A Quantity Theory Framework for Monetary Policy

Robert L. Hetzel

One of the oldest and most useful ideas in economics is the quantity theory of money. The quantity theory explains the determination of variables measured in dollars such as the price level. Modern expositions of the quantity theory assume that the monetary authority controls directly a reserve aggregate like the monetary base (currency plus bank deposits with the monetary authority). In actual practice, however, monetary authorities use an interest rate rather than a reserve aggregate as their policy variable. This fact poses a challenge to the quantity theorist. How does he reconcile his theory with actual policy procedures? There are no modern expositions of the quantity theory that assume interest rate targeting by the monetary authority.

This article provides such an exposition. The exposition brings out the standard quantity theory distinction between the determination of the real and nominal quantity of money and explains changes in the price level as equating the nominal demand with the nominal supply of money.

Modern expositions of the quantity theory assume reserve control in part because reserve control constitutes a major item on the reform agenda of quantity theorists. Control of reserves and, at one remove, a monetary aggregate constitutes control of a nominal variable and, therefore, draws attention to the responsibility of the monetary authority to control the price level, also a nominal variable. Quantity theorists dislike the interest rate as a policy variable. Interest rate control suggests that the monetary authority is controlling the

The views expressed in this article are those of the author and do not necessarily reflect those of the Federal Reserve Bank of Richmond or the Federal Reserve System.

price of resources made available to investors. The analysis here retains these concerns. In particular, the article explains how rate targeting encourages the public to confuse the monetary authority's control over nominal variables with control over real variables. These concerns motivate a proposal for a change in monetary policy procedures designed to help the Fed achieve its goal of price stability.

1. AN EXAMPLE AND SOME BASIC PRINCIPLES

An Example of Money Creation

Suppose the monetary authority sets a target for the interest rate and follows a "lean-against-the-wind" policy of raising its rate target when economic activity strengthens and lowering it when economic activity weakens. Because information on the economy becomes available with a lag, the monetary authority would then supply reserves when economic activity strengthens and withdraw them when economic activity weakens. Furthermore, it would not necessarily offset these changes in reserves later. As a result, random disturbances would be permanently incorporated into future levels of reserves and money. By following a "let bygones-be-bygones" policy of base drift in reserves, the monetary authority causes the price level to wander randomly.[1]

Suppose also that introduction of a new technology raises the rate of return on capital and, therefore, investment demand. When the market rate, reflecting this higher return, begins to rise above its targeted level, the monetary authority buys securities. As a result, the monetary base and the money stock increase.[2]

The individuals who sold securities to the monetary authority did so because they were offered a good price, not because they wanted to reduce their holdings of assets. After selling securities, they allocate their additional money among different assets to replace the securities sold. Temporarily, the increased demand for financial assets depresses the interest rate. Consequently, real expenditure rises until the price level increases sufficiently to return real money balances to their original level. Real money balances return to their original level through a rise in the price level, not through a fall in the nominal quantity of money.

[1] The idea that rate pegging by the monetary authority makes nominal variables into a random walk is mentioned in Friedman's (1969, p. 104) "The Role of Monetary Policy" and is developed systematically in Goodfriend (1987).

[2] This exposition can be compared to Friedman (1969), who uses the notion of a helicopter drop of money. The counterpart here to the helicopter is rate smoothing in the presence of a positive real sector disturbance.

Real Versus Nominal and the Natural Rate Assumption

An understanding of the consequences of the monetary authority's reserve injection begins with the distinction between real and nominal variables. Real variables are real quantities or relative prices. A real quantity is usually measured in physical units. The real quantity of money is a measure of the purchasing power or command over goods represented by the nominal quantity of money. A relative price is the price of a commodity expressed in terms of another commodity. The real rate of interest is a relative price measuring the price of commodities today in terms of commodities in the future. It is the market interest rate adjusted for expected inflation. In contrast to real variables, nominal variables are dollar amounts or dollar prices. Thus the nominal quantity of money is the number of dollars the public holds. A special case of a nominal variable is the market interest rate, which is the price of a dollar today in dollars tomorrow.

