Federal Reserve Intermediate Targets: Money or the Monetary Base?

By Carl M. Gambs

In conducting monetary policy in recent years, the Federal Reserve System has sought to control the growth rates of various money and credit aggregates.[1] These aggregates are intermediate monetary variables that are affected by Federal Reserve operations and that in turn affect the economy. However, at the same time that the Federal Reserve has been seeking to control the monetary aggregates, a series of financial innovations has reduced the usefulness of these aggregates as intermediate monetary variables. As a result, considerable attention is being given to redefining the monetary aggregates.[2] In addition, some economists have argued that the Federal Reserve should deemphasize the aggregates and rely on the monetary base—the sum of member bank reserves and currency held by nonmember banks and the nonbank public—as an intermediate variable.

This article analyzes the argument for using the monetary base as an intermediate target in place of the monetary aggregates—particularly M1. The first section of the article briefly examines the role of intermediate targets in economic policy. The second section reviews the argument for replacing money growth targets with a monetary base target. Next, a number of problems with using the monetary base as an intermediate target are discussed. The final section of the article summarizes the analysis.

THE ROLE OF INTERMEDIATE TARGETS

The term intermediate targets is used to distinguish the Federal Reserve's monetary targets from ultimate goal variables such as the growth of real output, the rate of inflation, and the unemployment rate, and from operating

1 Target growth ranges have been tentatively set for the period from the fourth quarter of 1979 through the fourth quarter of 1980 at 3 to 6 per cent (assuming ATS accounts will reduce M1 growth by 1½ per cent) for M1, which is currency plus privately held demand deposits; 5 to 8 per cent for M2 which equals M1 plus bank time and savings deposits other than large certificates of deposit; 6 to 9 per cent for M3, which is M2 plus deposits at mutual savings banks, savings and loan associations, and credit union shares; and 7½ to 10½ per cent for bank credit.

2 "Redefining the Monetary Aggregates," *Federal Reserve Bulletin,* Board of Governors of the Federal Reserve System, 65 (January 1979), pp. 13-42, and John Wenninger and Charles M. Sivesind, "Defining Money for a Changing Financial System," *Quarterly Review,* Federal Reserve Bank of New York, 4 (Spring 1979), pp. 1-8.

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variables such as bank reserves and the Federal funds rate.[3] The Federal Reserve can maintain a high (but by no means perfect) degree of control over operating variables. However, there is only a very loose relationship between these operating variables and goal variables. Given these circumstances, policymakers can find it useful to rely on intermediate target variables that are more closely related to economic goals than are the operating targets.

A good intermediate target variable is one that the Federal Reserve can control through its operating variables and about which information is readily available. However, a good intermediate variable also must be closely related to the ultimate goals of policy. Criteria for choosing a good intermediate target variable were summarized by the Federal Reserve's Advisory Committee on Monetary Statistics:

> In conducting monetary policy, the Federal Reserve should use as an intermediate target that monetary total (aggregate), or those totals, through which it can most reliably affect the behavior of its ultimate objectives—the price level, employment, output, and the like. Which total or totals best satisfy that requirement depends in turn on (1) how accurately the total can be measured; (2) how precisely, and at what costs, including unwanted side effects, the Fed can control the total; and (3) how closely and reliably changes in the total are related to the ultimate policy objectives.[4]

It should be emphasized that the question of whether the monetary base or the money stock should be used as an intermediate monetary target is different from the question of whether or not the monetary base should be used as an operating target to control the money stock. Economists have long had an interest in the monetary base as an operating variable.[5] In fact, the Federal Open Market Committee (FOMC) recently decided to use the monetary base and other reserve aggregates as operating variables to improve control over the monetary and credit aggregates. However, that decision did not constitute the replacement of money by the base as an intermediate target.

THE CASE FOR THE MONETARY BASE

Economists who advocate that the monetary aggregates should be deemphasized as intermediate variables in favor of the monetary base set forth a number of arguments.[6] The major argument is that recent financial innovations have made it difficult to properly define money and to determine the relationship between money and the economy. It is further argued that financial innovations have not changed the appropriate definition of the monetary base. In addition, it is held that the monetary base is

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[3] For a discussion of the role of intermediate policy targets, see Thomas R. Saving, "Monetary Policy Targets and Indicators," *Journal of Political Economy*, 75 (August 1967), pp. 446-56, and Benjamin M. Friedman, "Targets, Instruments, and Indicators of Monetary Policy," *Journal of Monetary Economics*, 1 (October 1975), pp. 443-73. It should be noted that Friedman and others have argued that the use of intermediate targets is, except under very restrictive conditions, suboptimal.

[4] Board of Governors of the Federal Reserve System, *Improving the Monetary Aggregates, Report of the Advisory Committee on Monetary Statistics* (June 1976), p. 7.

[5] Albert E. Burger, "Money Stock Control," *Controlling Monetary Aggregates II: The Implementation*, Federal Reserve Bank of Boston (1972), pp. 33-55.

[6] For example, see Allan H. Meltzer, "Avoiding the Monetary Shoals," *Wall Street Journal*, 59 (May 9, 1979), p. 20.

closely related to the economy and that the Federal Reserve has better control over the base than over the money supply.

The Base is Easier to Define

Beginning in the mid-1970s, a number of changes in the financial system provided households and firms with alternatives to holding the components of the traditional monetary aggregates. This has been especially true for demand deposits, the major component of the narrowly defined money supply, M1. M1 has traditionally been viewed as consisting of the nation's transactions balances—those financial assets used to conduct transactions. However, recent financial innovations have given rise to a growth in assets that are not included in M1 but which may be used for transactions purposes.

