piecewise linear growth path over time. If the impact of interest rate movements has changed systematically since the late 1950s, then we should be able to find evidence of it in this alternative specification.

In Table 1, the subcolumns labeled "β" and "γ" contain the intercept and slope coefficients of the time path of the interest rate parameter over each of the four calendar decades in the sample. If the original specification of the equation with the constant interest rate parameter is correct, then we would expect all of the intercept coefficients (the parameters reported in the "β" column) to be equal to one another, and all of the slope coefficients (the parameters reported in the "γ" column) to be equal to zero. If the effect of interest rates has evolved over time, however, then there should be significant variation among the "β" and "γ" parameters.

The estimates in Table 1 strongly imply that the interest rate coefficient has not been stable over the sample period. As a group, the "γ" slope coefficients are significantly different from zero and the "β" intercept coefficients vary significantly from one decade to another.[14] These results imply both that the effect of interest rate movements on GNP growth has evolved over time and that the pace of this evolution has varied across the decades.

This last result is perhaps easiest to discuss when it is presented graphically. The interest rate effect implied by the estimates in Table 1 is illustrated in Chart 1. The values plotted in this chart represent the impact of a 1 percentage point increase in the interest rate variable on the GNP growth rate. For instance, a value of −1.5 percent on these figures indicates that a 1 percentage point increase in the interest rate is associated with a 1.5 percentage point decline in the GNP

[13] The impact of an increase in interest rates is the implied effect of a permanent 1 percentage point increase in interest rates on the long-run rate of GNP growth, an effect which is calculated by dividing the interest rate coefficient α_3 by one minus the coefficient on the lagged dependent variable α_1.

[14] The hypothesis that the four "γ" slope coefficients are equal to zero is strongly rejected. The F-statistic of this hypothesis is 4.267, which is significant at the .3 percent level (with 4 and 124 degrees of freedom). The hypothesis that the four "β" intercept coefficients are the same is also strongly rejected, with an F-statistic equal to 3.600, which is significant at the 1.5 percent level (with 3 and 124 degrees of freedom).

growth rate (for example, from 3.5 to 2.0 percent). Reading across the chart gives the estimated pattern of this impact between 1957 and 1989.

As the chart makes clear, the estimated interest sensitivity of real GNP changed considerably between 1957 and 1989. The impact of a given change in interest rates declined between the 1950s and the 1970s and then leveled off during the 1980s.[15] Overall, the impact of a change in interest rates is estimated to be significantly smaller by the end of the 1980s than it had been two decades earlier.

Interest sensitivity in the 1950s

One somewhat striking result in Chart 1 is the sharp decline in interest sensitivity during the three years of the 1950s included in the sample period (1957 to 1959). Because of the strength of this result and in lieu of an obvious explanation stemming from financial market developments, we examine the decline more closely to ensure that it does not represent some source of bias in the estimates of the interest sensitivity parameters for the remaining decades in the sample.

A possible source of difficulty with the estimates of interest sensitivity for the 1950s is the fact that only the last three years of the decade are included in the sample. This constraint occurs because the particular fiscal policy variable used in the estimates is available only beginning in 1957. To see whether the short sample period in the 1950s is responsible for producing the estimated sharp decline in the interest sensitivity parameter during this period, we reestimated the basic equation, omitting the fiscal policy variable, FISCAL, and extending the sample period back to the first quarter of 1950. These estimates are contained in Table 2.

For comparison with the results in Table 1, the first column of Table 2 contains the equation omitting FISCAL estimated over the original 1957-89 sample period, while the second column contains estimates over the broader 1950-89 sample. As Chart 2 illustrates, omitting the fiscal policy variable from the equation has little effect on the interest sensitivity parameters in the shorter sample period; both the estimates including the variable (the long-dashed line in Chart 2) and the estimates excluding it (the short-dashed line) exhibit the same sharp decline in interest sensitivity during the 1957-59 period.

When the sample is extended back to 1950, this decline is still evident, although the change in slope between the 1950s and the 1960s is somewhat less pronounced. The results for the 1970s and 1980s are not much affected by the extension of the sample to the early 1950s. Overall, the basic finding with the extended sample is qualitatively unchanged. The interest sensitivity of real output (the solid line in Chart 2) continues to decrease substantially starting in the 1950s, with the rate of decline appearing to lessen somewhat during the 1960s and 1970s and to level off during the 1980s.

Accounting for alternative economic variables

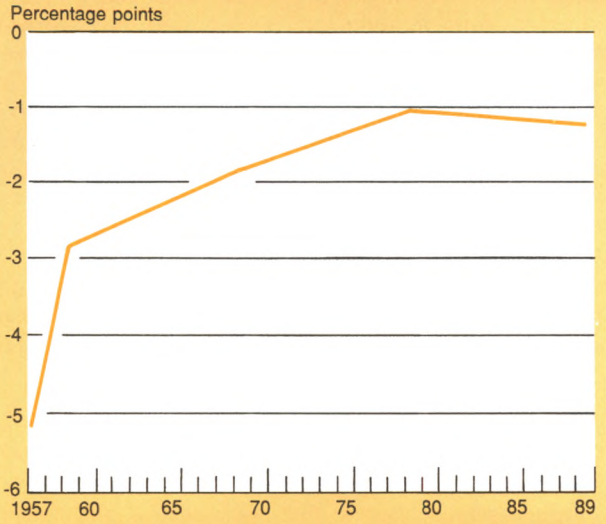
At first glance, the results in Charts 1 and 2 suggest that movements in interest rates had an extremely strong impact on GNP growth, particularly in the early part of the sample. Although the implied interest effect during this period is very large, recall that our estimates do not control for the influence of other variables in the economy and that our calculated interest effect therefore reflects the impact of all other factors on real GNP growth. The comparatively large size of the

[15] In statistical terms, the hypothesis that the "γ" slope coefficients are the same during the periods 1957-59 and 1960-69 is rejected with moderate statistical significance: the t-test value for this hypothesis is 1.809, which is significant at the 7.3 percent level (with 124 degrees of freedom). But the hypothesis that the "γ" slope coefficients are the same during the periods 1960-69 and 1970-79 cannot be rejected: the t-test value for this hypothesis is only .306. In addition, the hypothesis that the slope coefficients are both equal to zero is rejected at the 3.0 percent significance level.

Finally, as Table 1 shows, the "γ" slope coefficient during the 1980s is not significantly different from zero, consistent with the assertion that the sensitivity of GNP to interest rate variations did not change further during this period.

Chart 1

Interest Sensitivity of Aggregate Real GNP: Piecewise Linear Specification



Note: Line plotted shows response of long-run real GNP growth to a permanent 1 percentage point increase in the three-month Treasury bill rate.

implied interest effect in the early part of the sample can be interpreted in part as reflecting the influence of these other factors. The important fact to note from our estimates is not the *level* of the interest effects but their *movement* over time.

In fact, however, if important variables are omitted from our equations, then the time pattern of the interest sensitivity parameters might be biased by the influence of these omitted variables. To test the robustness of our results, we estimate alternative versions of the equation that control for a variety of possible omitted factors. If the pattern of interest sensitivity is not significantly altered when these other variables are included in the specification, we may infer that these alternative factors are not unduly influencing the results.

The additional variables tested as omitted explanatory factors are divided into two categories. The first category represents variables that act as predictors of future GNP growth. These variables include the lagged percent change in leading indicators and, proxying for the yield curve, the lagged spread between the ten-year and three-month Treasury rates. The second category of additional explanatory factors includes variables that control for alternative economic influences. These variables are the inflation rate, the lagged growth rate of M2, and as a more general test, a shifting intercept term.[16]

When these additional variables are held constant in the GNP equation, the interest rate coefficients capture the marginal impact of interest rate movements — that is, the influence of interest rates on the unpredicted or residual part of GNP growth. If the coefficient estimates reported in Table 1 are biased by the omission of important variables, then we would expect that the estimated impact of interest rate movements on the unpredicted part of GNP growth would be significantly different from the estimates derived from the equation omitting these alternative variables. If, however, the estimates in the two sets of regressions are substantially similar, then we can conclude that the coefficients are not significantly biased.

These alternative estimates are reported in Table 3 and illustrated in Chart 3. Looking first at the coefficients estimates for the two sets of alternative economic variables, note that the parameter estimates are consistent with our expectations and are significantly

[16]Since it is a contemporaneous variable, the inflation rate is potentially endogenous, so the first lag is used as an instrument for its contemporaneous value in the two-stage squares estimation.

Table 2

Interest Sensitivity of Real GNP: Regressions Beginning in 1950

$$\%GNP_t = \alpha_0 + \alpha_1 \%GNP_{t-1} + \alpha_3 r_t + \epsilon_t$$

Time-varying Equations

$$\alpha_3 = D_{50}(\beta_{50} + \gamma_{50}t) + D_{60}(\beta_{60} + \gamma_{60}t) + D_{70}(\beta_{70} + \gamma_{70}t) + D_{80}(\beta_{80} + \gamma_{80}t)$$

	1957-89			1950-89		
Constant		9.959			9.147	
		(1.768)			(1.537)	
Lagged dependent		.243			.382	
		(.087)			(.074)	
Interest rate		β	γ		β	γ
	1957-59	−5.475	.158	1950-59	−3.718	.064
		(1.462)	(.074)		(.865)	(.026)
	1960-69	−2.711	.020	1960-69	−2.943	.025
		(.930)	(.012)		(.776)	(.011)
	1970-79	−2.554	.017	1970-79	−2.360	.016
		(.706)	(.006)		(.654)	(.006)
	1980-89	−.353	−.0049	1980-89	−.264	−.0052
		(.602)	(.0058)		(.601)	(.0056)
Significance level of F-test for exclusion of time-varying coefficients		.002			.002	

Notes: The variable $\%GNP_t$ equals $400*(GNP_t/GNP_{t-1})$, where GNP is real gross national product. The variable r_t is the average three-month Treasury bill rate during the quarter. The variables D_{50}, D_{60}, D_{70}, and D_{80} are dummies for the years 1957-59 or 1950-59, 1960-69, 1970-79, and 1980-89, respectively. The equations are estimated by two-stage least squares using the first lag of the interest rate variable as an instrument for its contemporaneous value. The numbers in parentheses are standard errors.

different from zero, although at only moderate significance levels for all but the leading indicators variable. The results suggest that the lagged growth in the leading indicators is a very accurate predictor of eventual real GNP growth and that the increases in the slope of the yield curve and the growth rate of M2 are associated with higher GNP growth. Higher rates of inflation, however, appear to be associated with slower GNP growth. Although these variables have at least marginally significant predictive power in the GNP equation, allowing the intercept term to shift at the end of each decade does not appear to contribute to the equation's ability to explain the growth of GNP.[17]

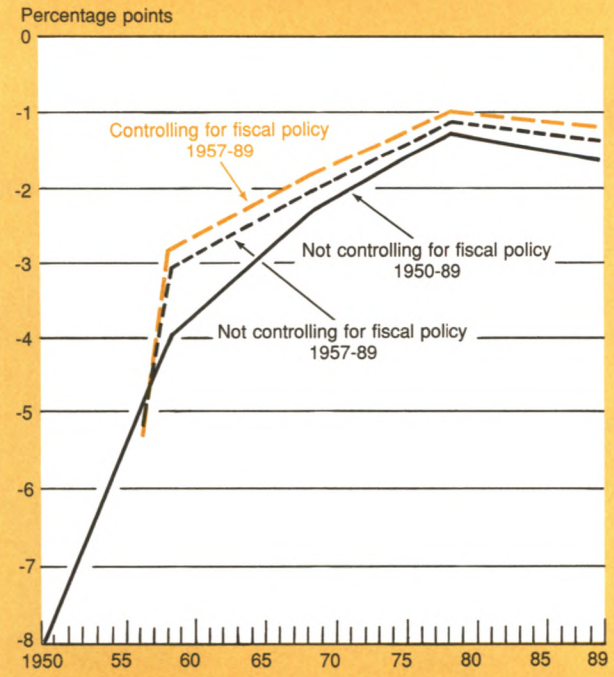
With the exception of the shifting intercept term, then, each of the four additional economic variables is able to explain some part of GNP growth. Even after controlling for the effects of other economic factors in this manner, however, it is still possible to identify a time-varying interest sensitivity. As Chart 3 illustrates, the basic time pattern of interest sensitivity remains in these alternative specifications of the GNP equation, although the level of the effect is altered. A comparison of Charts 1 and 3 reveals that the implied interest effects are somewhat smaller when inflation, the yield curve, and M2 growth are included in the specification, are somewhat larger when the intercept term is allowed to shift, and are significantly smaller when the leading indicator index is included as an explanatory variable.

The time-varying parameters describing the evolution of interest sensitivity continue to be statistically significant in most of these alternative specifications, reinforcing the conclusions based on our initial estimates. The exception to this finding is the specification controlling for leading indicators, which produces estimates of the time-varying interest sensitivity parameters that are not significantly different from zero. Despite the lack of statistical significance, however, the actual estimates in this case produce a time pattern of interest sensitivity that at least resembles the pattern produced by our initial estimates.

[17]The hypothesis that the four intercept coefficients are equal cannot be rejected. The F-statistic for this hypothesis is 1.072, which is significant at the 36.4 percent level (with 3 and 121 degrees of freedom).

Chart 2

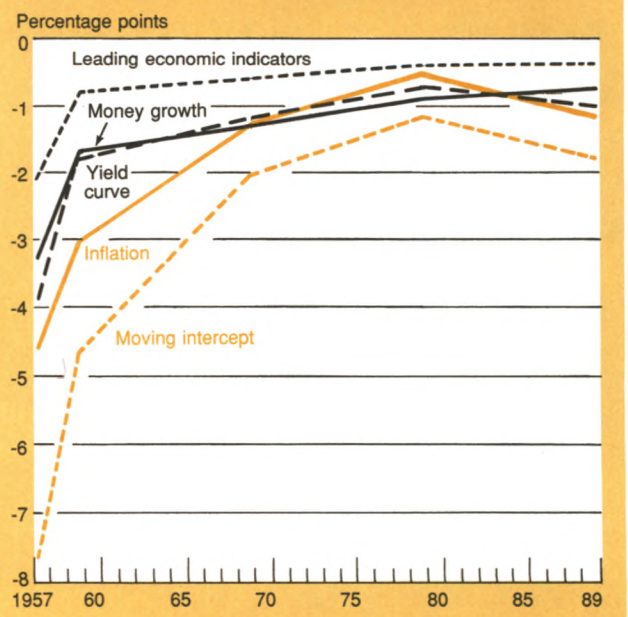
Interest Sensitivity of Aggregate Real GNP: Piecewise Linear Specification Beginning in 1950



Note: Lines plotted show response of long-run real GNP growth to a permanent 1 percentage point increase in the three-month Treasury bill rate.

