What Remains of Monetarism?

R.W. HAFER
Hafer chairs the department of economics and finance and is the director of the Office of Economic Education and Business Research at Southern Illinois University Edwardsville; he is also a visiting scholar at the Federal Reserve Bank of Atlanta. *He thanks Gerald Dwyer, Robert Hetzel, Garett Jones, Mack Ott, and Anna Schwartz for comments and criticisms on an earlier version of this paper presented at the Western Economics Association meetings in San Francisco in July 2001.*

> In economics as in other developing sciences, change erodes the value of popular terminology. Monetarism is a name that has been given to a particular set of propositions at a particular point of time. Like Keynesianism, fiscalism, or the "Treasury view," the particular set of propositions called monetarism does not fully describe the body of thought accepted by a loosely knit group of practicing economists any more than terms like Chicago, Cambridge or Austrian School describe the thought of all to whom the terms are applied.
>
> —Allan Meltzer, *The Structure of Monetarism*

MOST CENTRAL BANKS CONDUCT MONETARY POLICY BY MANIPULATING SHORT-TERM INTEREST RATES TO ACHIEVE CERTAIN POLICY OBJECTIVES, SUCH AS ECONOMIC GROWTH AND LOW INFLATION. BY MOST ACCOUNTS THE FEDERAL RESERVE HAS BEEN REMARKABLY SUCCESSFUL DURING THE PAST TWO DECADES AT ACHIEVING THESE GOALS. THE LENGTH OF the economic expansion from 1982 to 1990 and from 1991 to 2001 is unprecedented in U.S. history. In addition, inflation has fallen sharply since the 1970s, averaging less than 3 percent during the past decade. Looking back over this period, Taylor (1998) calls it the "Great Boom" in U.S. economic history.

The Fed's approach to policy was not always as successful as recent experience suggests, however. It was the Fed's policy of controlling short-term interest rates—more specifically, the federal funds rate—that gave rise to the sustained inflation that began in the early 1960s and ran through the early 1980s.[1] Indeed, this dismal track record increased interest in an alternative policy, one that focused more on the growth rate of the money supply. The basic idea behind this alternative policy, usually put under the umbrella name of "monetarism," was that, by controlling the growth of the money supply and not interest rates, the Fed could better control inflation and foster stable economic growth.

The power of monetarist arguments and the building empirical evidence supporting them were key factors leading up to the Fed's October 1979 announcement that it would place more weight on the monetary aggregates in policy deliberations. The Fed's apparent romance with an aggregates-based policy was short-lived, however. Citing the unusual behavior of money growth, in October 1982 the Fed abandoned monetary targets as operating guides and returned to targeting the federal funds

rate. Indeed, today monetary growth targets play no official role in the setting of U.S. monetary policy. The fact that money plays no role is not new in the history of U.S. policymaking.[2] The question is whether such disregard is justified by the data any more today than it was in the past.

This article addresses that question by discussing the development and apparent failure of monetarism as a guide to policy. This overview is useful because it puts today's disregard of monetary aggregates as policy tools into a historical perspective. The article also presents some empirical analysis using a sample of fifteen countries to explore whether the basic monetarist propositions still hold true. Before delving into these discussions and analysis, the article first provides a working definition of monetarism.

What Is Monetarism?

In its most generic form, *monetarism* is the term often used to describe a view or a body of work in which changes in the growth rates of the monetary aggregates play a central role in explaining economic activity, including changes in income (nominal and real) and prices. This view is directly linked to the quantity theory of money. To see this link, let

$$M = kY, \tag{1}$$

where M represents the nominal money stock, k is the public's desired ratio of money holdings to nominal income, and Y is nominal income. The so-called k-ratio is key to understanding the behavioral relationship between the money stock, income, and prices. If this ratio is constant, then M and Y move proportionally. If M is viewed as the nominal stock of money balances demanded by the public, equation (1) is a simple money demand function, where money demand depends largely on income.

The usefulness of equation (1) is demonstrated by a scenario in which the economy is in equilibrium, defined as a condition in which the quantity of money balances demanded is equal to the quantity supplied. If this condition holds, then any increase in the nominal stock of money (M) leads to an increase in either k or Y. If individuals do not initially alter their desired money-to-income ratio (k), an increase in the money stock leads directly to an increase in nominal income. Writing equation (1) in growth rate terms leads one to the following proposition: increasing the growth rate of the money stock leads to an increase in the growth rate of nominal income.

This proposition is important to understanding the nature of monetarism. First, the proposition suggests that movements in the money stock lead to similar movements in nominal income. If the money stock is by and large influenced by the actions of the monetary authority—the Federal Reserve System in the United States or the European Central Bank in Europe—then policy actions have predictable effects on the economy. Of course, how closely money and nominal income move together is the subject of much ongoing debate and empirical testing.

Second, equation (1) also suggests, as a matter of arithmetic, that changes in money can affect both real income and prices differently; nominal income (Y) is the product of real income (y) and prices (P). So equation (1) can be rewritten in the form

$$M = k(yP), \tag{2}$$

where $yP = Y$. If changes in the nominal money stock are not associated with permanent changes in real income and the k-ratio is stable, increases in inflation are linked directly to increases in money growth.

This age-old proposition recognizes the fact that increased money growth by itself cannot lead to an increase in the production of real goods. This fact can be illustrated by an example in which the money stock doubles, making Jane's checking account today twice as big as it was yesterday. What does Jane do? Of course, she might spend all the money, save it all, or spend and save it in varying proportions. The impact of these events on the overall economy is that demands for different goods are likely to change. For goods for which demand has increased, more of those goods are needed, so production increases. Real output (income) rises as more goods are produced. However, there is an upper limit to this production surge, a limit placed by existing plants, equipment, production technologies, and the current labor force. As demands for goods rise and the ability to produce more is constrained, profit-maximizing firms raise prices to ration the scarce goods. Over time, increasing the growth rate of the money supply is likely to be evidenced in rising inflation rates and not in increased rates at which goods and services are produced. This is the story that monetarists reinvigorated in the 1960s, which reappeared as the New Keynesian story of the 1980s and 1990s.[3]

This story provides a substantial foundation for understanding what monetarism is. Of course, exactly what constitutes monetarism varies as much as the number of individuals attempting to define it.[4] For the purposes of this article, the definition of monetarism comprises three facets. First, it refers to a set of testable propositions from which policy prescriptions are determined. For example, Milton Friedman's famous X percent rule for monetary policy is an

example of a policy prescription derived from empirical findings.[5] Second, movements in the money supply are considered to be a major factor explaining observed changes in income, prices, and, in the short run, real output. This view suggests that money and nominal income should be positively related, just as money growth and inflation should be. While monetary impulses may have an impact on real economic activity in the short run, money and real output are not likely to be related over time. Finally, the monetary authority is believed to be accountable, over time, for movements in the money stock. Even though most central banks use short-term interest rates as the policy tool, manipulating interest rates still requires changes in the reserve structure of the banking system, and these changes produce changes in the money stock.

This article uses these propositions to address the question raised in the article's title. The discussion focuses on the first two points, leaving the issue of money stock control for another study. Before turning to the empirical evidence on these points, however, it is useful to examine a brief history of monetarism's rise and fall as a policy guide.

A Brief History of Monetarism

Money's role in the macroeconomic theories developed during the 1930–60 period was negligible.[6] Following the Great Depression and World War II, the dominant view was that governments could successfully manage economies to achieve full employment. The tool by which such "demand management" could be conducted was fiscal policy. Monetary policy was considered important only in the sense that it would keep interest rates at levels necessary to maintain economic growth. Inflation was of little concern in the early postwar period.[7]

Against this mainstream view, some economists emphasized the empirical relationship between movements in the money stock, nominal income, and inflation. The early studies of Warburton (1966) stand out in this regard. Warburton tested the link between money and inflation and money and income, providing empirical support for the notion that increases in the growth rate of the money stock lead to similar increase in the inflation rate. He also found that short-run fluctuations in real output are related to similar changes in money growth. Both of these empirical results became a hallmark of modern monetarism. Unfortunately, Warburton's evidence and scholarly work received scant attention and did little to alter mainstream perceptions regarding the importance of money.

Although the history of monetarism in the postwar period contains many important and interesting contributions, this article focuses on three: the early work done by Milton Friedman and his associates, the Andersen-Jordan model of income determination and the subsequent St. Louis model, and the velocity shift of the early 1980s.

Friedman and Associates. The 1950s witnessed an increase in scholarly work on monetary theory and policy. Notable in this regard is the work of Milton Friedman and his students at the University of Chicago. Friedman's research agenda at the National Bureau of Economic Research (NBER) in the early 1950s began to focus on monetary economics.[8] For example, an early analysis examined the effects of money on the economy during wartime (Friedman 1952). The mid-1950s saw the publication of *Studies in the Quantity Theory of Money* (1956), a collection of articles by Friedman and his students in the monetary workshop at the University of Chicago. His introductory essay, "The

1. See Mayer (1999), DeLong (1997), or Sargent (1999) for a discussion of what is referred to as the "Great Inflation."
2. See Hafer (1999) and Meigs (1976) for a discussion of the early debates over the use of monetary targets. A review of policy actions taken by the Federal Open Market Committee (FOMC) reveals that, during the period from 1950 through 1979 and since 1982, monetary aggregates have been ignored more often than they have contributed to policy decisions.
3. See Mayer and Minford (1995), DeLong (2000), or Woodford (forthcoming).
4. Mayer (1978), for example, suggests more than a dozen attributes of what makes up monetarism, including notions about governmental intervention.
5. The so-called Taylor rule, which relates changes in the federal funds rate to deviations in inflation and output from their desired rates, is a recent policy rule derived from empirical findings. Its long-term viability, like Friedman's rule, will be subject to the vagaries of the underlying data.
6. Portions of this discussion draw on Hafer and Wheelock (2001). Note that the discussion deals only with monetarism as it developed in the United States, not elsewhere.
7. The notion that monetary policy actions, defined as changes in the growth rate of the money stock, are unrelated to economic activity and should not be given much due is not an idea that remained the exclusive property of economists in the 1940s or 1950s. More recent evidence of such a view is found in B. Friedman (1984, 1997).
8. As Friedman recalls it, "In 1950, Arthur Burns, who had taken over from [Wesley Claire] Mitchell as director of research, asked me whether I would take responsibility for the part of the study dealing with the role of money in business cycles. Both his invitation and my acceptance of it demonstrates the interest that I had already developed in the role of money" (Friedman and Friedman 1998, 227–28).