An individual's welfare depends upon his real income (the purchasing power of income measured in terms of goods) and the relative prices of the goods he consumes (the scarcity of those goods in terms of other goods). An individual is better off if his real income increases so he can consume more of all goods. He is no better off if his dollar income (and cash balances) increases, but at the same time all dollar prices increase by the same amount so his real income is unchanged. The idea that people care about real, not nominal, variables is called the natural rate assumption (hypothesis).[3]

The monetary authority controls a nominal variable—the monetary base. It follows from the natural rate assumption that the rise in the real rate of interest, which is governed by real factors like investment opportunities and the public's thrift, can only be restrained temporarily by changes in money creation. Similarly, the real quantity of money desired by the public is not changed by an injection of reserves. After the reserve injection, at the original price level, the public holds a larger quantity of real money balances than desired. The price level must rise to return real money balances to their desired, lower value.

The natural rate assumption thus implies that the monetary authority cannot maintain an arbitrary target for the interest rate. Although the interest rate is a nominal variable, its equilibrium value is the sum of the real rate consistent with equilibrium in the economy (the natural rate) and an inflation premium equal to the inflation expected by the public. If the monetary authority sets a

[3] Alternatively, one can say that individual choice is not affected by money illusion. Different economists, of course, give empirical content to the natural rate assumption in different ways. Most monetarists, for example, assign considerable importance to temporary effects of money on real variables because of transitory confusion between changes in the price level and changes in relative prices and because of the existence of contracts in nominal terms. The key assumption is that these monetary nonneutralities are transitory so that the monetary authority has no ability to affect real variables in a sustained or systematic way.

rate target below the equilibrium market rate (the nominal natural rate), banks have an incentive to acquire assets and their deposits and the money stock increase.[4] The public's money balances then rise above their desired level. The public responds by spending at a faster rate and the inflation rate rises.

Nominal Determinacy

A corollary to the natural rate assumption that the public cares only about real variables is the proposition that only the monetary authority can give nominal variables well-defined (determinate) equilibrium values. Patinkin (1965) showed that when the monetary authority targets the monetary base, the price level is made determinate through a real balance effect. A rise in the price level above its equilibrium value reduces the real value of the base and nominal money. This fall in real balances restrains the public's real expenditure until the price level falls back to its equilibrium value.

When the monetary authority targets an interest rate, however, the monetary base varies endogenously, that is, with the demand for it by the public. If the monetary authority does no more than specify an interest rate target, even one equal to the economy's nominal natural rate, a random movement in the price level will induce a corresponding change in the demand for nominal bank credit and, consequently, in the supply of nominal bank deposits and money. Changes in the money supply then validate the changes in money demand produced by changes in the price level, and the price level possesses no equilibrium value.

If the monetary authority targets an interest rate, it must provide a nominal reference point that gives nominal variables well-defined values. It does so by giving the expected future price level a well-defined value. Although with a rate target the monetary base is determined endogenously, the monetary authority limits the public's demand for it indirectly by giving the future price level expected by the public a well-defined value (Dotsey and King 1983; McCallum 1986). One way to understand nominal determinacy with rate targeting is to compare it to the way a monetary authority achieves nominal determinacy by exchange rate targeting. Assume the Fed targets the Deutsche mark price of a dollar. As shown in equation (1), the DM/$ exchange rate equals the product of the ratio of the German price level (DM/German good) to the U.S. price level ($/U.S. good) and the real terms of trade (German good/U.S. good). The nominal reference point or benchmark for the dollar is the German price level. If the U.S. price level rises above its equilibrium level, the foreign exchange value of the dollar falls, and the Fed buys dollars with Deutsche marks. The monetary

[4] The terminology "nominal natural rate" and "natural rate" is in Friedman's (1969, p. 101) "The Role of Monetary Policy."

base and the money stock fall and the price level returns to its equilibrium level.

$$\frac{DM}{\$} = \frac{\dfrac{DM}{German\ good}}{\dfrac{\$}{US\ good}} \cdot \frac{German\ good}{US\ good} \tag{1}$$

With a rate target, the nominal benchmark is the expected future price level. In the case of a rate target, the Fed targets the price of today's dollars ($\$_t$) in terms of tomorrow's dollars ($\$_{t+1}$), or one plus the interest rate ($1 + r_t$). As shown in equation (2), this price equals the product of the ratio of the future price level expected by the public to the contemporaneous price level and the real terms of trade with the future. If the price level were to rise above its equilibrium value, the ratio of the expected future price level to the contemporaneous price level would fall, that is, expected inflation would fall. Consequently, the inflation premium in the interest rate would decline. The resulting decline in the interest rate would increase the demand for money. It would also prompt the monetary authority to sell securities and decrease the monetary base. Because the demand for money would increase, while the supply would decrease, an excess demand for money would return the price level to its equilibrium value. If the price level were to deviate from its equilibrium value, a relative price effect would be created, analogous to a real balance effect, that would return the price level to its equilibrium value.[5]

