FEDERAL RESERVE BANK OF DALLAS

May 1989

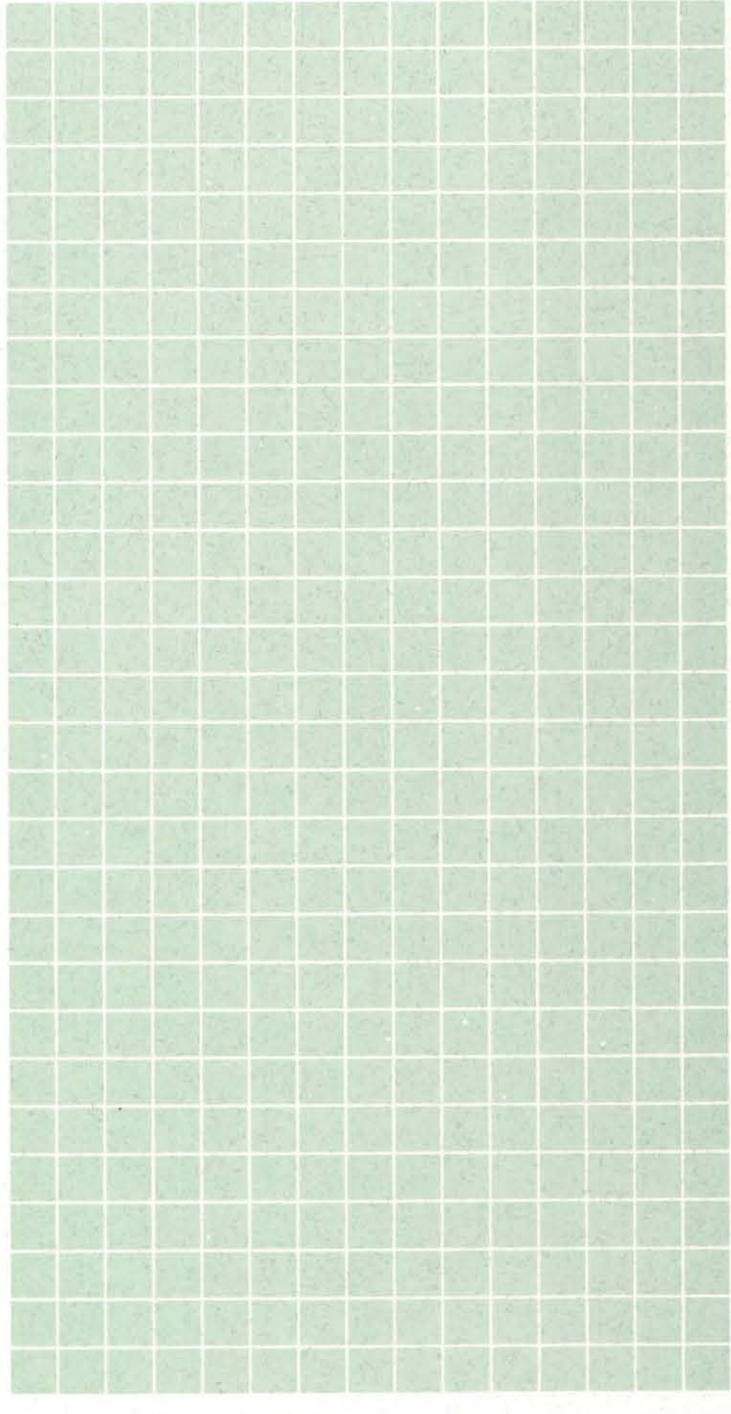
Economic Review

Money and Inflation in a Deregulated Financial Environment: An Overview

W. Michael Cox and
Harvey Rosenblum

Money, Wages, and Factor Scarcity as Predictors of Inflation

John K. Hill and
Kenneth J. Robinson



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Contents

W. Michael Cox
Vice President and Economic Advisor
Federal Reserve Bank of Dallas

Harvey Rosenblum
Senior Vice President and
Director of Research
Federal Reserve Bank of Dallas

Money and Inflation in a Deregulated Financial Environment: An Overview

Much attention has centered on the recent monetary and inflationary experience of the United States and on the role played by financial deregulation in the economic history of the 1980s.[1] While little doubt exists that there are many major differences in the financial landscape today as compared with only a few years ago, there is also little doubt that an understanding of these differences is essential to the proper management of the economy.[2]

Understanding the likely macroeconomic effects of financial deregulation is clearly important to the Federal Reserve in view of the direct linkage to monetary policy. The selection of a monetary aggregate, of an operating procedure, and of policy indicators or guidelines must all be reexamined in light of the new and deregulated financial environment. This is admittedly an ambitious challenge and one that will require substantial resources and extended research—effort certainly beyond the scope of any single study.

The work here provides an overview of the macroeconomic effects of financial deregulation and outlines extended research in this area that we plan over the coming months.[3] In this article, we specifically address three questions. First, what effect has financial deregulation had on the demand for money? Second, has financial deregulation significantly altered the money supply process—specifically, the relationship between base money and the monetary aggregates?[4] And third, which measure of money should the Federal Reserve target in the deregulated financial environment?

As we review these key questions, provisional answers are suggested whenever possible.[5] Our findings at this stage should be viewed as tentative. Nevertheless, we find substantial support for several basic conclusions from the mone-

[1] *We use the term "financial deregulation" to refer not only to legislated changes in the regulatory environment that have taken place over the past few years (such as the Depository Institutions Deregulation and Monetary Control Act) but also to private-sector financial innovations, which clearly have equally altered the financial landscape. We recognize also that financial deregulation has been somewhat a gradual process rather than an immediate one. See Gilbert (1986, 31) for details of the steps in the phaseout of Regulation Q.*

[2] *While we explicitly only consider the effects of financial deregulation, many other changes have taken place in the macroeconomic environment over the past few years—such as disinflation, the deposit insurance crisis, the transition to interstate banking, shocks in oil prices, and changes in tax laws. These changes have altered the underlying economics of the banking industry and contributed, at least temporarily, to the hostile banking environment.*

[3] *The work reported here draws in part from Cox and Haslag (1989).*

[4] *By definition, base money (sometimes called the monetary base, or high-powered money) is currency held by the nonbank public plus reserves of banks. See Table 1 for a complete listing and description of the components of the M1 and M2 monetary aggregates as well as the monetary base.*

[5] *For earlier acknowledgment of some of the potential effects of financial innovations, see Santomero and Siegel (1981), Tatom (1983), and Thornton (1983). More recently, see Roley (1985); Bradley and Jansen (1986); Christiano (1986); Keeley and Zimmerman (1986); Darby, Poole, Lindsey, Friedman, and Bazdarich (1987); Roth (1987); Stone and Thornton (1987); B. Friedman (1988); Motley (1988); and Wenninger (1988).*

tary and financial data of the 1980s. First and most important, because of financial deregulation, there appears to have been a permanent shift in the way in which people distribute their holdings of wealth among moneys and other assets. But this shift has been almost entirely among the components of the M2 monetary aggregate; to a much lesser extent, there have been shifts between M2 and other assets. As a result, there appears to be a stable long-term relationship between M2 and the price level, which reaffirms the notion that inflation is primarily a monetary phenomenon—at least, once you understand the evolving and proper definition of money.

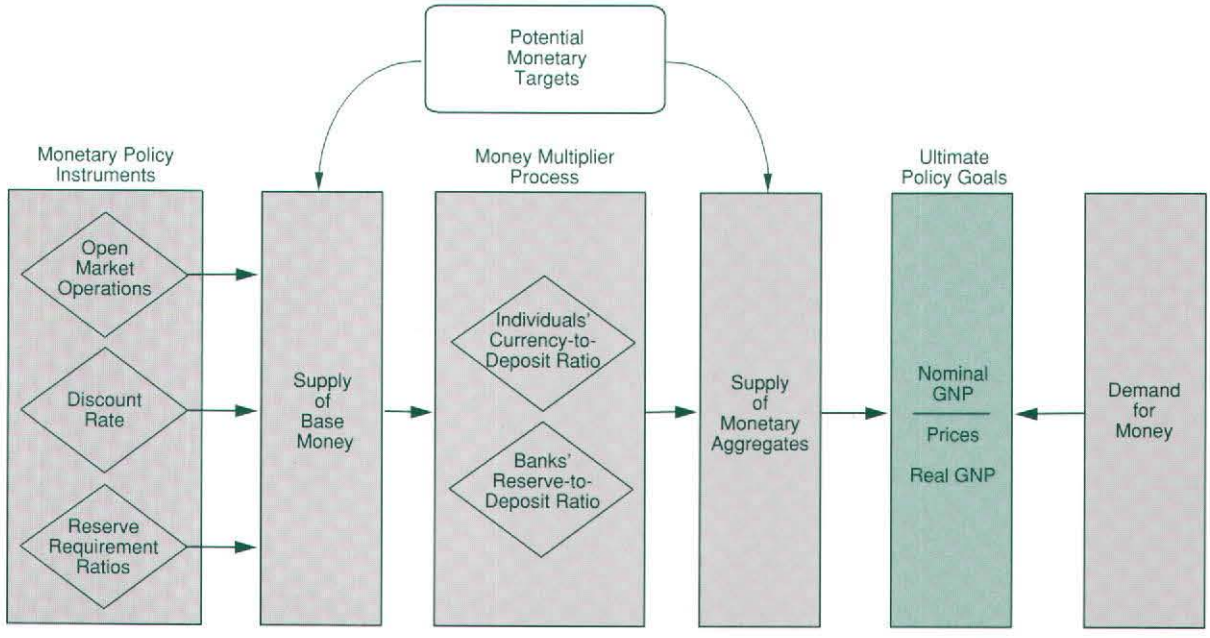
Financial deregulation also appears to have altered the behavior of the multiple relationship between the monetary aggregates and base money. In particular, the two primary effects of financial deregulation here appear to have been a slowing in the rate of growth of the M2-to-base money ratio but an increased responsiveness of money supply to temporary disturbances in money demand. Thus, for purposes of pursuing long-term goals for nominal GNP growth (that is, for inflation), M2 appears to dominate both the more narrow M1 and the monetary base as a target for Federal Reserve policy. But, for purposes of pursuing short-term objectives for nominal GNP growth, base money now deserves more attention as a potential monetary target.

Overview of the policy problem faced by the Federal Reserve

Before specific questions are considered, we will first set out the monetary problem faced by the Federal Reserve. By carefully defining our view of the Federal Reserve's objective and by outlining the various factors affecting achievement of that objective, we intend to put in perspective the specific questions addressed in this article. In addition, we hope to limit the ambiguities that naturally arise when pursuing a relationship between two variables, such as money and economic activity. While our decision to narrow the scope of possible linkages between these two variables is necessary for tractability, we recognize that there is no unanimously accepted view of the exact way in which monetary policy affects the economy.

