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Let the Market Do It

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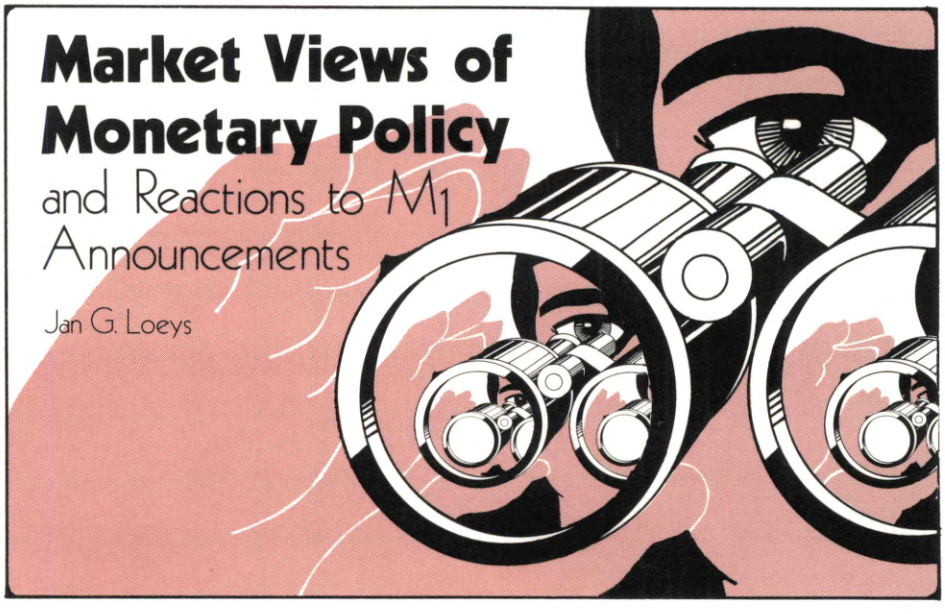

Market Views of Monetary Policy

and Reactions to M_1 Announcements

Jan G. Loeys

BUSINESS REVIEW

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Revealing Real Interest Rates:
Let the Market Do It

*Donald J. Mullineaux and Aris Protopapadakis**

"When money and goods change with reference to each other—in other words, when the money standard appreciates or depreciates in value in terms of goods—the numbers expressing the two rates of interest, one reckoned in terms of money and the other reckoned in terms of goods, will be quite different. Moreover, the money rate, the *only rate quoted in the market,* will be influenced by the appreciation or depreciation."

—Irving Fisher, *The Theory of Interest* (1930)

Most Americans today would view as commonplace the notion that inflation (what Professor Fisher calls a "depreciation of the monetary standard") affects interest rates. Living through the great inflation of the late 1960s and 1970s made the link between accelerating inflation and rising interest rates painfully obvious. Many would also recognize that inflation can drive a substantial wedge between the money interest rate and the so-called real rate of interest (what Fisher labels the rate "reckoned in terms of goods"). But few, if any, people could give a precise answer to the following seemingly simple question: "What is the real rate of interest on Treasury bills this week?

Fisher hints at one reason why. Only money rates are "quoted" by brokers and dealers and published in the financial press. No one can look in the *Wall Street Journal* or call his bank to find out the real rate. People instead are forced to make an estimate—an educated guess—about the level of real interest rates. And policymakers, who presumably care about interest rates at least as much as the rest of us, must do the same. That we are left with an error-prone estimation procedure to gauge real rates seems anomalous, since economists claim that real rates are more important than money rates for explaining many kinds of behavior.

It is possible to structure a means for markets to

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"reveal" real rates of interest, however. If some substantial borrower—the federal government, for example—issued bonds with interest and principal tied to some index of the general price level, then brokers who traded such bonds would be quoting a real rate of interest rather than a money rate. The yield on indexed Treasury securities, for example, would represent a real rate of interest based on a particular index.[1] Movements in the "quoted" real rates on indexed Treasury bonds could prove valuable to households, businesses, and policymakers.

WHY REAL INTEREST RATES MATTER....

To say that interest rates are important is like saying that kids like ice cream—few people will disagree with either suggestion. Crucial decisions—whether to consume or save, for example, whether to buy a car, whether to build a new plant, whether to pump oil from the ground or leave it there—all depend on the level of interest rates. Indeed, any decision that involves looking into the future—and almost all do—involves taking account of interest rates.

....to Households.... Households, for instance, must decide whether to consume today or at some point in the future. A decision to postpone consumption is, by definition, a decision to save. The expected real interest rate is the reward for saving, or, to put it another way, it is the amount of extra future consumption households expect to get by refraining from consuming today. Therefore, the higher this rate, the stronger the incentive to save.

When people decide to save, however, they typically do not set aside goods, such as groceries or tennis shoes, nor do they receive interest payments in goods. Rather they set aside money (they lend the money) and they are paid back in money. The distinction between receiving interest in the form of goods or in money is not important in a world where there is no inflation. In such a case, one dollar can be exchanged for the same basket of goods whether it's today or tomorrow. The money rate of interest (sometimes called the "nominal rate") would therefore be the same as the rate of interest expressed in terms of goods (the "real rate of interest"). An interest rate of 5 percent, for example, means that lending $1,000 gets you back $1,050 a year hence. But, since prices are unchanged, it also means that you can buy 5 percent *more* goods next year than you can buy today. With no possibility of inflation the expected real interest rate and the nominal interest rate are one and the same.

If there is some inflation, however, then it takes more money "tomorrow" than today to buy the *same* basket of goods. Therefore, if people expect to get extra goods by postponing consumption, the nominal (money) interest rate must include not just the expected real rate, but also a component that reflects the amount of anticipated inflation between today and tomorrow. This component, which is intended to preserve the consumer's purchasing power, is referred to as an inflation premium. For example, if the inflation premium is 5 percent and the nominal rate is 10 percent, then lending $1,000 gets you back $1,100 one year hence, but it only buys $1,050 worth of goods in this year's prices. In other words, the reward for saving is identical to that when nominal rates are 5 percent and there is no expected inflation. So, there is no incentive to consume less today simply because nominal rates are high. It would take a rise in the real rate to induce postponing more consumption.

....to Business.... Similarly, it is the expected real rate which firms must consider in deciding whether to build a new plant or install some new equipment. New equipment will benefit the stockholders of a corporation if the amount of extra goods which can be produced with the new machine adds more to the company's revenues than the costs of owning and operating the new equipment. The interest rate is an important component of those costs, because a firm must borrow the capital necessary to finance such purchases.[2]

[1] The "real" rate quoted on an indexed bond is in reference to a particular price index. The same bond tied to a different index could carry a different real rate. The expectation is that real rates with respect to a variety of indices will move together, enabling policymakers, households, and businesses to use the quoted real rates as indicators of the real rates not quoted.

[2] Borrowing in this context should be broadly conceived. It includes borrowing from financial institutions, issuing com-

When the company borrows to buy equipment, it pays the nominal rate on those borrowings. However, it is the size of the real rate component of that nominal rate that influences the firm's decision. The real rate reflects the cost (in percentage form) of financing *in terms of the good produced.* A 5 percent annual real rate, for example, suggests that if a widget firm borrows an amount equivalent to 100 widgets for one year, it would expect to repay 105 widgets-worth at year's end. Thus, the expected real interest rate allows for an easy comparison with the number of extra widgets that investment in new equipment would yield. If the new machine yields 110 widgets, then it's a good deal. The lower the real cost of borrowing (the real interest rate) the stronger the incentive for a business to buy new equipment or to build a new plant.