Quantity Theory of Money—A Restatement," is considered by some as the defining article that established modern monetarism.

Friedman posits in this essay that nominal income is closely related to monetary developments: simply put, the theory of money demand is really just a theory of nominal income determination. Mayer and Minford (1995) suggest that Friedman's essay shifted the debate from money's long-run effects on prices to its shorter-term influence on the business cycle. As they state, "This meant that the quantity theory could now explain changes in output as well as in prices, and could no longer be dismissed as arbitrarily assuming full employment" (4). This view contrasted sharply with the Keynesian orthodoxy, one in which money had little or no role.[9] Friedman's own view is that the publication of this book in 1956 was "the first major step in a counterrevolution in monetary theory that succeeded in restoring the classical quantity theory to academic respectability under the unlovely label of 'monetarism'" (Friedman and Friedman 1998, 228).[10]

In October 1982 the Fed abandoned monetary targets as operating guides and returned to targeting the federal funds rate. Indeed, today monetary growth targets play no official role in the setting of U.S. monetary policy.

Friedman's work during the 1950s laid the foundation for later studies linking the behavior of the economy to monetary policy actions. His early work at the NBER with Anna J. Schwartz began to focus more on the business cycle effects of money and monetary policy.[11] His testimony to the Joint Economic Committee in 1958 provides a glimpse into this early counter-attack on Keynesian orthodoxy. At that time policymakers within the Federal Reserve System typically expressed little concern over money's cyclical effects. Minutes of the FOMC's policy meetings indicate that committee members largely rejected the notion that movements in the money supply could be controlled, much less that changes in money growth affected economic activity in any predictable manner. A few members of the FOMC warned that significant shifts in money growth could cause undesirable shifts in the real economy and that the secular increase in money growth would likely raise inflation rates. Unfortunately, these concerns went largely unheeded.[12]

A critical event in the early monetarist assault on Keynesian policies occurred with the 1963 publication of Friedman and Meiselman's "The Relative Stability of Monetary Velocity and the Investment Multiplier in the United States, 1897–1958." The key empirical finding reported in the article rejected a core component in the Keynesian macro model—namely, the relative stability of the expenditure multiplier. Instead, Friedman and Meiselman demonstrated that the velocity of money, considered by Keynesians to be highly erratic and thus obviating any reliable money-income link, is relatively stable over time.[13] They argued that changes in the money stock are more likely caused by changes in the money supply—stemming directly from monetary policy actions—than from changes in the public's demand for money. This finding supported an underlying tenet of the quantity theory and the emerging monetarist argument: changes in nominal income are largely determined by changes in the money supply. Since movements in the money supply are related directly to policy actions, fluctuations in economic activity logically are tied to the Fed's policy actions.

Friedman and Meiselman's evidence and methodology were attacked and dismissed by mainstream economists. The criticisms of Ando and Modigliani (1965) and DePrano and Mayer (1965) were published in the *American Economic Review* along with the Friedman-Meiselman article and the latter's rebuttal (1965). The debate reflected a fundamental difference in views on the importance of money and the role of monetary policy. Friedman and Meiselman's evidence came from simple, reduced-form relations reminiscent of the quantity theory. Their conclusions were based on observed long-run relations in the data. Keynesian policies and viewpoints, represented by the Ando-Modigliani and DePrano-Mayer papers, relied on the output of newly developed, large-scale macroeconometric models. These models focused more on short-run dynamics, not long-run implications. Ando-Modigliani argued, for example, that the Friedman-Meiselman analysis used methods that were "inadequate" given the advances in econometrics and evidenced in the construction of large-scale models. In later analysis, Blinder and Solow (1974) suggested that the reduced-form approach taken by Friedman-Meiselman was "far too primitive to represent *any* theory" (cited in McCallum 1986, 11). The conventional view was that while different approaches generate different results, only the more sophisticated approach produces a reliable outcome.[14]

Finding that velocity appeared more stable than commonly thought heightened the debate over the relative effectiveness of monetary and fiscal actions as countercyclical policies. Most economists continued to support the use of fiscal actions as the only

effective policy tools available to manage real economic activity.[15]

The results of Friedman and Meiselman helped spur the development of a nascent monetarist research agenda. The publication in 1963 of Friedman and Schwartz's massive *A Monetary History of the United States: 1867–1960* provided even greater ammunition to the monetarist movement. In their study, Friedman and Schwartz documented the long-term, empirical relation between movements in the money supply, income, and prices. A major point established in their meticulous analysis of empirical relations and institutional detail was that movements in the money supply largely dictate observed changes in the economy. Indeed, a major contribution of the study was its description of policy blunders that led to the Great Depression. In the end, much of the blame was laid at the Fed's doorstep. While Friedman and Schwartz's *Monetary History* helped to establish a foundation for monetary policy emphasizing control of the monetary aggregates, the nature of the analysis was decidedly long-run.

Andersen-Jordan and the St. Louis Model. The heretofore long-run nature of the monetarist position changed dramatically with the 1968 publication of Andersen and Jordan's "Monetary and Fiscal Actions: A Test of Their Relative Importance." Their controversial results were based on testing the empirical relation between changes in nominal income and various measures of money and fiscal policy actions. The key equation can be written as

$$(3) \qquad Y_t = \alpha + \sum_{i=0}^{3} \beta_i M_{t-i} + \sum_{j=0}^{3} \lambda_j E_{t-j} + e_t,$$

where Y represents nominal GNP, M is the money stock (M1 or the monetary base), and E is one of several measures of fiscal policy actions.[16] The form of the equation explicitly recognizes the lagged effects of policy actions and allows a more precise estimation of the effects of changes in the policy variables. Andersen and Jordan, like Friedman and Meiselman, were interested in the role that money plays in explaining movements in nominal income.[17] But Andersen and Jordan extended the attack on the conventional wisdom by directly comparing the quantitative importance of the effect that monetary and fiscal impulses have on nominal income.

Money's role in explaining movements in nominal income was an important policy issue in 1968. Jordan recalls that "the 1966 credit crunch and subsequent 'mini recession' had demonstrated the potential for a restrictive monetary policy, measured in terms of a deceleration of monetary growth, to dominate an expansive fiscal impulse" (1986, 5).[18] The Andersen-Jordan results provided support for a key element in the monetarist position: namely, money is not only important in affecting nominal income but has a more direct and manageable impact on the economy than fiscal policy actions. In a significant way, the Andersen-Jordan results pushed the long-run monetarist propositions further into the short end of the policy horizon. Andersen and Jordan demonstrated that, by manipulating monetary aggregates, policymakers could achieve the kind of demand-management outcomes once thought possible only through fiscal policy actions.

Andersen and Jordan's results came under immediate criticism. A number of the criticisms

9. This view is debatable, as the exchange in Hafer (1986) between McCallum, Brunner, Blinder, and Gordon indicates.
10. Although Friedman is often considered the "father" of monetarism, it was Karl Brunner (1968) who coined the term.
11. This research would later be published in three volumes. See Friedman and Schwartz (1963, 1970, 1982).
12. Some members of the FOMC favored policies that placed more weight on the behavior of the money supply over financial market conditions. Of this small group, Delos Johns, president of the Federal Reserve Bank of St. Louis, and Malcolm Bryan, president of the Federal Reserve Bank of Atlanta, stand out. They based their policy recommendations on recent monetarist analyses. For a discussion of their contributions to the policy debate, see Meigs (1976) and Hafer (1999).
13. The velocity of money is simply the inverse of the k-ratio.
14. McCallum notes that "Most researchers in macroeconomics believed . . . that investigation of the issues under discussion could be adequately carried out in the context of a full specified, simultaneous-equation, econometric model"(1986, 11). Brunner rejected this notion, stating that "the use of a single equation with a single independent variable should now be clear. It was the appropriate choice for an assessment of the core class [of hypotheses]. It did not represent a single-equation *model* or a disposition to favor simple, as against sophistical, models" (1986, 41).
15. For a discussion of the issues surrounding the debate, see the articles in Hafer (1986).
16. Their analysis used three fiscal policy measures: the high-employment budget surplus, high-employment expenditures, and high-employment receipts.
17. Andersen-Jordan's intellectual link to earlier work by Karl Brunner is obvious. For example, Brunner and Balbach (1959) tested the relative role of money and fiscal policy actions and found that money played an important role.
18. The importance of the events surrounding the 1968 decline is revealed in Maisel's appraisal: "Monetarists' forecasts have had a fair record. The fact that they did well in 1968 when most others did poorly was a major cause of their initial popularity. . . . But I, at least, do not believe their record has been good enough to prove their simplified theory" (1973, 274).

were technical in nature.[19] It is interesting to note that some of the earliest and harshest criticisms came from within the Federal Reserve System itself. For example, DeLeeuw and Kalchbrenner (1969), both associated with the Board of Governors, argued that the monetary aggregate favored by Andersen and Jordan (the monetary base) was not exogenous with respect to movements in nominal income.[20] They also argued that Andersen and Jordan's results were inconsistent (and therefore suspect) with those generated by the Board of Governor's large-scale econometric model. Davis, an economist at the New York Fed, took up this argument, noting that the St. Louis equation "portrays a world [that is] in several respects sharply at variance with the expectations of most of us" (1968, 121). He suggested that monetarists build a structural model (like the FRB/MIT model) and reject the reduced-form approach that began with Friedman-Meiselman and was refined by Andersen and Jordan.[21]

The Andersen-Jordan results provided support for a key element in the monetarist position: namely, money is not only important in affecting nominal income but has a more direct and manageable impact on the economy than fiscal policy actions.