Chart 1 provides a diagrammatical overview of the monetary policy problem faced by the Fed-

Chart 1
Overview of the Policy Problem of the Federal Reserve



eral Reserve. Economic activity is viewed as being affected primarily by the two sides of the money market—money supply and money demand.[6] On the one side, the private sector demands various types of moneys—currency, bank reserves, demand deposits, other checkable deposits, money market deposit accounts, money market mutual funds, and so on.[7] On the other side, the Federal Reserve, together with private banks and households, determines (through a mechanism described later and known commonly as the money multiplier process) the supplies of the various moneys. These supplies include three simple-sum monetary measures—base money and the M1 and M2 monetary aggregates. (See Table 1 for a listing and description of the various types of money, including the monetary base and the M1 and M2 monetary aggregates.)

The Federal Reserve's objective, broadly speaking, is to achieve some ultimate policy *goal*—defined here as a particular level of nominal GNP—by manipulating its policy instruments. These are open market operations, reserve requirement ratios, and the discount rate.[8] In choosing particular values for these policy instruments, the Federal Reserve determines a specific magnitude for base money in the economy, which, through the money multiplier process, implies a level for each monetary aggregate.

Because variations in the private sector's demand for money (or moneys) render the existing stock of money (or moneys) inadequate or in excess, thereby affecting the economy's level of nominal GNP, the Federal Reserve may for practical reasons choose to adopt an intermediate policy goal, or monetary *target*. But also, because of variability in the money multiplier process, the Federal Reserve must decide whether that monetary target should be a more immediately controllable one, such as base money, or one further separated, such as M1 or M2.

These considerations frame the subject of the sections that follow. To proceed in a useful way, however, we need to clarify further and

Table 1
Components and Definitions of Money

	MB	M1	MT	M2
Bank reserves	✓			
Currency[1]	✓			
Travelers checks of nonbank issuers		✓		
Demand deposits[2]		✓		
Other checkable deposits (OCDs)[3]		✓		
Money market deposit accounts (MMDAs)			✓	
Money market mutual fund (MMMF) balances[4]			✓	
Savings and small-denomination time deposits[5]				✓
Overnight repurchase agreements and overnight Eurodollars[6]				✓

[1] Currency outside the Treasury, Federal Reserve Banks, and the vaults of depository institutions.

[2] Demand deposits at all commercial banks other than those due to depository institutions, the U.S. government, and foreign banks and official institutions less cash items in the process of collection and Federal Reserve float.

[3] Consist of negotiable order of withdrawal (NOW) and automatic transfer service (ATS) accounts at depository institutions, credit union share draft accounts, and demand deposits at thrift institutions.

[4] Balances in both taxable and tax-exempt general purpose and broker-dealer MMMFs.

[5] Time deposits, including retail repurchase agreements (RPs), in amounts of less than $100,000.

[6] Overnight (and continuing contract) repurchase agreements issued by all commercial banks and overnight Eurodollars issued to U.S. residents by foreign branches of U.S. banks worldwide.

NOTE: M2 excludes individual retirement accounts (IRAs) and Keogh balances held at depository institutions and money market funds and all balances held by money market funds (except institution-only funds), U.S. and foreign commercial banks, and the U.S. and foreign governments.

[6] *To center attention on the role played by monetary factors, all other influences on economic activity are ignored in Chart 1 and in the accompanying discussion.*

[7] *The term "bank" is used as a generic shorthand here, and throughout this study, to refer equally to all depository institutions.*

[8] *We are assuming here, of course, that the chain of the causality runs primarily from base money to the monetary aggregates and then to nominal income, rather than other possible scenarios.*

narrow somewhat the policy problem that we consider. Two caveats are thus made.

The first caveat concerns our interpretation of the use of nominal income as a policy objective of the Federal Reserve. By definition, nominal income is the level of *real* GNP evaluated at current prices. While it is reasonable that the Federal Reserve may have the ability, in the short run, to affect *both* real GNP and prices through expansion or contraction of the money supply, it is generally accepted that significant permanent effects of monetary policy on real GNP are not achievable. On the contrary, monetary policy in the long run is seen as affecting only prices. We thus find it convenient to retain nominal income as an overall goal of monetary policy, with the understanding that this variable is used to reflect movements in both real GNP and prices in the short run but as a guide to controlling inflation in the long run. With this clarification, we hope that the reader will not be distracted as we move sometimes synonymously between nominal GNP and prices in the discussion and charts that follow.

The second caveat concerns our definition and selection of variables to consider as money. What is money?[9] Does money include currency, bank reserves, demand deposits, other checkable deposits, money market mutual funds, money market deposit accounts, savings accounts, or what? Can money be measured accurately and usefully as a simple-sum variable—such as M1, M2, or base money? Or must money be aggregated in some other way to be valid? We admit at the outset that there is an extensive debate on this subject. And, frankly, no conclusive answer has yet emerged. Thus, for purposes of tractability, for ease of direct comparison, and because we wish later to consider monetary targets of the type historically employed, we choose to narrow the set of possible money measures to those of the purely simple-sum variety. These are M1, M2, and the monetary base.[10]

In view of the central role played separately by both the demand for and the supply of money in the Federal Reserve's policy problem, we turn now to focus on each of these in more detail. This is followed by an analysis and discussion of the issue of choosing a suitable monetary target. We begin our overview by looking at the effects that financial deregulation has had on the demand for the monetary aggregates.

Effect of financial deregulation on demand for the monetary aggregates

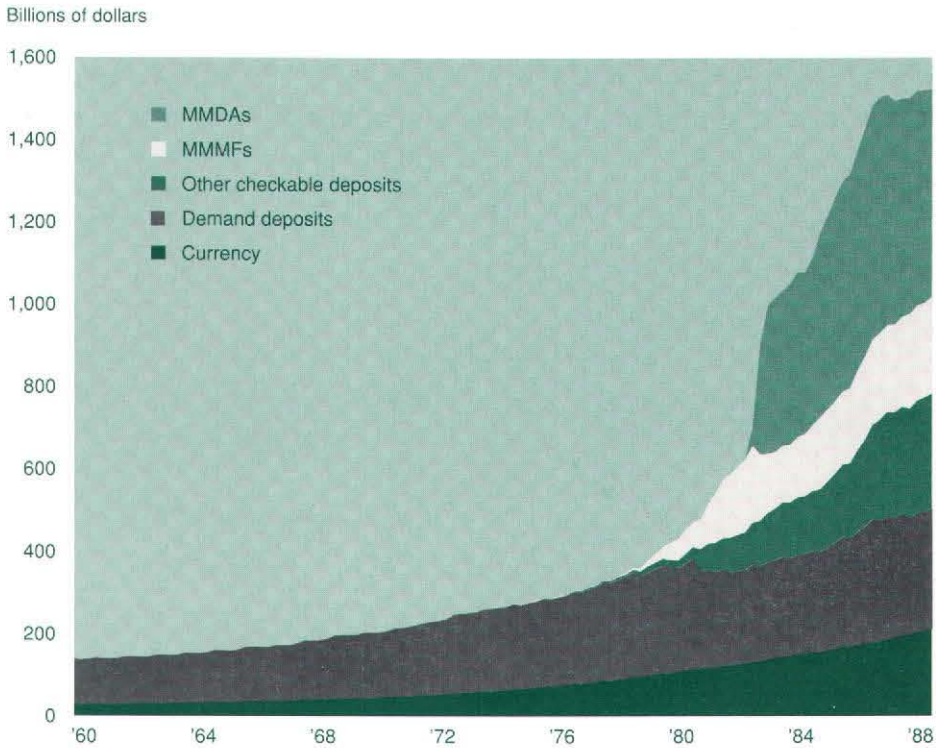
In this section, we examine the behavior of the demand for M1 and M2 over the period 1960–88. We postpone analysis of the demand for base money until the money multiplier process is considered. Although it would be possible, by separately studying banks' demand for reserves and households' demand for currency, to examine directly the demand for base money also, we choose the alternative strategy of treating base money usage as a *derived* demand—derived, that is, from the demand for the monetary aggregates and linked by means of the money multiplier process. We follow this strategy because, as shown later, we feel that there is valuable information to be learned from a separate study of the behavior of the money multiplier process over the period 1960–88.

As Table 1 shows, the task of defining money demand is complicated because there is no single measure of money. A question of central importance, then, is whether there has been a permanent change in the way in which people distribute their holdings of wealth among moneys and other assets because, at least in part, of financial deregulation. As Chart 2 shows, over the past decade there has been tremendous growth in the demand for three new financial instruments—other checkable deposits (which include NOW and Super NOW accounts), money market mutual funds, and money market deposit accounts—all of which are now fully and competitively interest-bearing and enjoy checking privileges to some

[9] *One could argue that the measures of money considered here reflect more the liquidity concept of money, rather than a transactions concept or net wealth concept of money. For a discussion of the various concepts of money and of the issue of money in a deregulated financial system, see, for example, O'Driscoll (1985, 1986) and Osborne (1985).*

[10] *We consider, as potential targets, neither individual monetary components (currency, demand deposits, etc.) nor monetary variables other than those of the simple-sum variety. In addition, we do not consider nonmonetary variables, such as nominal income or the interest rate.*

Chart 2
Transactions Balances



SOURCE: Board of Governors, Federal Reserve System.

degree.[11] Such tremendous growth in demand has no doubt been due largely to the interest-bearing nature of these accounts and to the rates they offer compared with those on alternative investments.

Now that a large part of money is explicitly interest-bearing, will the demand for some, or perhaps all, moneys grow more rapidly than in the past? Will money demand shrink? Or will it return to previous patterns of growth? To investigate these questions, we will ignore briefly the fact that there are various moneys as well as various alternative assets (securities, stocks, real property, etc.) and think generically in terms of "money" and "securities." This allows attention to be focused on the "opportunity cost" concept of holding money.

At any point in time, individuals choose to hold particular amounts of money and securities relative to their income, such ratios depending on interest rates paid on money compared with those offered on alternative assets.[12] The spread between interest rates paid on securities and those paid on money measures the opportunity cost of holding money compared with alternative assets.