If there is no significant inflation underway, then there is no reason to emphasize the distinction between real and nominal interest rates in making investment decisions. When inflation is high, however, nominal interest rates will also be high. But high nominal interest rates need not discourage investment if the real rate is low. The reason is simple: though higher inflation increases borrowing costs, it also raises revenue flows because a firm's product will sell at higher prices. A business will look through the impact of inflation on its profits to assess the "real" gains from investment, and the real interest rate serves as the standard against which those gains are compared.[3]

The expected real rate is a useful indicator of the amount of investment businesses are likely to undertake in any one year, because of its role in the way businesses make decisions. Increases in this rate tend to discourage investment, and conversely, declines in the expected real rate tend to encourage investment.

....and to Policymakers.... The importance of the real rate of interest has not been lost on monetary policymakers. Indeed, the short-run impact of changes in monetary policy is transmitted to the economy largely through changes in the real interest rate. If the Fed unexpectedly reduces the rate of money growth, for example, people try to make up for the "shortage" of money by selling various kinds of financial assets. This makes both nominal and real interest rates rise. Nominal rates rise because the sale of these assets depresses their prices. The real rate rises because the inflation premium adjusts slowly to changes in money growth.[4] Therefore, the expected real rate—namely, the difference between the nominal rate and the inflation premium—increases.

Consumers react to the rise in expected real rates by postponing purchases of new homes and automobiles, and firms react by cutting back on plans to build new plants and to buy equipment. Inventories are also likely to be trimmed since a higher real rate makes them more expensive to finance. These reactions to an increase in real rates reduce the overall demand for goods and services in the economy, and the growth rate of real GNP is likely to decline. Alternatively, if the Fed provides more money to the economy unexpectedly, then the real rate falls, at least temporarily, and economic growth accelerates for awhile.

The expected real rate of interest is one of the channels through which monetary policy influences the economy. In principle, therefore, the Fed can judge how its policy actions are influencing the economy by monitoring what is happening to the real rate of interest. A rising real rate would signal a more restrictive monetary policy, while a declining real rate would suggest some monetary ease, other things being equal. In practice, the Fed has a difficult time using the real rate as an indicator of the thrust of monetary policy, because it, like everyone else in the economy, lacks adequate knowledge of what the real rate is. There is no asset available in the financial markets which pays just a real rate. Instead, the real rate must be estimated in some fashion or other. Unfortunately, none of

mercial paper, selling long term bonds, using retained earnings, and floating new stock issues.

[3]We are not claiming here that inflation is "neutral" in the sense that it has no impact on real economic activity. Inflation can have an impact on relative prices of goods and on corporate profits. Rather, we claim that, since an individual corporation's investment decisions have no measurable impact on inflation, a corporation can calculate the real demand for its products as well as the costs of production in terms of its output, without reference to the trend growth in the prices of all the goods.

[4]Empirical evidence shows that inflation adjusts slowly to money growth; hence, expected inflation, that is, the inflation premium, also adjusts slowly.

the procedures used to gauge the expected real rate offers much promise of yielding good estimates.

THE REAL RATE MUST BE ESTIMATED

Analysts have a useful starting point for estimating the expected real rate, namely, today's nominal interest rate in the market. The expected real rate is embedded in the nominal rate, so one way to get at it is to separate the expected real rate from the other components that make up the nominal rate. One of these is the inflation premium; to identify that component in nominal rates, analysts must have some means of estimating the *anticipated* rate of inflation. Anticipated inflation is not the only "premium" which gets built into nominal interest rates. Lenders also will want some protection from the risk that their inflation forecast is likely to be wrong. If actual inflation exceeds what lenders and borrowers expected over the life of a loan contract, for instance, then lenders will unexpectedly lose purchasing power and borrowers will gain. Borrowers will repay lenders with "cheaper" dollars in terms of purchasing power. Should inflation fall short of expectations, lenders gain and borrowers lose. Inflation is indeed imperfectly predictable, so credit market participants find their future purchasing power at risk over the horizon of a loan. Since people typically are averse to risky situations, financial markets build a *risk premium* component into nominal interest rates to induce lenders to take on these risks. The more uncertain the outlook for inflation, the larger this risk premium is likely to be.

If good information is available on the size of the inflation premium and the risk premium, then these components can be "netted out" of the nominal interest rate.[5] What's left is the expected real rate, the compensation lenders require for postponing consumption when there is no inflation expected and no risk concerning the inflation outlook.[6] Calculating the expected real rate sounds like simple arithmetic: just subtract the inflation premium and the risk premium from the nominal rate.

THE REAL RATE ARITHMETIC HAS DIFFICULTIES...

Unfortunately, information about the expected inflation and risk premium components of interest rates is very hard to come by. How do we know, for example, what credit market participants expect inflation to be? One way is to ask them. But there are no comprehensive surveys of the inflation forecasts of borrowers and lenders, presumably because no one has strong incentives to collect such information. Furthermore, it is not obvious that borrowers and lenders have the incentives to be as careful in responding to surveys as they are in investing their money. There are surveys of professional economists' forecasts of inflation, (well-known examples are surveys by Joseph Livingston and Robert Eggert) but it is far from obvious that the average of such forecasts coincides with the average sentiment of credit market participants. Another shortcoming of such surveys is that they seldom contain inflation predictions for more than one year ahead. This makes it impossible to use the surveys to gauge long-term real rates of interest. Yet it is long-term real rates that probably matter most for certain key decisions, such as whether to build a new plant or to buy a house.

An alternative to extracting an average expected inflation from survey information is to forecast inflation using econometric models. But this method also has some difficulties. For one thing, the various forecasting models commercially available do not agree closely in their predictions of inflation, particularly over periods longer than a year. Furthermore, these longer-term forecasts have not been very accurate, which raises the question of whether inflation is inherently unpredictable or whether the models are not very good. In sum, while there are available measures of inflation expectations, they are of limited scope and doubtful quality.

While information on anticipated inflation is flawed, data on risk premia are virtually nonexis-

[5] For a more complete analysis of these concepts, see Simon Benninga and Aris Protopapadakis, "Real and Nominal Interest Rates Under Uncertainty: The Fisher Theorem and the Term Structure," *Journal of Political Economy* 91 (October, 1983).

[6] If there is some prospect of default on repayment of interest on principal, still another kind of premium gets built into a security's yield—a default risk premium. The securities we discuss in what follows— Treasury issues—are presumed to be free of default risk.

tent. There is no way to measure in any direct way the size of the risk premium. Nor has anyone developed a reliable technique for estimating the risk premium. Some analysts have tried to avoid this difficulty by assuming that the risk premium is zero (there is no risk premium), but there is no strong evidence to support that presumption. That neither the inflation premium nor the risk premium can be measured with much precision makes it very difficult to use the arithmetic procedure to determine the expected real rate of interest.

...AND SO DO ALTERNATIVE APPROACHES

The difficulties with the real rate arithmetic have prompted some economists to try an alternative method for estimating the expected real rate. They note that it is easy to calculate an "after-the-fact" or ex post real rate by simply subtracting the actual inflation rate over the horizon of a loan from the nominal rate on the loan.