Chart 3

Interest Sensitivity of Aggregate Real GNP: Controlling for Alternative Economic Factors



Note: Lines plotted show response of long-run real GNP growth to a permanent 1 percentage point increase in the three-month Treasury bill rate.

Alternative time-varying specifications

It is interesting to compare the basic piecewise linear estimates in Table 1 to some alternative time-varying interest sensitivity models. These estimates are presented in Table 4. The three equations contained in this table allow the interest rate coefficient, α_3, to vary with linear, quadratic, and logarithmic time trends. In each specification, the time-varying parameters are statistically significant and imply that the interest sensitivity of GNP declines over the sample period.

The patterns of interest sensitivity from these alternative models are presented in Chart 4. The quadratic and logarithmic trend specifications produce estimated time patterns broadly similar to those suggested by the piecewise linear estimates. The primary difference between the results of quadratic and logarithmic forms of the model and those of the piecewise linear specification is that the quadratic and logarithmic forms do not exhibit the same sharp decline in interest sensitivity during the 1950s.

Interestingly, however, the results of the quadratic estimation demonstrate the same flattening of the interest effect curve during the 1980s as was found in the piecewise linear estimates. The inflection point of the

Table 3

Interest Sensitivity of Real GNP: Additional Economic Factors as Determinants of GNP

$$\%GNP_t = \alpha_0 + \alpha_1 \%GNP_{t-1} + \alpha_2 FISCAL_t + \alpha_3 r_t + \alpha_4 FACTOR + \epsilon_t$$

	Additional Economic Variable									
	Leading Indicators		Yield Curve		Inflation Rate		Money Growth		Shifting Intercept	
$\alpha_3 = D_{50}(\beta_{50}+\gamma_{50}t) + D_{60}(\beta_{60}+\gamma_{60}t) + D_{70}(\beta_{70}+\gamma_{70}t) + D_{80}(\beta_{80}+\gamma_{80}t)$										
Constant	5.249		7.028		10.904		5.529			
	(1.569)		(2.428)		(1.955)		(2.745)			
1957-59									13.973	
									(3.950)	
1960-69									11.725	
									(2.725)	
1970-79									9.423	
									(1.906)	
1980-89									11.516	
									(3.379)	
Lagged dependent	.038		.175		.192		.152		.263	
	(.079)		(.092)		(.088)		(.094)		(.093)	
Fiscal policy	−4.254		−28.329		−14.692		−21.787		−17.289	
	(24.523)		(27.699)		(29.664)		(28.196)		(31.661)	
Additional economic factor	.918		.676		−.507		.359			
	(.149)		(.439)		(.280)		(.193)			
Interest rate	β	γ	β	γ	β	γ	β	γ	β	γ
1957-59	−3.091	.118	−4.699	.163	−4.681	.108	−3.926	.125	−7.463	.201
	(1.239)	(.062)	(1.499)	(.071)	(1.497)	(.078)	(1.631)	(.074)	(2.475)	(.107)
1960-69	−.817	.0038	−1.662	.011	−3.212	.034	−1.555	.0067	−4.414	.048
	(.792)	(.0104)	(1.093)	(.013)	(.979)	(.014)	(1.052)	(.0137)	(1.606)	(.023)
1970-79	−.870	.0047	−1.640	.010	−2.203	.018	−1.733	.0096	−2.494	.016
	(.631)	(.0055)	(.858)	(.007)	(.737)	(.007)	(.775)	(.0069)	(.864)	(.008)
1980-89	−.434	.00036	−.058	−.0055	.942	−.014	−1.094	.0032	.258	−.011
	(.501)	(.00484)	(.626)	(.0918)	(.969)	(.008)	(.676)	(.0067)	(.940)	(.093)
Significance level for F-test for exclusion of time-varying coeffcients	.202		.063		.001		.046		.052	
Significance level for F-test for time-varying intercept term									.364	

Notes: The variable $\%GNP_t$ equals $400*(GNP_t/GNP_{t-1})$, where GNP is real gross national product. The variable r_t is the average three-month Treasury bill rate during the quarter. $FISCAL_t$ is the eight-quarter change in the ratio of the full employment budget surplus or deficit to nominal GNP. The variables D_{50}, D_{60}, D_{70}, and D_{80} are dummies for the years 1957-59, 1960-69, 1970-79, and 1980-89, respectively. The variable $FACTOR_t$ is one of four additional economic factors, either the percent change in the index of leading indicators in the previous quarter, the lagged four-quarter growth rate of M2, the spread between the ten-year Treasury bond and the three-month Treasury bill rates (yield curve), or the four-quarter CPI inflation rate. The equations are estimated from 1957-I to 1989-IV by two-stage least squares using the first lag of the interest rate and alternative macroeconomic variables as instruments for their contemporaneous values. The numbers in parentheses are standard errors.

quadratic form occurs during the fourth quarter of 1982, a finding consistent with the implication of the piecewise linear estimation that the interest sensitivity of output was relatively constant during this period.

The role of changes in monetary policy regime

The estimates presented in Table 1 and Chart 1 suggest that, unlike the previous three decades, the 1980s have seen little net change in the interest sensitivity of real GNP. Aside from financial market developments, at least two explanations of this recent stability are possible. The first explanation involves the regime change at the Federal Reserve between 1979 and 1982. When monetary aggregates displaced interest rates as the primary monetary policy target, perceptions about interest rate variations may have been modified in such a way that the net response of output to changes in interest rates was altered. To the extent that this change in perception resulted in financial market innovation, of course, the regime shift represents another facet of the financial market evolution that is the focus of this analysis. If, however, the regime change at the Fed brought about changes in other aspects of the economy, then these changes could be influencing our results.

To test the regime change hypothesis, we reestimated the basic and time-varying forms of the model, this time allowing the coefficient on interest rates to vary with a proxy for the Federal Reserve regime. We used the within-quarter standard deviation of the weekly average federal funds rate for this proxy. Although this variable does not measure regime change per se, it does reflect shifts in the emphasis between interest rates and monetary aggregates as intermediate monetary targets.

Estimates of the basic form of the equation and estimates of the time-varying model, both controlling for fed funds rate variability, appear in the first and second columns of Table 5, respectively. In both versions of the equation, the variability of the fed funds rate does not have significant explanatory power, suggesting that it has little measurable effect on the interest sensitivity of

Table 4

Interest Sensitivity of Real GNP: Alternative Time-varying Specifications

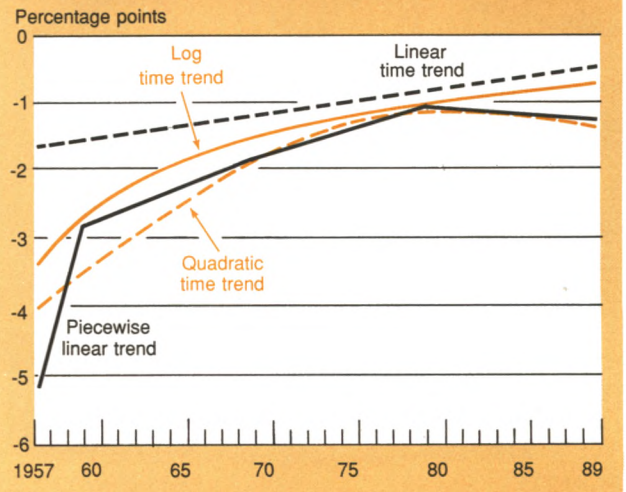
$$\%GNP_t = \alpha_0 + \alpha_1 \%GNP_{t-1} + \alpha_2 FISCAL_t + \alpha_3 r_t + \epsilon_t$$

	Linear	Quadratic	Log
	$\alpha_3 = \beta_0 + \beta_1 t$	$\alpha_3 = \beta_0 + \beta_1 t + \beta_2 t^2$	$\alpha_3 = \beta_0 + \beta_1 \log(t)$
Constant	6.577	9.511	8.213
	(1.215)	(1.706)	(1.401)
Lagged dependent	.230	.246	.225
	(.084)	(.086)	(.085)
Fiscal policy	−38.106	−25.694	−33.705
	(26.841)	(27.902)	(27.006)
Interest rate Constant	−1.334	−3.451	−4.226
	(.374)	(.886)	(1.055)
TIME	.0070	.046	
	(.0025)	(.015)	
TIME squared		−.00021	
		(.00008)	
Log TIME			.743
			(.201)
Significance level of F-test or t-test on exclusion of time-varying coefficients	.007	.001	.000

Notes: The variable $\%GNP_t$ equals $400*(GNP_t/GNP_{t-1})$, where GNP is real gross national product. The variable r_t is the average three-month Treasury bill rate during the quarter. $FISCAL_t$ is the eight-quarter change in the ratio of the full employment government budget surplus or deficit to nominal GNP. TIME is a linear time trend beginning in 1955-I. The equations are estimated from 1957-I to 1989-IV by two-stage least squares using the first lag of the interest rate variable as an instrument for its contemporaneous value. The numbers in parentheses are standard errors.

Chart 4

Interest Sensitivity of Aggregate Real GNP: With Alternative Time Trend Specifications



Note: Lines plotted show response of long-run real GNP growth to a permanent 1 percentage point increase in the three-month Treasury bill rate.

GNP. Moreover, the time-varying interest effects are still strongly evident in this specification of the model, with point estimates generally similar to those in Table 1. To the extent, then, that fed funds rate variability is an adequate proxy, our results appear not to be driven by the 1979-82 regime shift at the Federal Reserve.

Another test of the impact of the 1979-82 Federal Reserve regime shift can be derived from long-term Treasury rates. As discussed above, one alternative explanation for the estimated decline in interest sensitivity is that this decline simply reflects the adaptation of the economy to the more volatile short-term interest rates generated by the change in Federal Reserve operating procedure. The volatility of long-term interest rates was presumably less affected by the move to monetary growth targeting, suggesting that the sensitivity of the economy to movements in these long-term interest rates might not have changed significantly. If, however, we find a time pattern of long-term interest rate sensitivity similar to that found for short-term rates, then we can take this as evidence that our basic results are not driven by the Federal Reserve regime shift.

Table 6 and Chart 5 present estimates of the basic

Table 5

Interest Sensitivity of Real GNP: Fed Funds Rate Variability as a Determinant of Sensitivity

$$\%GNP_t = \alpha_0 + \alpha_1 \%GNP_{t-1} + \alpha_2 FISCAL_t + \alpha_3 r_t + \epsilon_t$$

	Basic Equation	Time-varying Equation	
	$\alpha_3 = \delta_0 + \delta_1 \sigma_t$	$\alpha_3 = \delta\sigma_t + D_{50}(\beta_{50} + \gamma_{50}t) + D_{60}(\beta_{60} + \gamma_{60}t) + D_{70}(\beta_{70} + \gamma_{70}t) + D_{80}(\beta_{80} + \gamma_{80}t)$	
Constant	4.129	10.285	
	(1.300)	(2.811)	
Lagged dependent	.243	.223	
	(.084)	(.090)	
Fiscal policy	−50.565	−36.111	
	(26.450)	(29.681)	
Interest rate			
Constant	−.308		
	(.275)		
Fed funds variance	−.039	.097	
	(.161)	(.255)	
		β	γ
1957-59		−6.967	.226
		(1.917)	(.088)
1960-69		−2.894	.022
		(1.421)	(.017)
1970-79		−2.396	.014
		(.796)	(.007)
1980-89		−.868	−.0015
		(1.266)	(.0083)
Significance level of F-test for exclusion of time-varying coefficients		.004	

Notes: The variable $\%GNP_t$ equals $400*(GNP_t/GNP_{t-1})$, where GNP is real gross national product. The variable r_t is the average three-month Treasury bill rate during the quarter. $FISCAL_t$ is the eight-quarter change in the ratio of the full employment government budget surplus or deficit to nominal GNP. σ_t is the within-quarter variance of the weekly average federal funds rate. The variables D_{50}, D_{60}, D_{70}, and D_{80} are dummies for the years 1957-59, 1960-69, 1970-79, and 1980-89, respectively. The equations are estimated from 1957-I to 1989-IV by two-stage least squares using the first lag of the interest rate variable as an instrument for its contemporaneous value. The numbers in parentheses are standard errors.

Table 6

Interest Sensitivity of Real GNP: Ten-Year Treasury Bond Rate

$$\%GNP_t = \alpha_0 + \alpha_1 \%GNP_{t-1} + \alpha_2 FISCAL_t + \alpha_3 r_t + \epsilon_t$$

	Basic Equation	Time-varying Equation	
	α_3 = Constant	$\alpha_3 = D_{50}(\beta_{50} + \gamma_{50}t) + D_{60}(\beta_{60} + \gamma_{60}t) + D_{70}(\beta_{70} + \gamma_{70}t) + D_{80}(\beta_{80} + \gamma_{80}t)$	
Constant	3.531	10.680	
	(.969)	(2.874)	
Lagged dependent	.261	.212	
	(.083)	(.086)	
Fiscal policy	−59.619	−63.098	
	(26.096)	(27.042)	
Interest rate			
Constant	−.204	β	γ
	(.116)		
1957-59		−4.664	.135
		(1.367)	(.059)
1960-69		−2.239	.014
		(.959)	(.010)
1970-79		−2.289	.014
		(.932)	(.007)
1980-89		−.857	.00013
		(.521)	(.00488)
Significance level of F-test for exclusion of time-varying coefficients		.017	

Notes: The variable $\%GNP_t$ equals $400*(GNP_t/GNP_{t-1})$, where GNP is real gross national product. The variable r_t is the average ten-year Treasury bill rate during the quarter. $FISCAL_t$ is the eight-quarter change in the ratio of the full employment government budget surplus or deficit to nominal GNP. The variables D_{50}, D_{60}, D_{70}, and D_{80} are dummies for the years 1957-59, 1960-69, 1970-79, and 1980-89, respectively. The equations are estimated from 1957-I to 1989-IV by two-stage least squares using the first lag of the interest rate variable as an instrument for its contemporaneous value. The numbers in parentheses are standard errors.

and time-varying specifications of the GNP equation using the ten-year Treasury bond yield as the interest rate measure. Just as the equations using the three-month Treasury rate demonstrated the variable influence of short-term interest rates, these estimates imply that the influence of long-term Treasury rate movements has not been stable over time.[18] Moreover, as Chart 5 reveals, the implied time pattern of interest sensitivity to movements in the long-term Treasury rate is quite similar to that for the short-term Treasury rate. Together with the estimates that control for fed funds rate variability, these estimates suggest that the time pattern of interest sensitivity is not generated by the 1979-82 Federal Reserve regime change.