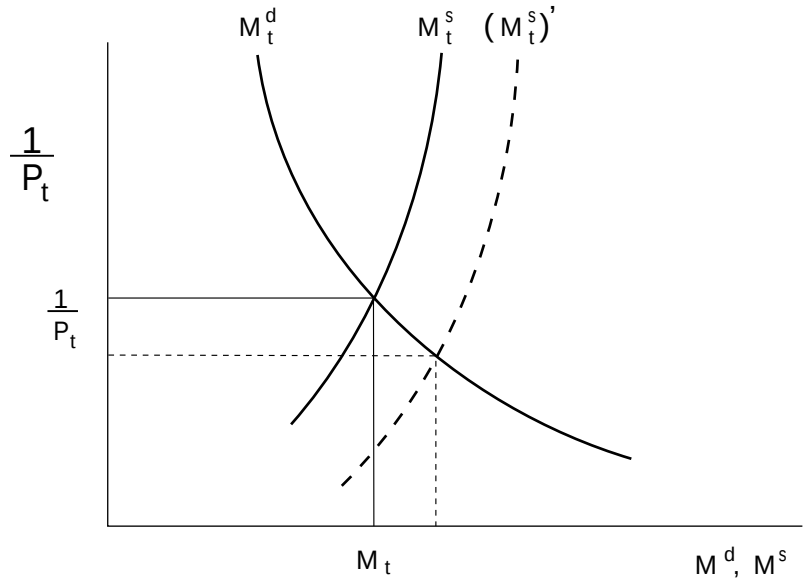
$$1 + r_t = \frac{\$_{t+1}}{\$_t} = \frac{E_t\left(\dfrac{\$}{good}\right)_{t+1}}{\left(\dfrac{\$}{good}\right)_t} \cdot \frac{(good)_{t+1}}{(good)_t} \tag{2}$$

A Graphical Presentation of the Quantity Theory

The quantity theory can be summarized with the money demand and supply schedules of Figure 1, which determine the nominal money stock and the goods price of money (the inverse of the price level). For the reasons explained in

[5] In practice, the monetary authority does not tie down the expected future price level by targeting a fixed value of the price level. Instead, it allows the price level to vary in response to shocks. It must, however, impart inertia to changes in the public's expectation of the future price level relative to changes in its contemporaneous value. It does so through its dislike for large jumps in nominal prices. Goodfriend (1987) defines jumps relative to expected values. He assumes that the monetary authority dislikes both discrepancies between the contemporaneous price level and the prior period's expectation of the contemporaneous price level and between the contemporaneous price level and the expected future price level. In this way, the monetary authority imposes a level and a change constraint on prices that make the public's expectation of the future price level well defined, while still allowing it to vary.

Figure 1 The Supply of and Demand for Money



the preceding section, the schedules are well defined because the monetary authority behaves in a way that allows the public to form an expectation of the future price level. (See also Hetzel [1988].)

The nominal money demand schedule (M_t^d) is the product of the price level and the demand for real money. Because increases in the price level (reductions in the inverse of the price level) cause proportional increases in the demand for nominal money, the demand schedule is negatively sloped. The schedules in Figure 1 are drawn for a given expectation of the future price level. A rise in the price level above its equilibrium value, given the public's expectation of the future price level, causes a reduction in expected inflation. As a consequence, the market rate of interest falls through a reduction in the inflation premium. The reduction in the market rate generates an increase in the quantity of money demanded, which adds to the curvature of the money demand schedule.