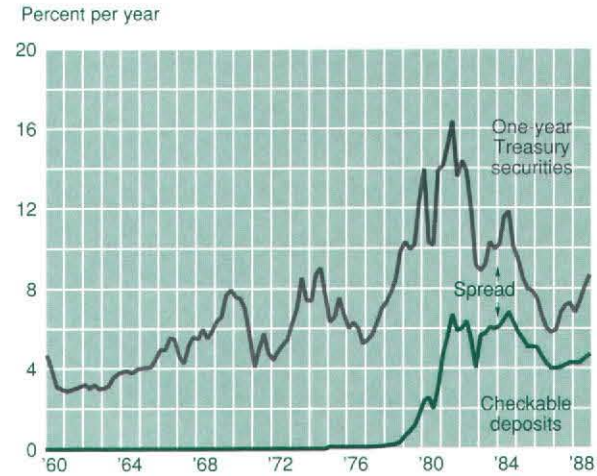
[11] *NOW accounts were authorized for all depository institutions as of January 1, 1980, and Super NOWs as of January 5, 1983. A Super NOW is defined as a NOW account involving an agreement between the depositor and depository institution that requires a $2,500 minimum balance ($1,000 effective January 1, 1985) and provides that funds deposited are eligible to earn more than 5.25 percent interest. Beginning in 1986, the distinction between NOW accounts and Super NOWs was removed, and all accounts thereafter were classified as NOWs.*

[12] *This choice depends also, of course, on individuals' tastes and on transactions technology.*

Chart 3 shows one measure of this opportunity cost—the spread between the interest rate paid on one-year U.S. Treasury securities and the rates paid on checkable deposits (calculated on a weighted-average basis)—over the period 1960–88.[13] Clearly, the spread between interest rates paid on checkable deposits and those on alternative assets has narrowed substantially as a result of financial deregulation.[14]

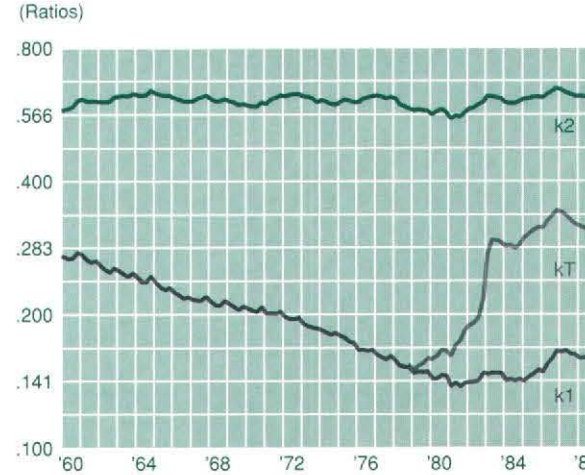
Because interest-bearing checking accounts have made money more like bonds, financial deregulation could have resulted in a sharp increase in the demand for money relative to income, leading even to unruly behavior of the demand for money. The latter would be the case, for example, if changes in the interest rate differential between money and securities encouraged individuals to shift more sharply back and forth between these forms of wealth than previously was

Chart 3
Interest Rates



SOURCE OF PRIMARY DATA: Board of Governors, Federal Reserve System.

Chart 4
The Demand for Money Per Dollar of Income



NOTE: k1 is the M1-to-GNP ratio, k2 is the M2-to-GNP ratio, and kT is the MT-to-GNP ratio. See Table 1 for a description of the M1, M2, and MT monetary aggregates.

SOURCES OF PRIMARY DATA: Board of Governors, Federal Reserve System. U.S. Department of Commerce.

[13] *The interest rate on checkable deposits referred to here is calculated as a weighted average of the interest rates paid on demand deposits (that rate being treated as zero), other checkable deposits (in particular, the average interest rate paid on NOW and Super NOW accounts), money market deposit accounts, and money market mutual funds. Specifically, $R_{CD} = (OCD/CD)R_{OCD} + (MMDA/CD)R_{MMDA} + (MMMF/CD)R_{MMMF}$, where R_{CD} is the average interest rate on checkable deposits (CD), R_{OCD} is the interest rate on other checkable deposits (OCD), R_{MMDA} is the interest rate on money market deposit accounts (MMDA), and R_{MMMF} is the interest rate on money market mutual funds (MMMF). (Before 1982, interest rate data on NOW and Super NOW accounts are unavailable and are estimated.) We explicitly exclude from this calculation the interest rate paid on savings accounts because those interest rate data are generally available only in terms of legal maximums (see footnote 36) and not as market rates. The spread is calculated as the one-year Treasury security rate less the calculated rate on checkable deposits.*

[14] *The spread may be measured with a variety of interest rates on moneys and alternative assets. We have chosen to measure the spread in a way that approximates both the opportunity cost to households of demanding interest-bearing checkable deposits and the profit to banks of supplying those deposits. It should be pointed out, though, that the spread behaves very similarly across a variety of interest rate comparisons, so the choice here is not critical. See footnote 13 for a description of how the interest rate on checkable deposits is constructed. Also, we recognize that banks implicitly offered positive rates of return on checkable deposits before financial deregulation. To circumvent legal prohibition of interest, for example, banks often offered "gifts."*

the case.[15] The effects on the demand for money of the emergence of interest-bearing checking accounts can be seen by examining the historical behavior of the money-income ratio. Chart 4 shows three monetary aggregates—M1, M2, and a transactions aggregate, MT—relative to GNP over the period 1960–88.[16] These ratios are denoted as k1, k2, and kT, respectively.

Has financial deregulation led to a permanent and radical change in the way people distribute their holdings of wealth among moneys and other assets? Is the demand for money now very different from that in the past and perhaps much more erratic? As Chart 4 shows, the demand for M1 does appear to have changed dramatically over the past decade. The k1 ratio—which fell at an average annual rate of roughly 3 percent from 1960 to 1981—began to grow in the early 1980s.[17] While not obvious from Chart 4, M1 has also become much less *predictable*, with the variability in the growth rate of the M1-to-GNP ratio increasing by nearly 2½ times since 1981. In short, there is reason to suspect a deterioration in the stability of the demand for M1. This deterioration is even more notable in a broader transactions aggregate, MT—defined as the sum of currency, demand deposits, other checkable deposits, money market mutual funds, and money market deposit accounts.[18]

In the case of M2, however, apparently no significant deterioration has been caused by the movement from a regulated financial environment to a deregulated one.[19] The demand for M2 relative to income has remained remarkably stable over this entire period, as seen in Chart 4 by the relatively flat line for the k2 ratio (the M2-to-GNP ratio) compared with the lines for k1 and kT. The finding suggests that the increased demand for transactions balances has come largely at the expense of other M2 components—in particular, savings and small time deposits—and only slightly at the expense of other assets. Chart 5 further supports this finding.[20]

A closer look at the k2 ratio gives us a better idea of just how much difference the emergence of interest-bearing checkable deposits has made to the demand for M2. Chart 6 compares recent movements in the k2 ratio with those of the interest rate spread between one-year Treasury securities and checkable deposits. The chart points out two important relationships. First, the demand for M2 relative to income is closely related to the spread in interest rates. Specifically, as the spread falls, the demand for M2 rises. Second and more

[15] *Preliminary statistical tests indicate a heightened sensitivity of money demand to changes in the interest-rate-spread variable over the period 1983–88 compared with 1960–81. This result suggests a potentially increased substitutability between money and alternative assets (due presumably to the interest-bearing nature of money accounts). For evidence on the substitutability among various monetary assets, see Gauger and Schroeter (1989).*

[16] *See Table 1 for definitions of the monetary aggregates.*

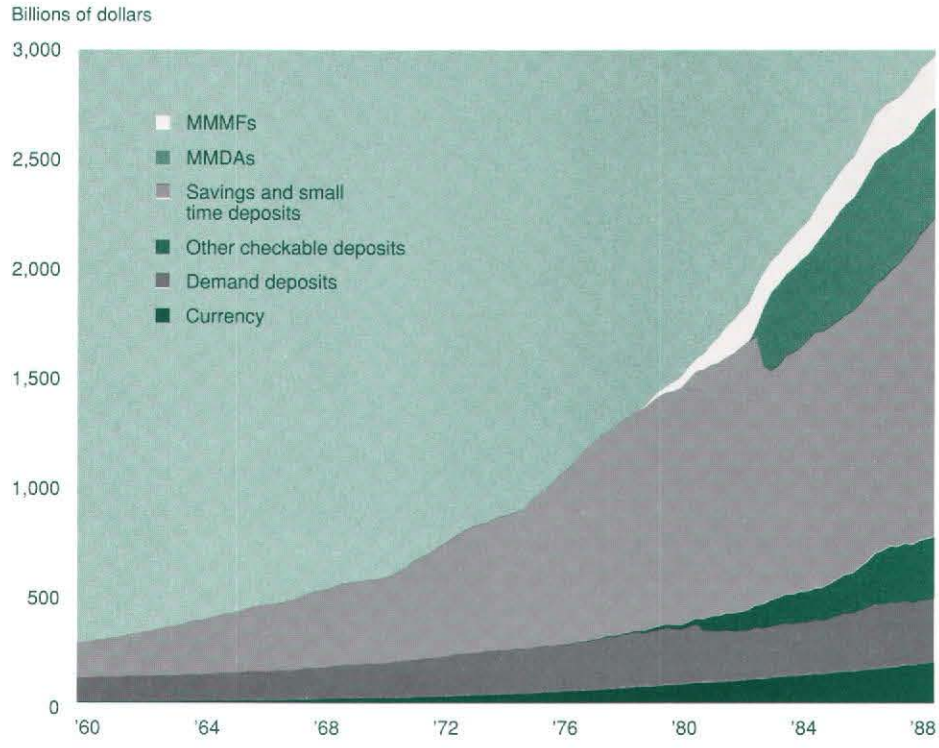
[17] *While financial deregulation has been more of a gradual process than an immediate one, for purposes of comparisons between the regulated environment and the deregulated one, we need to separate the data into clearly defined periods. The procedure we opted for was to divide the data into three periods—a period generally characterizing a regulated financial environment, one characterizing a deregulated environment, and a transition period (treated as one year) between these two. Tests were then conducted examining the behavior of several monetary and financial variables reported here, such as the money-to-GNP ratios and the M2 money multiplier, to determine the period of maximum likelihood of a break in the data. The suggested subperiods from those tests were found to be 1960–81 and 1983–88.*

[18] *This monetary aggregate is sometimes referred to as M1+ or M2–.*

[19] *In response to the proliferation of new financial instruments offered by both bank and nonbank financial institutions in the second half of the 1970s, the Federal Reserve was compelled to redefine the monetary aggregates in 1980 (see Simpson 1980). At that time, it was not known whether (or how) prior, existing, and anticipated deregulation of banking would affect the relationships between the various monetary aggregates and nominal income, inflation, and other real-sector and financial variables. Given nearly a decade for these relationships to evolve and to be measured and understood, we now find M2 emerging as the most useful monetary aggregate. When the monetary aggregates were in the process of redefinition, few economists would have forecast this result. And as deregulation or reregulation takes new directions, these relationships may change. Such changes may necessitate the preeminence of another monetary aggregate and/or further redefinition of the monetary aggregates as new financial instruments are created with medium-of-exchange or store-of-value properties.*

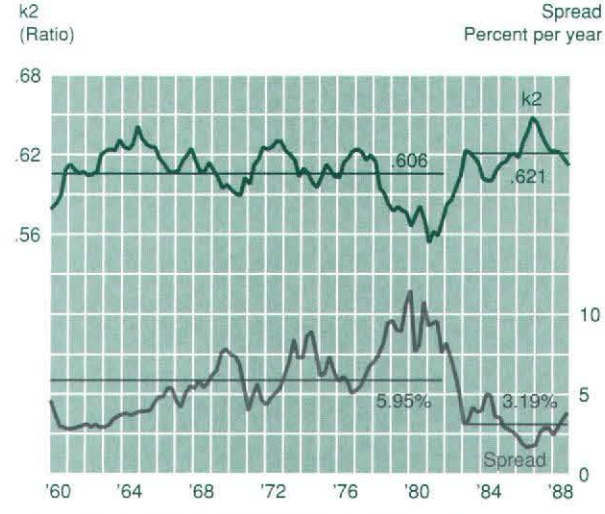
[20] *Chart 5 excludes one component of M2—overnight repurchase agreements and overnight Eurodollars—which make up approximately only 2½ percent of M2.*

Chart 5
M2 Components



SOURCE: Board of Governors, Federal Reserve System.