If economists can uncover a set of factors—an econometric model—which explains the ex post real rate, then it should be possible to use that model to estimate the expected real rate. Factors that have been used to explain ex post real rates include the behavior of real GNP, investment, federal deficits, money growth, and inflation.

There are several difficulties with this approach to estimating expected real rates, however. First, the statistical methodology assumes that market expectations of inflation *were correct on average* over the horizon of the interest rate in question. While this may be a valid view over long periods of time and during periods of relatively stable policy, it probably doesn't hold over shorter periods or when the policy environment is changing. A second difficulty is that this approach fails to take account of the behavior of the risk premium. If the economy is characterized by changing risk premia, the ex post rate approach will mismeasure the expected real rate of interest. Thus, both the arithmetic and ex-post rate approaches to estimating expected real rates seem unsatisfactory.

CAN THE MARKET REVEAL REAL RATES OF INTEREST?

Markets frequently are touted as sources of cheap information. By relying on prices to convey information about relative demands and supplies, for example, both buyers and sellers can avoid collecting huge amounts of data to help them decide how to behave. Unfortunately, no market currently conveys direct information about the real rate of interest. But it may be possible to create such a market.

The prospect, which has been suggested on a number of occasions in recent years, is for the U.S. Treasury to offer bonds which are indexed to a measure of the price level. The amount of interest and principal paid on indexed bonds (the yield) is adjusted in line with movements in the designated price index.[7] If inflation increases during the second year of a two-year security, for instance, the yield to the bond holder automatically rises, while if inflation falls, the yield falls.[8] One of the advantages these bonds offer is that the interest rate quoted on them in the financial press would be the expected real rate of interest on these securities. In other words, now you can open the *Wall Street Journal* and answer the question we posed earlier: "What's the real rate of interest on Treasury bills this week?"

The market reveals a real rate because holders of index-linked securities will be compensated for whatever inflation occurs over the life of a loan contract, so they need not build any inflation forecast into the rate they require for lending. Morever, the yield on index-linked bonds need contain no "risk premium" against unexpected future inflation, since inflation will not erode

[7] There are two possible types of indexing. One is to add the amount of actual inflation to the agreed upon coupon payment. Thus if inflation turns out to be 6 percent and the agreed upon coupon rate is 2 percent, the total interest paid would be 8 percent. An alternative method is to pay the agreed upon coupon rate but to increase the face value of the nominal bond by the inflation rate. In the example above the coupon payment would be only 2 percent but the face value of the bond would increase by 6 percent. Since both methods of indexing insure the purchasing power of the owner of the bond against inflation, the agreed upon coupon rate is the real rate of interest.

[8] There are, of course, a number of details that would need to be specified in an indexed-bond contract, including the specific price index to be used, the frequency of adjustment, procedures for handling issues such as possible revisions in the index and the tax treatment of the index-related compensation. In a highly developed market for such securities, bonds indexed to different price-level indices might well be available, just as options on several different stock-market indices are now available.

future purchasing power. The quoted yield on an indexed security is the real rate, pure and simple.

Treasury issues of indexed securities would, of course, provide direct information only about real rates on government bonds. It would still be necessary for people and businesses to estimate real rates on other kinds of assets.[9] However, the changes in the yields on indexed securities would provide valuable information as indicators of probable changes in other real rates. These other rates would be expected to change when indexed-bond yields change because investors can choose to hold either kind of security in their portfolios. A rise in yields on indexed bonds would therefore require a rise in other real rates to make those other assets as attractive as indexed-linked securities.

From the viewpoint of monetary policymaking, indexed bonds would fill a crucial need. Fed decisionmakers would have a very important indicator of the economic impact of monetary policy, which could alert them that a particular policy course may have run "too far." From a monetary policy standpoint it would be most useful to have indexed Treasury bonds in a series of maturities. Information about changes in short-term real rates could then be distinguished from changes in long-term real rates. Such a distinction is important because the movement of real rates at different maturity classes yields information about different aspects of real economic activity. Short-term real rates generally affect working capital and inventory decisions, for example, while long rates affect the outcomes for housing and for investment in plant and equipment.

Indexed bonds are likely to answer certain needs for consumers and businesses even beyond providing valuable information. Investors cannot presently purchase insurance against unexpected inflation in the form of indexed securities; nor is it easy to think of a way for investors to combine purchases and sales of other assets that will guarantee preservation of purchasing power against inflation. Consequently, indexed bonds would have to make at least some investors better off.

The ramifications of having indexed bonds are, in fact, even broader. In a world without indexed bonds, the government can end up, in a sense, defaulting on some of its debt if inflation is in excess of what people expect. Suppose people purchasing Treasury securities anticipate 6 percent inflation, but government policies produce a 10 percent rise in the price level. Then each dollar of debt the government repays yields 4 percent less purchasing power than people expected when they bought the bonds. The government has repaid its nominal debt, but has "defaulted" in terms of purchasing power. Many economists believe that this possibility of defaulting weakens the government's incentives to prevent surprise inflations.[10] With indexed bonds, however, the government simply cannot "default" on its debt in purchasing power terms.

CONCLUSION

There is much to be said in favor of proposals for the U.S. Treasury to begin issuing index-linked securities. Policymakers would benefit from the availability of improved information, and if better information produced better policies, then everyone would be better off. In addition, investors are likely to gain from the existence of such bonds. Financial markets have fostered a large number of innovations in recent years which provide more information and allow investors to better manage risks, including a wide range of financial futures contracts, options, and even options on futures. The substantial growth in the volume of these new assets suggests there is a large demand for securities which allow investors to manage risks better and which reveal information. Indexed-linked securities would make a welcome addition to the menu of such assets.

[9] The private sector's failure to provide index-linked securities has been a puzzle to financial economists. Some have argued that risk considerations militate against the use of indexed-bonds by businesses. In particular, since actual inflation is unpredictable, corporations issuing indexed securities commit to an unknown stream of future interest payments. And there is no guarantee that the price of its own products will match up well with the rate of inflation. The real interest rate *in terms of its own products* is therefore uncertain if it issues indexed bonds.

[10] See T. Sargent and N. Wallace, "Some Unpleasant Monetarist Arithmetic," Federal Reserve Bank of Minneapolis *Quarterly Review* (Fall, 1981) pp. 1-18.

Market Views of Monetary Policy and Reactions To M1 Announcements

*Jan G. Loeys**

The highlight of the week for any true "Fed watcher" is the Thursday afternoon announcement of the Federal Reserve's most recent estimates of the monetary aggregates.[1] In recent years, financial markets throughout the world have reacted strongly to these announcements. The markets' preoccupation with these weekly money numbers has been the subject of a lot of controversy; some have even likened it to a "giant crap game."[2] The markets' response to these money stock announcements may not be irrational, however. Rather, money stock data may contain information that market participants use to revise their expectations about future monetary policy actions and credit market conditions.

These market expectations presumably depend upon the public's perception of the Fed and its policies. If the market changes its view of monetary policymaking, it will also change the way it interprets monetary data and how it reacts to the money stock announcements. Therefore, observing

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[1] Between February 1980 and February 1984, these estimates were released on Friday afternoon.