The role of inflation

A second potential explanation of the pattern of interest sensitivity during the 1980s concerns inflation. It is possible that the high inflation of the late 1970s somehow altered the response of output in various economic sectors to changes in nominal interest rates, perhaps by affecting the way expectations were formed or by bringing about institutional changes in pricing and indexation. If this is the case, then our estimates could be confounding the effects of inflation with those of financial market evolution.

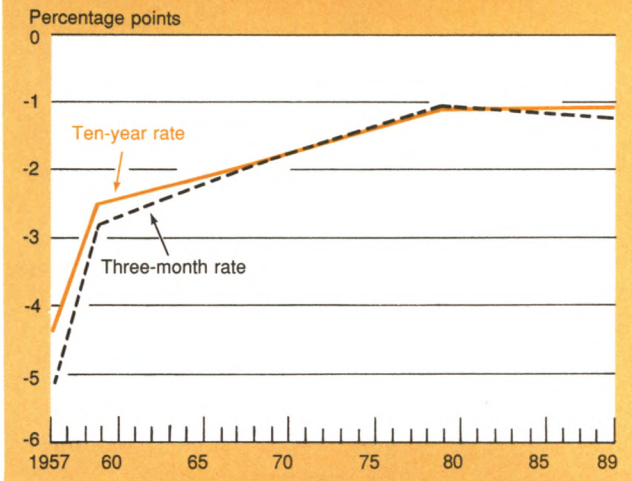
To control for the effects of inflation, we allowed the coefficient on interest rates to vary with the rate of inflation in the basic and piecewise linear forms of the equation.[19] The resulting estimates are contained in

[18]The hypothesis that the four "γ" coefficients are equal to zero, implying a constant interest rate coefficient, is strongly rejected. The F-statistic for this hypothesis is 3.127, which is significant at the 1.7 level (with 4 and 124 degrees of freedom).

[19]We used the four-quarter change in the CPI as a measure of the rate of inflation. Note that these estimates are distinct from those discussed earlier that had inflation entering the equation as an independent explanatory variable. In that specification, the rate of

Chart 5

Interest Sensitivity of Aggregate Real GNP: With Ten-Year and Three-Month Treasury Rates



Note: Lines plotted show response of long-run real GNP growth to a permanent 1 percentage point increase in the three-month or ten-year Treasury bill rate.

Table 7

Interest Sensitivity of Real GNP: Inflation as a Determinant of Sensitivity

$$\%GNP_t = \alpha_0 + \alpha_1 \%GNP_{t-1} + \alpha_2 FISCAL_t + \alpha_3 r_t + \epsilon_t$$

	Basic Equation	Time-varying Equation	
	$\alpha_3 = \delta_0 + \delta_1 \pi_t$	$\alpha_3 = \delta \pi_t + D_{50}(\beta_{50} + \gamma_{50} t) + D_{60}(\beta_{60} + \gamma_{60} t) + D_{70}(\beta_{70} + \gamma_{70} t) + D_{80}(\beta_{80} + \gamma_{80} t)$	
Constant	3.412 (1.035)	8.603 (1.923)	
Lagged dependent	.205 (.086)	.193 (.090)	
Fiscal policy	−43.156 (26.444)	−12.778 (30.364)	
Interest rate			
Constant	.017 (.249)		
Inflation	−.036 (.020)	−.058 (.032)	
		β	γ
1957-59		−4.654 (1.528)	.143 (.074)
1960-69		−2.206 (.968)	.021 (.012)
1970-79		−2.120 (.751)	.021 (.007)
1980-89		1.457 (1.192)	−.016 (.009)
Significance level of F-test for exclusion of time-varying coefficients		.002	

Notes: The variable $\%GNP_t$ equals $400*(GNP_t/GNP_{t-1})$, where GNP is real gross national product. The variable r_t is the average three-month Treasury bill rate during the quarter. $FISCAL_t$ is the eight-quarter change in the ratio of the full employment government budget surplus or deficit to nominal GNP. π_t is the four-quarter CPI inflation rate. The variables D_{50}, D_{60}, D_{70}, and D_{80} are dummies for the years 1957-59, 1960-69, 1970-79, and 1980-89, respectively. The equations are estimated from 1957-I to 1989-IV by two-stage least squares using the first lag of the interest rate variable as an instrument for its contemporaneous value. The numbers in parentheses are standard errors.

Table 7 and illustrated in Chart 6. As the estimates in Table 7 demonstrate, the rate of inflation has a marginally significant effect on the interest rate sensitivity parameter, suggesting that in periods of high inflation, the impact of monetary policy through a change in interest rates is strengthened. Moreover, the time-varying coefficients of the piecewise linear specification continue to be highly significant even after this modification.

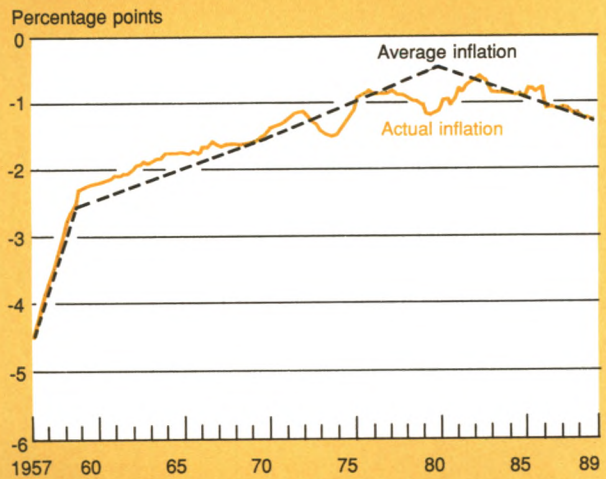
As illustrated in Chart 6, the time pattern of interest sensitivity is altered somewhat by controlling for inflation. This chart shows the estimated interest sensitivity when actual inflation is taken into account (the solid line) and when inflation is held fixed at its sample mean (the dashed line). This second series represents the marginal trend in interest sensitivity after controlling for inflation and can be compared to the line in Chart 1.

The apparent effect of inflation in this specification is to introduce some cyclical variation into the time pattern of the overall measure of interest sensitivity. Periods of high inflation, such as the early and late 1970s, also appear to be periods of temporarily increasing interest sensitivity. The overall trend, however, is towards a decline of the interest rate impact on real output.

Footnote 19 (continued)
inflation acted to predict GNP growth directly; in this specification, the inflation rate determines the sensitivity of GNP growth to interest rate movements.

Chart 6

Interest Sensitivity of Aggregate Real GNP: Piecewise Linear Specification with Interacted Inflation



Note: Lines plotted show response of long-run real GNP growth to a permanent 1 percentage point increase in the three-month Treasury bill rate.

By holding the rate of inflation constant, we can derive the marginal trend in interest sensitivity from our estimates. As a comparison with Chart 1 reveals, the time-related marginal trend in this interest sensitivity (the dashed line in Chart 6) is essentially unchanged by controlling for inflation. As in the earlier estimates, this component of the estimated interest sensitivity decreases from the 1950s to the 1970s. Unlike the previous estimates, however, the estimates controlling for inflation show the slope of the marginal trend line to be more distinctly (and in a statistical sense, significantly) negative during the 1980s. Thus, controlling for inflation alters the prior findings somewhat in that it appears to identify an underlying drift towards an increased interest sensitivity of GNP during the 1980s.

Comparison with previous research

It is revealing to compare the outcome of our analysis with the findings of Friedman, Bosworth, Kahn, and Akhtar and Harris, all of whom attempt to measure changes in the interest sensitivity of output over the past three decades. As noted earlier, these authors examine the interest sensitivity of activity in several major economic sectors and use their findings about individual sectors to draw conclusions about the interest sensitivity of the aggregate economy. Friedman concludes that there has been little net change in the ability of the Federal Reserve to affect real economic activity through movements in interest rates, while Akhtar and Harris find that the influence of interest rates (net of credit rationing effects) and exchange rates on aggregate output in the mid- to late 1980s was probably stronger than in the period from 1960 to the mid-1970s. From both aggregate and sectoral evidence, Kahn concludes that the interest sensitivity of the economy has actually declined. Bosworth argues that monetary policy lags may have become longer and more uncertain, possibly lessening the shorter run relationship between interest rates and economic activity.

Our results agree most closely with Kahn's findings. Focusing on the results we derived by controlling for inflation, note that our estimate of the interest sensitivity of output at the end of the 1980s is at a level similar to that first reached during the early to mid-1970s (see Chart 6), although it is greater (in absolute value) than its value in the early 1980s. Overall, however, the net interest impact derived from our estimates appears to be somewhat less than that prevailing during the 1960s.

Conclusion

To the extent that our estimates of the interest sensi-

tivity of output are actually reflecting the effects of financial market evolution since the late 1950s, we can conclude that these developments tended to reduce the interest sensitivity of output through the 1970s but may have acted to increase this sensitivity during the 1980s. This finding has some intuitive appeal since the evolution of interest sensitivity corresponds in a general way to the hypothesized effects of various financial market developments. For instance, our estimates suggest that the interest sensitivity of output declined during the 1960s and 1970s, a period during which the development of bank funding markets, deregulation of deposit rate ceilings, and increased access to nonbank credit markets are assumed to have reduced the incidence of quantity credit rationing and thereby diminished the impact of interest rate variations on GNP. Similarly, we find that during the 1980s—the period in which increases in leverage and the internationalization of financial markets are hypothesized to have led to a more potent monetary policy—our measure of interest sensitivity increased. Although it is probably overstating the case to draw a close association between particular financial market developments and the results of our simple estimation procedure, it is nonetheless reassuring to find at least a broad correspondence between these developments and the results presented here. While our aggregate approach makes it difficult to identify precisely the effects of financial market evolution, our findings suggest that there have been measurable changes in the relationship between interest rates and real output over the past three decades.

Intermediate Targets and Indicators for Monetary Policy: An Introduction to the Issues

by Richard G. Davis

This article is the introductory essay for a volume of papers, Intermediate Targets and Indicators for Monetary Policy: A Critical Survey, *to be published by the Federal Reserve Bank of New York in December. In addition to the present essay, the volume includes a number of papers surveying the potential usefulness of various measures that have been proposed from time to time as intermediate policy targets and indicators. It also contains a critical review of some recent academic literature bearing on the "rules versus discretion" issue, together with a paper surveying the Federal Reserve's use of targets and operating guides in the postwar period.*

The volume will be available from the Public Information Department of the Federal Reserve Bank of New York. Purchase information appears on page 91 of this issue of the Quarterly Review.

Over the years, a broad array of mainly financial variables has been proposed for use in formulating and implementing monetary policy. This collection of papers examines the potential value of these various measures as intermediate targets and/or indicators of monetary policy. It includes a review of the Federal Reserve's evolving approach to the use of policy targets and operating guides in the postwar period. It also contains an analysis of the recent academic literature on the theory of policy rules that is relevant to the potential usefulness of intermediate targets.

Systematic analysis of monetary tactics and strategy in light of the relationships among policy instruments, a broad array of monetary and financial variables and measures of economic performance, began to expand rapidly in the late 1950s. Over the subsequent decades the subject has generated a large body of literature. One early source of motivation for this work was monetarist criticisms of the Federal Reserve's post-Accord procedures. In these procedures, the behavior of the money stock played, at most, only a limited role. Another impetus to the literature on monetary tactics was progress in modeling the markets for reserves and money. This work provided far greater analytical and quantitative detail on the connection between Federal Reserve actions and the response of the reserve and money aggregates than had previously been available.

Continuing controversy over the appropriate role of money stock targets sustained and intensified interest in the question of intermediate targets and their implementation in the 1960s and 1970s. Interest in the subject was especially intense in the period after the October 1979 announcement of a change in operating procedures designed to improve the implementation of targets for the monetary aggregates. By the early 1980s, signs of an emerging breakdown in the existing relationships of the money measures to the economy generated suggestions that money stock targets be

augmented or replaced by broad measures of liquid assets and credit. As the extent of the shift in the relationship of *all* these various measures to GNP became more apparent, however, research interest in their use as intermediate targets or indicators waned and their role in policy making diminished. More recently, as discussed in the relevant papers in this volume, some interest has been expressed by economists and policy makers in possible roles for nominal GNP and/or for market measures such as commodity prices, the yield curve, and foreign exchange rates as policy targets and/or indicators.

In general, however, confidence that there exist financial measures that can replace in part or in whole a basically judgmental, pragmatic, and eclectic approach to policy seems currently (1990) at a rather low ebb. Virtually without exception, the results reported in this volume support such a skeptical attitude. Nevertheless, as argued below, the issue is far from closed. Indeed, interest in the problem of devising and implementing "intermediate" guides for policy is likely to prove a hardy perennial in the years ahead.

Some terminology

One product of the debate on these issues has been the development of a useful and reasonably settled vocabulary to discuss them. One can imagine a spectrum of economic measures that has, at one end, the "ultimate targets" of monetary policy. These almost always include the price level and real output and sometimes also include the behavior of the balance of payments and the foreign exchange value of the dollar.

At the other end of this spectrum are the "instruments" of monetary policy. These include open market operations, the discount rate, and in earlier periods, required reserve ratios and Regulation Q ceilings on deposit interest rates. Just one step along the spectrum beyond these instruments are "operating targets," measures that can be controlled with a rather high degree of precision through manipulation of the policy instruments. Potential operating targets include measures such as nonborrowed reserves, the nonborrowed monetary base, and short-term money market rates, most notably the federal funds rate. Borrowings from the discount window clearly also constituted a potential operating target under the system of lagged reserve accounting that prevailed between 1968 and 1984, since the Trading Desk could take required reserves as predetermined within any reserve averaging period. Even under the present system of approximately contemporaneous reserve accounting, most people would probably still want to count borrowings as a potential operating target—though to achieve it in any given reserve maintenance period means that the Desk must correctly estimate required reserves in the current period as well as market factors supplying reserves and the levels of excess reserves.

"Intermediate" measures, whether considered as "targets" or as "indicators," are variables that, as the term suggests, are intermediate between (1) the instruments and operating targets that are capable of rather tight control and (2) the ultimate target measures that can only be influenced indirectly. Measures of the money stock are perhaps the classic examples of such "intermediate" variables, but as noted, the list includes other broad financial aggregates, such as credit extended to the nonfinancial sectors, as well as market measures, such as the foreign exchange rate, that are thought to be significantly influenced by movements in the operating targets.

Some measures, as discussed in more detail in the appropriate papers, are a little harder to classify. Thus, for example, short-term interest rates are usually treated as operating targets but may also be treated as intermediate targets. Conversely, the monetary base is most often discussed as an intermediate measure but sometimes, more controversially, is viewed as a potential operating target. Nominal GNP is sometimes treated as a potential intermediate measure, at one step removed from its ultimate target components of prices and real output.