Under the assumption that the central bank smooths the market rate, the fall in the market rate due to the rise in the price level just described causes the monetary authority to reduce the monetary base and the money supply. The nominal money supply schedule (M_t^s), therefore, is positively sloped. In contrast to the money demand schedule, which depends primarily on the behavior of the public, the money supply schedule depends upon the reserve-supplying behavior of the monetary authority. Shifts in the money supply schedule depend upon the extent to which the monetary authority smooths the interest rate, that

is, the extent to which it varies reserves when the interest rate changes. Shifts in the money supply schedule also depend upon the extent of base drift, that is, the extent to which, if at all, the monetary authority subsequently offsets changes in reserves induced by changes in the interest rate. Finally, shifts in the money supply schedule depend upon the trend rate of growth of reserves, money, and prices the monetary authority allows.[6]

These schedules are summarized in the quantity equation (3):

$$M^s = (k \cdot y) \cdot P, \text{ where } (k \cdot y) \cdot P = M^d. \tag{3}$$

The fraction of real output (y) the public wants to hold as money is k, which is a function of variables like the interest rate. The public's demand for real money then is $(k \cdot y)$, and its demand for nominal money is $(k \cdot y)$ times the price level P. The price level varies to make the nominal value of real money desired by the public (M^d) equal to the nominal supply (M^s).

The schedule $(M_t^s)'$ shows the rightward shift in the money supply schedule discussed in Section 2, where the monetary authority smooths the interest rate during a positive real sector disturbance to aggregate demand. The graphical illustration of this example highlights the key ideas of the quantity theory. First, it is useful to organize an understanding of the price level by classifying variables according to the way in which they affect money demand and supply schedules. Second, the money supply schedule, whose behavior is dominated by the monetary authority, shifts independently of the money demand schedule. Third, because the equilibrium values of real variables are ultimately tied down by real factors, shifts in the money supply schedule eventually appear as changes in the price level.

Over periods of time too short for the price level to vary sufficiently to equate the nominal quantity of money supplied and demanded, it is useful to view nominal output, rather than the price level, as the equilibrating variable, as in equation (4).

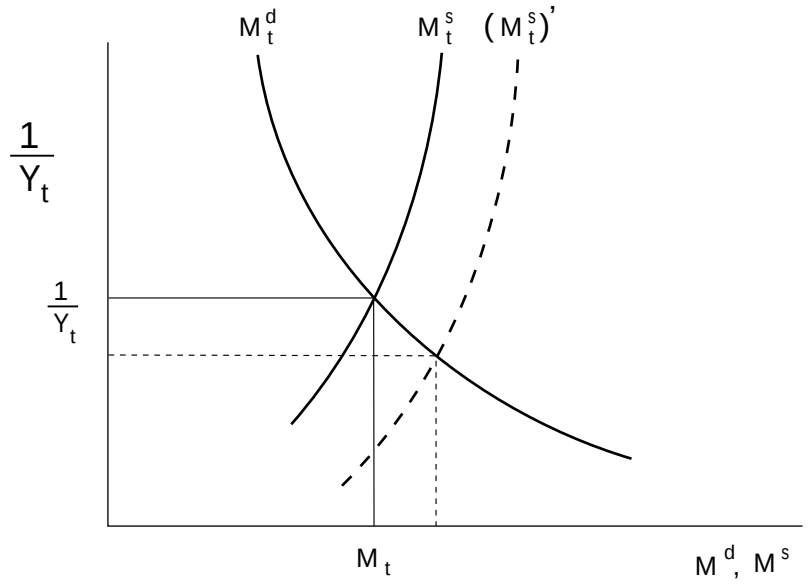
$$M^s = k \cdot (y \cdot P) = k \cdot Y, \text{ where } k \cdot Y = M^d \tag{4}$$

Nominal output (Y) is the product of real output (y) and the price level (P).

Figure 2 illustrates equation (4). If at the actual level of nominal output money supply M^s exceeds money demand M^d, $1/Y_t$ exceeds its equilibrium

[6] The money supply schedule depends upon the behavior of the monetary authority summarized in its reserves-supply function and the behavior of commercial banks and the public summarized in the reserves-money multiplier. With rate targeting, the key behavioral relationships of the money supply function concern the former rather than the latter relationship. Fluctuations in the reserves-currency and reserves-deposits ratios of the reserves-money multiplier are automatically offset at the prevailing funds rate target. For example, if currency flows out of banks or if banks increase the desired level of excess reserves, the funds rate rises. In order to maintain its funds rate target, the monetary authority supplies reserves, thereby accommodating changes in these ratios and avoiding a change in deposits.