[2] Marcia Stigum, *The Money Market: Myth, Reality, and Practice.* (New York: Dow Jones-Irwin, 1983), p. 272.

changes in market reactions to the weekly money stock announcements may provide interesting information on how the public's perception of monetary policymaking has changed in recent years.

M1 ANNOUNCEMENTS AND MARKET REACTIONS

Every Thursday at 4:30 P.M., after the New York Stock Exchange closes, the Fed makes public a series of statistical releases. The release that has drawn the most attention is H.6, which contains detailed statistical information on the various money stock measures and their components. The public tends to focus on the Fed's latest weekly estimate of M1.[3]

The public's preoccupation with this weekly M1 number is evident in the turbulent motion in financial markets whenever the M1 estimate differs from what was expected. If the M1 estimate is higher than expected, interest rates on assets of all maturities tend to rise; if the M1 estimate is unexpectedly low, most interest rates tend to drop.[4] Figure 1 shows how, in recent years, interest rates of different maturities have reacted to the announcement of an unexpected 1 percent increase in M1. The negative slope of the response curve indicates that short-term interest rates have reacted more strongly than interest rates on long-term assets.

At first glance, this phenomenon seems to contradict economic theory, which suggests that an increase in the money supply is associated with a *drop* in short-term interest rates (other things being equal), not a rise. But such a conclusion fails to recognize that money supply data are released with a lag. The M1 number announced on a Thursday afternoon measures the average M1 level in the week that ended *ten days prior.* Therefore, the inverse relation between money and interest rates should be observed two weeks before the announcement. So it would be a mistake to look for rate declines just when the information is made public. Rather, there must be something about the announcement itself that causes interest rates to rise.

Economists have suggested that the explanation lies in what announcements about past money stock levels lead the market to expect about the future. It may be rational for market participants to use money supply data as a signal of Fed intentions for monetary policy. In particular, markets are likely to be concerned with how the Fed itself will react to the money supply figure.

INTERPRETING THE ANNOUNCEMENT

Since the early 1970s, the Fed has increasingly defined its long-run policy in terms of how fast it wants the money supply to grow. At the beginning of each year, the Fed sets targets for growth in several measures of the money supply over a four-quarter horizon. The targets, expressed as ranges, are announced publicly during Congressional testimony by the Fed Chairman. The Chairman also will indicate how the monetary objectives are related to the Fed's ultimate policy goals of price stability and sustainable economic growth.

Financial market participants are concerned about the money supply for the same reasons the Fed is. In particular, people recognize that sharp fluctuations in the money supply can have damaging effects on the economy. If money grows too fast, inflation will accelerate. If money is in short supply, the pace of economic activity will falter. To gauge the future behavior of the economy, therefore, people will keep a careful watch on the behavior of money. And since the Fed plays a key role in influencing the money supply, people also keep an eye on the Fed.

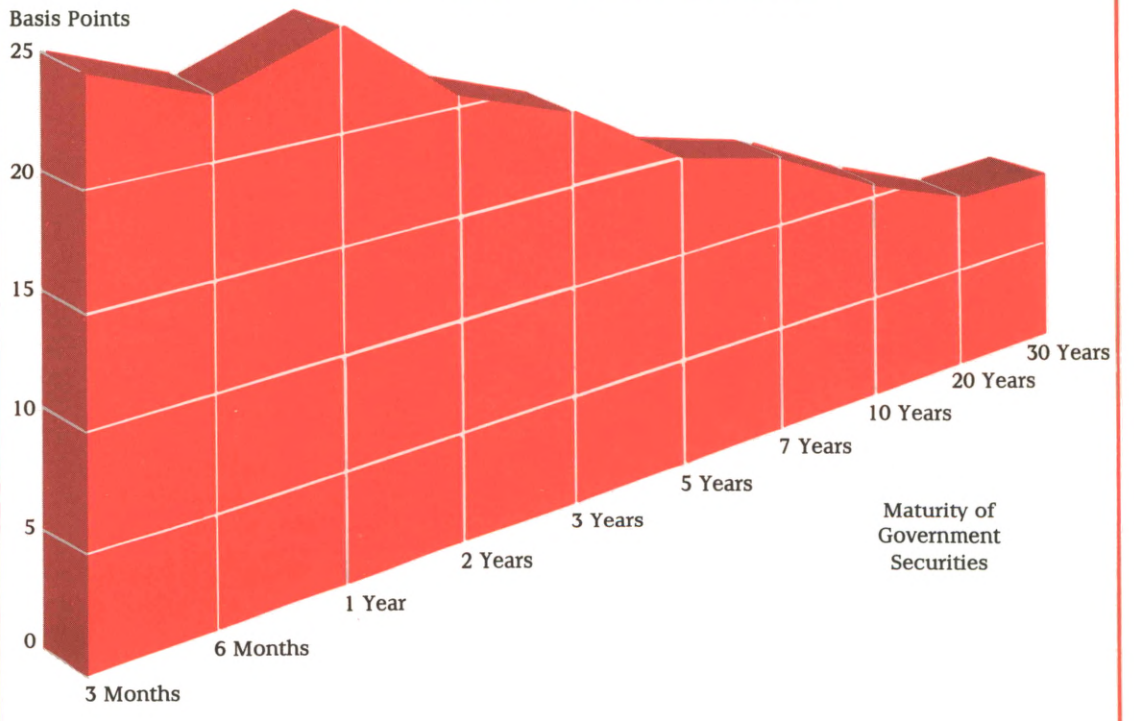
In the eyes of many, the Fed's role is to keep the money supply "well behaved," that is, consistent with its ultimate goals of price stability and economic growth. If a particular movement in the money supply seems likely to inflict some damage on the economy, the Fed needs to take some corrective action to get money "back on track." Unfortunately, however, short-term movements in

[3] M1, the narrowest monetary aggregate, consists of currency, nonbank travelers checks, demand deposits, and other checkable deposits.

[4] The impact of money stock announcements can be felt in many markets, such as those for stocks, commodities, and foreign exchange. Economists have shown how, in recent years, the announcement of an unexpected rise in M1 has been followed by lower equity and commodity prices and a stronger value of the dollar vis-a-vis foreign currencies. For a survey of these studies, see Bradford Cornell, "The Money Suppy Announcements Puzzle," *American Economic Review* (September 1983), pp. 644-655.

FIGURE 1

THE AVERAGE RESPONSE OF INTEREST RATES TO MONEY ANNOUNCEMENTS OVER THE PERIOD NOVEMBER 1977-DECEMBER 1983



This graph and the graphs that follow illustrate the rise in interest rates over the whole maturity spectrum one working day following the announcement of an unanticipated 1 percent rise in M1 (this amounts to $3 to $5 billion during this period). An unanticipated M1 change is measured as the announced M1 change minus the median change forecasted in a survey of government securities dealers (see the Appendix).

the money supply are highly volatile, and it is very difficult to know when a given change in money portends future trouble. Both the Fed and the public must make some judgments, nevertheless, about whether the behavior of money is getting out of hand. While the Fed makes little public comment on its views about short-run money movements, the market's interest rate response to money supply announcements tells us something about how people *expect the Fed to react* to a money supply fluctuation. If people expect a prompt offsetting response by the Fed to a sharp rise in the money supply, short-term rates should rise, generating what's called a "policy anticipation effect." If market participants believe the Fed is delaying a necessary offsetting response to a bulge in the money supply, then long-term rates should increase with the announcement, producing an "expected inflation effect."