Chart 6
Interest Rate Spread and Demand for M2



SOURCES OF PRIMARY DATA: Board of Governors,
Federal Reserve System.
U.S. Department of Commerce.

important, the reduction in the spread caused by financial deregulation has not had a significant effect on the demand for M2. We estimate that deregulation of the financial environment has reduced the spread in interest rates to an average of 3.2 percent from 5.9 percent. In response, however, the demand for M2 per dollar of income has increased to only 62.0 cents from 60.6 cents. That is, the demand for M2 per dollar of income has increased by roughly only 2 percent during the period of financial deregulation.[21]

Effect of financial deregulation on the money supply process

In addition to affecting households' demand for the various types of money, financial deregulation may have significantly altered the process of money supply creation.[22] In this section, we examine the effect that financial deregulation has had on the relationship between the aggregates and base money over the period 1960–88. Particular attention is paid to the M2 money multiplier—that is, to the relationship between base money and the M2 monetary aggregate.

In the previous section, we examined the historical linkage between the monetary aggregates and nominal GNP. As Chart 1 points out, however, one other linkage is equally important in the overall connection between Federal Reserve policy instruments and policy goals. It is the linkage between base money (referred to alternatively as the monetary base, or high-powered money) and the monetary aggregates—known commonly as the money multiplier process.

By definition, base money is the total volume of currency held by the nonbank public plus reserves of banks (adjusted for changes in reserve requirements).[23] The monetary base is one important and useful measure of money because it is the measure over which the Federal Reserve has most immediate control. Base money rises, for example, as the Federal Reserve either purchases some asset, reduces its nonmonetary liabilities (through either the open market or the discount window), or lowers reserve requirements of banks. As a practical matter, open market purchases and sales of government securities are the medium most often associated with changes in the base. Indeed, open market operations are the central tool with which the Federal Reserve guides monetary policy over the long run.

Because of the fractional reserve nature of banking, an increase in base money causes a multiple increase in each of the monetary aggregates. Consider, for example, the M2 monetary aggregate and its relationship to the monetary base. Recall that M2 consists of currency plus deposits (demand deposits plus other checkable deposits plus money market deposit accounts plus money market mutual funds plus savings and small time deposits), and base money is currency plus bank reserves.[24] Using c to denote the ratio at which

[21] *In contrast to M1 money demand, M2 money demand also appears to be more stable. In particular, in statistical tests relating the (log of the) level of k1 and k2, individually, to the interest rate spread (and to a constant and time), significantly more of the variation in k2 is shown as explained in the period 1983–88 (compared with the period 1960–81) but significantly less for k1.*

[22] *For an overview of the behavior of the M1 and M2 money multipliers over the period 1960–87 (and a brief discussion of the role played by the emergence of interest-bearing checking accounts), see Burger (1988).*

[23] *In practice, there are two measures of the monetary base—the source base and the adjusted monetary base. These measures differ primarily on the basis of whether they adjust for changes in reserve requirements. The source base is a simple accounting construct equal to net assets of the Federal Reserve System. The source base rises, for example, when the Federal Reserve purchases some asset or reduces its nonmonetary liabilities. As a practical matter, the source base is manipulated either through an open market purchase or sale of government securities by the Federal Reserve System or by System lending through the discount window. The adjusted monetary base, on the other hand, additionally adjusts the source base to account for the magnitude of reserves freed by a change in reserve requirements. A reduction in reserve requirements, for example, frees bank reserves in an amount that could have been achieved directly through an open market purchase of government securities by the System. Thus, to capture the effects of changes in all three of the System's policy instruments—open market operations, the discount rate, and reserve requirement ratios—we use the adjusted monetary base. In particular, we use the St. Louis adjusted monetary base. See Haslag and Hein (1989) for a more thorough description of the monetary base and its relationship to GNP.*

[24] *Again, for exposition, we are ignoring overnight repurchase agreements and overnight Eurodollars.*

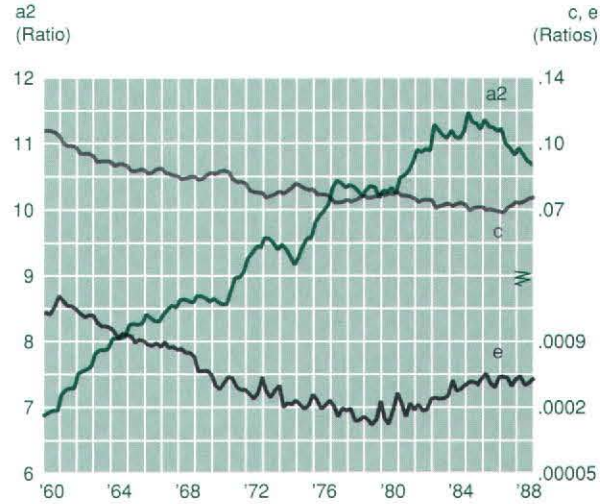
individuals wish to hold currency relative to M2 deposits, e as the ratio at which banks hold reserves (in excess of those required) relative to M2 deposits, and B as the monetary base (adjusted for reserve requirements), it is easy to show that M2 is a multiple of base money.[25] Specifically, the relationship is $M2 = a2 \bullet B$, where $a2 = (c + 1)/(c + e)$ is the M2 "money multiplier." This equation says simply that open market purchases or sales of government securities by the Federal Reserve (as well as other operations on base money) have an eventual multiple impact on the M2 supply of money, where the *size* of that multiple depends on the preferences of individuals regarding their holdings of currency relative to deposits (c) and depends on banks' preferences (e) regarding the amount of reserves to hold relative to deposits.

To illustrate the money multiplier process further, consider the case where the Federal Reserve wishes to increase the monetary aggregates. The Federal Reserve, say, purchases government securities held by banks, which increases bank reserves and, thus, base money. Banks, in turn, loan out a portion of the additional reserves (depending on their choice of e), of which individuals redeposit a portion (depending on their choice of c), thus providing additional deposits, of which banks loan out a portion, and so on. This progression of redepositing and relending is termed the money multiplier process, because it is through this mechanism that an increase in the monetary base has an eventual multiplier impact on any given monetary aggregate.

In essence, the money multiplier is the transmission in the linkage between the engine of base money growth and the speed, or growth rate, of the monetary aggregates. This transmission depends on the preferences of both individuals and banks, which, in turn, depend on underlying economic variables (such as transactions technology, tastes) and, also, on the spread between interest rates paid on money and those on alternative assets.

For purposes of seeing the effect that financial deregulation has had on the money supply process, we must understand next the role that the interest rate spread plays in banks' choice of the excess reserve-to-deposit ratio. On the one hand, deposits held as reserves serve a direct economic function to banks in that they allow banks to meet unanticipated cash drains, manage the efficient allocation of bank liabilities and assets over time, and satisfy reserve requirements without borrowing at the discount window. On the other hand, though, the spread reflects the potential net unit profit to banks from borrowing funds in the deposit market and investing those funds elsewhere (drawing down reserves).[26] A decrease in the spread, then, is apt to increase banks' chosen excess reserve-to-deposit ratio as it lowers the economic benefit to banks of lending

Chart 7
Currency Relative to M2 Deposits, Excess Reserves Relative to M2 Deposits, and the M2 Money Multiplier



NOTE: c is currency relative to M2 deposits, e is excess reserves relative to M2 deposits, and a2 is the M2 money multiplier.
SOURCE: Board of Governors, Federal Reserve System.

[25] *We recognize that not all M2-type deposits are at institutions defined as "depository institutions" and under the direct supervision of the Federal Reserve. Examples of these are cash management accounts at money market brokerage firms.*

[26] *For the sake of exposition, this discussion ignores other types of institutional borrowing and lending costs (loan origination costs, advertising costs, etc.) that might affect banking profitability. In addition, banks are treated as lending in the same investment market generally available to individuals, so the spread shown earlier for individuals (the opportunity cost concept) may be used to approximate that pertinent to the borrowing and lending decisions faced by banks.*

deposits instead of retaining those deposits as reserves.

Chart 7 shows the behavior of the excess reserve-to-deposit ratio and the M2 money multiplier over the period 1960–88. As that chart reveals, the excess reserve-to-deposit ratio, which fell steadily through the period 1960–80, began to level off in the early 1980s and has in recent years shown signs even of growth. Apparently, the emergence of interest-bearing checkable deposits and the implied narrowing of the spread between borrowing and lending rates of banks have had a significant impact on banks' chosen reserve-to-deposit ratio.[27]

Note also, though, in view of the relatively small magnitude of the excess reserve-to-deposit ratio, that this effect on the M2 money multiplier has not been the predominant one. Even more significantly impacting the M2 money multiplier has been the emergence of a new pattern of behavior for the currency-to-deposit ratio. As Chart 7 shows, the currency-to-M2 deposit ratio, which fell at an average annual rate of 1.4 percent over the period 1960–81, has altered its long-term course and in recent years has *grown* at an average annual rate of 0.3 percent. Such an increase in relative currency holdings might have been expected, in part, given the general decline in interest rates on alternative investments over the decade (encouraging households to substitute out of these interest-bearing instruments and into cash). Still, the increase would *not* have been predicted from the emergence of interest-bearing deposit accounts. Indeed, one might have expected that financial deregulation would *reduce* the currency-to-deposit ratio as households reduced their cash balances and sought the attractiveness of interest-bearing checking accounts.[28]

The basic lesson to be learned from studying the new and puzzling behavior of the currency-to-deposit ratio, then, is that there remains a good deal of uncertainty about the way in which financial deregulation has affected the money multiplier process.[29] Nonetheless, the M2 money multiplier has departed from its established pattern of 2.1-percent average annual growth over the period 1960–81 and has slowed to virtually no growth (with some signs, in fact, of declining over the past three to four years). Furthermore, the variability in the growth rate of the M2 money multiplier has increased sharply over the past few years.[30] And as a result, the transmission mechanism from the Federal Reserve's operating variable—base money—to the ultimate monetary target(s)—the monetary aggregate(s)—has been made potentially less certain because of financial deregulation.

Chart 8 shows the implications of these results for the demand for base money. Reflecting a

Chart 8
The Demand for Base Money Per Dollar of Income

NOTE: kB is the monetary base-to-GNP ratio.
SOURCES OF PRIMARY DATA: Board of Governors, Federal Reserve System. U.S. Department of Commerce.