The various intermediate measures may have the potential to serve as intermediate "targets" and/or as intermediate "indicators" of monetary policy. "Targets" are, obviously enough, objectives the Federal Reserve seeks to achieve over some time period with some degree of precision and under some particular set of circumstances. The concept acquired legislative status with the 1975 congressional resolution requiring the Federal Reserve to report on its "plans and objectives with respect to the growth of the monetary and credit aggregates over the coming year," language that was repeated in the Humphrey-Hawkins legislation of 1978. The concept of an "intermediate target" seems to imply that to qualify, a measure should be (a) reasonably subject to control by the Federal Reserve through adjustment of its operating targets and (b) reasonably closely (that is, predictably) related to the ultimate targets or, in practice, at least to nominal GNP. Consequently, the papers in this volume examine the various measures considered as potential intermediate targets from both points of view.

The concept of intermediate measures as monetary "indicators" is a bit more complicated because it is sometimes taken to mean a measure of the stance of monetary policy and is sometimes interpreted as an indicator of current or future developments in the economy. In much of the earlier literature (early 1960s), the

term was interpreted in the sense of indicators of the stance of monetary policy—that is, as measures that could provide, in some sense, an index of monetary "ease" or "restraint." The attempt to pin down such an index produced, and indeed continues to produce, a certain amount of confusion and ambiguity. Consider, for example, a situation in which the Federal Reserve is using interest rates as an operating target and has no intermediate target objective for the money stock. Suppose on entering a recession, the policy makers progressively lower their interest rate target, but, owing to the recession-induced decline in the demand for money, the money stock falls (probably along with a drop in total reserves). Measured in terms of intentionality, policy has clearly "eased," because the declining short-term rates are, at least in large part, the direct result of policy decisions to ease. But if one believes that it is not intentionality but rather the impact of policy on the economy that matters, and if one also believes that this impact is best signaled by the money stock, then in this instance, the declining money stock indexes not an "easing" but a "tightening" of policy.

This may be a terminological problem in the sense that one may want to talk about an indicator of policy intentions or an indicator of policy impact and these may not be the same thing. But the distinction between measures of intention and measures of impact, if they are in fact different, may also raise an econometric issue: how to decide which intermediate measure, if any, should be treated as "predetermined" for estimating purposes. In this example, the money stock or short-term rates?

In any case, the recent technical literature has tended to focus on intermediate "indicators" (sometimes, in this context, also called "information variables") not as measures of the stance of policy, but as measures of the present or prospective state of the economy. This is the sense in which the term is generally used in the present volume. To be sure, there are places in the literature where the two senses of a monetary "indicator" are conflated. For example, a rise in commodity prices or a steepening of the yield curve may be taken as indicating *both* that the prospects are for rising inflation in the future *and* that policy has been "easy" or, perhaps, "too easy."

Clearly, the main requirement for a good intermediate indicator of the state of the economy is that it be reliably (predictably) related to the current or prospective behavior of ultimate goals such as inflation and/or real output. In practice, statistical tests have often been couched in terms of the relationship of the measure to nominal GNP.

A question arises whether a measure that has proved to be a good indicator in this sense can then be used as an intermediate *target* while still continuing to be a good *indicator*. It has sometimes been asserted that when a financial aggregate such as the money stock becomes an intermediate target, presumably chosen in part because of its good indicator properties, these properties will then be altered (for the worse?) by the very fact of its targeting by the authorities. This may or may not be a problem with respect to financial aggregates that are treated both as intermediate targets and indicators. It clearly could be a complicating issue, however, for such market measures as commodity prices, interest rates, and the foreign exchange rate. Knowledge in the market that the behavior of the measure is being used by the authorities to make policy decisions is very likely to alter that behavior. Partly for this reason, proponents of these latter measures have generally advocated them for only a single purpose: for example, commodity prices and the yield curve, simply as indicators; interest rates and the dollar, either as indicators or as operating or intermediate targets, but *not both* as indicators and as targets.

Is there a case for intermediate targets?

It is clear that a coherent monetary policy requires a decision on operating targets. It is equally clear that "indicator" measures providing advance information about the current or prospective state of the economy are, almost by definition, of value. The usefulness of intermediate monetary *targets,* however, has always been more controversial. No measure selected for such a role will ever be perfectly predictably related to the ultimate targets that matter. At least *some* uncertainty, *some* short-term instability, and *some* longer term drift in the relationship of any intermediate target to final objectives seems inevitable.

It has therefore been argued that the use of intermediate targets will result in suboptimal decisions. Policy makers will adjust their operating targets, not directly in terms of the settings most likely to achieve their ultimate objectives but, instead, in terms of the settings most likely to achieve the intermediate target. According to this line of thought, intermediate measures such as the money supply may be useful, at best, as variables that may shed light on (1) the current state of the economy, perhaps because of more prompt reporting, or (2) the economy's prospective future state, because of leading indicator properties. On the other hand, their use as intermediate targets is likely only to produce poorer control over ultimate targets than if instruments were adjusted directly in terms of objectives for these latter targets.

The logic of this criticism of intermediate measures as *targets* seems impeccable. Nevertheless, it misses

the heart of the case for the use of such targets, a case that encompasses a much wider range of considerations. This broader case envisions a number of potential benefits from the use of intermediate targets. It has been argued, for example, that intermediate targets can usefully provide a means of communicating the central bank's intentions to the public. Moreover, such targets can provide a form of central bank accountability.

The ultimate target measures may not be well suited for these various purposes. Thus, as discussed in the paper on nominal GNP targeting, there may be real problems in having an independent central bank set or announce goals for *ultimate* targets. Equally to the point, actual economic performance over any given period is subject to many important influences in addition to monetary policy. Hence it may be quite inappropriate to judge the success of this policy by the actual performance of the economy—that is, by the ultimate target measures—given the role of nonmonetary influences. By contrast, an intermediate target—a goal for the rate of money growth, for example—can be judged in advance for its probable consistency with acceptable economic outcomes. Moreover, it can be used to judge, ex post, whether the central bank's day-to-day decisions have been appropriate to achieving its intermediate target objective. Moreover, the existence of an intermediate target, defined over time periods such as a year, can be useful to the central bank as an internal check on the appropriateness of the shorter term settings of its operating targets.[1]

But there are other fundamental arguments for the use of intermediate targets—provided suitable targets can be found. Thus it has generally been argued that over the long run, monetary policy can only affect nominal magnitudes. Its longer run influence over real growth, real interest rates, and employment mainly reflects its success or lack of success in achieving an environment in which economic decisions can be made with a minimum of concern and uncertainty about price level instability. If this view is correct, the appeal of intermediate targets in providing a "nominal anchor" for policy decisions is fairly clear. Such targets can provide, in principle, an indication that the longer run thrust of policy will be consistent with longer run goals for price behavior. In principle, at least, any one of the various monetary and credit aggregates could, if used as intermediate targets, provide this kind of "nominal anchor" for policy—as could nominal GNP.

[1]These various arguments were cited in a speech, "The Contributions and Limitations of 'Monetary' Analysis," given by Paul A. Volcker in September 1976 and most recently reprinted in the 75th anniversary issue of the Federal Reserve Bank of New York's *Quarterly Review*, May 1989.

Another role that has been suggested for intermediate targets is in dealing with the potential conflict that may exist between short- and long-run optimal policy, an issue known as the "time consistency problem" in the academic literature and in more informal discussions as the "credibility problem." A conflict between short-run and long-run optimizing can arise from the fact that in the short run, the monetary authorities can probably engineer some extra real output, at least up to a point. They can only do this, however, through an expansionary policy that yields more inflation than is built into the public's expectations. According to widely accepted theory, increases in wages and prices that are more rapid than expected will "fool" the public into supplying more labor and goods under the mistaken impression that the higher wages and prices represent higher *real* rewards.

In the short run, there may be pressure on the central bank to seek output gains through such "surprise" inflation. But once the public comes to recognize that the policy makers are operating in a way that accelerates inflation, the public will anticipate this acceleration. Put simply, the attempt to boost output through policies that create surprise inflation will be self-defeating. Over time, the public will catch on, and the higher inflation will no longer be a "surprise." Inflation that is anticipated will have no power to induce higher output. Thus over the longer run, the effort to induce higher output through excessively stimulative policies will fail. Output will be no higher than it otherwise would have been—trending at its potential rate over time—but the rate of inflation will be higher. Thus on balance, stimulative policies that seem attractive period by period will, over the longer run, simply result in higher inflation without any output gains—a result desired by no one.

An intermediate target, publicly announced and faithfully adhered to, could, in theory, avoid this kind of outcome. It could do so by effectively tying the hands of the authorities, preventing them from yielding to the temptation to seek short-run output gains in a process that over the longer run only guarantees higher inflation. Probably the best known prescription for using an intermediate target in this way is the constant money growth "rule" or, in some versions, money growth targets that settle down to such a rule after some period of accommodation to disequilibrium initial conditions.

Of course a monetary growth rule also has potential disadvantages. Thus while it may ensure reasonable long-run price stability, it makes no provision for accommodating shocks—whether from supply or demand—and thus may achieve long-run price stability only at the expense of unsatisfactory shorter run outcomes for both output and prices. It might be possible to design a more complex monetary growth rule that

allows money growth to adjust to such short-run disturbances, but in a predetermined way that still prevents the authorities from seeking short-run output gains at the expense of higher average inflation. However, monetary rules that embody such automatic response features may themselves create credibility problems — as discussed in the paper in this collection that reviews the "time consistency" literature.

It has to be emphasized that all these various potential virtues of intermediate targets — improved accountability, improved communication with the public, provision of a nominal anchor, and prevention of short-run decisions that serve merely to raise inflation over the longer run — can be achieved only if *suitable* target measures exist. As noted earlier, "suitable" in this context means measures that are "sufficiently" controllable and "sufficiently" stable in their relation to the ultimate objectives. But this is not an all or nothing matter. *No* intermediate target will be perfectly controllable, even over a year. And no measure will be related in a perfectly predictable way to the ultimate targets. At least some slippage on both counts is inevitable. On the other hand, even if there is some slippage, the benefits derived from intermediate targeting may, over the longer run, outweigh the costs that arise as a result of this slippage. Clearly it is a matter of more or less — that is, a question of *how much* slippage can be expected from the use of intermediate targets, on the one hand, and *how much* one values their potential longer run benefits on the other. Typically, individuals most concerned with long-run inflation results have tended to minimize the problems with intermediate targets, while those most concerned with the shorter run real output consequences have tended to worry most about these problems.

Evaluating the candidates

Eight papers in this volume examine individual candidates or groups of candidates — for example, the multiple measures of money and credit — as potential targets and/or indicators of policy. While the papers differ somewhat in organization and emphasis, they all touch on certain common issues. These include (1) the theoretical basis for believing that the particular measures in question might be useful targets or indicators, (2) the statistical evidence for believing a relationship to ultimate targets exists and evidence for the stability of any such relationship, (3) issues of central bank control, and (4) the question whether the measure, even if not used as a formal target, might be useful in a subordinate role. For example, the paper on interest rates considers the possibility that even if interest rates make little sense as an intermediate target, upper and lower bounds for real short-term rates might nevertheless be useful as "constraints" on settings for an interest rate operating target.

As noted earlier, the most frequently advocated measures for intermediate targeting over the past three decades have been the various measures of the money stock and the monetary base, and more recently, liquid assets and various credit measures. The statistical results for these measures form a vast literature varying in method, sophistication, periods covered, and conclusions. This literature is summarized and evaluated in some detail in the individual papers in this volume. It may be useful here, however, to give some crude sense of the problems that developed for these measures in the 1980s.

Charts 1 to 6 show the departure from trends of the GNP velocities of a number of potential intermediate target measures in the 1980s. These departures are clearly large in all cases — greatest for M1, the monetary base, and nonfinancial credit; less for M2, M3, and liquid assets. These departures from past experience are fairly easy to explain in some cases. Thus the velocity of narrow money (and the monetary base) almost certainly fell because of declines in inflation, nominal interest rates, and hence the opportunity cost of holding these measures. Explanations in the case of the broader measures that internalize the effects of market interest rate movements seem less clear.

In any case, the same pattern of major departures from earlier postwar relationships is evident in Table 1, showing regressions of growth in nominal GNP on current and lagged growth in these various financial measures. As the error measures suggest, equations estimated on data from 1960 to 1979 do a very poor job in estimating GNP growth in the 1980s. And as Table 2 shows, similar equations estimated over data from 1981 to 1989 have almost no explanatory power, with coefficients that are not significant (indeed usually negative!) for all measures except the monetary base. This kind of result makes clear the reasons for the growing disillusionment in recent years with the potential of these measures as intermediate targets or indicators.