DeLong (2000) argues that the next significant development in the monetarist counter-revolution came with the 1970 publication of Andersen and Carlson's "A Monetarist Model for Economic Stabilization." Usually referred to as the St. Louis model, this study and subsequent refinement of the model put monetarism on similar footing with Keynesian models. The St. Louis model was "monetarist" in the sense that, even though money appears only in the total spending equation, its effects percolate throughout. For example, the effects from an increase in the growth rate of the money supply could be traced through its impact on nominal spending, changes in the price level, real output, long-term interest rates, and unemployment.[22] Since price level changes came about through a simple Phillips-curve relation embedded in the model, no claim was made that that relationship was being ignored. In fact, Andersen and Carlson explicitly state that their analysis was used "to estimate the response of output and prices to monetary and fiscal actions, not to test a hypothesized structure" (1970, 10–11).

The St. Louis model strengthened monetarism's place in policy discussions in several ways. First, monetarist analysis moved into the realm of short-run policy dynamics. Second, the estimated relationships provided support for the theoretical findings of Friedman (1968) and Phelps (1967) that there does not exist a long-run, exploitable trade-off between inflation and unemployment, as many Keynesian economists believed. Estimates of the St. Louis model also demonstrated that expansionary monetary policy can produce a short-run increase in real economic growth (a reduction in the unemployment rate) but that it will vanish over time as inflation picks up and the economy returns to its potential rate of growth. Such actions, taken repeatedly, impart an inflationary bias to the economy.[23]

Third, the Andersen-Carlson results showed that monetary policy, not fiscal policy, is a more potent tool for economic stabilization. Now monetary policy was defined in concrete terms. Instead of terms like "money market pressure" or "tone and feel," a vocabulary that popularized monetary policy analysis in the 1950s and 1960s (and has resurfaced in recent times), changes in the growth of the monetary aggregates could be calculated and their effects analyzed. The St. Louis model helped push the monetarist agenda to the forefront of the short-run stabilization debate more forcefully than previous work had. Dewald argues that "monetarism was [now] widely interpreted as providing an alternative to short run Keynesian model forecasts" (1988, 6).

The Rise and Fall of Monetarism as a Policy Guide. As the success of monetarist predictions mounted, monetarists began to shift from testing rival policies to arguing for the use of monetary aggregates as a short-run stabilization tool. Ongoing development of the St. Louis model and its variants, along with its use for policy analysis, pushed monetarism away from its roots in the long-term relations embodied in the quantity theory. By the mid-1970s, monetarism had elbowed its way squarely into the arena of short-run stabilization issues.[24] Unlike the large-scale macroeconometric models that contained hundreds of variables and equations, the archetypal monetarist model allowed one to analyze stabilization issues using a handful of equations.[25]

The increase in inflation rates throughout the 1970s led many to reconsider monetarist calls for a policy of steady money growth. Even though the inflation spikes of the 1970s were related directly to oil price shocks, the rising trend rate of inflation since the mid-1960s shadowed a similar increase in the average rate of money growth.[26] The Fed began, reluctantly, to adopt parts of the monetarist platform. In the mid-1970s, monetary targets were being used in official policy analysis; there is substantial evidence, however, that these targets were

more window-dressing than strict policy guidelines (Friedman 1982).

The most dramatic shift toward a monetarist-like policy occurred in October 1979. At that time the Fed announced that it would henceforth emphasize policy procedures aimed more at controlling nonborrowed reserves than at the federal funds rate.[27] This shift was made to reduce inflation rates, which were then running in double digits. The restrictive policies enacted served to help lower inflation (and inflationary expectations), but they also sent the economy into the deepest postwar recession on record.

Monetarist theory predicted the outcome: A swift, sharp reduction in money growth (and the attendant spike in interest rates) initially affected real economic activity and then, over time, lowered inflation. Although monetarists predicted the outcome, they neither favored the policy nor claimed credit for it.[28] While monetarists attempted to disassociate themselves from the Fed's policies and to provide alternative procedures to achieve the desired money growth,[29] public perception and professional opinion quickly rejected the so-called monetarist policies being followed by the Fed. Attacks on monetarism surged not only in academic journals but in the popular press as well.[30]

Whether the Fed truly embraced a monetarist policy agenda in 1979 remains debatable, but the Fed's policies dealt a severe blow to monetarism. In addition, sweeping deregulation associated with the Depository Institutions Deregulation and Monetary Control Act of 1980 gave rise to increased volatility in the empirical links between the existing monetary aggregates and the economy. The spread of interest-bearing checking accounts severely altered the relationship between narrow measures of money and income from their historical norms. The most visible effect was the unexpected and large shift in velocity in the early 1980s, which severely reduced the accuracy of monetarist model predictions of nominal income growth and inflation.[31] As the 1980s progressed, deregulation of the banking system, largely a response to the disintermediation that occurred in response to the inflation of the 1970s, and the quickened pace of financial innovations altered the historical empirical relationships between money, income, and prices.

19. For reference to previous studies, see Hafer and Wheelock (2001).
20. Deleeuw and Kalchbrenner (1969) decomposed the monetary base into what they argued were the most exogenous components: reserves less bank borrowings—the adjusted base—and the adjusted base less currency. With this change they found that when the adjusted base was paired with real high-employment receipts, the sum of the estimated coefficients on lagged money—a measure of the monetary multiplier—was less than that found by Andersen and Jordan. Even so, the results were striking enough to show that monetary policy appeared "to exert a powerful influence."
21. Brunner (1986) notes in his survey that this criticism confused competing economic theory with testing a core class of hypotheses that are derived from theory. Even so, the stigma attached to reduced-form results dogged the debate. Regardless of the amount of empirical support for the finding that money influenced nominal income, monetary policy continues to this day to focus on the behavior of interest rates as *the* mechanism by which policy actions are transmitted to the economy.
22. Output is determined as the difference between total spending and the price level. As Andersen and Carlson note, "This method of determining the change in total spending and its division between output change and price change differs from most econometric models. A standard practice in econometric model building is to determine output and prices separately, then combine them to determine total spending" (1970, 10).
23. For a discussion about the role of monetary policy in generating the spiraling inflation that began in the 1960s, see the interviews in Mayer (1999).
24. Hafer and Wheelock (2001) detail the difficulties that this focus placed on the popularity of monetarism in policy discussions. Tavlas (personal correspondence) suggests that the movement to a shorter-term focus occurred much earlier, evidenced by the publication of Friedman (1972).
25. The 1970 version of the St. Louis model, for example, contained eight equations and eleven economic variables.
26. Fed Governor Gramley is quoted in Grieder (1987) as saying, "When you look back over the past fifteen years, you find that inflation kept getting worse. It got worse for a whole variety of reasons, *but certainly one of them was that the course of monetary policy over this long period had permitted a rapid increase in money and credit*" (emphasis added) (1987, 94). For discussions of the "Great Inflation," see DeLong (1997), Mayer (1999), and Sargent (1999).
27. For a timely overview of the so-called monetarist experiment, see Brunner (1983).
28. See the debate between M. Friedman (1984) and B. Friedman (1984).
29. For example, a number of studies demonstrated that the money multiplier was easily forecast, thus allowing the Fed to achieve monetary growth targets. See, among others, Johannes and Rasche (1979) and Hafer and Hein (1984) for examples of such analyses. Of course, the vacuous argument made against such evidence was that, once the Fed began to target the money stock, the ability to forecast the multiplier would be impaired.
30. Batten and Stone (1983) provide a partial listing of the articles taking a negative view of the monetarist experiment. (The author's personal favorite is Kaldor 1982.)
31. A key ingredient of the earlier success of short-run, empirical monetarist models had been the relative stability of velocity over much of the postwar period, even though this point was recognized early in the debate. See, among others, Rasche (1972).

In light of these events, policymakers quickly rejected monetary aggregates as a policy tool. In lieu of money, they once again returned to the manipulation of the federal funds rate to achieve policy objectives. Since the early 1980s, monetary aggregates have played a minimal role in the conduct of U.S. monetary policy. In the early 1990s, Taylor (1993) showed that U.S. monetary policy could be described accurately by relating movements in the federal funds rate to deviations in inflation from a posited target rate and deviations in real output growth from potential growth. The so-called Taylor rule has dominated much of the research on monetary policy during the past decade, both as a model of Fed behavior and as a model to guide policy decisions.[32] What is notable in this monetary policy rule is that money does not appear.

Unlike the large-scale macroeconometric models that contained hundreds of variables and equations, the archetypal monetarist model allowed one to analyze stabilization issues using a handful of equations.

The failure of monetarism to survive as a policy guide has been noted by Fed Governor Meyer (2001), who stated, "Monetarism is about money, but money plays no explicit role in today's consensus macro model, and it plays virtually no role in the conduct of monetary policy, at least in the United States."[33] The consensus macro model to which Meyer refers is described in McCallum (1999) and Rudebusch and Svensson (2000), among others. In this model, money's purpose is only to assist the central bank in determining the interest rate. The consensus macro model determines the inflation rate, the level of output, and the interest rate without any direct reference to the behavior of the money stock. As McCallum notes, "This is the basic point that has led many researchers to ignore money and, indeed, that has led the staff of the Fed's Board of Governors to construct a large, sophisticated, and expensive new macroeconometric model that does not recognize money in any capacity" (1999, 7). Meltzer echoes this in his observation that "Most working economists, most central bank staffs, and market practitioners do not use money growth to predict inflation" (1999, 25).

It would be incorrect, however, to conclude that monetarism failed. In fact, several of its key tenets have become characteristics of current economic thinking. DeLong (2000) and Woodford (forthcoming), for example, argue that the general acceptance of policy rules is a direct descendant of the monetarist agenda. In addition, the very fact that monetary policy, not fiscal policy, is considered the major weapon to combat economic fluctuation is a clear victory for the monetarist view. Still, interest rate manipulation once again dominates controlling growth in the monetary aggregates as a means of achieving stable economic growth and low inflation. The policy role of money is back to where it was almost forty years ago, and policy discussion today is similar to that found in the FOMC minutes from the 1960s.[34]

Monetarism is based on an empirical relation between movements in the money supply and income and prices. Thus, is there any informational content in the monetary aggregates that could help determine the direction and thrust of policy actions? Answering this question occupies the remainder of this article.