[27] *This result is strongly supported by statistical analysis, indicating a highly statistically significant relation between the interest-rate-spread variable introduced here and both the excess reserve-to-deposit ratio and the M2 money multiplier.*

[28] *Of course, there is also the potential effect that deregulation has had, through heightened financial fragility, on the currency-to-deposit ratio.*

[29] *See Burger (1988) for a discussion of the recent behavior of the currency-to-deposit ratio.*

[30] *Specifically, the variance in the annualized quarterly growth rate of the M2 money multiplier has increased from an average of 0.18 percentage point over the period 1960–80 to 0.26 percentage point over the period 1982–88.*

higher demand for both bank reserves and currency relative to M2 deposits and currency, the base-to-GNP (kB) ratio has departed in recent years from its historically declining pattern. Specifically, while the kB ratio fell at an average annual rate of 2.3 percent over the period 1960–81, this ratio has grown over the past six years at an average annual rate of nearly 0.6 percent.

The Federal Reserve's money target in the new financial environment

We turn now to the issue of establishing targets to guide monetary policy. In the past, repeated arguments have been made for targeting M1 and M2 and, more recently, for targeting the monetary base.[31] Arguments have also been made that the Federal Reserve should target both interest rates and nominal income. Practically speaking, these are too many targets to consider within the scope of this article. For simplification and for ease of direct comparison, then, we consider only three potential Federal Reserve targets. These are base money, M1, and M2—all, notably, monetary targets.

In this section, we set out a simple rule for monetary targeting and then evaluate the implications of applying three alternative targets to follow that rule. We admit at the outset that our choice of a targeting procedure is potentially overly simple. Nonetheless, it serves as a useful device for comparing the merits of alternative targets, while also providing a valuable benchmark against which to judge more sophisticated targeting procedures. We should also indicate that, whereas our discussion to this point has been cast in terms of *levels* of variables, for purposes of considering alternative targets by which to achieve both short-term *and* long-term goals, it is much more meaningful to conduct the analysis henceforth in terms of rates of growth.

Is there some monetary variable that the Federal Reserve can target in an effort to control nominal GNP growth and, if so, what is that variable? To investigate this question, we must first define our use of the term "monetary targeting procedure." Should the procedure be one of allowing the monetary variable to grow within certain prespecified ranges; should there be some "feedback" rule for money growth from observing nominal GNP, interest rates, or some other policy indicator; should the Federal Reserve adopt, say, a constant growth rate rule for the monetary variable in question, as has been frequently suggested; or should some other targeting procedure be followed?

Given the complexities of this problem and in view of our desire to focus on the merits of pursuing alternative monetary targets (rather than alternative targeting *procedures*), we adopt the simplest monetary targeting procedure—a constant growth rate rule. That is, whichever of the three monetary variables the Federal Reserve targets, a constant growth rate is presumed to be adopted for that variable. This is accomplished for base money by direct control of the Federal Reserve balance sheet. Achievement of a constant growth rate for each of the monetary aggregates would admittedly be more difficult (if not impossible in the very short run) because of the influence of private forces on the money multiplier process. Nevertheless, this rule is achievable in principle (certainly, at least approximately) by raising or lowering the growth rate of the monetary base to offset movements in either of the money multipliers.

We must also specify whether the Federal Reserve's objective is to achieve a desired nominal GNP goal in the short run (a goal for real GNP and the price level combined), in the long run (a goal for prices), or both. There is no necessary reason why a goal of minimizing temporary disturbances in nominal GNP would call for the same monetary target as would a goal of preventing deviations from a desired permanent path for nominal GNP (inflation). This is an important distinction and one that we feel should not be ignored. Our approach, thus, is to assume that the Federal Reserve is concerned about each type of

[31] *For early historical support for the choice of M2 as the appropriate monetary aggregate to target, see Friedman and Schwartz (1963). More recently, see McMillin and Fackler (1984), Judd and Trehan (1987), M. Friedman (1988), Mehra (1988), and Wenninger (1988). Support for targeting the monetary base may be found, for example, in Fama (1983), Andersen (1975), Andersen and Karnosky (1977), McCallum (1987, 1988), Hall (1988), Neal (1988), and Shadow Open Market Committee (1985–).*

Table 2
Trend Growth and Deviations from Trend Growth in a2 and the k Ratios

(Annual averages, in percentage points)

	Trend growth				Deviation from trend growth			
	k1	k2	a2	kB	k1	k2	a2	kB
1960–81	–3.18	–0.18	2.12	–2.30	1.75	2.55	2.32	1.87
1983–88	1.13	0.25	–0.29	0.55	5.15	2.99	1.79	2.28

NOTE: a2 is the M2 money multiplier calculated as the ratio of M2 to base money. k1 is the M1-to-GNP ratio, k2 is the M2-to-GNP ratio, and kB is the base money-to-GNP ratio. See footnote 17 for an explanation of the choice of periods over which these variables are compared.
SOURCES OF PRIMARY DATA: Board of Governors, Federal Reserve System.
U.S. Department of Commerce.

disturbance to nominal GNP growth—short and long run—and to evaluate the relative merits of pursuing different monetary targets in terms of their abilities to achieve *both* short-run and long-run desired rates of GNP growth.

In sum, then, the problem we are considering is one where the Federal Reserve wishes to control nominal GNP growth as much as possible, both in the long run and in the short run, by adopting a constant growth rate rule for either M1, M2, or the monetary base. What are the relative merits of targeting each of these money variables to achieve this goal? As Table 2 shows, the answer to this question is not immediately straightforward because there are generally two types of shocks that may occur (and have historically occurred) to money demand and to money supply growth, each of which affects nominal GNP growth differently. Broadly speaking, these two types of shocks are temporary shocks and permanent shocks.

Consider first the case of permanent shocks to the growth rate in money demand or money supply. Examples of these shocks are shown in Charts 4, 6, and 7 and Table 2, where arguably permanent shifts have occurred in the growth rates of the k1 ratio, the k2 ratio, and a2 (the M2 money multiplier) over the past decade. As shown in Table 2, over the past few years the average annual rate of growth in k1 has risen to 1.1 percent from –3.2 percent previously—a shift of 4.3 percentage points. Thus (by our calculations), continuing to target M1 over this period—that is, continuing to allow M1 to grow at its 1960–81 average annual value—would have tightened nominal GNP growth to under 2.4 percent from its actual average of nearly 6.3 percent. Targeting the monetary base, in turn, would have tightened nominal GNP growth to 3.1 percent, because of the sharp downward shift (a shift of 2.4 percentage points) in the trend rate of growth of the M2 money multiplier. Targeting M2, on the other hand, would have produced almost no discernible effect on the growth rate of nominal GNP, as the k2 ratio remained stable throughout this period (a trend shift of only 0.4 percentage point). On the basis of these results and for purposes of achieving long-term objectives for nominal GNP growth (inflation), a policy of targeting M2 would then be implied.

Charts 9, 10, and 11 further underscore this point.[32] While M1 has been led astray by the

[32] *In Charts 9, 10, and 11, the lines depicting the level of prices have been adjusted by adding respective constant rates of growth quarterly. These constants are calculated, in each case, as the average quarterly growth rate of real GNP plus the average quarterly growth rate of the individual money-to-GNP ratio over the period 1960–88.*

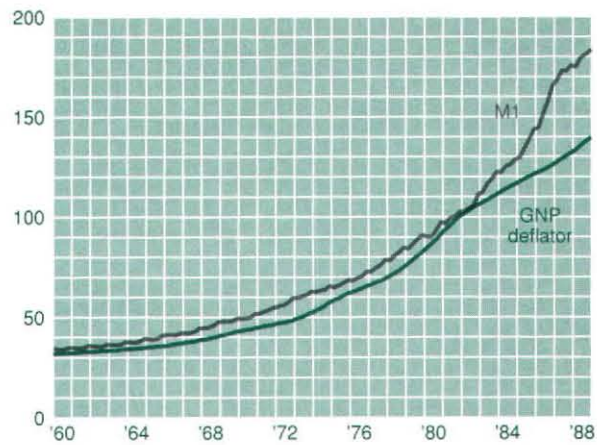
newfound attractiveness of interest-bearing deposits (Chart 9) and while the relationship between the monetary base and prices has been impaired by the effects of financial deregulation on the money multiplier process (Chart 10), the relationship between M2 and prices (Chart 11) has remained remarkably stable.[33] There *has* been a permanent change in the way in which people distribute their holdings of wealth between moneys and other assets because of financial deregulation, *but* this shift has been almost entirely among the components of M2 and not between M2 and other assets. It is for this reason that the long-term relationship between M2 and prices has not been significantly damaged by financial deregulation.

Consider now the implications of temporary shocks to money demand and money supply growth, shown in Table 2 as deviations from the trend rates of growth for each of the periods 1960–81 and 1983–88. What are the effects of these types of monetary shocks on nominal GNP growth? To answer this question, recognize first that money supply adjusts partially and automatically to meet disturbances in money demand. Consider, for example, the case of an increase in money demand. An increase in the demand for money relative to other assets causes a widening of the spread between interest rates on deposits and those on alternative investments, thereby inducing banks to make more loans, which, through the money multiplier process described above, increases the money supply. Part of this automatic adjustment process was in place before financial deregulation because interest rates on alternative assets could respond to changes in the demand for money; but now, *deposit* interest rates also can respond, which aids in the automatic adjustment of money supply to accommodate shifts in money demand.

In short, there are fundamental economic reasons why households' demand for M2 per dollar of income (k2) and the M2 money multiplier (a2) would historically be significantly correlated—indeed, even more correlated in a deregulated financial environment. While potentially tentative, our estimates confirm that the statistical correlation between the quarterly growth

Chart 9
M1 and Prices

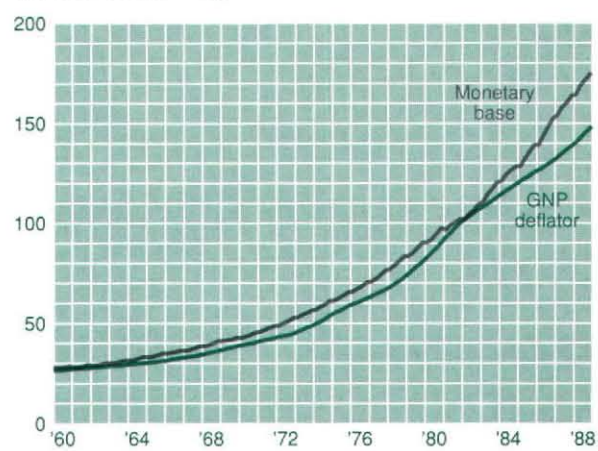
(Indexes, 1981:Q4 = 100)



SOURCES OF PRIMARY DATA: Board of Governors, Federal Reserve System. U.S. Department of Commerce.

Chart 10
Base Money and Prices

(Indexes, 1981:Q4 = 100)



SOURCES OF PRIMARY DATA: Board of Governors, Federal Reserve System. U.S. Department of Commerce.