Figure 2 The Supply of and Demand for Money



value, and the public will increase its expenditure in an attempt to reduce its money holdings. The result will be to raise nominal expenditure until nominal output rises ($1/Y$ falls) to its equilibrium value.[7]

Quantity Theory and Monetarist Hypotheses

Milton Friedman and Anna Schwartz (1963) have given the quantity theory a specific form, often referred to as monetarism, through their hypothesis that shifts in the money supply schedule have been large relative to shifts in the money demand schedule.[8] Their hypothesis possesses two distinct parts. The first is that large shifts in the money supply schedule have destabilized the

[7] Figure 2 is drawn assuming a given expectation of the future level of nominal output. Because nominal output is the product of the price level and real output, the slopes of its schedules are determined by the relationship of the contemporaneous price level relative to the expected future price level, as explained for Figure 1. The relationship of contemporaneous real output relative to expected future real output reinforces these price relationships. A level of real output that is high relative to expected future real output causes the public to save a relatively large fraction of its income and depresses the real rate. The resulting decline in the market rate increases the demand for money by lowering money's opportunity cost. Also, the supply of money falls because of rate smoothing by the monetary authority.

[8] Friedman prefers the term quantity theory to monetarism, which was coined by the staff of the Federal Reserve Bank of St. Louis for an article in their *Review* by Karl Brunner (1968). A number of economists helped revive the quantity theory in the United States, for example, Karl Brunner and Allan Meltzer, Phillip Cagan, Thomas Mayer, William Poole, and Clark Warburton.

behavior of nominal and real income. Their empirical evidence for this part is twofold. They show that turning points in the rate of growth of the money stock have preceded turning points in the business cycle. They also argue that shifts in the money supply schedule can often be attributed to specific historical circumstances rather than to contemporaneous changes in economic activity. The second part of their general hypothesis is that much of the observed variability in real money demand has resulted from prior actions of the monetary authority. Specifically, destabilizing shifts in the money supply schedule have produced destabilizing shifts in the money demand schedule. These empirical generalizations lead Friedman (1959) to recommend moderate, stable money growth.

There is now a consensus that the quantity theory is the only useful framework for explaining the long-run behavior of prices. The monetary authority can shift the money supply schedule independently of the money demand schedule so that it can control the long-run behavior of the price level. The magnitude of secular shifts in the money demand function is limited by real factors like growth in real income and payments technology. There is no such limitation on the behavior of the money supply. Over long periods of time, inflation has reflected the behavior of the money supply. There is less consensus over Friedman and Schwartz's hypotheses about the monetary causes of the business cycle and the stability of money demand. The basic quantity theory assumption that the price level is a monetary phenomenon does not require acceptance of these latter two hypotheses, however.

2. THE QUANTITY THEORY AS A GUIDE FOR POLICY

Interest rate targeting encourages the public to confuse the role of the monetary authority, which is to control the nominal quantity of money and the price level, with the role of commercial banks, which is to set a real rate of interest that rations available resources to investors. The quantity theory counters this confusion through its distinction between money and credit and between nominal and real variables.

The monetary authority is responsible for the money creation of commercial banks. In addition to creating deposits, commercial banks ration credit by setting its price, the real interest rate. When the monetary authority targets an interest rate, the public is encouraged to assume that the monetary authority can control the credit rationing of commercial banks. The public then assumes that the monetary authority can ensure a steady flow of credit to the economy and can avoid "large" changes in the price of credit. When the monetary authority tries to manage the extension of credit, the money supply becomes a function of credit demand. The resulting changes in money require changes in the price level. The view of monetary policy as the management of credit has at times produced large deflations as in the Depression and, at other times, large inflations as in wartime.

When the commercial banking system extends credit by adding to the assets it holds, it must persuade the public to hold a larger real value of deposits. If this intermediation does not simply draw funds away from other forms of intermediation, the increase in bank deposits must correspond to a reduction in consumption by the public. When the monetary authority extends credit by acquiring an asset, however, it does no more than create through a bookkeeping operation the corresponding liabilities (the monetary base). Because monetary base creation requires no one to refrain from consumption, it does not increase the resources available to investors. A "central bank" does not intermediate between savers and investors. It is not a bank, and it cannot increase the resources commercial banks make available to investors.