Empirical Evidence

This section provides some empirical evidence aimed at answering the question raised in the article's title as well as Meyer's (2001) corollary question: Does money matter? The analysis approaches this task in three interrelated parts. First, data from a sample of diverse countries is examined to determine whether money growth and nominal income growth are positively and significantly related. Next, the link between money and inflation is investigated. Finally, the effect of money on short-term fluctuations in real output is tested. Overall, the evidence indicates that movements in the money supply still help explain movements in nominal income, prices, and real output.

Data. The analysis uses annual post–World War II data from a diverse sample of countries. The data include two measures of money (M1 and M2), the price level (measured using the consumer price index [CPI]), nominal income (gross domestic product [GDP]), and real income (real GDP). The choice of countries is based on no specific criteria beyond data availability, attempting to provide a wide range in economic experience, and keeping the discussion tractable. The attempt is not to achieve total coverage but to test the general applicability of several key monetarist propositions. The sample of countries, the period covered, and summary statistics are provided in Table 1.[35]

Fifteen countries, including developed and developing countries, make up the sample. This sample covers a wide variety of economic experiences. For example, the average annual inflation rate averages a little over 9 percent, ranging from Malta's 3.3 percent to Indonesia's 23.3 percent. Similarly, average annual nominal GDP growth spreads across a wide

TABLE 1
Summary Statistics

Country	Sample	Average Rates of Growth (Percent)				
		M1	M2	Price Level	Nominal GDP	Real GDP
Canada	1950–99	7.9	8.7	3.5	8.0	3.8
Chile	1960–99	23.7	26.4	16.5	21.7	5.2
Colombia	1955–99	20.0	22.9	16.6	21.2	4.6
Denmark	1950–99	8.3	8.2	5.3	8.2	3.0
Egypt	1952–99	10.8	13.5	7.6	12.4	4.9
Iceland	1951–98	20.5	21.4	16.1	21.4	5.3
Indonesia	1965–99	31.4	36.4	23.3	31.5	8.2
Japan	1953–99	10.5	11.0	4.0	9.2	5.3
Korea	1966–99	19.0	23.2	9.2	18.7	9.4
Malta	1957–99	7.8	9.6	3.3	8.7	5.4
Pakistan	1956–99	11.8	12.8	7.4	12.3	5.0
Philippines	1950–99	11.9	14.6	8.1	12.4	4.3
South Africa	1965–99	15.2	13.4	9.8	13.7	3.8
Thailand	1953–99	10.5	14.5	4.7	10.7	5.9
United States	1959–99	5.6	6.9	4.4	7.3	2.9
Averages		14.5	16.2	9.3	14.5	5.1

Source: International Monetary Fund, International Financial Statistics CD, December 2000.

range, from 7.3 percent in the United States to 31.5 percent in Indonesia. One aspect worth noting is that average nominal GDP growth across the sample is closer to money growth than is inflation or real GDP growth. As Table 1 shows, the average growth rate of the money supply—14.5 percent for M1 and 16.2 percent for M2—is closer to nominal GDP growth (14.5 percent) than to average inflation (9.3 percent). It should also be noted that average real GDP growth (5.1 percent) is noticeably less than money growth. Finally, the range of growth rates for real GDP—2.9 percent to 9.4 percent—is less than the range recorded for nominal GDP growth and inflation.[36] As a first approximation, these data suggest a closer relation between money and nominal income than between money and inflation or money and real output.

Correlations. If money matters for policy, there should be a correlation between money growth, nominal income growth, and inflation. In addition, if money growth has little impact on real output in the long run, then a smaller correlation between money growth and real output growth should be found in the data. It is useful to compare correlations across three time horizons, using annual observations of each variable, to assess the link between money and

32. For a critical analysis of the Taylor rule and its applicability, see Hetzel (2000) and the works cited therein. Arguably, the Taylor rule suffers from the same problems as the monetarist rule—namely, reliance on short-term empirical relationships in the data to drive policy implications. As Hetzel demonstrates, policies derived from the rule change over time, thus yielding questionable guidance.
33. There is an inconsistency to recent discussions concerning the role of money in monetary policy and the ultimate policy objective of price stability. For instance, Meyer (2001) states that money "plays virtually no explicit role in the conduct of monetary policy" in the United States and that "money matters—indeed it is just about all that matters—for inflation in the long run." While price stability is widely acknowledged as the appropriate long-run objective of monetary policy, many economists argue that policymakers should respond to fluctuations in real output or employment as part of their strategy to achieve price stability and, ultimately, to support maximum sustainable economic growth. This position is taken in Mishkin (2000), for example.
34. Consider Estrella and Mishkin's argument that "the inability of monetary aggregates to perform well as straightforward information variables in recent periods has the implication that they cannot be used to signal the stance of monetary policy, an important requirement if money growth targets are to be used as part of a strategy to increase the transparency of monetary policy to the public and the markets" (1996, 29).
35. All data are from the December 2000 International Financial Statistics CD.
36. This correlation between money growth, income growth, and inflation using a cross-section of countries has been documented previously. For recent examples, see Dwyer and Hafer (1988, 1999) and the references cited therein.

the economy. The analysis uses rolling averages of growth rates over one- three- and five-year intervals. This approach, similar to that of Dewald (1998) and Dwyer (1998), smoothes short-run fluctuations in the series that may mask the underlying, long-term relationship.[37] The correlations are reported in Table 2.

The results based on annual observations indicate a wide range of correlation for the money-price link. The correlation between M1 growth and inflation for the United States is 0.21. Using M2, the annual correlation is zero. This finding seems to support the contention that there is little informational content in the money growth numbers that policymakers can exploit. Looking across countries, the range of the annual correlation is from –0.04 for the Philippines to 0.97 for Indonesia. Considering the money-inflation relationship across countries, the average correlation between M1 growth and inflation is about 0.25 percent. Using M2 growth, the average correlation increases slightly to 0.40 percent. In either case, these correlations suggest a fairly loose relationship at an annual horizon. Indeed, this evidence suggests that the money-inflation link is rather weak over a period as short as one year.

Policies that increase money growth are more likely, over time, to generate increased inflation, not faster growth in the production of goods and services.

When the growth rates are averaged over time, the correlation between money and inflation generally increases. In Thailand, for example, the M1-inflation correlation is essentially zero with annual data but increases to 0.27 using the three-year average data and to 0.42 for the five-year averaged data. If M2 is used, the five-year correlation jumps to 0.63. This increase is also found in most other countries for which the annual correlations are rather low. For instance, the M2-inflation correlation using annual data for the United States is 0.21 but is 0.56 using the five-year interval. In one instance—Canada—there is no noticeable increase in the correlation between M1 growth and inflation even as longer averages are used. However, the money-inflation correlation in Canada is noticeably larger using the broader M2 measure: the correlation increases from 0.57 percent with annual data to 0.74 percent using five-year averages.

The results in Table 2 indicate that the link between money and inflation improves as the time horizon increases. The cross-country average correlation between M1 growth and inflation is 0.25 at an annual frequency but 0.60 percent when five-year averages are used. Similarly, the correlation between M2 growth and inflation jumps from a sample average of 0.40 using annual data to 0.70 with five-year averages. These results are consistent with the proposition that money growth and inflation are related more closely in the long run.

Table 2 reveals, in all instances but one, a positive correlation between annual money growth and nominal GDP growth, and in most cases this correlation increases as the time interval expands. For example, for the United States the correlation between annual M2 and GDP growth rates is 0.49, increasing to 0.85 when the data are averaged over five years. A similar increase in correlation is reported for most other countries although the magnitude of the increase varies. As with inflation, comparing the averages across countries is useful. For instance, the sample average money-GDP correlation using annual data is 0.40 percent using M1 and 0.57 percent using M2. When five-year averages are used, the correlation increases to 0.65 and 0.83, respectively. This evidence indicates not only that there is a positive correlation between money growth and nominal income growth but that this correlation increases as the time interval increases. This outcome also is consistent with the proposition that income growth and money growth are positively related.

Finally, monetarists often claim that the correlation between money growth and real income growth weakens over time relative to money-inflation and money-nominal income. The results in Table 2 bear this out. The correlation between money growth and real GDP growth using the five-year averages is considerably smaller than the corresponding correlations between money growth, inflation, and nominal income growth. Even though there are instances in which the correlation appears relatively large (for example, Malta [0.84] and Japan [0.82]), on average the money-real income correlations are smaller. This general view again is supported by measuring the average correlations across countries. The average M1–real income correlation is 0.26 percent at an annual horizon and only 0.19 using the five-year averages. If M2 is used, the correlations are 0.27 and 0.17, respectively. This evidence suggests

37. Dwyer (1998, n. 3) notes that a drawback of using rolling averages is that it induces serial correlation. Because each observation uses overlapping data, the usual tests for zero correlation are invalid. Even so, such averaging does not preclude comparing correlations as the time interval changes.