The other property required of a potential intermediate *target* (as opposed to *indicator*) is of course controllability, and that poses a different set of problems. Some of the broader measures, such as total liquid assets and aggregate credit, are clearly not closely related to Federal Reserve operating targets. They can perhaps only be controlled indirectly — that is, by first controlling GNP! The narrower measures such as M1 and M2 have clearly retained substantial interest rate sensitivity for horizons out to a year or so because many of their component own-rates respond only slowly to changes in market rates. As a result, growth in such measures may be rather sensitive to changes

Chart 1

Velocity of Monetary Base (GNP/Monetary Base)

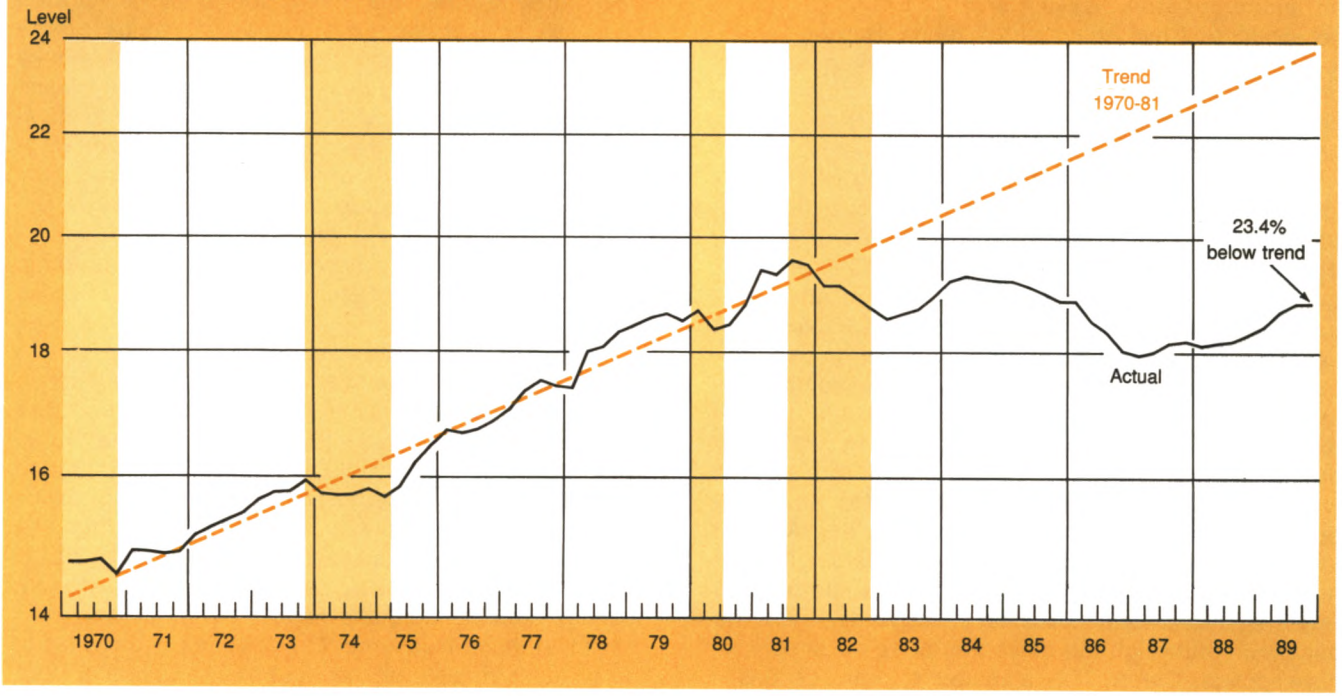


Chart 2

Velocity of M1 (GNP/M1)

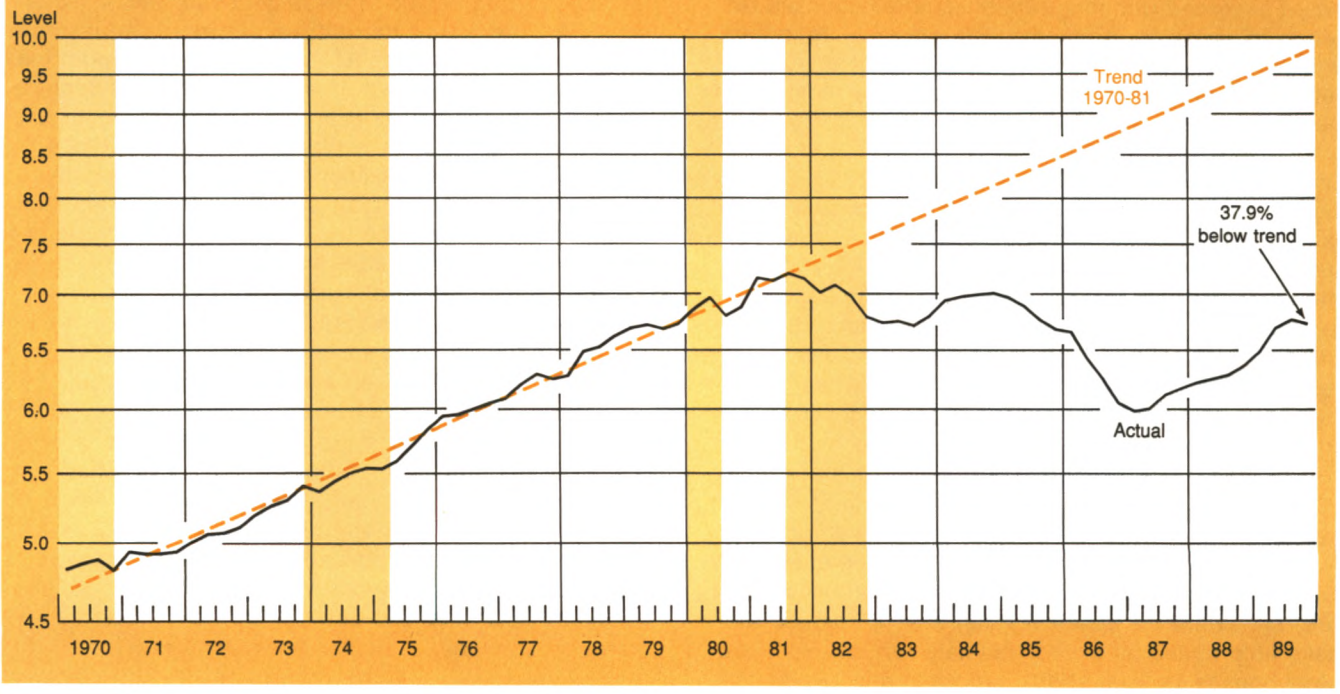


Chart 3

Velocity of M2 (GNP/M2)

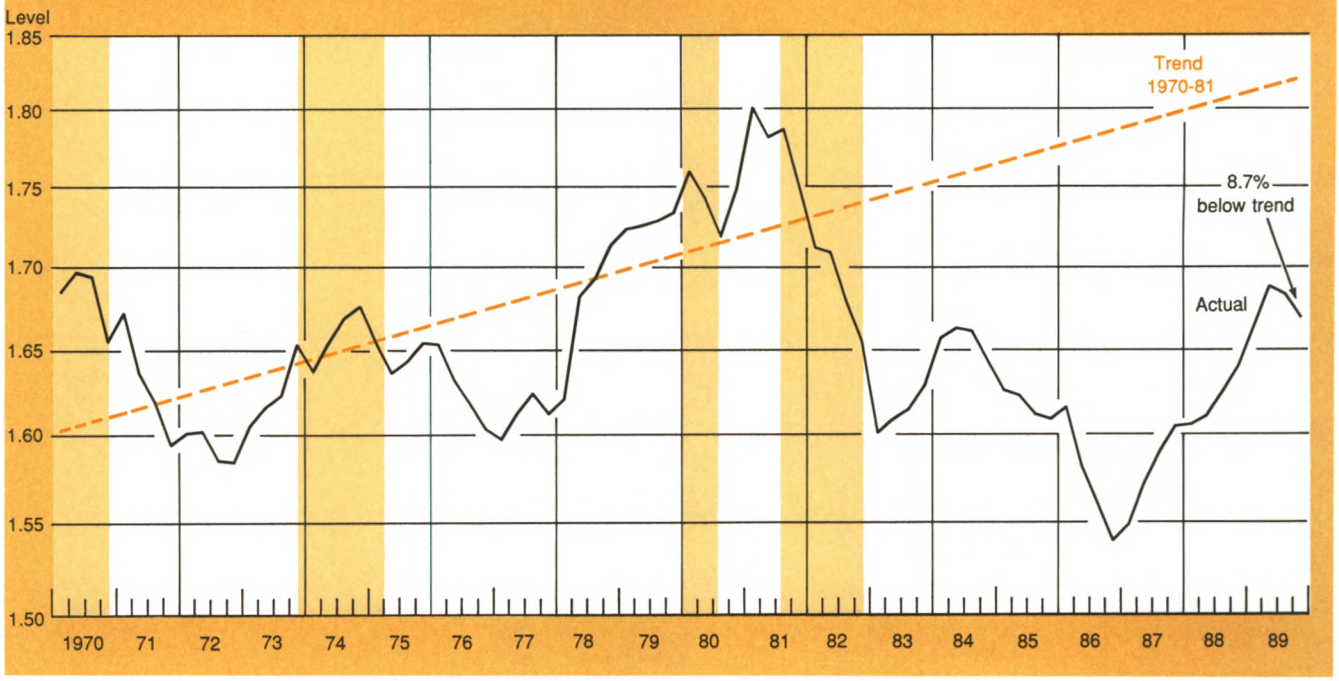


Chart 4

Velocity of M3 (GNP/M3)

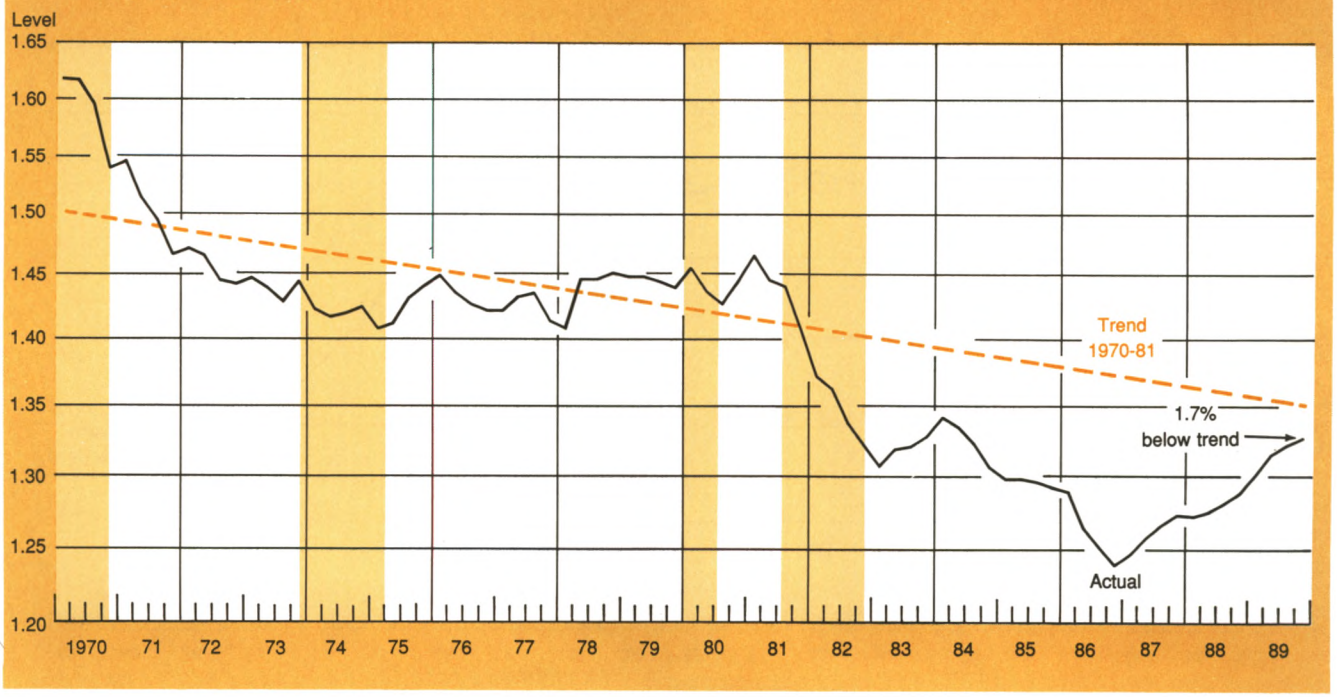


Chart 5

Velocity of L (GNP/L)

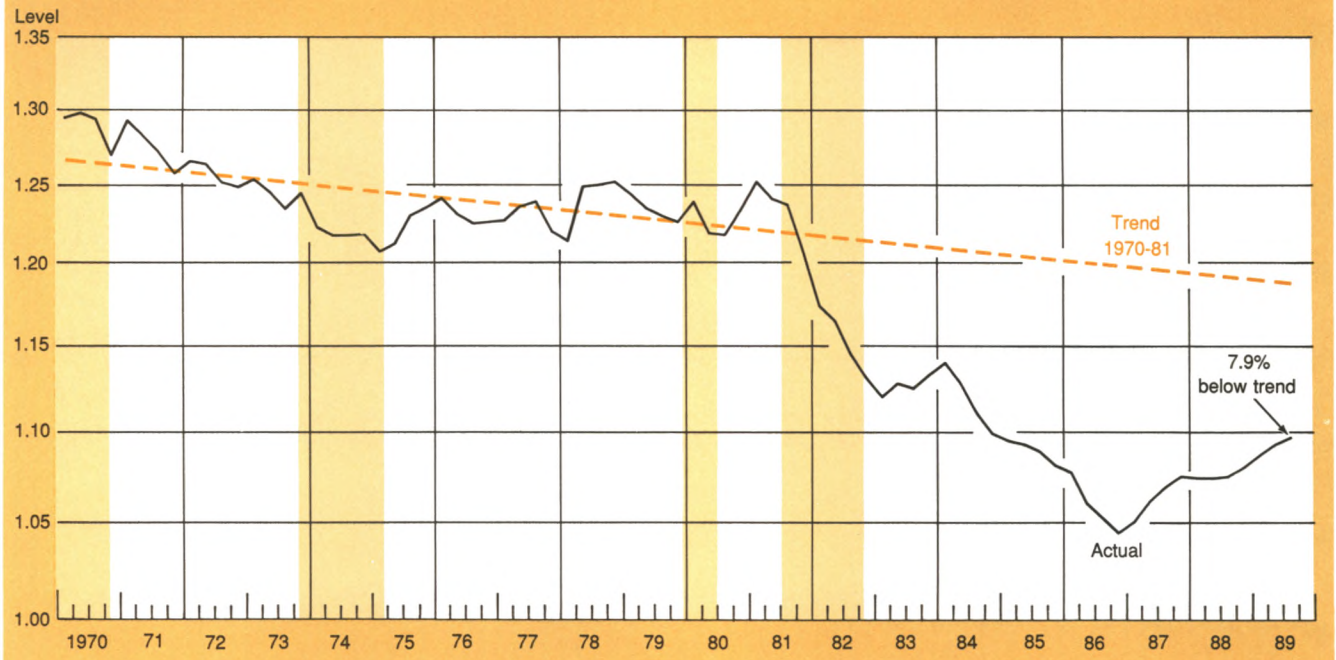
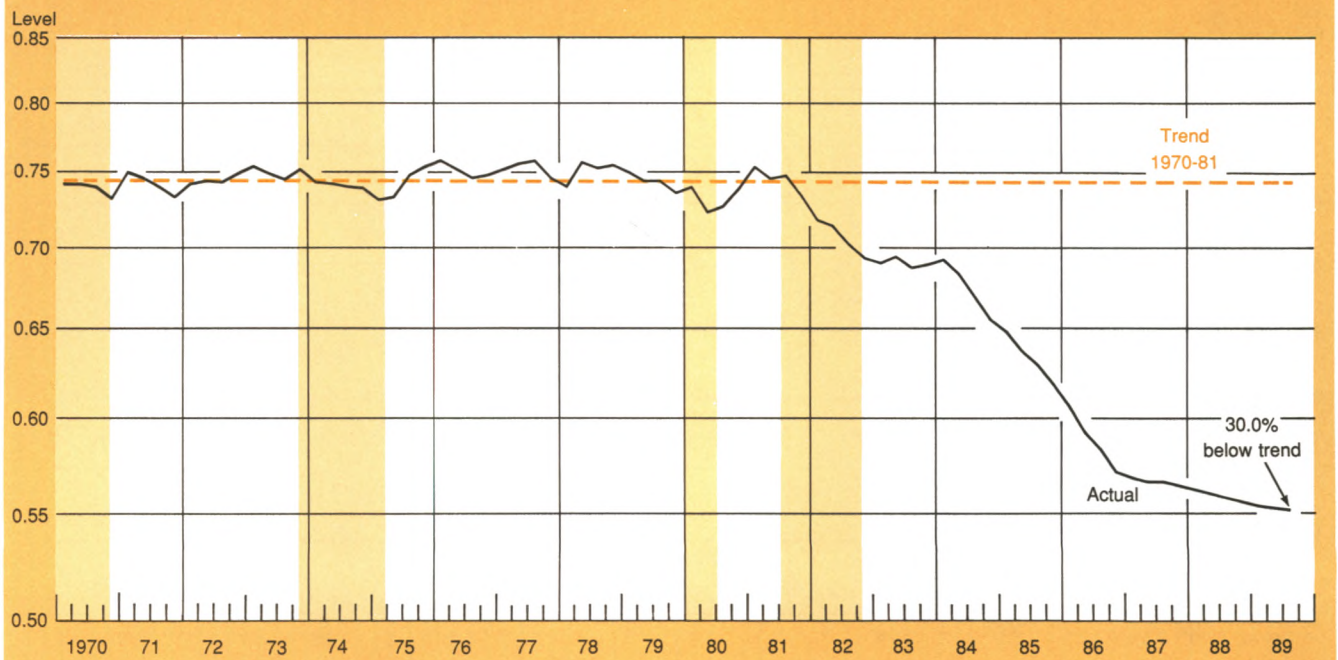


Chart 6

Velocity of Nonfinancial Debt (GNP/Debt)



in interest rate operating targets. That very sensitivity is itself a problem, however. Thus it makes the GNP outcome associated with any successfully-achieved growth rate target for the aggregate quite sensitive to shifts in the demand for goods and services — at least over periods out to a year or so. Use of such targets, therefore, either will imply a wide range of uncertainty about the GNP outcome associated with a given money growth rate or will make it seem desirable to define targets in terms of broad ranges of growth rates. This latter approach, however, clearly weakens the usefulness of such targets for many of the purposes they are designed to serve.