[33] *Our choice to represent the relationship between money and prices in terms of levels in Charts 9, 10, and 11, and in the accompanying discussion, is statistically supported by evidence that the level of prices is co-integrated (at the 10-percent level or greater) with each of the variables M1, M2, and the monetary base.*

rates of k2 and a2 has increased to 0.72 over the period 1983–88 from 0.49 during the period 1960–81.

What implications does this hold for the choice of an appropriate monetary aggregate with which to achieve short-term stability in nominal GNP growth? Because a policy of targeting the monetary base allows the money multiplier to remain freely flexible and available to help equilibrate the money market—that is, to absorb disturbances in money demand or money supply—such a policy potentially lessens the transmission of those disturbances to nominal GNP growth in the economy.[34] A policy of targeting M2, on the other hand, ignores the benefits of the automatic equilibrating mechanism offered by the money multiplier process, thereby allowing those disturbances to be transmitted more fully to nominal GNP in the economy.

In sum, then, there are merits to targeting M2 and the monetary base and relatively little merit to targeting M1. The merits of targeting M2 lie primarily with the fact that the M2-to-GNP ratio has proven quite stable historically; thus, targeting M2 growth is a relatively simple way of achieving long-term goals for inflation. The merits of targeting base money, on the other hand, lie primarily with the stabilizing nature of the money multiplier process; monetary aggregates can adjust to accommodate partially any temporary shocks to money demand.

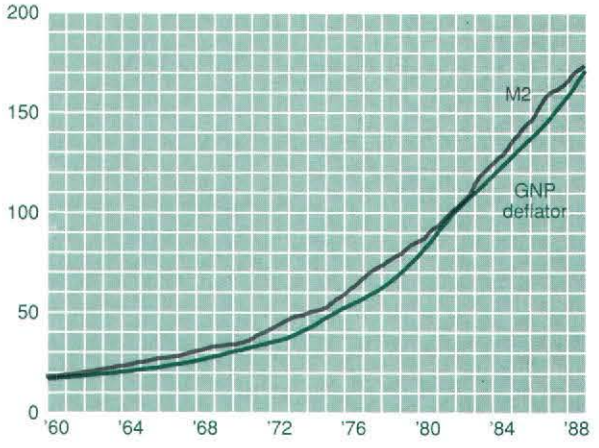
The bottom line, then, is that, if the Federal Reserve is concerned primarily with controlling inflation, a constant growth rate rule for M2 may be the more reasonable policy to pursue. If the goal is more one of temporary stability in nominal GNP growth, then such a targeting rule for the monetary base is likely preferred, especially in a deregulated financial environment. In either case, there is good reason to argue that M1 has lost much of its reliability as a monetary target.

Conclusions and projections

Over the past decade, the banking and monetary system of the United States has fundamentally and perhaps irrevocably changed. There are clearly many major differences in the financial environment today as compared with only a few years ago. Perhaps the greatest of these differences is the way in which people hold money and wealth.[35] As recently as 10 years ago, individuals used chiefly currency and demand deposits for transactions balances, while they preferred savings accounts, interest-bearing securities, and other assets as stores of value. In this old, regulated financial environment, checkable bank deposits were prohibited from paying interest, and rates on savings deposits were limited to a maximum of 5½ percent.[36]

Chart 11
M2 and Prices

(Indexes, 1981:Q4 = 100)



SOURCES OF PRIMARY DATA: Board of Governors, Federal Reserve System. U.S. Department of Commerce.

[34] *See Santomero and Siegel (1981) for theoretical examination of the effects of financial deregulation on the stability of the macroeconomy.*

[35] *See Santoni (1987) for an exposition of the relationship between national wealth and M1 money demand over the period 1960–86.*

[36] *The 5.5-percent legal maximum became effective January 1, 1984. Before that time (and over the period with which this study is concerned), the legal maximums were as follows: January 1, 1957–December 31, 1961, 3 percent; January 1, 1962–January 20, 1970, 4 percent; January 21, 1970–June 30, 1973, 4.5 percent; July 1, 1973–June 30, 1979, 5 percent; July 1, 1979–December 31, 1983, 5.25 percent; and beginning January 1, 1984, 5.5 percent. Note also that transferability between savings and checking deposits was severely restricted by regulation.*

Induced by inflation and high interest rates in the late 1970s, however, financial innovations, such as money market mutual funds, began to change the way in which people hold money and wealth. And with the subsequent enactment of the Depository Institutions Deregulation and Monetary Control Act of 1980, a new era of money and banking was officially ushered in. The act guaranteed full rite of passage to a new and *de*regulated financial world and codified changes in the nature of money that had evolved over the prior decade. In short, a large part of what is called "money" became explicitly interest-bearing and, thus, much more like bonds and other earning assets than previously.

The emergence of a new market-determined "price" for checkable deposits has had, and will continue to have, important effects on the economy. For one, the narrowing of the interest rate spread between "funds borrowed and funds lent" by depository institutions implies potentially fundamental changes in banking profitability, bank failure rates, the composition of bank loan portfolios, and so on. These microeconomic, or structural, ramifications of financial deregulation are important to the economy, and they are important to the Federal Reserve because they bear directly on the function of supervision and regulation. But financial deregulation also has important *macro*economic effects on the level and stability of prices, interest rates, and GNP in the economy.

This article provides an overview of some key questions regarding the impact of financial deregulation on the macroeconomy. We have four basic conclusions.

1. Financial deregulation does appear to have caused a permanent shift in the way in which people distribute their holdings of wealth among moneys and other assets. But this shift has been almost entirely among the components of the M2 monetary aggregate and not between M2 and other assets.

2. There appears to be a stable relationship between M2 and the price level. This stability reaffirms the notion that inflation is primarily a monetary phenomenon once one understands the evolving and proper definition of money.

3. Financial deregulation appears to have altered the relationship between the monetary aggregates and the Federal Reserve's primary instrument of monetary control—base money. In particular, financial deregulation has apparently slowed the rate of growth of the M2-to-base money ratio but has yielded an increased responsiveness of money supply to temporary disturbances in money demand.

4. Thus, for purposes of pursuing long-term goals for nominal GNP growth (goals for inflation), M2 appears to dominate both the more narrow M1 and the monetary base as a target for Federal Reserve policy. But for purposes of pursuing short-term goals for nominal GNP growth, base money is likely the preferred target, especially in the deregulated financial environment.

Based on these findings, what can we point to as reducing inflation in the United States during the early 1980s, and what projections can be made about the nation's future course of inflation? The work here indicates that the inflationary era of the late 1970s can be linked largely to excessive growth in the M2 monetary aggregate during that period.[37] Furthermore, the deceleration in inflation during the early 1980s appears to be due largely to deceleration in the rate of M2 money growth and can be credited only a little to financial deregulation or innovations in the payments mechanism. Because financial deregulation has not significantly altered the long-term relationship between M2 money and prices, the future course for inflation will continue to depend largely on the course of M2 money growth, which the Federal Reserve is obliged to restrain for price stability.

[37] *M2 grew at an annual rate of 10 to 13 percent for a 10-quarter period ending in the fourth quarter of 1978. This was followed by a buildup in inflation averaging 8 to 10 percent at an annual rate over an 11-quarter period ending in the fourth quarter of 1981.*

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John K. Hill
Senior Economist and Policy Advisor
Federal Reserve Bank of Dallas

Kenneth J. Robinson
Economist, Financial Industry
Studies Department
Federal Reserve Bank of Dallas

Money, Wages, and Factor Scarcity as Predictors of Inflation

In the monetarist view, inflation is caused by money growth in excess of growth in real money demand. But to say that money is the source of inflation does not guarantee that inflation can be predicted well from past changes in the money supply. This point became especially clear during the middle 1980s, when rapid money growth failed to produce significant inflation because of a coincident shift in asset demands toward money, especially components of the M1 monetary aggregate.

With the breakdown in the relationship between money and prices, there has been considerable interest in the use of other statistics to forecast inflation. Among other variables, previous studies have considered the gap between actual output and potential output, changes in commodity prices, movements in the foreign exchange value of the dollar, and growth in private and public debt.[1] These studies generally conclude that it is easy to improve upon the forecast performance of M1, especially over the decade of the 1980s. The forecast superiority of nonmoney variables is less clear, however, when money is defined as M2, a broader aggregate.

In this article, we evaluate the usefulness of wage growth and measures of factor scarcity as predictors of inflation. An analysis of wages predicts inflation from information on growth in the total compensation of nonagricultural employees. An analysis of factor scarcity predicts inflation using two measures of input scarcity: (1) the difference between the unemployment rate and an estimate of the natural rate of unemployment (measuring labor scarcity) and (2) the capacity utilization rate (measuring capital scarcity). For purposes of comparison, we also consider two monetary aggregates as predictors of inflation, M1 and M2.

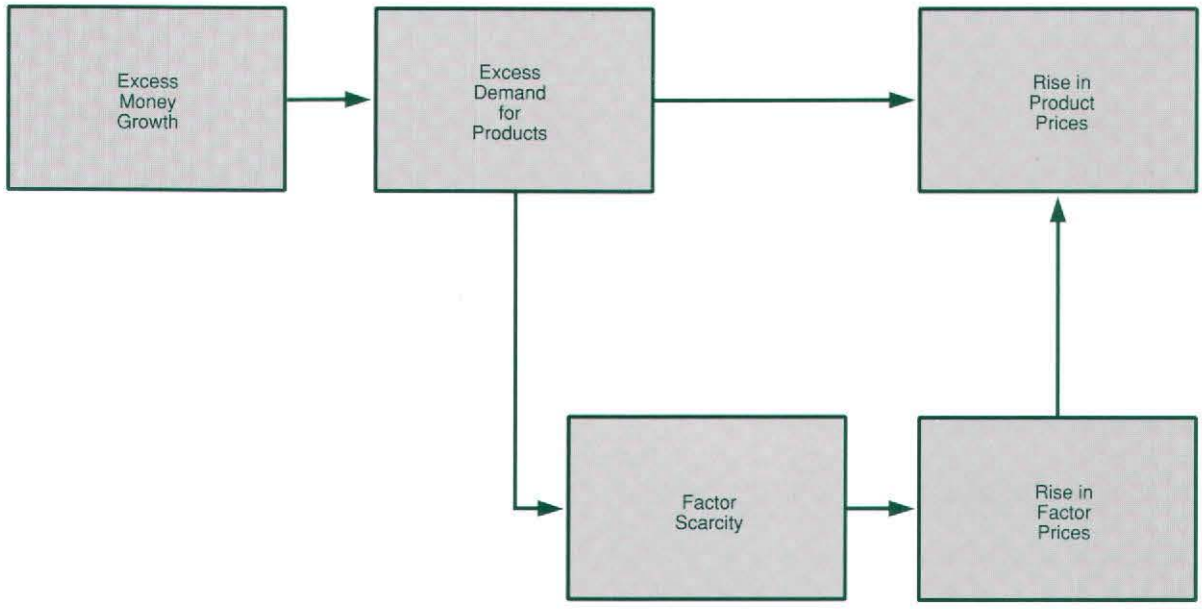
The forecasting methods derive from an analysis of inflation in U.S. consumer prices over the period 1960–80. Each method is evaluated on the basis of how well it has predicted inflation during the 1980s and how much advance notice it gives of an impending change in inflation. We find that inflation forecasts from wage growth and factor scarcity have been substantially more accurate than forecasts based on M1 growth and have also been more accurate than those based on M2 growth. We do find, however, that M1 and M2 give greater advance warning of inflation.