TABLE 2
Correlations

Country	Pair[a]	M1 Time Interval			M2 Time Interval		
		1-Year	3-Year	5-Year	1-Year	3-Year	5-Year
Canada	M, P	.00	.05	.16	.57	.71	.74
	M, GDP	–.09	.14	.17	.61	.81	.81
	M, RGDP	–.10	.14	.03	.17	.24	.15
Chile	M, P	.66	.69	.75	.60	.86	.87
	M, GDP	.78	.77	.75	.51	.62	.72
	M, RGDP	.72	.57	.37	.14	–.12	–.21
Colombia	M, P	.40	.77	.87	.57	.84	.90
	M, GDP	.50	.53	.46	.70	.90	.93
	M, RGDP	.12	.06	–.12	.18	.06	–.10
Denmark	M, P	.21	.55	.62	.33	.50	.49
	M.GDP	.26	.41	.41	.38	.72	.74
	M, RGDP	.07	.11	.13	.08	.05	.07
Egypt	M, P	.44	.32	.28	.62	.71	.77
	M, GDP	.62	.76	.81	.76	.87	.92
	M, RGDP	.33	.50	.49	.29	.38	.33
Iceland	M, P	.78	.92	.95	.82	.93	.96
	M, GDP	.81	.93	.94	.82	.92	.94
	M, RGDP	–.02	–.06	–.17	–.08	–.12	–.20
Indonesia	M, P	.35	.74	.94	.57	.72	.95
	M, GDP	.56	.86	.97	.70	.79	.96
	M, RGDP	.38	.43	.58	.27	.30	.50
Japan	M, P	.30	.46	.52	.41	.49	.55
	M, GDP	.59	.77	.84	.78	.91	.96
	M, RGDP	.50	.62	.68	.65	.79	.82
Korea	M, P	.19	.58	.74	.44	.78	.77
	M, GDP	.55	.86	.92	.53	.82	.82
	M, RGDP	.50	.71	.75	.21	.35	.51
Malta	M, P	.37	.64	.70	.06	.36	.52
	M, GDP	.56	.79	.82	.59	.83	.89
	M, RGDP	.39	.54	.59	.70	.81	.84
Pakistan	M, P	.02	.31	.61	.04	.34	.61
	M, GDP	.16	.32	.64	.19	.40	.66
	M, RGDP	.25	.02	.06	.26	.11	.10
Philippines	M, P	–.04	.51	.70	.14	.47	.74
	M, GDP	.08	.59	.70	.30	.53	.66
	M, RGDP	.18	–.10	–.41	.17	–.11	–.58
South Africa	M, P	.04	.28	.45	.17	.33	.61
	M, GDP	.34	.40	.40	.57	.70	.73
	M, RGDP	.33	.13	–.27	.49	.42	–.13
Thailand	M, P	–.01	.27	.42	.40	.51	.63
	M, GDP	.17	.51	.63	.63	.77	.84
	M, RGDP	.21	.33	.34	.32	.39	.37
United States	M, P	.00	.14	.28	.21	.43	.56
	M, GDP	.10	.22	.25	.49	.77	.85
	M, RGDP	.11	.03	–.16	.21	.19	.13

[a] The variables are money growth (M); the inflation rate (P), measured using the CPI; nominal GDP growth (GDP); and real GDP growth (RGDP). All variables are measured as logarithmic first differences.

that, in the long run, changes in money growth are more likely to affect changes in nominal income and inflation than changes in real output.

Why should money be related more closely with changes in prices and nominal GDP than changes in real output? If real output growth is, over time, determined by real factors, such as population growth or technology, then changes in money growth should be reflected in prices and nominal income (see equation [2]). The correlations do not reject the notion that, in the long run, changes in the growth rates of money have less effect on the path of real economic activity than on nominal income growth and inflation.[38] This finding is in line with monetarist propositions and has an important policy implication: Policies that increase money growth are more likely, over time, to generate increased inflation, not faster growth in the production of goods and services.

It appears that changes in the real money stock may significantly affect short-term economic activity even after the impact of changes in the real rate of interest is accounted for.

Money and Nominal Income. Equation (1) suggests that changes in the stock of money are directly and positively associated with movements in nominal income, given the k-ratio. This hypothesized relationship is used to examine an important monetarist proposition—namely, that there exists a positive connection between changes in the stock of money and the level of nominal income. The correlations in Table 2 generally do not reject this notion. To further check whether money growth can serve as an indicator of nominal income growth, this analysis employs so-called Granger causality tests. The idea is to determine whether there is information in money growth that, once estimates have been conditioned on past income growth, significantly improves the prediction of income. Even though such test results should be viewed with some caution, they are instructive. Table 3 reports the outcome of these pairwise causality tests between money growth (M1 and M2) and nominal income growth.[39]

The first two columns of Table 3 report statistics associated with testing the hypothesis that M1 growth does not cause GDP growth. A statistically significant test statistic allows one to reject that hypothesis. The hypothesis is rejected in ten instances at a 10 percent level of significance (eleven if one permits the 12 percent significance level found for Pakistan). These results suggest that in two-thirds of the countries examined there is evidence that changes in money growth have a significant impact on nominal income growth. The second column tests the companion hypothesis, whether GDP growth does not cause M1 growth. The results of that test indicate that this hypothesis is rejected in five cases, again using a 10 percent level of significance. The results suggest that GDP growth does not cause money growth in nine out of fifteen instances.

The third and fourth columns of Table 3 report the results using the broader M2 measure of money. Overall, the results are comparable to those using M1. The hypothesis that M2 growth does not cause GDP growth is rejected in eight instances, and in seven cases the hypothesis that GDP growth does not cause M2 growth is rejected. These results suggest that the choice of the monetary aggregate has some effect on the test outcome. Overall, the results in Table 3 indicate that there is a causal link from money growth to nominal income in many countries.

An even more restrictive hypothesis can be tested: Does money have a *unidirectional* effect on nominal GDP? This hypothesis is important to establish the usefulness of monetary aggregates in conducting monetary policy. If changes in money do not stem from changes in income, money could serve as a useful measure of the thrust of policy actions.[40] The results for M1 found in Table 3 indicate that one would answer this question in the affirmative for seven countries: Canada, Colombia, Egypt, Japan, Malta, the Philippines, and Thailand. Unidirectional causation from M2 to income cannot be rejected for Canada, Colombia, Egypt, Korea, and the Philippines. Note that changing the definition of money affects the outcome for Malta, Korea, and Thailand. The array of economic experiences captured by this subsample of countries suggests that the money-income relation does not hold only for certain types of economies.

Conversely, is evidence of unidirectional causation running from GDP growth to money growth? Such a finding is most damaging to the idea that monetary aggregates are useful in setting policy because it signals that money growth is not exogenous to changes in income growth. The hypothesis that GDP unidirectionally causes M1 is not rejected in only two countries—Iceland and Pakistan. In the remaining countries, there is evidence of bidirectional causation (Chile, Denmark, and Korea) or no discernable relation (Indonesia, South Africa, and the United States). Replacing M1 with M2 leads to the following outcomes: the hypothesis that GDP growth unidirectionally causes M2 is not rejected for Iceland, Malta, Pakistan, and South Africa at the 10 percent level. Bidirectional causation is not ruled out for Denmark,

TABLE 3
Pairwise Causality Tests

Country	F-statistics (Probability)							
	M1 Does Not Cause GDP		GDP Does Not Cause M1		M2 Does Not Cause GDP		GDP Does Not Cause M2	
Canada	2.45	(0.09)	0.33	(0.72)	3.21	(0.05)	1.22	(0.30)
Chile	3.41	(0.05)	5.68	(0.01)	0.51	(0.61)	1.88	(0.19)
Colombia	18.88	(0.00)	1.28	(0.29)	5.67	(0.01)	2.23	(0.12)
Denmark	4.43	(0.02)	7.07	(0.00)	2.94	(0.06)	6.32	(0.00)
Egypt	11.74	(0.00)	0.41	(0.67)	18.41	(0.00)	0.36	(0.70)
Iceland	0.78	(0.46)	9.24	(0.00)	1.49	(0.24)	9.92	(0.00)
Indonesia	0.88	(0.43)	0.32	(0.73)	0.41	(0.67)	0.52	(0.60)
Japan	5.06	(0.02)	1.76	(0.18)	7.78	(0.00)	2.89	(0.07)
Korea	5.05	(0.02)	3.73	(0.04)	3.66	(0.04)	1.79	(0.19)
Malta	4.16	(0.02)	1.58	(0.22)	1.36	(0.27)	8.54	(0.00)
Pakistan	2.26	(0.12)	3.06	(0.06)	1.23	(0.30)	5.18	(0.01)
Philippines	13.13	(0.00)	0.78	(0.46)	11.99	(0.00)	0.09	(0.91)
South Africa	0.40	(0.67)	0.61	(0.55)	2.02	(0.15)	2.57	(0.10)
Thailand	4.04	(0.02)	0.82	(0.45)	1.09	(0.35)	1.98	(0.15)
United States	0.68	(0.51)	1.16	(0.33)	8.18	(0.00)	3.18	(0.05)

Japan, and the United States. The remaining countries indicate no reliable statistical relation. The fact that the GDP-to-money causation is relatively weak across most countries suggests that money may possess potentially useful policy information.

Money and Inflation. The view often stated by policymakers is that the objective of monetary policy is to keep inflation at bay. Some central banks announce explicit inflation targets although Mishkin (2000) points out that the Federal Reserve has been reluctant to do so. As Meyer (2001) notes, "Given the widespread commitment to price stability, monetarists believe that central banks should therefore give appropriate attention to money growth in the conduct of monetary policy." Is there evidence to support this belief?

A number of recent studies find that movements in the nominal money stock and the price level are positively related. Two approaches are used in these studies. Dewald (1998), for example, averages money growth and inflation data over time, sometimes for periods as long as a decade. The other approach, used in Dwyer and Hafer (1988, 1999), for example, averages data over shorter time spans but across a large number of countries. The analysis in this article examines the temporal relationship between money and prices on a country-by-country basis to gauge the generality of the connection and to illustrate the idiosyncratic nature of the relationships.

To better illuminate the link between money and prices, equation (2) can be solved for the price level to yield

$$P = k^{-1}(M/y). \tag{4}$$

Equation (4) states that, given the k-ratio, changes in the ratio of money to real output are reflected in the price level. If the k-ratio is relatively stable over time,[41] the price level and money per unit of output should move together over time.