The belief that the monetary authority regulates the flow of credit entails the implicit assumption that the quantity of money is self-regulating. The fallacy in this assumption is the failure to distinguish between the mechanism for limiting real credit extension and that for limiting money creation. As explained below, the real interest rate limits the quantity of real credit demanded, but not the nominal quantity of money demanded.

If money were a commodity, its equilibrium quantity would depend upon its real resource costs of production. The market mechanism that limits the supply of a commodity through the real costs of production, however, does not limit the quantity of bank deposits. It is true that banks incur resource costs in providing deposits. The resources that can be obtained in exchange for a dollar of deposits, however, greatly exceed the bookkeeping cost of creating that dollar. Because the resources obtained from creating an additional dollar exceed the cost of creating that dollar, the monetary authority must limit the nominal quantity of deposits and money.

The way market forces limit the availability of real credit differs from the way the monetary authority limits the nominal quantity of money. When a bank extends credit, it credits the deposits of the borrower. The borrower then draws down those deposits in order to purchase goods and services. The bank loses reserves when it loses the deposits. When the bank goes into the market for reserves (issues CDs or borrows federal funds) to replace the lost reserves, it must pay the market rate of interest. The real rate implicit in the market rate limits the real amount of credit banks extend because it conveys information about the scarcity of resources. The interest rate does not, however, convey information about the "scarcity" of nominal money.

3. FOMC PROCEDURES IN A QUANTITY THEORY PERSPECTIVE: A PROPOSED CHANGE

How can the natural rate assumption that the monetary authority cannot control the real rate in a sustained way be reconciled with the fact that the Federal Open

Market Committee (FOMC) uses the funds rate as its policy instrument?[9] The FOMC can use the funds rate to target a nominal variable. The simplest case would be to set the funds rate to achieve a target for money (McCallum 1981). As part of such targeting procedures, the Fed shapes the way the public forms its predictions of the future values of nominal variables. Those predictions, in particular the expected future value of the price level, make the contemporaneous price level well defined. With a target for the rate of growth of nominal output, for example, the expected inflation rate would equal the targeted growth in nominal output minus the expected growth in real output.

An implication of the quantity theory is that, to stabilize the price level, the monetary authority must set its interest rate target equal to the economy's equilibrium rate. Because an interest rate consists of two parts, a real rate and an inflation premium, it follows that the monetary authority must perform two tasks in setting its rate instrument. First, it must change its instrument in line with changes in the economy's equilibrium real rate. Second, as explained above, it must set the interest rate in a way that allows the public to predict the future price level.

This section suggests two changes designed to help the monetary authority achieve these two tasks. The first requires an explicit target for inflation. The second involves the use of indexed bonds to measure the correspondence between the monetary authority's implicit target for inflation and the public's expectation for inflation.[10]

Milton Friedman (1959) for one has argued that targeting inflation or the price level directly would be destabilizing. For this reason, it would be useful to use nominal output as an intermediate target. With the suggested changes, for example, at its December meeting, the FOMC would vote on an explicit multi-year target path for inflation. At the February meeting, FOMC members would submit their predictions for real output growth for the current year

[9] At times, the FOMC has targeted the funds rate directly. Other times it has targeted the funds rate indirectly by setting the discount rate and a target for the level of borrowed reserves. Given the positive relationship between borrowed reserves and the difference between the funds rate and the discount rate, the latter procedure amounts to an indirect funds rate target.

[10] Implementation of the proposal advanced here would require creation of a measure of expected inflation through the issue of Treasury zero-coupon bonds with different maturities. Half the bonds would be indexed to the price level and half would be conventional, nonindexed bonds. Unlike holders of the nonindexed bonds, holders of the indexed bonds would not have to worry about the depreciation due to inflation of the dollar payment they receive when their bonds mature. For this reason, the difference in yield between the nonindexed and indexed bonds would provide a measure of expected inflation. Moreover, the existence of bonds of different maturities would provide a term structure of expected inflation. Given the current value of the price level, this term structure would yield estimates of the price level expected in future years.

The Fed could issue the indexed bonds. (It would buy short-term securities to offset the resulting decline in the monetary base.) It would be better for the Treasury to issue the bonds, however, because it could issue them in sufficient quantities to ensure a liquid market. For more discussion, see Hetzel (1992), U.S. Congress (1992a), and the testimony by Michael Boskin, Alan Greenspan, Representative Stephen Neal, William Poole, and Alan Walters in U.S. Congress (1992b).

consistent with the long-run inflation target. When combined with the current-year inflation target, the median value of FOMC members' predictions for real output growth would yield an intermediate target for nominal output growth. The Board staff would convert the target for nominal output growth into an intra-yearly target path in level form. At subsequent FOMC meetings, the Board staff would display its predictions of nominal output relative to this target path.