Alternative inflation forecasts are made for 1989 and 1990. The results offer mixed signals about the future course of inflation. Forecasts derived from recent movements in the unemployment rate and capacity utilization rate suggest a

Most of the research on this article was conducted while Robinson was in the Research Department at the Federal Reserve Bank of Dallas.

[1] *Stockton and Glassman (1987) and Mehra (1988) examine the predictive accuracy of an augmented Phillips curve model, whose principal explanatory variable is the gap between actual output and potential output. Recent studies of commodity prices as predictors of inflation include Boughton and Branson (1988) and Furlong (1989). Roth (1986) evaluates the performance of several composite leading indicators of inflation, including the following explanatory variables: movements in the foreign exchange value of the dollar, growth in private and public debt, the ratio of employment to population, and the percentage of purchasing agents experiencing slower deliveries.*

Chart 1
The Inflation Transmission Process



moderate rise in inflation over the next two years. In contrast, forecasts derived from recent M2 growth and wage growth point toward a significant slowing in the rate of inflation.

The inflation transmission process

Chart 1 provides a simplified description of the inflation process. Inflation begins with excess money growth—that is, an increase in the money stock that exceeds the additional amount the public would choose to hold at constant prices. This excess can happen either because the money supply is growing rapidly or because money demand is weak. Whichever is the reason, through its effect on spending and interest rates, the excess in money growth produces an aggregate excess in the demand for goods and services. The excess in demand, then, has a direct effect on product prices.

But there is also an indirect effect—one that operates through factor markets and the costs of production. Because of high product demand, firms are encouraged to hire more workers and order more raw materials, creating shortages of labor and other factors of production. These shortages lead to a rise in factor prices. The increase in factor prices is eventually passed through to product prices, completing the inflationary process.[2]

It is clear from Chart 1 that there are several ways of gaining information on the future course of inflation. Money growth itself will prove to be a good predictor of inflation, provided that monetary excesses are more the result of changes in money supply than changes in money demand. If

[2] *To simplify the exposition, we have ignored the feedback loop that runs from product-price inflation, and its effect on inflationary expectations, to factor-price inflation. For purposes of this article, it is only necessary to know that forecasts of inflation in consumer prices can be improved by making use of prior information on wage growth and factor scarcity.*

[3] *Alchian and Allen (1972, 95–97) provide an instructive example of how an increase in final demand often first pulls up the prices of labor, raw materials, and goods in early stages of production. In their example, businessmen wait until costs go up before raising prices. This practice creates the illusion of cost-push inflation.*

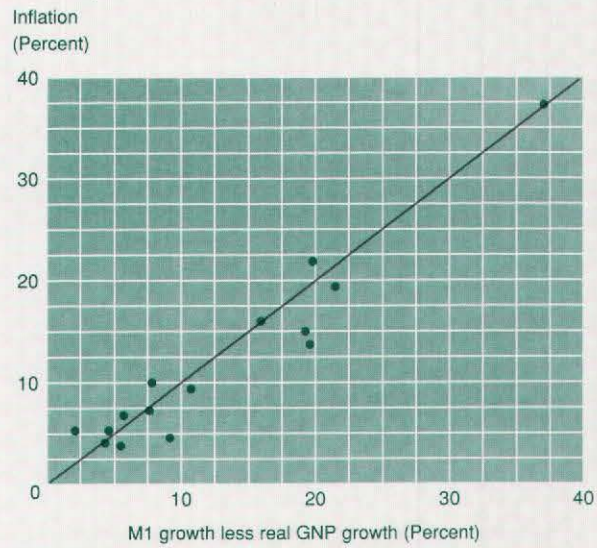
[4] *The forecasts are based on actual values of M1 growth but predicted values of inflation, unless those values were known at the beginning of the forecast period.*

Table 1
Inflation in 15 Selected Countries, 1960–80

	Average annual rates (Percent)
Brazil	37.3
Iceland	21.9
Peru	19.4
Colombia	16.0
South Korea	15.0
Yugoslavia	13.7
Philippines	10.0
Mexico	9.4
Japan	7.3
France	6.8
Canada	5.3
United States	5.3
Venezuela	4.6
Switzerland	4.1
West Germany	3.8

SOURCE OF PRIMARY DATA:
International Monetary Fund.

Chart 2
Money Growth and Inflation:
An International Comparison



Each of the 15 countries listed in Table 1 is represented by a point in Chart 2. The height of each point along the vertical axis is the average annual rate of inflation over the 1960–80 period. The length of each point along the horizontal axis is the difference between the average growth rate of M1 and the average growth rate of real GNP over the same period. If inflation can be projected without error by taking the difference between M1 growth and real GNP growth, then all the points will line up along the straight line in the chart. While short of being perfect, the theory worked well over the sample period.

inflation tends to manifest itself first in the costs of production, then information on factor scarcity and factor prices will also prove helpful in predicting inflation.[3]

Money growth as a predictor of inflation

Money growth has been a historically reliable predictor of inflation, both in the United States and in other nations of the world. This can be seen from an international comparison of inflation and M1 growth rates. Table 1 shows a sample of 15 countries and their average annual rates of inflation over the period 1960–80. The countries were selected to represent a broad range of inflation experiences. Inflation occurs whenever money supply grows faster than real money demand. If the demand for M1 grows in line with the general level of economic activity, the rate of inflation can be projected as the difference between the growth rate of M1 and the growth rate of real GNP (gross national product). As Chart 2 shows, this simple theory worked well in predicting inflation over the sample period.

The usually stable relationship between M1 and the price level weakened considerably during the 1980s. This was especially true in the United States, where disinflation and a deregulation of the interest payable on checkable deposits altered the character of M1 demand. These results came across clearly in our own analysis. A statistical model relating current inflation to past values of M1 growth was estimated using U.S. data for the 1960–80 period (*see the box*). The model then was used to construct a sequence of two-year forecasts for 1981–82, 1983–84, 1985–86, and 1987–88.[4] The results, presented in Chart 3,

Estimation of Forecast Models

We estimated four models to forecast inflation. The models correspond to the four explanatory variables discussed in the text: M1 growth, M2 growth, wage growth, and a composite measure of factor scarcity. Labor scarcity is measured by the difference between the actual unemployment rate and the natural rate of unemployment, and capital scarcity is measured by the capacity utilization rate.[1] The models were estimated using quarterly data from the period 1960–80. To ensure that the data were stationary, the autocorrelation functions of all series were examined.

The dependent variable in the regressions is the rate of inflation, as measured by the consumer price index. The independent variables include lags of the inflation rate, which allows past inflation rates to play a role in predicting future inflation. Akaike's final prediction error (FPE) was used to obtain the number of lags of inflation to include in the estimation equation. The FPE criterion was also used to obtain the proper lag lengths of the other independent variables. This procedure led to the following prediction equations:

$$(1)\quad INF_t = \alpha_0 + \sum_{i=1}^{2} \alpha_{1i} INF_{t-i} + \sum_{i=1}^{8} \alpha_{2i} M1G_{t-i},$$

$$R^2 = .85; \text{SSE} = 155.5.$$

$$(2)\quad INF_t = \beta_0 + \sum_{i=1}^{2} \beta_{1i} INF_{t-i} + \sum_{i=1}^{9} \beta_{2i} M2G_{t-i},$$

$$R^2 = .83; \text{SSE} = 178.6.$$

$$(3)\quad INF_t = \gamma_0 + \sum_{i=1}^{2} \gamma_{1i} INF_{t-i} + \sum_{i=1}^{2} \gamma_{2i} WAGE_{t-i},$$

$$R^2 = .79; \text{SSE} = 236.6.$$

and

$$(4)\quad INF_t = \delta_0 + \sum_{i=1}^{2} \delta_{1i} INF_{t-i} + \sum_{i=1}^{4} \delta_{2i} DIF_{t-i} + \sum_{i=1}^{4} \delta_{3i} CAP_{t-i},$$

$$R^2 = .85; \text{SSE} = 173.1.$$

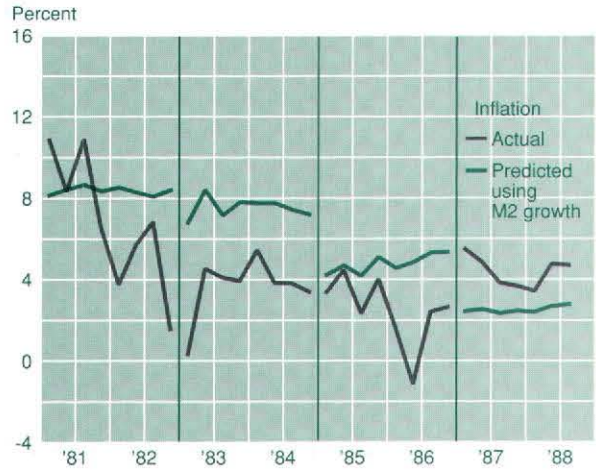
where *INF* is the inflation rate and *M1G*, *M2G*, and *WAGE* represent growth rates of M1, M2, and wages, respectively. *DIF* is the difference between the unemployment rate and the natural rate of unemployment, and *CAP* is the capacity utilization rate. The Box-Pierce *Q* statistics indicated that the residuals from these equations were white noise.

[1] The growth rates of all the variables were calculated using first differences of the logarithms. All variables were seasonally adjusted and, except for the natural rate of unemployment, were obtained from CITIBASE, the Citibank data set. Wages were measured by the average hourly compensation of all nonagricultural employees. The natural rate of unemployment is from Gordon (1984). Capacity utilization refers only to manufacturing industries.

Chart 3
M1 Growth and Inflation
(Annualized rates)

SOURCES OF PRIMARY DATA: Board of Governors, Federal Reserve System. U.S. Bureau of Labor Statistics.

Chart 4
M2 Growth and Inflation
(Annualized rates)



SOURCES OF PRIMARY DATA: Board of Governors, Federal Reserve System. U.S. Bureau of Labor Statistics.

clearly show the tendency for M1 to overpredict inflation during the 1980s. The mean forecast error—that is, the average difference between projected inflation and actual inflation—was 6.7 percentage points.

Money continues to play an essential role in determining the price level. Information on M1 growth failed to predict inflation accurately during the 1981–88 period because of significant changes in money demand. Thus, what ordinarily would have seemed like excessive money growth was not excessive at all but, rather, was very much in line with the public's demand for M1.