Suppose M1 rises above target and the market believes the Fed will act promptly to bring M1 back to target. How does the Fed do this? It tightens the

supply of reserves to financial institutions, which will force short-term interest rates to rise. In fact, the very expectation of this Fed action causes short rates to rise immediately.[5] (The reason involves rational behavior on the part of financial institutions. If banks expect reserves to be more expensive in the future, it pays to acquire them today. But if all banks try to acquire reserves today, they drive up the interest rate on federal funds, the market where banks borrow reserves from one another.) Moreover, the more vigorously and the faster the market expects the Fed to react, the more short-term rates will rise. Thus, the policy anticipation effect explains an increase in short-term interest rates on the heels of the announcement of an unexpected money stock increase.

In reality, people do not always know where exactly the Fed wants M1 to be at each moment in time, in part because the annual targets for the monetary aggregates are expressed as ranges (rather than single points) and because the Fed does not make weekly announcements of its intentions. Moreover, because the monetary control mechanism is far from perfect, the Fed has not always been able to meet the annual target ranges for M1. In the face of this uncertainty about future money growth, the best forecast presumes the Fed will only partially compensate for a sharp rise above the long-run target, tightening up somewhat, but perhaps not enough to bring M1 "back on target."[6] This presumption implies that long-term money growth may be higher than previously expected. Since more rapid money growth leads to higher inflation, but with a lag (averaging 18 months to 2 years in empirical research), long-term interest rates will rise because lenders require a higher "inflation premium" to compensate their expected loss of purchasing power.[7] This has been called the "expected inflation effect."

Uncertainty about Fed intentions for long-run money growth, therefore, explains how both short and long rates can rise after the announcement of an unexpected surge in M1: short rates rise in anticipation of some Fed tightening, and long rates rise in anticipation of higher long-term money growth and, hence, inflation. The more uncertain people are about long-run money growth, the more likely they are to raise their long-run money growth expectations after the announcement of an unexpected jump in M1, and the less they will expect the Fed to tighten up in the near future. In other words, the higher this uncertainty, the more responsive long rates will be to money announcements, and the less responsive short rates will be.

HAS THE MARKET'S VIEW OF MONETARY POLICY CHANGED IN RECENT YEARS?

We have examined how the public's perception of monetary policy can affect the way interest

[5] Short rates may rise even without the Fed tightening the supply of reserves. Between September 1968 and February 1984, during any given Thursday-to-the-following-Wednesday period, banks were required to hold a certain amount of reserves, as a percentage of deposits outstanding two weeks before. At the beginning of a statement week, a bank knows the exact amount of reserves it is required to hold on average during the coming seven days, but it does not know how much other banks must hold. The H.6 release published during any given week, however, contains estimates of the aggregate level of deposits for the week on which current reserve requirements are based. If these deposits, which make up most of M1, were higher than anticipated, banks know that total market demand for reserves during the current week is stronger than expected. As a result banks will raise the level of the federal funds rate they think clears the market, unless they believe the Federal Reserve will take offsetting actions. This 2-week lag in reserve requirement accounting was reduced to 2 days starting in February 1984, so this effect should have disappeared by now.

[6] This point was first developed by Gikas Hardouvelis, "Market Perceptions of Federal Reserve Policy and the Weekly Monetary Announcements," *Mimeo,* U.C. Berkeley (March 1983).

[7] Another possible explanation for the reaction of long rates is based on the expectations theory of the term structure. According to this theory, yields on assets of different maturities are not independent of each other because they apply to partially overlapping periods. For example, a five-year yield and a two-year yield overlap for the first two years. The three-year yield over the period starting two years hence—implicit in the difference between the five-year and the two-year rate—is called a forward rate. To assure that a movement in the yield on a longer-term maturity is not due merely to its overlap with a shorter-term maturity, the announcement effects also have been estimated using these forward rates (see Jan G. Loeys, "Federal Reserve Operating Procedures, Policy Uncertainty, and the Weekly Money Stock Announcements," Federal Reserve Bank of Philadelphia, *Working Paper* (1983)). The estimated response curves were slightly lower than those for spot rates but were still significantly above zero—at least, up until the seven-year mark—except for the periods before October 1979 and during 1982. This result suggests that the overlap with short-term rates is not enough to explain the response of long-term rates of interest to money announcements.

rates react to money stock announcements. Observing changes in the response pattern of interest rates may, therefore, reveal something about how the public adjusts its views of monetary policymaking. An econometric analysis of the reaction of interest rates to money announcements over the period November 1977 to December 1983 suggested that there were three distinct shifts in the interest rate response pattern. [8]

The October 1979 Shift. The first shift occurred in October 1979. Figure 2 shows that before this date only short rates reacted in any significant way to money announcements, but in October 1979 interest rates over the whole maturity spectrum began to respond much more strongly. The impact of the announcement of an unanticipated 1 percent rise in M1 on the 3-month rate rose from 7 to 37 basis points, while the response of the 30-year yield rose from essentially zero to 14 basis points.

The most likely cause of this shift is the October 1979 change in Fed operating procedures, which was essentially a change in its instrument to control the money supply. Prior to October 1979 the Fed focused on the federal funds rate as its instrument to control M1. If M1 grew too fast, the federal funds rate would be forced up, while, if M1 grew too slowly, this rate would be moved down. This approach did not work particularly well, however, because it did not allow enough flexibility in the federal funds rate to keep M1 on track. Consequently, more often than not the Fed failed to achieve its monetary targets.

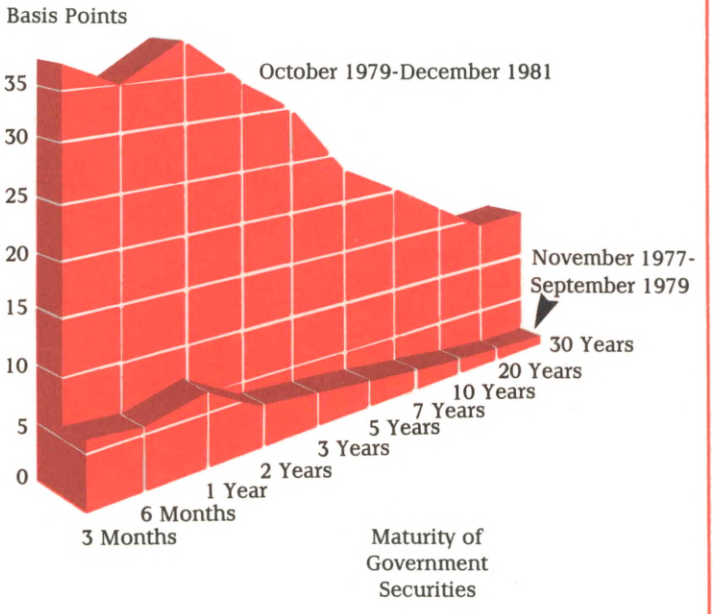
Following October 1979 the Fed's operating procedures focused more on bank reserves in controlling money, which allowed more variability in short-term interest rates. It was argued that this approach would give the Fed better and closer control of M1 over shorter time horizons. The increased response of short rates immediately after the new procedures were announced indicates that financial markets expected that the Fed would indeed act faster and more vigorously to keep M1 under control.