38. In a similar vein, Barro (1996) finds that there is no significant relation between inflation and economic growth for a large sample of countries. If inflation is, in the long run, determined by money growth, then Barro's results imply that money growth and real economic growth also are not related over time.
39. For each test, two regressions are estimated, one with nominal income growth as the dependent variable, another with money growth as the dependent variable. To conserve on degrees of freedom, the explanatory variables in each regression consist of two lags of money growth and nominal GDP growth. In essence, then, the causality tests conducted here simply ask whether there is any information in the variables that, after the estimates are conditioned with lags of the dependent variable, improve the explanatory power of the equation.
40. A classic treatment of the instrument-indicator issue is Brunner (1969).
41. This point has been the subject of intense and long-lasting debate, whether the issue revolved around the k-ratio or the demand for real money balances. Although there is evidence that the demand for money is somewhat volatile in the short run, there is compelling evidence to suggest that the economic relationship is stable over time. See, for example, Hoffman and Rasche (1996) and the articles cited therein for evidence on this point.

Real output (y) plays an important role in this story. The range of average output growth for the countries studied here is considerably less than the range for inflation and nominal income growth (see Table 1). This result suggests that real output growth may be determined less by nominal factors, such as money growth, and more by real factors, such as population growth, changes in technology, and changes in the capital stock. If one takes output in the long run as being determined exogenously to monetary policy, then the only impact of changes in the growth rate of money is on the price level. In other words, equation (4) shows that if the k-ratio is stable and real output is determined independently of money, there is a one-to-one connection between changes in money and the price level.

The data indicate that money growth is directly related to nominal income growth and inflation. Moreover, the evidence suggests a weaker relation between money growth and real output growth in the long run.

To investigate the link between money and prices within the context of equation (4), the ratio of money to real income is plotted along with the price level for each country. The resulting graphs are shown in the chart on page 27. The scale for each graph is logarithmic—that is, the slope of the money-output ratio and the price level lines represent rates of change. Similar slopes thus indicate that the growth rates of the underlying series are positively related.

The chart shows that for every country there is a positive, long-run relationship between the money and price series. It is informative that the recent deviation in the United States, which occurred during the early 1990s, is not unique. Such deviations occur, sometimes even frequently, but the two series persistently move together over time. Whether for a high-inflation country such as Indonesia or Chile or a low-inflation country like Japan, the plots in the chart indicate that increases in the growth of money, given output growth, are associated with higher rates of inflation.

Correlations between the two series (not reported) indicate that there is nearly a one-to-one relation between money and prices.[42] This evidence corroborates the results in Table 2, where the correlation between money growth alone and inflation increases over lengthening time intervals. The upshot is that an increase in the growth rate of money relative to real output is likely to impart upward pressure on the price level. Failure by central bankers to heed this signal may create inflationary increases that, as occurred in the past, necessitate restrictive measures.[43]

Money and Real Output. Current U.S. monetary policy, according to Meltzer (1998, 1999), McCallum (1999), and Meyer (2001), utilizes several economic models in which money generally plays no direct role. This view is based on a popular macroeconomic model in which movements in real output are a function solely of changes in the real rate of interest. In this model, monetary policy affects real economic activity only indirectly through its impact on the real rate of interest. Movements in the money supply, therefore, are viewed as having no independent effect on output.[44]

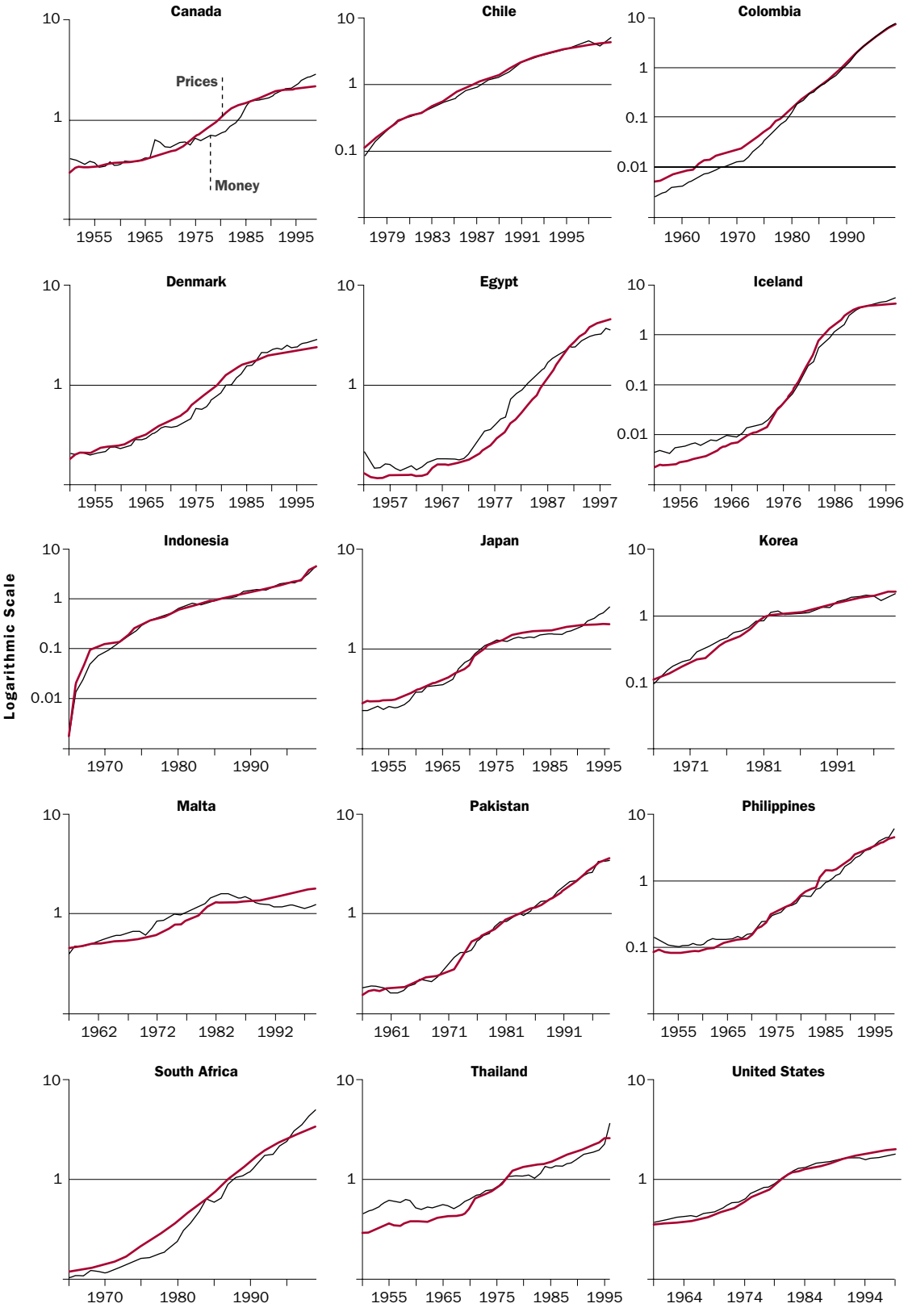
The policy implications of this so-called consensus model have been criticized by a number of economists, such as Meltzer (1999) and Nelson (2000). The popular view is that policy actions taken by a central bank first produce changes in a number of financial returns. The transmission mechanism—the route by which policy actions affect the real economy—thus works primarily through an interest rate channel. A change in policy—that is, a change in the target federal funds rate—leads to a series of changes in other interest rates that induce individuals to reallocate portfolios of financial and real assets, thus producing a change in economic activity. Taking such a narrow focus usually means that one considers only one real interest rate as reflective of policy actions—thus, the focus on the federal funds rate as the sole policy indicator.

This narrow view ignores the potential effects that arise through other avenues, such as changes in real long-term rates or in the return on real assets. Meltzer (1999) tests for the impact of monetary policy actions on aggregate demand by estimating a consumption function in which both short-term real interest rates and real money balances appear. Arguing that prices are relatively sticky in the short run, Meltzer finds that, even after accounting for the effect of the short-term real rate, movements in the real monetary base exert a statistically significant, independent effect on consumption.

Nelson (2000) also tests for the effect of changes in real money balances on aggregate demand using data from the United States and the United Kingdom.

42. The lone exception is Malta, where the correlation is 0.84. For all other countries, the correlation exceeds 0.90.
43. For a useful discussion of such policies and the inflation they engendered in the United States, see Mayer (1999).
44. Examples of recent studies employing such models include Rudebusch and Svensson (1999, 2000) and McCallum and Nelson (1999), among others.

The Correlation between Money and Prices



Source: International Monetary Fund, International Financial Statistics CD, December 2000.

TABLE 4
Detrended Output Regressions: M1

Country	y_{t-1}	y_{t-2}	$real_{t-1}$	$real_{t-2}$	$money_{t-1}$	$money_{t-2}$	adjR^2	*DW*
Canada	1.084	–0.297					0.710	1.85
	(7.76)	(1.86)						
	1.194	–0.387	–0.007	0.004	0.059		0.785	1.86
	(7.36)	(2.46)	(3.67)	(2.54)	(1.23)			
Chile	1.285	–0.659					0.799	2.53
	(8.54)	(4.43)						
	0.969	–.0387	0.001		0.210		0.821	2.43
	(6.05)	(2.43)	(0.30)		(2.15)			
Denmark	1.112	–.0267					0.760	1.94
	(8.31)	(2.70)						
	1.231	–0.418	–0.002		0.107	–0.113	0.787	1.91
	(7.55)	(2.32)	(1.20)		(1.85)	(2.01)		
Japan	1.259	–0.390					0.847	1.93
	(9.23)	(3.19)						
	1.027	–0.256	–0.001		0.282		0.877	1.76
	(6.34)	(1.99)	(0.70)		(4.29)			
South Africa	1.049	–0.450					0.588	1.86
	(6.84)	(3.32)						
	0.898	–0.327	–0.001		0.103		0.599	1.86
	(5.01)	(2.06)	(0.70)		(1.97)			
Pakistan	0.884						0.768	1.64
	(10.92)							
	0.856		0.002		–0.114		0.774	1.52
	(9.56)		(1.63)		(1.84)			
United States	1.155	–0.442					0.685	1.96
	(8.31)	(3.29)						
	1.030	–0.250	0.001		0.107		0.686	1.81
	(7.62)	(1.25)	(0.42)		(1.10)			

Notes: All equations include a constant term. Figures in parentheses are absolute values of t-statistics based on White heteroskedasticity-consistent standard errors.