Financial deregulation is thought to have had a much smaller effect on the demand for M2 than on the demand for M1.[5] One would suspect, then, that the relationship of inflation to M2 growth that existed in prior decades might continue to apply during the 1980s. This seems to be the case. Shown in Chart 4 are a series of two-year inflation forecasts derived from the historical relationship between M2 and inflation. During the 1980s, inflation forecasts based on M2 have been much more accurate than those based on M1. The average forecast error for the M2 model was 3.1 percentage points—less than half the error of the M1 model.

Wage growth as a predictor of inflation

With the breakdown in the relationship between M1 and the price level, there has been more interest in not only other monetary aggregates but also other kinds of economic variables as predictors of inflation. One of the more popular variables is wage growth. Increases in wages are not the root cause of inflation. But if inflation tends to manifest itself first in wages, then wages can serve as a leading indicator of inflation.

To evaluate the usefulness of wage growth as a predictor of inflation, we explained current inflation by using past values of growth in the total compensation of nonagricultural employees.[6]

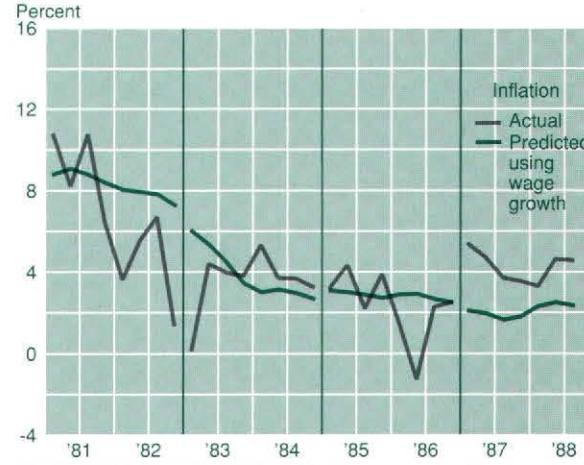
[5] *For example, see the article by Cox and Rosenblum in this* Economic Review.

[6] *As an alternative measure of wages, we considered the series on average hourly earnings of manufacturing workers. The in-sample forecasts derived from this measure were slightly less accurate, however, than those based on the compensation measure. Another often-watched barometer of wage pressures is the employment cost index. Unfortunately, this series is only available beginning with 1976 and, therefore, could not be considered.*

The analysis revealed that information on wage growth contributes, in a statistically significant way, to the prediction of future inflation rates. Shown in Chart 5 are inflation forecasts made with the wage model. During the 1980s, wage growth has proven more accurate as a predictor of inflation than has M2 growth. The average forecast error for the wage model was 1.8 percentage points—more than a full percentage point lower than the average error for the M2 model.

Although they have proven accurate in recent years, inflation forecasts based on wage growth provide relatively little advance warning. Almost three-fourths of the final effect on inflation of a given wage increase is realized after six quarters. The effect of money growth, on the other hand, is much more protracted. Only 20 percent of the final effect of M2 growth (and 40 percent of the effect of M1 growth) is realized after six quarters.

Chart 5
Wage Growth and Inflation
(Annualized rates)



SOURCE OF PRIMARY DATA: U.S. Bureau of Labor Statistics.

Factor scarcity as a predictor of inflation

Two other nonmoney statistics that are watched closely as signs of inflationary pressures are the unemployment rate and the capacity utilization rate. The presumption is that increases in inflation are preceded by a tightening of labor markets and greater use of plant capacity. To evaluate this thesis, we estimated a model relating current inflation to two measures of factor scarcity: (1) the difference between the civilian unemployment rate and Gordon's (1984) estimate of the natural rate of unemployment and (2) the Federal Reserve Board's industrial capacity utilization rate. In measuring labor market tightness, we follow conventional theory by adjusting the observed unemployment rate for changes in the natural rate.[7] Gordon's series on the natural rate is relatively conservative, with a range of less than 1 percentage point over our sample period.

Chart 6 shows the results of inflation forecasts made with the factor-scarcity model. The forecasts were slightly more accurate than those from the wage-growth model. The average forecast error of the factor-scarcity model was 1.5 percentage points. This compares with an average error of 1.8 percentage points in the wage model.

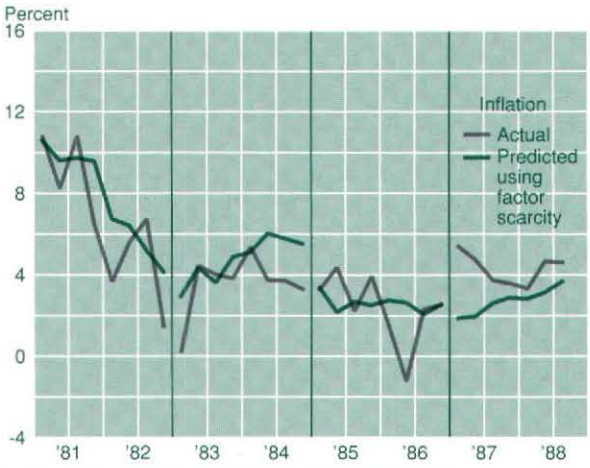
Roughly 50 percent of the ultimate effect on inflation of changes in the unemployment rate or changes in the capacity utilization rate occurs within the first six quarters. Thus, their effect on inflation is more immediate than that of M2 but is more delayed than that of wages.

Comparison of alternative predictors of inflation

We now review the performance of the alternative methods of predicting inflation. The first column in Table 2 shows the average forecast error made by each model over the 1981–88 pe-

[7] *The natural rate of unemployment is intended to measure only the unemployment that is frictional or structural in nature. It excludes any unemployment arising from cyclical fluctuations in aggregate labor demand. In most studies, the natural rate is assumed to depend primarily on demographic factors, such as the age and racial distribution of the population, and institutional factors, including minimum wages and unemployment insurance. Recently, however, Rissman (1986) has argued that the natural rate is affected by long-term changes in the industrial distribution of employment and that, when these effects are accounted for, the natural rate exhibits substantially more variability than previously believed. See Carlson (1988) for an introduction to the concept and determinants of the natural rate.*

Chart 6
Factor Scarcity and Inflation
(Annualized rates)



SOURCES OF PRIMARY DATA: Board of Governors, Federal Reserve System.
U.S. Bureau of Labor Statistics.

Table 2
Comparison of Alternative Predictors of Inflation

	Average forecast error, 1981–88[1]	Percent effect after six quarters
M1 growth	6.7	43
M2 growth	3.1	19
Wage growth	1.8	74
Factor scarcity	1.5	51

[1] In percentage points.
SOURCES OF PRIMARY DATA:
Board of Governors, Federal Reserve System.
U.S. Bureau of Labor Statistics.

riod. M1 proved to be completely unreliable as a predictor of inflation. The broader money aggregate, M2, was much more accurate, with less than half the average forecast error of M1. But the models that were most successful in predicting inflation during the period were those based on wage growth and measures of factor scarcity. The factor-scarcity model had only 50 percent of the average error of the M2 model, and the wage model only 60 percent of the error of the M2 model.

To be useful as a predictor of inflation, an economic variable not only must forecast accurately but also should provide significant advance notice of a change in inflation. The numbers in the second column of Table 2 indicate how much of the final effect on inflation of a given increase in an explanatory variable is realized within the first six quarters. The larger the number is, the less the advance warning given by the variable. Our results indicate that wages and measures of factor scarcity provide less advance notice of a change in inflation than do the monetary aggregates. This is especially true of wages. Three-fourths of the effect on inflation of a given increase in wage growth is felt within the first six quarters. In contrast, only 20 to 40 percent of the effect of money growth occurs within the first six quarters.

Inflation forecasts for 1989 and 1990

Table 3 shows alternative inflation forecasts for 1989 and 1990.[8] Some of the forecasts rely heavily on events that have already taken place. This is especially true of the 1989 forecast derived from past values of M2 growth. Some additional information on future events must be supplied, however. In the case of the M2 model, we assume that M2 grows at a 6-percent annual rate. For the other models, we assume that wage growth, unemployment, and capacity utilization remain at the values they achieved during the third quarter of 1988. The natural rate of unem-

[8] *Because of its recent unreliability, no inflation forecasts were generated from the M1 model.*

Table 3
Alternative Inflation Forecasts

(Annual rates, in percent)

	1988 actual	1989 forecast	1990 forecast
M2 growth	4.4	3.2	2.3
Wage growth	4.4	3.4	3.5
Factor scarcity	4.4	5.5	6.3

SOURCES OF PRIMARY DATA:
Board of Governors, Federal Reserve System.
U.S. Bureau of Labor Statistics.

ployment is assumed to be 5.5 percent.

The models give very different impressions about the future course of inflation. Growth in M2 over the past several years has slowed enough to project a significant decline in the rate of inflation—by as much as 2 full percentage points over the next two years. Analysis of recent wage growth also indicates that the rate of inflation will decline. The factor-scarcity model, on the other hand, points toward an increase in inflation during both 1989 and 1990. These projections reflect, of course, the significant decline in the unemployment rate and rise in the capacity utilization rate that took place in 1987 and 1988. With such a wide variance in the forecasts, the U.S. inflation experience over the next two years is certain to prove valuable in assessing the merits of the alternative predictors of inflation.

Policy implications

In the 1980s, wage growth and measures of factor scarcity have predicted inflation more accurately than have the monetary aggregates M1 and M2. If nonmoney statistics are to serve as guides or indicator variables for monetary policy, however, they must also provide considerable advance notice of an acceleration in inflation. On this count, they are less satisfactory. This is especially true of wages. Movements in wages during 1988 are much more revealing about inflation in 1989 than they are about inflation in 1990. Unfortunately, monetary policy made during 1988, when the information on wages was available, is likely to have the majority of its effect in 1990 and beyond, with relatively little effect on inflation in 1989.

By this argument, information on factor scarcity could prove more helpful to policymakers, because its relationship to inflation is more delayed. The principal difficulty with measures of factor scarcity is that they may not always accurately reflect the degree of scarcity in productive capacity. Theoretical measures of labor market tightness, for example, require knowledge of an unobservable variable—the natural rate of unemployment. Our own findings lend a certain support to Gordon's method of estimating the natural rate. But because the natural rate is unobservable, there is always the potential for serious disagreement over what the measured unemployment rate is actually saying about labor market tightness.[9]

Until money demand becomes more stable, or at least more predictable, monetary policy must be conducted in an eclectic fashion, with an assortment of statistics being used to assess the inflationary climate. Information on wage growth and factor scarcity can be useful in this regard. But because of short lead times and potential measurement problems, neither of these variables should be relied upon exclusively as a guide for monetary policy.

[9] *Recently, the capacity utilization rate has been criticized as a series whose meaning may be changing. It is argued that computerization and restructurings have made U.S. industry more efficient, with the result that businesses are able to expand output further before facing production bottlenecks and delivery backlogs. See the report by Stout (1988).*

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