The strong response of long-term rates of interest was surprising at first. It suggests that the abrupt change in policy made it difficult initially for market participants to determine exactly what the Fed was

[8] See the Appendix for details on how these structural shifts were identified.

FIGURE 2

THE RESPONSE CURVE MOVES UP SHARPLY IN OCTOBER 1979 . . .



up to.[9] In particular, there may have been high uncertainty about what long-run money growth would be. Although the Fed was expected to act faster to keep M1 on target—and would thus control it over shorter time horizons—it was not immediately obvious what that target was.

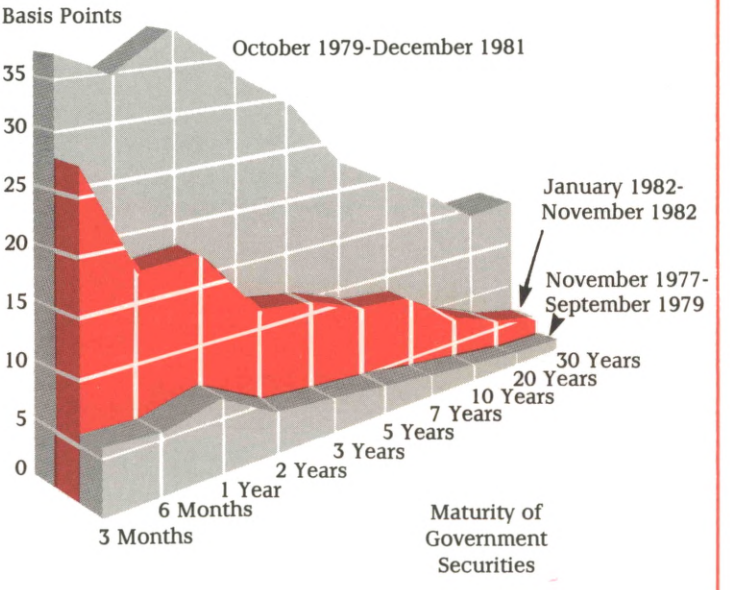
Another consequence of the new operating procedures also bears considering. The federal funds rate become very volatile after the shift towards a reserves-based operating procedure. Therefore, changes in this rate could not be "read" anymore as signals of the Fed's policy intentions. But reserves were also very volatile following the policy shift, and, therefore, also "unreadable." In consequence, market participants might have come to rely more on money movements as signals of sustained deviations from the longer-run paths of money growth.[10] These two factors, higher uncertainty about the direction of long-run monetary policy, and the increased importance of M1 fluctuations as potential signals of where the Fed is heading, may explain why long-term bond markets became more sensitive to money stock announcements.

The January 1982 Shift. The second shift in the interest rate response curve took place around January 1982. Figure 3 shows that the curve moved back down, although not to its pre-October 1979 level. One explanation might be that, because of the recession that started in July 1981, financial markets expected the Fed to follow a policy directed more towards smoothing interest rates than towards keeping the monetary aggregates close to target. However, there is no evidence that such a policy change did take place around this time: in fact, during 1982, the federal funds rate was as volatile as in 1980-81.

A more likely explanation is that after two years under the new operating procedures the public had gained some experience—and confidence—with how the Fed would react to money stock fluctuations. The drop in the response of the 3-month rate, for example, is not very significant, which suggests that the market had only marginally revised its perception of the Fed's tolerance for short-run deviations of money from target. The response of long rates, on the other hand, dropped to a point that was statistically not very

FIGURE 3

. . . BUT DROPS AGAIN IN JANUARY 1982



[9] Recall that there had been no such abrupt change in Fed policy since World War II.

[10] For more details on this argument, see Loeys, "Federal Reserve Operating Procedures, Policy Uncertainty, and the Weekly Money Stock Announcements," Federal Reserve Bank of Philadelphia, *Working Paper* (1983).

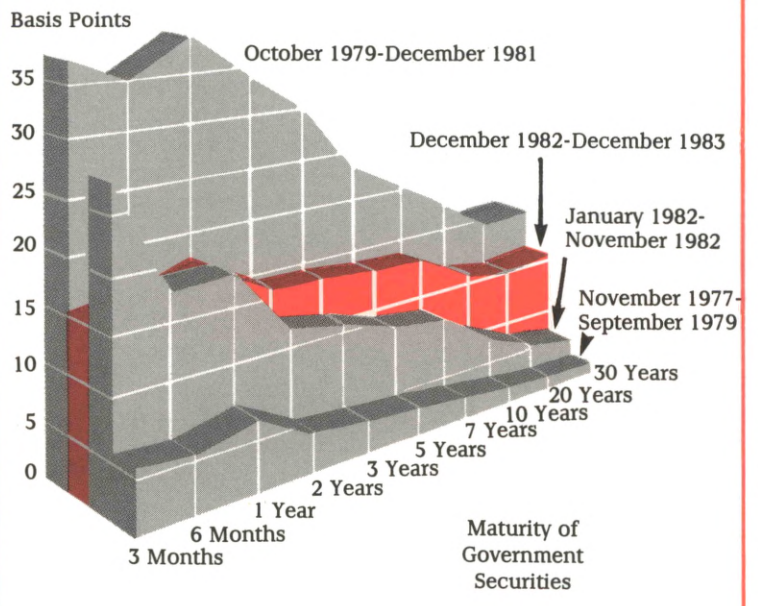
different from zero during 1982, which indicates reduced uncertainty about long-run monetary policy.

The December 1982 Shift. The third shift took place around the end of 1982, this time taking the form of a significant *rise* in the reaction of long rates together with a *drop* in the reaction of short rates (Figure 4). This flattening of the response curve occurred just two months after the Fed had decided to de-emphasize M1 in favor of the broader aggregates, M2 and M3. This decision was taken because of technical problems that were judged to make M1 unreliable as a guide to policy (see THE OCTOBER 1982 DE-EMPHASIS OF M1). The decline in the reaction of short-term rates to M1 announcements suggests that market participants "believed" the Fed's statements concerning the reduced role of that aggregate in the policy process. The fact that the response curve did not drop to its pre-October 1979 level, however, indicates that financial markets did not perceive that the Fed had returned to targeting the federal funds rate directly. M1 still played a significant role, in the market's view, though less so than before.

The increased response of long rates indicates that in 1983, financial markets may have become more uncertain once again about the direction of long-term monetary policy. Articles in the financial press during 1983, for example, showed a lot of confusion about the stance of monetary policy, and the shape of the recovery. Perhaps market participants judged that prospects had increased that the Fed would fail to keep long-term money growth from accelerating. If so, this would account for the increased responsiveness of long rates to money announcements.

FIGURE 4

IN DECEMBER 1982 THE RESPONSE CURVE TURNS FLAT



CONCLUSION

The impact of monetary policy actions upon the economy depends crucially upon the behavior of consumers and businesses, which, in turn, is influenced by their expectations of future monetary policy. The way financial markets react to releases of the Fed's money stock estimates can provide valuable information on how markets perceive monetary policy operations. In general, the more short-term interest rates react to money announcements, the faster the Fed is seen to correct deviations of money from target. The more long rates react relative to short rates, on the other hand, the more uncertain the market may be about long-term money growth, or the more the market may be using M1 numbers as signals of where monetary policy is heading.