In contrast to previous findings (such as Rudebusch and Svensson 2000), Nelson reports that deviations in real output from its trend (or potential) are explained by real short-term interest rates *and* real monetary base growth. Nelson's finding is important because it demonstrates a direct, independent effect of changes in monetary aggregates on aggregate demand.[45] Movements in the monetary base—an aggregate over which the monetary authority arguably has some control—thus affect the real economy in the short run. Nelson argues that "when yields besides the short-term rate enter both the IS and LM relations, it is possible that real money growth might be a valuable summary statistic for these yields and might therefore contain information about GDP not present in short-term interest rates" (2000, 18).[46]

This article tests for the independent effects of real money balances on real output once the

effects of a real short-term interest rate have been accounted for. Using Nelson's approach, the following equation is estimated:

$$(5) \qquad y_t = a + b_i y_{t-i} + c_i r_{t-i} + d_i m_{t-i} + e_t,$$

where y is deviations of real output from trend, r represents the real rate of interest, m is real money balances, e is an error term, and the terms a–d are coefficients to be estimated. Nelson (2000) provides a discussion of the underlying theory, which predicts that the expected sign on the real rate of interest should be negative: An increase in the real rate, if all other factors remain the same, should lower aggregate demand. The expected sign on real money balances is positive, suggesting that expansionary monetary policy leads to a (temporary) increase in real output growth above trend.

The paucity of data on short-term rates reduces the sample to seven countries: Canada, Chile, Denmark, Japan, Pakistan, South Africa, and the United States.[47] As a first approximation, real interest rates are calculated as the observed nominal interest rate minus the actual rate of inflation. To calculate the growth of real money balances, nominal money balances are deflated by the CPI, and the logarithmic first difference of the series is calculated. Finally, recent work focuses on the impact of real rates and real balances on deviations of real GDP from potential or trend values. Since measuring potential GDP is difficult under the best of circumstances, this analysis measures the output gap as deviations of real GDP from a quadratic trend.[48]

Table 4 reports the outcome from estimating equation (5) for the seven countries when M1 is the monetary aggregate used. Two regressions are reported for each country. The first is a regression of the output gap on its own lagged values. The lag length reported is based on experimentation with longer lag lengths, using only the last lag that achieves statistical significance. In most instances the significant lags are limited to the first two. The second equation adds to this equation lagged values of the real interest rate and lagged values of real money growth.

The results generally indicate that lagged real interest rates do not achieve statistical significance. For example, the real rate is significant only for Canada, and even there the cumulative effect is quite small. Similarly, Nelson (2000) also reports that the real rate is insignificant (and positive) for the United Kingdom. These results do not support the hypothesis that changes in the real rate of interest explain movements in detrended output growth. The results for lagged real M1 growth are more positive, though not overwhelming. Across the countries tested, this study finds that money generally exerts a positive effect on detrended real output for Chile, Japan, and South Africa. In two instances, Denmark and Pakistan, the estimated coefficients are counter to the theoretically expected positive sign.[49]

Table 5 reports the results when M2 is used to estimate equation (5). Switching to the broader measure leads to money's insignificance for Chile, in contrast to the outcome found using M1. However, switching to the broader measure produces a significant result for the United States. Overall, using M2 yields a significant monetary effect on the output gap in Canada, Denmark, Japan, South Africa, and the United States. In these five cases, an increase in real M2 growth, all other things being equal, is associated with an increase in the output gap.

These results are supportive of Meltzer (1999) and Nelson (2000). It appears that changes in the real money stock may significantly affect short-term economic activity even after the impact of changes in the real rate of interest is accounted for. Moreover, it should be noted that the importance of the real rate of interest is by no means supported in these results. Though tentative, the results reported here, especially using M2, do not support the widely held opinion that money should play no role in monetary policy.

45. There is literature that addresses the unresolved issue of whether real output is affected in the short run by changes in money growth independently of changes in short-term interest rates. For recent studies of this issue and evidence suggesting that there is a significant money-output link, see Hafer and Kutan (1997) or Swanson (1998) and the articles cited therein.
46. Nelson (2000) provides a theoretical model in which the appearance of real money balances is justified as an explanatory variable in the model. As he suggests (p. 28), real money balances act as a proxy for the effects of policy actions on the multitude of yields that in all likelihood enter the aggregate demand and money demand functions.
47. The rates used for each country are the T-bill rate (Canada and South Africa), market lending rate (Chile), discount rate (Denmark), call money rate (Japan and Pakistan), and the federal funds rate (the United States). All rates are from the International Monetary Fund's International Financial Statistics database.
48. This series is generated as the residual from a regression of log real GDP on time and time squared.
49. Although not reported, this analysis also tested for temporal stability in the extended equations. In all cases except Canada, the calculated test statistics do not permit rejection of the hypothesis of stability. The break point tested is 1980.

TABLE 5
Detrended Output Regressions: M2

Country	y_{t-1}	y_{t-2}	$real_{t-1}$	$real_{t-2}$	$money_{t-1}$	$money_{t-2}$	adjR^2	*DW*
Canada	1.084	–0.297					0.710	1.85
	(7.76)	(1.86)						
	1.171	–0.396	–0.008	0.004	0.034		0.776	1.86
	(6.34)	(2.20)	(3.32)	(2.79)	(0.32)			
Chile	1.285	–0.659					0.799	2.53
	(8.54)	(4.43)						
	1.235	0.640	0.001		0.073		0.780	2.42
	(5.76)	(3.89)	(0.11)		(0.28)			
Denmark	1.112	–0.0267					0.760	1.94
	(8.31)	(2.70)						
	1.113	–0.278	–0.002		0.144		0.779	1.81
	(7.26)	(1.56)	(1.22)		(2.12)			
Japan	1.259	–0.390					0.847	1.93
	(9.23)	(3.19)						
	1.241	–0.373	–0.002		0.409	–0.238	0.886	1.95
	(10.07)	(3.20)	(0.84)		(4.57)	(2.12)		
South Africa	1.049	–0.450					0.588	1.86
	(6.84)	(3.32)						
	0.736	–0.185	–0.001		0.361		0.660	1.79
	(5.31)	(1.43)	(0.83)		(3.39)			
Pakistan	0.884						0.768	1.64
	(10.92)							
	0.855		0.002		–0.084		0.776	1.56
	(8.98)		(1.42)		(1.26)			
United States	1.155	–0.442					0.685	1.96
	(8.31)	(3.29)						
	0.728	0.155	0.001		0.435		0.796	1.69
	(5.24)	(0.77)	(1.13)		(4.79)			

Notes: All equations include a constant term. Figures in parentheses are absolute values of t-statistics based on White heteroskedasticity-consistent standard errors.

Conclusion

So what does remain of monetarism? Does money matter? The evidence presented in this article suggests that a blanket dismissal of monetary aggregates as uninformative for policy decisions is premature. The data from a variety of economies indicate that money growth is directly related to nominal income growth and inflation. Moreover, the evidence suggests a weaker relation between money growth and real output growth in the long run. These findings change as the time horizon moves from annual to multiyear averages. But the pattern is what monetarism suggests should occur, in keeping with its foundation in the quantity theory. While these results do not support a version of monetarism in which short-term manipulation of the monetary aggregates delivers direct and precise control over movements in

income and prices, they also do not reject the notion that changes in money growth have important effects on the economy. Failure to acknowledge this empirical fact could give rise to undesirable policy consequences, as evidenced by the inflation of the 1970s or the dramatic and deep recession of the early 1980s.

If one is skeptical about the role of money and prefers interest rates as the key policy tool, the results presented here do not provide overwhelming support for that position. It appears that there is more likely to be a short-run response of real output to a change in money growth than a change in real interest rates. Of course, these estimates are based on only one measure of the real rate, but the outcome is similar to Nelson's (2000) more rigorous analysis. Together, his results and those in this study do not provide much empirical support for the use of interest rates as key policy variables to achieve stable economic growth.

The results presented here signal a call for continued research into the links between money and the economy, the assessment of existing and new measures of the money aggregates, and the role that money should play in policy. In the end, it appears that quite a bit of monetarism remains.

REFERENCES

ANDERSEN, LEONALL C., AND JERRY L. JORDAN. 1968. Monetary and fiscal actions: A test of their relative importance in economic stabilization. Federal Reserve Bank of St. Louis *Review* 50 (November): 11–24.

ANDERSEN, LEONALL C., AND KEITH M. CARLSON. 1970. A monetarist model for economic stabilization. Federal Reserve Bank of St. Louis *Review* 52 (April): 7–25.

ANDO, ALBERT, AND FRANCO MODIGLIANI. 1965. The relative stability of monetary velocity and the investment multiplier. *American Economic Review* 55 (September): 693–728.

BARRO, ROBERT J. Inflation and growth. 1996. Federal Reserve Bank of St. Louis *Review* 78 (May/June): 153–69.

BATTEN, DALLAS S., AND COURTENAY C. STONE. 1983. Are monetarists an endangered species? Federal Reserve Bank of St. Louis *Review* 65 (May): 5–16.

BLINDER, ALAN S., AND ROBERT M. SOLOW. 1974. Analytical foundations of fiscal policy. In *The economics of public finance.* Washington: The Brookings Institution.

BRUNNER, KARL. 1968. The role of money and monetary policy. Federal Reserve Bank of St. Louis *Review* 50 (July): 9–24.

———. 1969. Monetary analysis and Federal Reserve policy. In *Targets and indicators of monetary policy*, edited by Karl Brunner. San Francisco: Chandler Publishing.

———. 1983. Has monetarism failed? *Cato Journal* 3 (Spring): 23–62.