The breakdown in earlier relationships between financial aggregates and nominal GNP in the 1980s has lead a number of academic writers to suggest that the velocity problem could be "solved" by targeting nominal GNP directly. Such an approach has some attractive features. A long-run nominal GNP growth rule set in light of the expected trend growth in real output would establish a "nominal anchor" for policy. Adhered to as a "rule," with or without automatic feedback mechanisms, it would solve the short run/long run inconsistency problem and would satisfy the other objectives of an intermediate target. In the short run, adherence to a nominal GNP target would automatically offset both the price and the real effects of demand shifts and would split the impact of supply shifts between real output and prices.

Unfortunately, the nominal GNP approach appears to have equally large problems. First, it "solves" the velocity problem only on the assumption that there exists a way of accurately achieving a nominal GNP target with the means at the disposal of the central bank. Obviously the method of choice would *not* be through intermediate money targets, for that would simply reintroduce the velocity problem. A different option would be to aim at GNP targets through constant resettings of an interest rate operating target. Clearly success with such an approach is far from assured.

A second difficulty is that to get a handle on final objectives with a nominal GNP target, you need to have a predictable relationship between nominal GNP and output in the short-run — that is, you need to be able to predict the price/output split resulting from a given GNP result, at least to the extent that you have short-run output objectives. But of course this problem is shared with other potential intermediate targets such as money growth rates.

A third difficulty is that a fixed nominal GNP rule could, under quite plausible conditions examined in the GNP paper in this volume, generate problems of dynamic instability in the path of real output in the face of supply shocks and, apparently, in the face of prior misses in hitting the nominal GNP objective. Such problems can be avoided by resetting, on a discretionary basis, the nominal GNP target year by year. But this approach would create a very uncomfortable situation for a central bank that is "independent within the government." Year-by-year settings of GNP targets

Table 1

Summary Statistics from Reduced Form Equations

1960-II to 1979-IV

				Actual-Predicted for 1980-89		
	$\bar{R}^2$	SEE	DW	Average Error	Average Absolute Error	RMSE
Y = 2.49 + 1.18M1 (2.39) (6.29)	0.34	3.66	2.05	−4.13	5.72	6.16
Y = 1.43 + 0.85M2 (0.99) (5.19)	0.24	3.92	1.86	−0.38	3.55	4.48
Y = 1.57 + 0.75M3 (1.07) (5.07)	0.23	3.94	1.86	−0.55	3.40	4.49
Y = 0.37 + 0.93L (0.25) (5.69)	0.30	3.78	2.01	−0.97†	3.67†	4.54†
Y = 1.00 + 0.87Debt (0.59) (4.54)	0.29	3.80	2.08	−2.65†	4.35†	4.77†
Y = 2.72 + 0.98Base (2.34) (5.33)	0.27	3.85	1.92	−2.40	3.99	4.41

Notes: All equations regress the growth rate of nominal GNP on the current and four lagged growth rates of the financial aggregate. Figures in parentheses are "t" values. L represents the Federal Reserve Board's measure of liquid assets.

†1980-I to 1989-III

would come very close to setting year-by-year targets for real growth and inflation. Such a situation could well create pressures for precisely the kind of short-term optimization that produces the worst of all possible worlds over the long run — that is, it would seem to maximize the risks of creating the kind of "time consistency" problem cited earlier. Overall, it seems quite possible that as a practical matter, discretionary nominal GNP targeting could result in worse inflation outcomes than might exist in the absence of any intermediate target at all. In summary, the nominal GNP route appears, on closer examination, to be no panacea for the problems created by the velocity instabilities of the 1980s.

The remaining measures examined in this volume, commodity prices, the yield curve, and the foreign exchange value of the dollar, have generally been proposed as intermediate indicators that might be used to guide settings of the operating targets, rather than as intermediate targets themselves. Because these markets are often regarded as efficient in incorporating relevant economic information, they could perhaps signal changes in the economic outlook very quickly.

In the case of commodity prices, it seems likely that these prices could in fact be targeted through direct open market operations in commodity markets. Indeed, that is just what a "commodity standard," whether defined in terms of a basket of commodities or a single commodity such as gold, would involve. Instead of such operations, it has been suggested merely that commodity prices may represent sensitive advance indicators of changes in general inflation rates that can be used to signal the need to tighten or ease the conventional operating targets.

Table 2

Summary Statistics from Reduced Form Equations

1981-I to 1989-IV

	$\bar{R}^2$	SEE	DW
Y = 5.85 + 0.16M1 (4.17) (1.03)	0.06	3.67	1.36
Y = 7.21 + 0.01M2 (2.88) (−0.02)	0.02	3.76	1.31
Y = 8.05 + 0.06M3 (3.16) (−0.21)	0	3.79	1.33
Y = 9.46 + 0.21L (3.33) (−0.21)	0.06†	3.69†	1.38†
Y = 10.80 + 0.30Debt (2.85) (−0.90)	0.07†	3.66†	1.51†
Y = 0.37 + .99Base (0.12) (2.56)	0.16	3.48	1.51

Notes: All equations regress the growth rate of nominal GNP on the current and four lagged growth rates of the financial aggregate. Figures in parentheses are "t" values. L represents the Federal Reserve Board's measure of liquid assets.

†1981-I to 1989-III

The results surveyed in the paper on commodity prices included in this volume suggest that movements in commodity price indexes do have a marginal contribution, but only a marginal contribution, to make in forecasting inflation. As leading indicators of turning points in broad movements in the overall inflation rate, commodity price measures, suitably averaged and smoothed, do have some predictive value. But they have also at times given false signals of turning points in the general inflation rate. In the case of correct signals, moreover, their lead times tend to be rather variable and there appears to be little relation between the *magnitude* of commodity price movements and the magnitudes of subsequent movements in overall inflation. On balance, it appears that commodity prices may be reasonable additions to the items the central bank "looks at" when it surveys the prospects for inflation. They do not, however, add much to more conventional methods of assessing the outlook for inflation.

Another market measure that has been proposed as an indicator but not as a target of monetary policy is the yield curve. In this case, the question whether the measure is to be thought of as an indicator of the stance of policy or an indicator of the future course of the economy is somewhat ambiguous. And this ambiguity is directly related to the theoretical assumptions underlying the attention sometimes given to the yield curve for either or both of these roles. Belief in the indicator properties of the yield curve appears to rest on the expectations theory of the yield curve — the view that longer term rates should be regarded as (weighted) averages of the market's expectations of the future course of successive short rates. While this theory has considerable intuitive appeal, empirical tests of its validity over the years have produced mixed results.

Even if the expectations theory of the yield curve is accepted as correct, moreover, the theoretical implications of particular yield curve configurations, as interpretations both of monetary policy and of prospective economic performance, appear to be ambiguous. This ambiguity stems in part from another widely accepted theoretical premise — that nominal interest rates reflect the sum of a real rate and an inflation premium that allows for the expected rate of inflation over the life of the instrument. Thus an upward rising yield curve, for example, could imply either that the market expects real short-term rates to rise in the future or that it expects the rate of inflation to rise.

Against this background, the paper on the yield curve

in this volume points out that it would be very hard for a central bank to interpret the significance of, for example, a steepening of the yield curve on the basis of theoretical considerations alone. Such a steepening could mean that the market expects inflation to accelerate, which the central bank could interpret as a need to tighten. Alternatively, it could mean that the market expects a rise in the productivity of capital and hence a rise in real short-term rates and an acceleration of real growth. This cause of a steepening in the yield curve might or might not imply a need to change the settings of operating targets depending on circumstances. A third possibility is that the steepening reflects a market judgment about the future of monetary policy itself—that is, that policy is expected to tighten, real short rates to rise, and therefore, quite possibly, real growth to slow. So a central bank looking at a change in the yield curve must try to sort out its possible meanings and then must decide what implications, if any, the change may have for policy.

Despite these interpretive ambiguities at the theoretical level, the yield curve paper gives some fairly concrete results. It suggests, for example, that the Federal Reserve does have significant power to affect the yield curve by changing the federal funds rate as an operating measure. Since no one proposes the yield curve as a *target,* however, this is of rather limited significance. But the paper goes on to suggest that the yield curve, simply as an empirical matter, has proved to have significant forecasting value for both real output and inflation, even in the presence of other forecasting variables such as short-term interest rates, the leading indicators, and the consensus of economists' forecasts.

One has to wonder, however, how this forecasting value might be affected if the yield curve were to become a major forecasting tool for the authorities and if the market were to become aware of such a development and were to respond accordingly. A kind of "two-person game" situation between the market and the authorities might greatly distort the behavior of the yield curve relative to what it would be in the absence of a belief in its indicator significance.

Finally, the increasing sensitivity of the U.S. economy to international developments has led to growing interest in the use of the foreign exchange value of the dollar as a guide for U.S. monetary policy. However, the paper on this topic emphasizes that, because of important differences between exchange rates and more traditional variables, the systematic use of the dollar's value in U.S. monetary policy operations is likely to be highly problematic and would almost certainly raise considerations beyond those traditionally incorporated in U.S. policy deliberations. In particular, manipulation of policy instruments to regularly counter or "target" dollar movements could be destabilizing for the U.S. economy under a wide range of circumstances and could require a significant degree of international policy coordination.

The paper does suggest that exchange rates can play a useful role as policy indicators but generally only under fairly limited circumstances. At times, for example, foreign exchange market conditions have proved helpful in gauging market perceptions and the likely reactions to policy changes. Beyond these circumstances, however, the evidence raises considerable doubts about the reliability of exchange rates as regular indicators of underlying inflation pressures or the monetary policy stance. Accordingly, on present knowledge, the case for upgrading the role of the dollar in U.S. monetary policy formulation appears questionable.

A future for intermediate targets?

The cumulative effect of the papers included in this volume is to leave one impressed with the limitations of *all* the various measures, certainly as intermediate targets and, for the most part, even simply as indicators. But if all potential intermediate targets have problems, it is also important to recall the many ways in which policy conducted without *any* such target is itself less than satisfying.

In practice, conducting policy without reference to intermediate targets means setting operating targets directly in line with changing assessments of the likely outcomes for the ultimate goal variables. Perhaps most often, this will mean adjusting some money market rate in line with changing projections of the future behavior, under assumed paths for such a rate, of prices and real output.

The difficulties of this approach to policy making are numerous. Perhaps the most obvious problem is the need to assess correctly the *future* state of the economy under alternative assumptions about settings of the operating targets. Note that it is the future state of the economy that matters given the universally acknowledged existence of significant lags in the impact of policy on output and prices. While there is substantial evidence that experienced macro forecasters can improve significantly on naive extrapolative procedures in projecting the future, it is also clear that forecasting remains as much an art as a science. Macro forecasting normally reflects a blend of reliance on econometric models, interpretation of incoming information (both statistical and "anecdotal") on the current state of the economy, and the selective use of an array of leading indicator measures. While such forecasting is clearly useful—indeed, absolutely necessary given the lags of policy's impact—it is also obviously fallible. As a further complication, policy

decisions must be based on *multiple* forecasts, implicit or explicit, that are conditional on multiple alternative settings of the operating variables under consideration.

The well-known limitations on the ability to forecast raise the risk, moreover, that policy makers will find themselves putting undue weight on the *current* state of the economy despite the acknowledged importance of lags in the process. And of course absent intermediate targets, policy-making procedures do not readily lend themselves to an "objective," quantitative way of communicating the intentions of policy to the public or of evaluating its success after the fact. Even more serious, an approach that relies on setting operating targets in light of projected future economic outcomes fails to provide a "nominal anchor" for policy and does nothing to solve the conflict between period-by-period and long-run optimizing in policy making.

So we have a real tension here. On the one hand, intermediate targets, if suitable ones exist, have the potential for improving the overall performance of monetary policy, especially over the longer run. But, to repeat, "suitable" means not merely controllable, but sufficiently tightly related to ultimate goals that slippages can be ignored and thus the forecasting problem bypassed. The experience of the 1980s has left serious doubts that such "suitable" target measures do in fact exist. Faced with this tension, the Federal Reserve has in practice compromised. It has continued to set intermediate targets for money and credit aggregates — as, indeed, it is required to do by law — but it has defined these targets in terms of rather wide ranges (generally 4 percentage points for annual growth rates). Moreover, on occasion the Federal Reserve has felt free to allow even these wide ranges to be violated when it has appeared likely that the targets could be achieved only at the expense of inferior economic outcomes — or at least outcomes that are "inferior" within the one-year time horizon of the current targeting process. The target measures have been given more attention when at the top or bottom of their ranges, with particular attention focused on the behavior of M2. In summary, intermediate targets have continued to exist, but only as rather wide ranges and without any clearly defined means of connecting them with day-to-day or month-to-month operational decisions.