Also at the February meeting, the Board staff would continue to make predictions for money growth for the current year consistent with the inflation target. Subsequent observations of money and nominal output relative to their intra-yearly paths would offer information useful in assessing whether the FOMC was achieving its inflation target.

Assuming the existence of indexed bonds with varying maturities, the FOMC would have available a measure of the price level expected by the public in succeeding years. These observations on the expected price level would be displayed relative to the multi-year target path for the price level consistent with the FOMC's inflation targets. In setting the funds rate, the FOMC would take account of the gap between the targeted path for the price level and the path expected by the public.

These procedures would keep the funds rate equal to the economy's equilibrium rate. They would also make the inflation premium in the equilibrium rate, that is, the inflation expected by the public, consistent with the Fed's objective for inflation. Responding to the measure of expected inflation made available by indexed bonds, the Fed would keep expected inflation on target.

4. CONCLUDING COMMENT

With the suggested policy procedures, the FOMC could still use the funds rate as its policy variable. Changes in the funds rate would appear reasonable in that they would respond to changes in the real rate as reflected in the yield on the indexed bond. However, changes in the funds rate would be explicitly directed toward achieving an inflation target.

These procedures possess a quantity theory spirit in that they keep the monetary authority's attention focused on nominal variables under its control—the rate of growth of nominal output and the price level. Despite their quantity theory spirit, the suggested procedures do not depend on stability of the public's demand function for money. Money, nevertheless, would play an important role. The money targets advertise to the public that the price level is a monetary phenomenon and that monetary authority alone has the responsibility for control of the price level. Public discussion by the FOMC of its targets for money would constitute an important way of influencing the public's expectation of the future price level and of keeping that expectation in line with the FOMC's target.

REFERENCES

Brunner, Karl. "The Role of Money and Monetary Policy," Federal Reserve Bank of St. Louis *Review,* vol. 50 (July 1968), pp. 9–24.

Dotsey, Michael, and Robert G. King. "Monetary Instruments and Policy Rules in a Rational Expectations Environment," *Journal of Monetary Economics,* vol. 12 (September 1983), pp. 357–82.

Friedman, Milton. *The Optimium Quantity of Money.* Chicago: Aldine, 1969.

_____. *A Program for Monetary Stability.* New York: Fordham University Press, 1959.

_____, and Anna J. Schwartz. *A Monetary History of the United States, 1867–1960.* Princeton: Princeton University Press, 1963.

Goodfriend, Marvin. "Interest Rate Smoothing and Price Level Trend-Stationarity," *Journal of Monetary Economics,* vol. 19 (May 1987), pp. 335–48.

Hetzel, Robert L. "Indexed Bonds as an Aid to Monetary Policy," Federal Reserve Bank of Richmond *Economic Review,* vol. 78 (September/October 1992), pp. 13–23.

_____. "The Monetary Responsibilities of a Central Bank," Federal Reserve Bank of Richmond *Economic Review,* vol. 74 (September/October 1988), pp. 19–31.

McCallum, Bennett T. "Some Issues Concerning Interest Rate Pegging, Price Level Determinacy, and the Real Bills Doctrine," *Journal of Monetary Economics,* vol. 17 (January 1986), pp. 135–60.

_____. "Price Level Determinacy with an Interest Rate Policy Rule and Rational Expectations," *Journal of Monetary Economics,* vol. 8 (November 1981), pp. 319–29.

Patinkin, Don. *Money, Interest, and Prices.* New York: Harper & Row, 1965.

U.S. Congress. "Fighting Inflation and Reducing the Deficit: The Role of Inflation-Indexed Treasury Bonds," Thirty-Third Report by the Committee on Government Operations. 102 Cong. 2 Sess., October 29, 1992a.

_____. "Inflation-Indexed Treasury Debt as an Aid to Monetary Policy." Hearings before the House Commerce, Consumer, and Monetary Affairs Subcommittee of the Committee on Government Operations. 102 Cong. 2 Sess., June 16 and 25, 1992b.