An analysis of the pattern of interest rate reactions to money

THE OCTOBER 1982 DE-EMPHASIS OF M1

Technical problems with M1 arose from two sources. First, the expiration of $31 billion of all-savers certificates in October was expected to raise M1 temporarily because these funds would pass through transaction accounts before being redistributed to other assets. Second, Congress was in the process of allowing depository institutions to offer Money Market Deposit Accounts, which were expected to attract funds out of M1.[a] Since both the magnitude and timing of these shifts were difficult to estimate, the Fed decided "that it would place much less than the usual weight on the [M1] aggregate's movements... and that it would not set a specific objective for its growth."[b] This policy was continued throughout 1983 because of further deregulation—in the form of Super-NOW accounts— and because of a suspected shift in the demand for M1.[c] Both these factors were judged to make M1 unreliable as a guide to policy.

[a]For more details, see "Monetary Policy and Open Market Operations in 1982," Federal Reserve Bank of New York, *Quarterly Review,* (Spring 1983), p. 41.

[b]"FOMC Domestic Policy Directive," meeting held on October 5, 1982, *69th Annual Report,* 1982, Board of Governors of the Federal Reserve System, p. 125. This directive was not released until November, but Chairman Volcker mentioned it during a speech before the Business Council on October 10 *(American Banker,* October 13, 1982).

[c]*Monetary Policy Objectives for 1983,* Summary Report of the Federal Reserve Board, February 16, 1983, p. 3.

announcements during recent years turned up three major shifts. The first shift, just after the October 1979 change in Fed operating procedures, reflects a market perception that the Fed would act faster and more vigorously to control M1 in the short run, although this abrupt policy change did seem to create some confusion about the Fed's long-run monetary policy intentions. A few years under the new operating procedures seems to have made the market more confident about the direction of monetary policy, as suggested by the second shift in the market's response to money announcements, in early 1982. The third shift—around December 1982—is consistent with the October 1982 de-emphasis of M1 as an intermediate target of monetary policy, although the market did not seem to believe that the Fed had returned to a federal funds rate policy such as it followed before October 1979. Like the October 1979 change, however, this policy change did create some uncertainty among market participants about the direction of monetary policy.

APPENDIX

REGRESSING INTEREST RATES ON MONEY ANNOUNCEMENTS

The Data. Financial markets generally are thought to make efficient use of all available information. If, before M1 is announced, markets have reason to believe that the money supply has changed that week, interest rates will have incorporated that belief before the actual number is released. But if the announced change is different from what people expected, then the release contains new information and interest rates will be affected. The proper variable to explain interest rate movements around the M1 release time, therefore, is the unanticipated part of the announced change in M1.

Market expectations are usually not directly observable, and finding reasonable proxies for them has always been difficult for economic researchers. Fortunately, a survey of government securities dealers exists which has proven to be quite reliable as a proxy of market expectations.[a] Each Tuesday, Money Market Services, Inc. of San Francisco surveys 50 to 60 dealers and asks them how much they expect M1 to change at the next announcement. The difference, expressed as a percentage, between the announced change in M1 and the median survey forecast is our measure of the unanticipated change in M1.

The reaction of financial markets is measured over the whole term structure of interest rates, from a three-month Treasury bill to a 30-year government security. Data on the monetary aggregates are currently released on Thursdays, at 4:30 p.m. To measure the impact of these announcements, one must obtain observations on interest rates closely before and after the release time. The change in interest rates is thus measured between the 3:30 p.m. closing yield on Thursday and the closing yield on Friday.[b] The sample period extends from November 1977 to December 1983.

The Estimation.[c] The 10 equations are specified as follows:

$$\Delta R_{it} = \alpha_i + \beta_i \Delta M_t^u + \varepsilon_{it}, \qquad \text{For } i = 1, 2, \ldots, 10,$$

where ΔR_{it} denotes the change in the i-th rate of interest in week t, and ΔM_t^u the unanticipated change in M1 of week t-2, expressed as a percentage and announced during week t. The constants (α_i's) are included to adjust for any systematic change in the interest rates not related to the money announcements. To account for the relatively high contemporaneous correlation (around 0.6) between the different error terms, the 10 equations were estimated simultaneously using Zellner's seemingly unrelated regression technique.

To test for stability in the response coefficients (β_i's), slope dummy variables were introduced in each equation

$$\Delta R_{it} = \alpha_i + \beta_i \Delta M_t^u + \delta_i \Delta M_t^u D_t + \varepsilon_{it},$$

where $D_t = 1$ if $t \geq T$ and zero otherwise. The δ_i parameters measure the change in the β_i's after time T. Inclusion of the dummy variables significantly raised the value of the likelihood function, which is a measure of how well the model fits the data, for almost any value of T. This indicates that the β's were subject to at least one shift. The timing of this shift was decided by trying out different values of T, and choosing the one that maximized the likelihood function. A first (local) maximum was located for October 1979. Testing for further instabilities by including a second set of 10 dummy variables yielded a second breaking point around January 1982. A third breaking point was found around December 1982.

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[a] See, for example, Jacob Grossman, "The 'Rationality' of Money Supply Expectations and the Short Run Response of Interest Rates to Monetary Surprises," *Journal of Money, Credit, and Banking* (November 1981), pp. 409-424, or Thomas Urich and Paul Wachtel, "The Structure of Expectations of the Weekly Money Supply Announcement," *NBER Working Paper #1090* (March 1983). However, R. Hafer, "Weekly Money Supply Forecasts: Effects of the October 1979 Change in Monetary Control Procedures," Federal Reserve Bank of St. Louis, *Review* (April 1983), argues that since October 1979 these forecasts have been biased and inefficient.

[b] Between February 1980 and February 1984, M1 was announced on Fridays. For this period the change in interest rates is measured as the difference between the Friday and the Monday closing yields.

[c] This section summarizes the results of Loeys (1983), "Federal Reserve Operating Procedures,..."

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1983

No. 83-1 Robert H. DeFina, "Union-Nonunion Wage Differentials and the Functional Distribution of Income: Some Simulation Results from a General Equilibrium Model."

No. 83-2 Nicholas Carlozzi, "The Structure, Parameterization and Solution of a Multicountry Simulation Model."

No. 83-3 Nicholas Carlozzi and John B. Taylor, "International Capital Mobility and the Coordination of Monetary Rules." (Reissued in *Exchange Rate Management Under Uncertainty,* ed. J. Bhandari, MIT Press, 1984.)

No. 83-4 Brian R. Horrigan, "Pitfalls in Analyzing Deficits and Inflation."

No. 83-5 Herb Taylor, "The Role of the Discount Window in Monetary Policy Under Alternative Operating Procedures and Reserve Requirement Systems."

No. 83-6 Brian C. Gendreau, "Carrying Costs and Treasury Bill Futures."

No. 83-7 Edwin S. Mills, "Metropolitan Central City Population and Employment Growth During the 1970's."

No. 83-8 Gerald A. Carlino, "Declining City Productivity and the Growth of Rural Regions: A Test of Alternative Explanations." (Revision forthcoming in the *Journal of Urban Economics,* 1984.)

No. 83-9 Simon Benninga and Aris Protopapadakis, "General Equilibrium Properties of the Term Structure of Interest Rates."