———. 1986. Fiscal policy in macro theory: A survey and evaluation. In *The monetary versus fiscal policy debate: Lessons from two decades*, edited by R. W. Hafer, 33–116. Totowa, N.J.: Rowman and Allanheld.

BRUNNER, KARL, AND ANATOL B. BALBACH. 1959. An evaluation of two types of monetary theories. In *Proceedings of the thirty-fourth annual conference of the Western Economic Association*, 78–84.

DAVIS, RICHARD G. 1968. The role of the money supply in business cycles. Federal Reserve Bank of New York *Monthly Review* April: 63–73.

DELEEUW, FRANK, AND JOHN KALCHBRENNER. 1969. Monetary and fiscal actions: A test of their relative importance in economic stabilization—comment. Federal Reserve Bank of St. Louis *Review* 51 (April): 6–11.

DELONG, J. BRADFORD. 1997. America's only peacetime inflation: The 1970s. In *Reducing inflation,* edited by Christina Romer and David Romer. Chicago: University of Chicago Press: 247–76.

———. 2000. The triumph of monetarism? *Journal of Economic Perspectives* 14 (Winter): 83–94.

DEPRANO, MICHAEL, AND THOMAS MAYER. 1965. Tests of the relative importance of autonomous expenditures and money. *American Economic Review* 55 (September): 729–52.

DEWALD, WILLIAM G. 1988. Monetarism is dead; long live the quantity theory. Federal Reserve Bank of St. Louis *Review* 70 (July/August): 3–18.

———. 1998. Historical U.S. money growth, inflation and inflation credibility. Federal Reserve Bank of St. Louis *Review* 80: (November/December): 13–23.

DWYER, GERALD P., JR. 1998. Is money a leading indicator of inflation? Paper presented at the International Conference on the Conduct of Monetary Policy, Institute of Economics, Academia Sinica, Taipei, Taiwan.

DWYER, GERALD P., JR., AND R.W. HAFER. 1988. Is money irrelevant? Federal Reserve Bank of St. Louis *Review* 70 (May/June): 3–17.

———. 1999. Are money and inflation still related? Federal Reserve Bank of Atlanta *Economic Review* 84 (Second Quarter): 32–43.

ESTRELLA, ARTURO, AND FREDERIC S. MISHKIN. 1996. Is there a role of monetary aggregates in the conduct of monetary policy? NBER Working Paper 5845, November.

FRIEDMAN, BENJAMIN M. 1984. Lessons from the 1979–82 monetary policy experiment. *American Economic Review, Papers and Proceedings* 74 (May): 382–87.

———. 1997. The rise and fall of money growth targets as guidelines for U.S. monetary policy. In *Towards more effective monetary policy*, edited by Iwao Kuroda, 137–64. New York: St. Martin's Press.

FRIEDMAN, MILTON. 1952. Price, income, and monetary changes in three wartime periods. *American Economic Review* 42 (May): 612–25.

———, ed. 1956. *Studies in the quantity theory of money*. Chicago: University of Chicago Press.

———. 1968. The role of monetary policy. *American Economic Review* 58 (March): 1–17.

———. 1972. Comments on the critics. *Journal of Political Economy* 80 (September/October): 906–50.

———. 1982. Monetary policy: Theory and practice. *Journal of Money, Credit, and Banking* 14 (February): 98–118.

———. 1984. Lessons from the 1979–82 monetary policy experiment. *American Economic Review, Papers and Proceedings* 74 (May): 397–400.

FRIEDMAN, MILTON, AND ROSE FRIEDMAN. 1998. *Two lucky people: Memoirs*. Chicago: The University of Chicago Press.

FRIEDMAN, MILTON, AND DAVID MEISELMAN. 1963. The relative stability of monetary velocity and the investment multiplier in the United States, 1897–1958. In *Stabilization policies*. Englewood Cliffs, N.J.: Prentice Hall.

———. 1965. Reply to Ando and Modigliani and to DePrano and Mayer. *American Economic Review* 55 (September): 753–85.

FRIEDMAN, MILTON, AND ANNA J. SCHWARTZ. 1963. *A monetary history of the United States, 1867–1960*. Princeton: Princeton University Press.

———. 1970. *Monetary statistics of the United States: Estimates, sources, and methods*. New York: National Bureau of Economic Research.

———. 1982. *Monetary trends in the United States and the United Kingdom: Their relation to income, prices, and interest rates, 1867–1975*. Chicago: University of Chicago Press.

GRIEDER, WILLIAM. 1987. *Secrets of the temple: How the Federal Reserve runs the country.* New York: Simon and Schuster.

HAFER, R.W., ed. 1986. *The monetary versus fiscal policy debate: Lessons from two decades*. Totowa, N.J.: Rowman and Allanheld.

———. 1999. Against the tide: Malcolm Bryan and the introduction of monetary aggregate targets. Federal Reserve Bank of Atlanta *Economic Review* 84 (First Quarter): 20–37.

HAFER, R.W., AND SCOTT E. HEIN. 1984. Predicting the money multiplier: Forecasts from component and aggregate models. *Journal of Monetary Economics* 14 (November): 375–84.

HAFER, R.W., AND ALI M. KUTAN. 1997. More evidence on the money-output relationship. *Economic Inquiry* 35 (January): 48–58.

HAFER, R.W., AND DAVID C. WHEELOCK. 2001. The rise and fall of a policy rule: Monetarism at the St. Louis Fed, 1968–86. Federal Reserve Bank of St. Louis *Economic Review* 83 (January/February): 1–24.

HETZEL, ROBERT L. 2000. The Taylor rule: Is it a useful guide to understanding monetary policy? Federal Reserve Bank of Richmond *Economic Quarterly* 86 (Spring,): 1–33.

HOFFMAN, DENNIS, AND ROBERT H. RASCHE. 1996. *Aggregate money demand functions: Empirical applications in cointegrated systems*. Boston: Kluwer Academic Publishers.

JOHANNES, JAMES, AND ROBERT H. RASCHE. 1979. Predicting the money multiplier. *Journal of Monetary Economics* 5 (July): 301–25.

JORDAN, JERRY L. 1986. The Andersen-Jordan approach after nearly 20 years. Federal Reserve Bank of St. Louis *Review* 68 (October): 5–8.

KALDOR, NICHOLAUS. 1982. *The scourge of monetarism.* Oxford: Oxford University Press.

MAISEL, SHERMAN J. 1973. *Managing the dollar.* New York: W.W. Norton & Company.

MAYER, THOMAS, ed. 1978. *The structure of monetarism*. New York: W.W. Norton & Company.

———. 1999. *Monetary policy and the great inflation in the United States: The Federal Reserve and the failure of macroeconomic policy, 1965–1979*. Cheltenham, U.K.: Edward Elgar.

MAYER, THOMAS, AND PATRICK MINFORD. 1995. Monetarism. University of California Davis Working Paper 95-21, December.

MCCALLUM, BENNETT T. 1986. Monetary versus fiscal policy effects: A Review of the debate. In *The monetary versus fiscal policy debate: Lessons from two decades*, edited by R.W. Hafer, 9–32. Totowa, N.J.: Rowman and Allanheld.

———. 1999. Recent developments in the analysis of monetary policy rules. Federal Reserve Bank of St. Louis *Review* 81 (November/December): 3–11.

MCCALLUM, BENNETT T., AND EDWARD NELSON. 1999. An optimising IS-LM specification for monetary policy and business cycle analysis. *Journal of Money, Credit, and Banking* 31, no. 3:296–316.

MEIGS, A. JAMES. 1976. Campaigning for monetary reform: The Federal Reserve Bank of St. Louis in 1959 and 1960. *Journal of Monetary Economics* 2 (November): 439–53.

MELTZER, ALLAN H. 1978. Monetarist, Keynesian, and quantity theories. In *The structure of monetarism*, edited by Thomas Mayer. New York: W.W. Norton & Company.

———. 1998. Monetarism: The issues and the outcome. *Atlantic Economic Journal* 26 (March): 8–31.

———. 1999. The transmission process. Carnegie-Mellon University. Manuscript.

MEYER, LAURENCE. 2001. Does money matter? Homer Jones Memorial Lecture presented at Washington University, St. Louis, March.

MISHKIN, FREDERIC S. 2000. What should central banks do? Federal Reserve Bank of St. Louis *Review* 82 (November/December): 1–14.

NELSON, EDWARD. 2000. Direct effects of base money on aggregate demand: Theory and evidence. Bank of England. Unpublished paper.

PHELPS, EDMUND S. 1967. Phillips curves, expectations of inflation and optimal unemployment over time. *Economica* 34 (August): 254–81.

RASCHE, ROBERT H. 1972. Comments on a monetarist approach to demand management. Federal Reserve Bank of St. Louis *Review* 54 (January): 26–32.

RUDEBUSCH, G.D., AND L.E.O. SVENSSON. 1999. Policy rules for inflation targeting. In *Monetary policy rules*, edited by John B. Taylor, 203–46. Chicago: University of Chicago Press.

———. 2000. Eurosystems monetary targeting: Lessons from U.S. data. Institute for International Economic Studies. Unpublished paper.

SARGENT, THOMAS J. 1999. *The conquest of American inflation*. Princeton, N.J.: Princeton University Press.

SWANSON, NORMAN R. 1998. Money and output viewed through a rolling window. *Journal of Monetary Economics* 41 (June), 455–73.

TAYLOR, JOHN B. 1993. Discretion versus policy rules in practice. *Carnegie-Rochester Conference Series on Public Policy* 39 (December): 195–214.

———. 1998. Monetary policy and the long boom. Federal Reserve Bank of St. Louis *Review* 80 (November/December): 3–11.

TAVLAS, GEORGE. 2001. Letter to author, May 3.

WARBURTON, CLARK. 1966. *Depression, inflation, and monetary policy: Selected papers, 1945–53.* Baltimore: Johns Hopkins Press.

WOODFORD, MICHAEL. Forthcoming. Revolution and evolution in twentieth-century macroeconomics. In *Frontiers of the mind in the Twentieth Century*, edited by P. Gifford. Cambridge: Harvard University Press.