Even under these circumstances, the extant intermediate targets have had some value in providing a "nominal anchor" — though one that tends to drag a bit — and have provided a means of connecting, if somewhat loosely, short- to intermediate-run objectives with the longer run objectives for price performance. Nevertheless, it is apparent that their usefulness for these purposes falls far short of what, at least in theory, could be provided by more formal adherence to a *satisfactory* intermediate target.

The broad appeal of the intermediate target concept is such that interest in it seems bound to persist. Research on the subject has continued, both within and without the Federal Reserve System. In particular, some economists at the Federal Reserve Board have developed evidence to suggest that long-run M2 velocity may have retained enough stability to make M2 behavior a useful indicator of the longer run behavior of inflation. In the meanwhile, it is possible that after the major shocks to the monetary aggregates (and possibly also to broad credit measures) from financial innovation and deregulation in the 1980s, these aggregates may settle down to a pattern of behavior that, if changed from earlier decades, has nevertheless again become predictable enough to be useful.

The future role of intermediate targets in the policy-making process is certainly likely to depend in part on such potential developments. But given the short-run slippages that would inevitably persist between intermediate targets and ultimate objectives even under the best of circumstances, the future role of intermediate targets probably also depends on the weight that is given to the objective of long-run price stability. It is in the context of such an objective that the potential usefulness of intermediate targets is particularly clear.

Treasury and Federal Reserve Foreign Exchange Operations

May-July 1990

The dollar generally declined during the May-July reporting period. At first the easier tone for the dollar largely reflected improving sentiment towards other currencies, especially the mark and yen. But by late June, the focus began to shift to the dollar, and sentiment towards the dollar deteriorated in the midst of talk of a worsening U.S. fiscal deficit, a weakening domestic economy, and possible declines in U.S. interest rates in an environment of rising worldwide demand for capital. By the close of the period, the dollar had declined more than 8 percent against the yen and 5½ percent against the mark, approaching the previous postwar low against the latter currency. Against sterling, the dollar declined 12 percent. On a trade-weighted basis, as measured by the staff of the Federal Reserve Board of Governors, the dollar declined about 6 percent.

During the period, no operations aimed at influencing the level of the dollar were carried out. Over the course of the reporting period, the Desk sold a total of $1 billion equivalent of marks in the market on behalf of the Exchange Stabilization Fund (ESF). The sales were part of a U.S. Treasury operation to adjust balances and facilitate the retiring of a portion of the amounts held by the Federal Reserve under the ESF's warehousing arrangements with the Federal Reserve.

May through mid-June

The dollar was trading narrowly around DM1.68 and ¥159 as the period opened. The dollar benefited from the release of reports late in the previous period and early in May suggesting that U.S. economic growth and price pressures were strong enough that any move in monetary policy would be toward greater restraint. That perception of U.S. economic prospects was temporarily challenged early in May following a weaker than expected April U.S. employment report released May 4, growing concerns about the U.S. budget deficit, and nervousness about the impact of the savings and loan crisis on the economic outlook. The April retail sales and producer price data released on May 11 raised further questions about the strength of the economy, and the dollar moved down to DM1.6260 and ¥152.62. These factors were offset later in the month by comments from a number of Federal Reserve officials reaffirming their view that the principal challenge facing the economy was the persistence of inflationary pressures.

Much of the market's attention during the weeks of May and early June, however, focused on other currencies. A major area of interest was how the mark would be affected by German economic and monetary union. Ever since the West German government had first announced in February its commitment to rapid economic and monetary union, there had been great interest in the terms of the forthcoming currency conversion. Market participants had been wary of the possibility that, in an effort to stabilize the East German economy, the authorities might set a conversion rate for the East German "ost-mark" so favorable to the East Germans as to generate an explosive increase in deutsche mark monetary aggregates and spending power. The actual terms of the conversion,

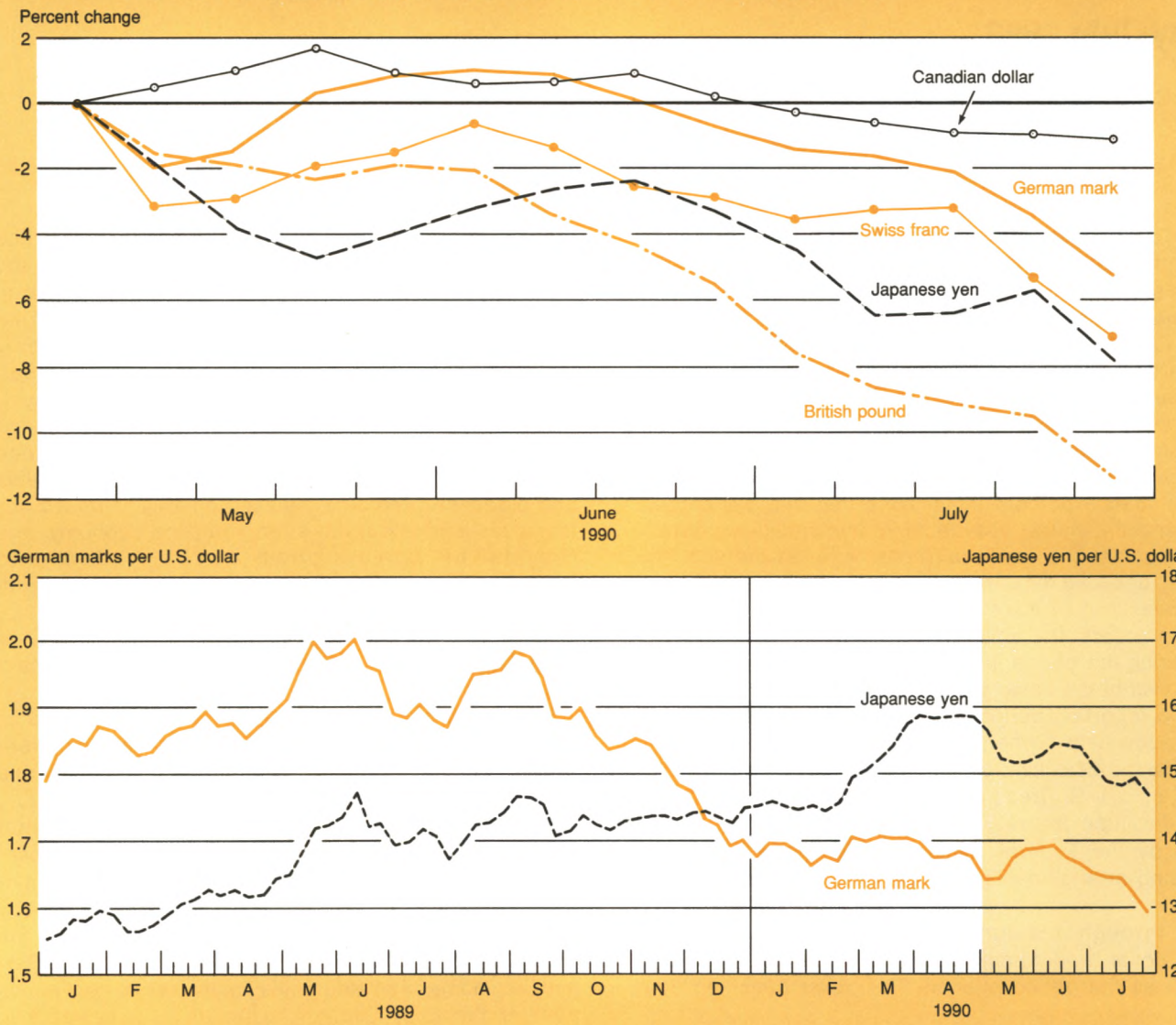
A report presented by Sam Y. Cross, Executive Vice President in charge of the Foreign Group at the Federal Reserve Bank of New York and Manager of Foreign Operations for the System Open Market Account. Paul DiLeo was primarily responsible for preparation of the report.

announced in early May, alleviated these concerns. Accordingly, early in the period, with most market participants convinced that union would boost an already strong German economy and impart to monetary policy a further bias towards restraint for the period ahead, the mark found renewed support in the exchange markets.

Nevertheless, some market participants remained leery of Germany's ability to accommodate union without serious negative repercussions for financial markets, price pressures, or the political landscape. As a result, sentiment towards the mark tended to fluctuate for most of May and June, alternating between more and less sanguine views of the likely short-term reper-

Chart 1

Through mid-June the dollar fluctuated without clear direction, largely in response to developments affecting other currencies, then declined through the end of the period as sentiment deteriorated.



The top chart shows the percent change of weekly average rates for the dollar from May 1, 1990. The bottom chart shows the weekly average rates for the dollar against the German mark and Japanese yen from January 1989. All rates are New York closing quotations.

cussions. Among the issues attracting market attention were the mix of tax and debt financing that the West German government would use to help finance structural adjustment in East Germany, the possibility of a backlash against the incumbent political parties by West German voters alarmed by the potential costs of union, and recurrent reports of conflicts between the Bundesbank and the government over the mechanisms of monetary union.

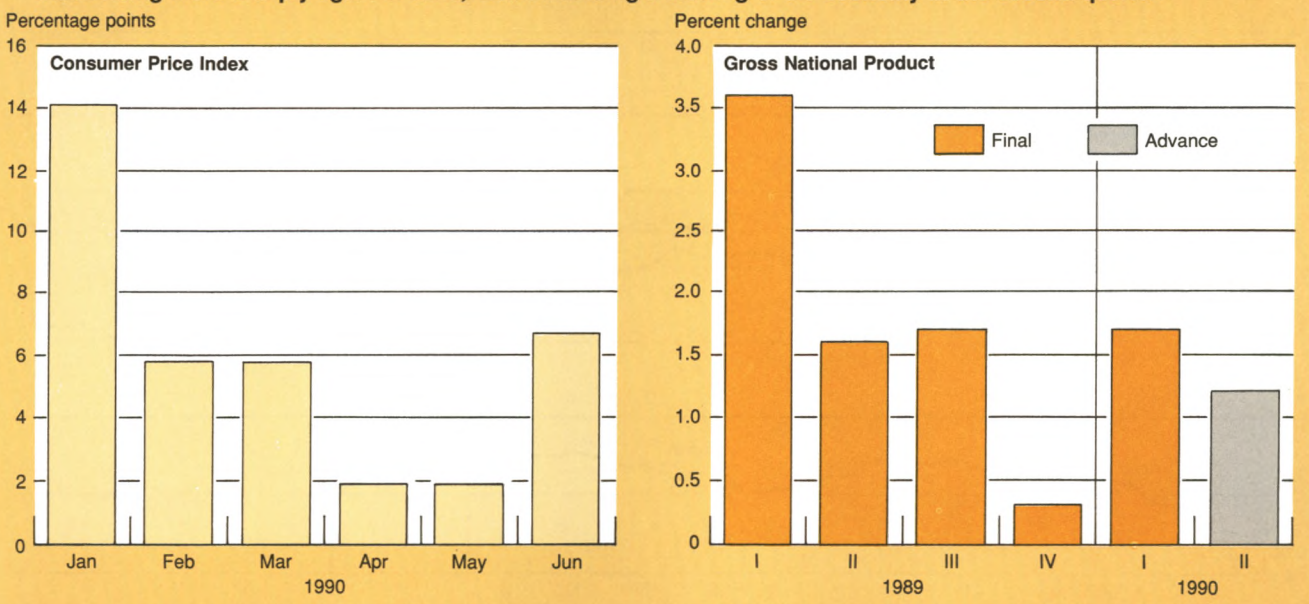
The yen, on the other hand, consistently strengthened during much of May. Analysts were articulating a more balanced assessment of Japanese economic policy and political stability than had been heard for several months. Political, financial, and economic concerns that had weighed on that currency earlier in the year subsided. Public opinion polls indicated that Prime Minister Kaifu had succeeded in clearly establishing his own leadership and in translating his personal popularity into renewed support for the ruling Liberal Democratic Party. The May 6 Group of Seven (G-7) meeting was seen in the market as demonstrating more cohesion among the governments with respect to Japanese concerns. The volatility displayed by Japanese financial markets earlier in the year had dampened — in fact, the Nikkei Dow-Jones index had recovered steadily since early April — and concerns that Japanese financial market conditions would have a major negative impact on economic performance gave way to renewed expectations that interest rates might tend to firm. In this context, reports circulated that Japanese investors were reconsidering their expectations of persistent yen weakness and the hedging strategies for dollar investments associated with those expectations. Amid these conditions, the dollar declined through the ¥150 level on May 25 before recovering somewhat.

Thus, the dollar moved up on balance against the mark from its early May low and was trading around DM 1.68 by the middle of June, showing at times a tendency to firm. Against the yen, in contrast, it declined more than 3 percent since early May to trade around ¥154 by mid-June.

Meanwhile, a number of high-yielding currencies showed strength, as they would from time to time through the end of the period. The Canadian dollar, although weighed down during May and June by concerns over political uncertainty relating to the constitutional status of Quebec, demonstrated considerable underlying buoyancy as differentials over U.S. interest

Chart 2

Data released during the period provided evidence of the persistence of price pressures, with the consumer price index rising more sharply again in June, notwithstanding a slowing of the economy in the second quarter.