83-1

UNION-NONUNION WAGE DIFFERENTIALS AND THE FUNCTIONAL DISTRIBUTION OF INCOME: SOME SIMULATION RESULTS FROM A GENERAL EQUILIBRIUM MODEL

Robert H. DeFina

During the past two decades, a number of studies have established the ability of unions to obtain wages for their members that exceed the payment to similar, but nonunionized workers. This article investigates empirically the impact that this wage differential has on the real incomes of union labor, nonunion labor, and capital. The analysis is accomplished by solving explicitly a numerically specified general equilibrium system with and without the union wage premium. Comparison of real factor incomes in each equilibrium yields the desired information. The findings indicate that union labor gains as a result of the differential, while nonunion labor and capital lose. This outcome is realized both in terms of real income levels and in a redistributive sense.

Selected Abstracts 1983

83-3
INTERNATIONAL CAPITAL MOBILITY AND THE COORDINATION OF MONETARY RULES

Nicholas Carlozzi
and
John B. Taylor

The paper develops a two-country model with flexible exchange rates and perfect capital mobility for evaluating alternative macroeconomic policy rules. Macroeconomic performance is measured in terms of *fluctuations* in inflation and output. Expectations are rational, and prices are sticky; wage setting is staggered over time. The countries are linked by aggregate spending effects, relative price effects, and mark-up pricing arrangements. The model is solved and analyzed through deterministic and stochastic simulation techniques. The results suggest that international capital mobility is not necessarily an impediment to efficient domestic macroeconomic performance. Changes in the *expected* appreciation or a depreciation of the exchange rate along with differentials between *real* interest rates in the two countries can permit macroeconomic performance in one country to be relatively independent of the policy rule chosen by the other country. The results depend on the particular parameter values used in the model and suggest the need for further econometric work to determine the size of these parameters.

83-4
PITFALLS IN ANALYZING INFLATION AND UNEMPLOYMENT

Brian R. Horrigan

When can we know whether deficits cause inflation or inflation causes deficits? The correlation we observe between deficits and inflation does not permit an inference about causality. In steady state, higher inflation is always associated with higher deficits, regardless of what caused the inflation. The causal relation between deficits and inflation can only be inferred from a study of disequilibrium situations. In disequilibrium, the inflation-adjusted deficit is a better measure of the stance of fiscal policy than the conventional deficit.

83-5
THE ROLE OF THE DISCOUNT WINDOW IN MONETARY POLICY UNDER ALTERNATIVE OPERATING PROCEDURES AND RESERVE REQUIREMENT SYSTEMS

Herb Taylor

The paper uses a simple model of the reserves market to demonstrate the implications of discount window administration procedures for short-run money control. It is shown that when the Fed uses a funds rate operating procedure to control the money stock, discount window procedures do not affect the volatility of the money stock. When the Fed uses a reserves operating procedure combined with lagged reserve requirements, a relatively liberal discount window policy is shown to improve money control. With contemporaneous reserve requirements, the case for a more restrictive discount window policy is stronger, though a penalty discount rate does not necessarily maximize short-run money control.

83-6
CARRYING COSTS AND TREASURY BILL FUTURES

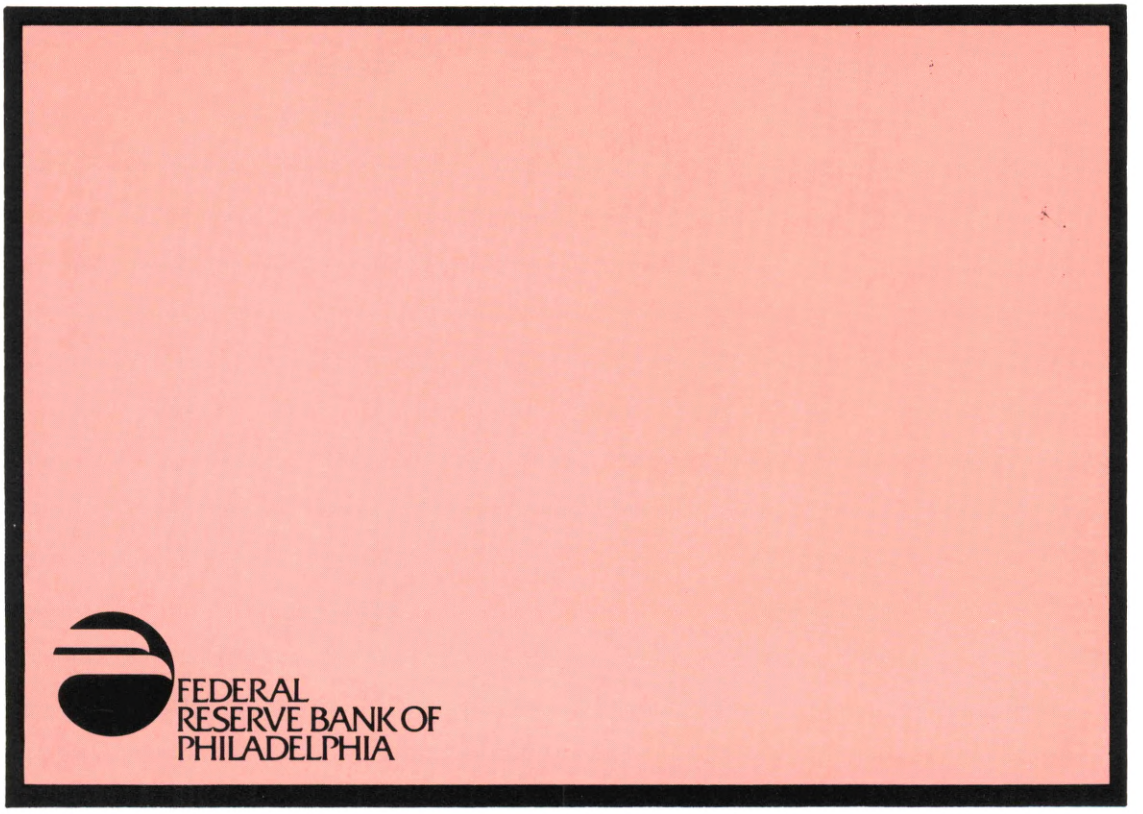
Brian C. Gendreau

Researchers have consistently found that yields on Treasury bill futures differ significantly from corresponding forward rates implicit in the term structure of interest rates. This paper focuses on the borrowing costs faced by investors as the source of that difference. Rates of return attainable on forward bills created implicitly by financing Treasury bills with term repurchase agreements are calculated and found to be not significantly different from yields on Treasury bill futures contracts. These results suggest that risk premia in the repurchase market are reflected in Treasury bill futures yields, and can explain why those yields differ from forward rates.

83-7
METROPOLITAN CENTRAL CITY POPULATION AND EMPLOYMENT GROWTH DURING THE 1970s

by Edwin S. Mills

This paper studies the determinants of Metropolitan Central City Population and Employment Growth from 1970 to 1980 using census data for metropolitan areas with at least 250,000 population. Central city and suburban population and employment growth are analyzed in a four-equation model. Population and employment growth reinforce each other strongly in central cities. Suburban population growth stimulates central city employment growth, but suburban employment growth is at the expense of central city employment growth. Central city population and employment growth are affected strongly by variables over which communities have control. Many eastern and northern central cities could have replaced decline with substantial growth by better control of crime and taxes and by improved educational systems.



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