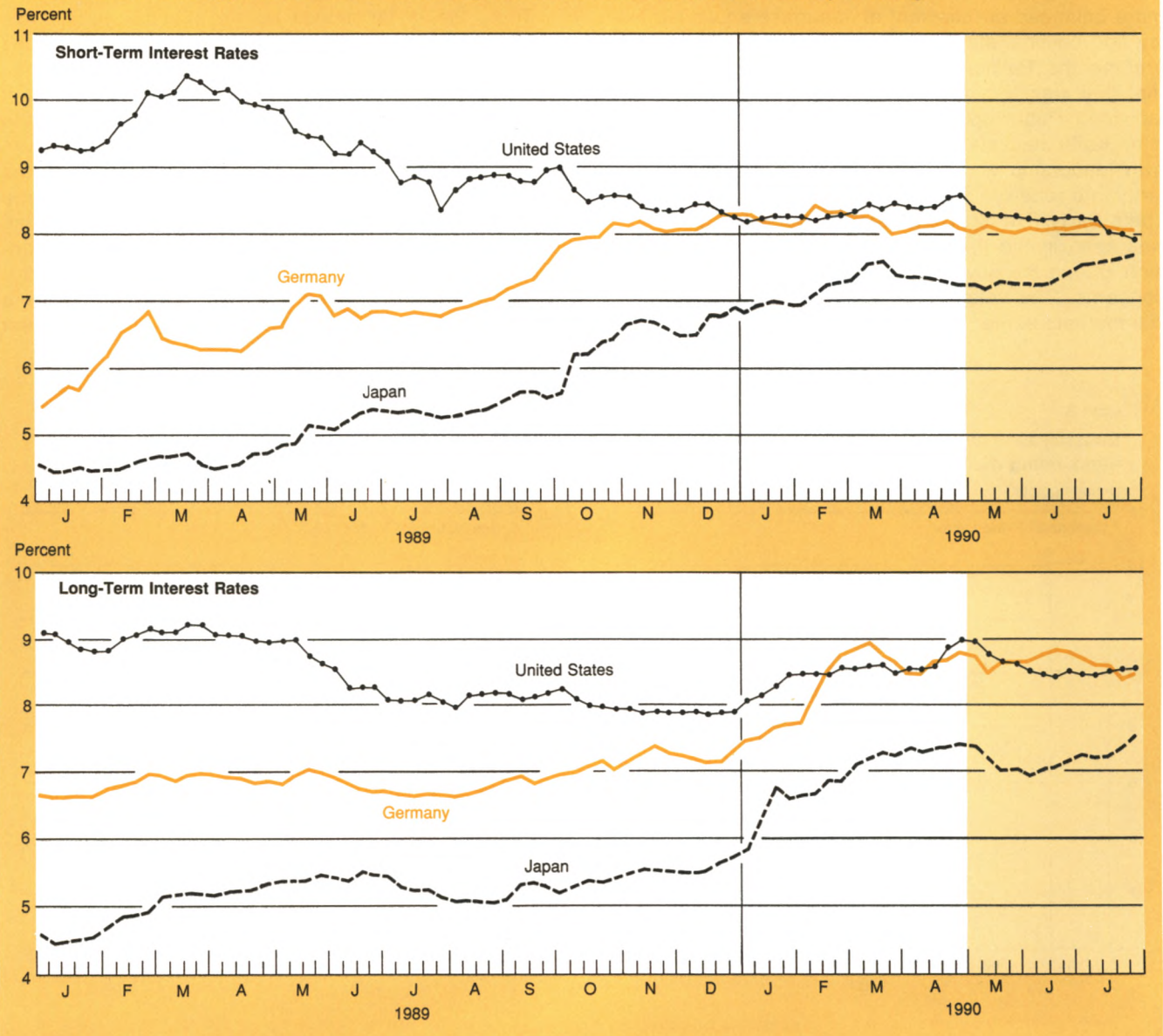
The left chart shows the monthly rise in the seasonally adjusted U.S. consumer price index, annualized. Consumer price data for April, May, and June were released on May 16, June 15, and July 18, respectively. The right chart shows the seasonally adjusted rate of change in gross national product, adjusted for inflation. The advance report for the second quarter, as well as revisions to data for previous quarters, was released July 27.

rates increased from already high levels. Even though the Quebec question was left unresolved when a June 23 deadline for unanimous provincial approval of the so-called Meech Lake Accord passed without the necessary action, the Canadian dollar rebounded quickly. The currency then traded near ten-year highs for most of July.

Sterling also benefited during this period as relatively high yields coincided with an increasing sense on the part of market participants that the United Kingdom would soon join the Exchange Rate Mechanism (ERM) of the European Monetary System. Attention to the

Chart 3

U.S. interest rates appeared to be on a declining trend, while rates abroad were steady or rising.



The top chart shows weekly average U.S., German, and Japanese three-month Euromarket interest rates. The bottom chart shows weekly average U.S., German, and Japanese government long-bond yields.

possibility of early ERM entry was sparked by a press report on June 12 that the government was contemplating entry as early as the fall. Sterling promptly strengthened, rising above $1.70, and subsequently reached a nineteen-month high of $1.8650 on July 31.

Finally, the higher yielding ERM currencies also strengthened as market participants perceived that there was little risk of an ERM realignment in the foreseeable future. In particular, the Italian lira remained at the top of the narrow band throughout the period and the Spanish peseta moved to the top of its wider band. All other currencies tended to bunch together at the bottom of the bands against the lira and the peseta, and a number of currencies reached their bilateral limits at times.

Table 1

Federal Reserve Reciprocal Currency Arrangements

In Millions of Dollars

Institution	Amount of Facility July 31, 1990
Austrian National Bank	250
National Bank of Belgium	1,000
Bank of Canada	2,000
National Bank of Denmark	250
Bank of England	3,000
Bank of France	2,000
Deutsche Bundesbank	6,000
Bank of Italy	3,000
Bank of Japan	5,000
Bank of Mexico	700
Netherlands Bank	500
Bank of Norway	250
Bank of Sweden	300
Swiss National Bank	4,000
Bank for International Settlements	
Dollars against Swiss francs	600
Dollars against other authorized European currencies	1,250
Total	30,100

Late June and July

A succession of statements by Federal Reserve officials during June had strengthened the view that the central bank remained sensitive to the need to resist inflation and that the economic signs did not warrant a change in policy direction. At the same time, market participants adopted a moderately cautious attitude towards the yen as the final round of the Structural Impediments Initiative (SII) negotiations approached with what appeared to be major areas of disagreement outstanding. There was also some caution towards the mark as the July 1 effective date of economic and monetary union neared. By June 25 the dollar was trading around DM 1.67 and ¥155.

Toward the end of June, market participants began to reassess the outlook for the U.S. economy and monetary policy. After President Bush's statement acknowledging that tax revenue increases could be a part of a deficit reduction package, market participants began to expect that agreement with Congress on such a package might lead to a decline in U.S. interest rates at a time when German and Japanese rates appeared likely to remain steady or, looking further ahead, even rise. The initial reaction of the foreign exchange market was muted as attention was focused on political and economic developments elsewhere.

In the weeks that followed, the dollar softened as developments in Germany and Japan were seen as favorable for their currencies. In Germany, initial reports following German economic and monetary union and the currency conversion were reassuring. Indications were that the feared surge in consumption was not materializing. Although some monetary tightening was still expected eventually, there appeared to be no immediate large increase in demand pressures, as East Germans took a cautious view of their prospects in light of the economic restructuring and uncer-

Table 2

Drawings and Repayments by Foreign Central Banks under Reciprocal Currency Arrangements with the Federal Reserve System

In Millions of Dollars; Drawings(+) or Repayments(−)

Central Bank Drawing on the Federal Reserve System	Amount of Facility	Outstanding as of April 30, 1990	May	June	July	Outstanding as of July 31, 1990
Bank of Mexico†	700.0	541.8	−28.4	−117.0	−396.5	0

Note: Data are on a value-date basis. Components in Table 3 may not add to totals because of rounding.

†Represents the FOMC portion of a $1,300 million short-term credit facility established on March 23, 1990.

tainties that lay ahead. Nevertheless, the mark, which had moved down in the ERM since early in the year, declined further to trade near its bilateral parity limit with the Italian lira and Spanish peseta. With regard to the yen, the conclusion of the SII negotiations was seen as a positive development. Fears that the negotiations would result in agreements that would undermine support for the Kaifu government were largely erased when the highly visible issue of increased public works spending by the Japanese government was satisfactorily resolved. By July 9 the dollar had drifted down more than 1 percent against the mark and almost 3 percent against the yen from its level in late June to close at DM1.65 and ¥151.

On July 10, at the time of the Houston Summit, a number of comments by U.S. officials served to revive market participants' expectations of an early easing in U.S. monetary policy. The dollar began to trade with a softer tone. The dollar firmed somewhat the next day when the final summit communiqué was released and did not contain any references to new initiatives on exchange rates, which some had expected. Then, on July 12, Chairman Greenspan told the Senate Banking Committee that the Federal Reserve might ease monetary policy to offset a firming in credit market conditions suggested by a tightening of terms on credit from banks and sluggish growth in M2. The market had not expected that statement and the dollar promptly declined, closing the day at ¥147.45 and DM1.6355.

During the remaining two weeks of the period, the dollar declined by a modest amount as interest rate and financial market developments further reduced the attractiveness of dollar investments. In particular, market participants noted the decline in the U.S. stock market on July 23, which was associated with disappointing earnings by a number of firms. New signs of weakening U.S. economic growth, particularly the second-quarter GNP data released July 27, were seen in

Warehousing Operations

During the three-month period, the Exchange Stabilization Fund (ESF) of the Treasury both unwound and renewed warehousing transactions with the Federal Reserve. Warehousing operations have been carried out from time to time since 1963. In carrying out such an operation, the Federal Reserve buys the foreign currency in a spot purchase from the Treasury and simultaneously sells it back to the Treasury at the same exchange rate for a future maturity date. A key aspect of this arrangement is that the Federal Reserve and the Treasury agree to use the same exchange rate to initiate and reverse the transaction; consequently, neither party incurs any foreign exchange rate risk as a result of the transaction itself. The ESF may realize a profit or loss at the time the warehousing transaction is undertaken or renewed, and it remains exposed to valuation gains or losses on the foreign currencies being warehoused (Table 4). A warehousing transaction is reversed when the Treasury repays dollars and the Federal Reserve repays the foreign currency it has acquired from the Treasury.

Table 3

Drawings and Repayments by Foreign Central Banks under Special Swap Arrangements with the U.S. Treasury

In Millions of Dollars; Drawings(+) or Repayments(−)

Central Bank Drawing on the U.S. Treasury	Amount of Facility	Outstanding as of April 30, 1990	May	June	July	Outstanding as of July 31, 1990
Central Bank of Costa Rica†	27.5	—	+27.5 −27.5	—	—	—
Bank of Mexico‡	600.0	464.4	−24.3	−100.2	−339.9	0.0
Bank of Guyana§	31.8	—	—	+31.8	−18.3	13.4
National Bank of Hungary‖	20.0	—	—	+11.1	+8.9	20.0
Central Bank of Honduras#	82.3	—	—	+82.3	−25.0	57.3

Note: Data are on a value-date basis. The ESF's facility with the National Bank of Poland, inactive since February 9, expired on May 31, 1990. Components may not add to totals in Table 2 because of rounding.

†Represents intraday facility with the ESF established May 18, 1990.
‡Represents the ESF portion of a $1,300 million short-term credit facility established on March 23, 1990.
§Represents the ESF portion of a $178 million short-term credit facility established on June 18, 1990.
‖Represents the ESF portion of a $280 million short-term credit facility established on June 18, 1990.
#Represents the ESF portion of a $147.3 million short-term credit facility established on June 28, 1990.

contrast with continued strong growth in a number of other countries. These factors suggested that interest rate differentials would move further against the dollar. Despite occasional upward movements associated with increased tensions in the Middle East, the dollar closed the period at DM1.5868 and ¥145.85, within a few basis points of its lows for the period reached earlier that day.

The U.S. monetary authorities did not intervene in the exchange market during the reporting period to influence exchange rates. From late May through mid-July, the Desk acquired dollars against sales of marks on behalf of the ESF as part of an operation to adjust ESF balances and facilitate reversal of a portion of the outstanding warehousing of foreign currency with the Federal Reserve. During this time, a total of $2,000 million was acquired, of which $1,000 million was acquired in the market and $1,000 million in a direct transaction with another central bank. The market transactions were conducted as conditions permitted without significantly influencing prevailing exchange rates.

The ESF exchanged the dollars acquired through these transactions for foreign currencies it had warehoused with the Federal Reserve, leaving at the close of the period an amount of $7,000 million equivalent of foreign currency still warehoused with the Federal Reserve. The Treasury realized profits of $329.7 million from the sale of German marks, as well as profits of $459.0 million from renewals of warehousing transactions that also occurred during the period.

* * *

In other operations during the period, the Treasury agreed with the International Monetary Fund (IMF) to exchange SDRs for dollars with foreign monetary authorities that needed SDRs for payment of IMF charges and for repurchases. Through end-July, a total of $120.9 million equivalent of SDRs was exchanged. The Treasury, through the ESF, also participated in multilateral credit facilities to provide near-term economic support to Guyana, Honduras, and Hungary and provided assistance to Costa Rica through an intraday facility. Mexico repaid in full the remainder of its commitments to the U.S. authorities.

Guyana. On June 18, the ESF, along with the Bank for International Settlements (representing certain member central banks) and the Kreditanstalt für Wiederaufbau of West Germany, agreed to establish a multilateral financing facility for Guyana to help clear arrears with the IMF and with other international financial institutions and to facilitate the introduction of an economic adjustment program supported by the IMF and the World Bank. The ESF's share of the $178 million facility was $31.8 million. Guyana drew the entire amount of the facility on June 20 and repaid $18.3 million to the ESF on July 31.

Honduras. On June 28, the ESF, together with certain Latin American central banks, established a financing facility for Honduras totaling $147.3 million to facilitate implementation of an IMF-supported economic adjustment program. Honduras drew the full amount on the same day. The ESF participation in the facility was $82.3 million. On July 5, Honduras repaid $25.0 million to the ESF.

Hungary. On June 18, the ESF and the Bank for International Settlements (acting for certain member central banks) agreed to provide a multilateral facility for Hungary. Hungary received the full proceeds of the $280 million facility through three drawings made on June 21, July 16, and July 30. The ESF provided $20 million under the facility.

Costa Rica. The ESF agreed to provide Costa Rica a $27.5 million intraday facility to facilitate the implementation of its debt restructuring agreement. On May 21, Costa Rica drew the entire amount of the facility and repaid on the same day, thereby liquidating the facility.

Mexico. At the beginning of the period, Mexico's outstanding commitments on a short-term credit facility to the Federal Reserve and Treasury stood at $541.8 million and $464.4 million, respectively. Partial repayments were made on May 23, June 1, and July 11 and a final payment on July 31.

As of the end of July, cumulative bookkeeping or valuation gains on outstanding foreign currency balances were $3,547.5 million for the Federal Reserve and $1,519.5 million for the ESF (the latter figure includes valuation gains on warehoused funds). These valuation gains represent the increase in dollar value of outstanding currency assets valued at end-of-period

Table 4

Net Profits (+) or Losses (−) on United States Treasury and Federal Reserve Foreign Exchange Operations

In Millions of Dollars

May 1, 1990 to July 31, 1990	Federal Reserve	U.S. Treasury Exchange Stabilization Fund
Realized	0	+788.7
Valuation profits and losses on outstanding assets and liabilities as of July 31, 1990	+3,547.5	+1,519.5

Note: Data are on a value-date basis.

exchange rates, compared with rates prevailing at the time the foreign currencies were acquired.

The Federal Reserve and the ESF regularly invest their foreign currency balances in a variety of instruments that yield market-related rates of return and that have a high degree of quality and liquidity. A portion of the balances is invested in securities issued by foreign governments. As of the end of July, holdings of such securities by the Federal Reserve amounted to $7,239.2 million equivalent, and holdings by the Treasury amounted to the equivalent of $7,391.7 million valued at end-of-period exchange rates.

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