There have been a number of such financial innovations, including NOW accounts, savings and loan bill paying services, the use of repurchase agreements as a cash management tool, corporate savings accounts, savings accounts which allow automatic transfers to checking accounts (ATS accounts), credit union share drafts, and money market mutual funds.[7] As of September 1979, there were $7 billion in ATS accounts, $6 billion in NOW accounts, $1 billion in credit union share draft accounts, $35 billion in money market mutual funds, and $43 billion in repurchase agreements. The sum of these assets is $92 billion, about one-fourth of the amount of M1.

Since all these items are potential transactions balances and close substitutes for demand deposits, some economists argue that they should be included in M1. However, there is no reason to assume that all the funds in them would otherwise have been lodged in M1 balances; indeed, there is considerable evidence that this is not the case.[8] As a result, it is difficult to define a monetary aggregate that contains all transactions balances and is quantitatively the same as M1 would have been had the financial innovations not occurred. These definitional problems have reduced the usefulness of M1 as an intermediate variable, and similar, although less pronounced, problems exist for other monetary aggregates.

The appropriate definition of the monetary base, unlike the monetary aggregates, is not affected by the financial innovations of recent years.[9] The monetary base can continue to be defined as currency held by nonmember banks and the nonbank public plus member bank reserves.[10] Thus, it is argued, the usefulness of the base as an intermediate target has not been reduced.

The Monetary Base is Closely Related to the Economy

Another argument for using the monetary base as an intermediate target is that the base is closely related to the economy, while financial innovations have altered the relationship between the monetary aggregates and the

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7 For a discussion of these innovations, see "Redefining the Monetary Aggregates," and Wenninger and Sivesind, "Defining Money for a Changing Financial System."

8 For example, one study indicates that only about half of the funds in automatic transfer accounts came from demand deposits. Bank Administration Institute, *Automatic Transfer Service, Nov. 1, 1978-Dec. 15, 1978—A Research Summary* (February 1979).

9 However, as will be noted later, financial innovations may have affected the relationship between the base and the economy. Furthermore, it is possible that future innovations—for example, proposals to pay interest on a portion of bank reserves—might complicate the task of defining the base.

10 The monetary base can alternatively be expressed as the sum of currency outside the Federal Reserve and the Treasury and member bank deposits at the Federal Reserve.

economy. In recent years, it has been common to study the relationship between the economy and various monetary variables by means of a single equation model relating total spending, as measured by GNP, to a monetary variable.[11] These equations also usually contain some measure of fiscal stimulus, and sometimes include other variables as well. Generally such estimates have been made using M1, but researchers who have also tried using the monetary base in a single equation model have usually found that it is almost as closely related to GNP as is M1.[12]

Table 1 shows representative equations for the relationship between percentage changes in GNP and the monetary base and M1, estimated with quarterly data for the period 1953-78.[13]

While the R^2 for the monetary base equation in Table 1 is not as high as for the M1 equation (0.35 compared with 0.44), it does show that the monetary base explains a fairly high portion of the changes in GNP.

The Federal Reserve Has Control Over the Base

The final argument for using the monetary

Table 1
M1 AND BASE SPENDING EQUATIONS
1953-78

$$\dot{Y}_t = k + \sum_{i=0}^{4} m_i \dot{M}_{t-i} + \sum_{i=0}^{4} e_i \dot{E}_{t-i}$$

	M1	Monetary Base
m_0	0.41 (2.95)	0.07 (0.28)
m_1	0.47 (5.90)	0.46 (3.21)
m_2	0.31 (2.49)	0.54 (2.59)
m_3	0.07 (0.92)	0.17 (1.19)
m_4	−0.08 (−0.58)	−0.29 (−1.27)
Σm_i	1.18 (6.53)	0.94 (5.67)
e_0	0.08 (2.07)	0.06 (1.39)
e_1	0.06 (2.36)	0.04 (1.33)
e_2	0.00 (0.01)	−0.02 (−0.59)
e_3	−0.06 (−2.27)	−0.08 (−2.71)
e_4	−0.07 (−1.98)	−0.09 (−2.25)
Σe_i	0.01 (0.07)	−0.09 (−1.09)
k	2.61 (3.23)	3.59 (4.49)
R^2	0.44	0.35
$\bar{R}^2$	0.41	0.31
S.E.	3.74	4.04
D.W.	1.88	1.67

$\dot{Y}$ = Percentage change in nominal GNP at an annual rate.
$\dot{M}$ = Percentage change in the monetary variable—M1 or the monetary base.
$\dot{E}$ = Percentage change in high employment Government expenditures.
t-statistics in parentheses.

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11 For a discussion of potential strengths and weaknesses of single equation models, see Bryon Higgins and V. Vance Roley, "Monetary Policy and Economic Performance: Evidence from Single Equation Models," *Economic Review*, Federal Reserve Bank of Kansas City (January 1979), pp. 4-6. It should be noted that the single equation approach contains numerous econometric difficulties. While results from the approach can be taken as indicating a relationship between variables, many econometricians feel that the results should not be interpreted as giving any indication as to the direction of causation.

12 See Higgins and Roley, "Evidence from Single Equation Models," and Leonall C. Andersen, "Selection of a Monetary Aggregate for Economic Stabilization," *Review*, Federal Reserve Bank of St. Louis, 57 (October 1975), pp. 9-15.

13 The specification used here in both equations is the one used for M1 in Keith M. Carlson, "Does the St. Louis Equation Now Believe in Fiscal Policy?" *Review*, Federal Reserve Bank of St. Louis, 60 (February 1978), pp. 13-19. Specifically, a fourth degree polynomial distributed lag, with both endpoints constrained to zero, is used. Higgins and Roley get qualitatively similar results when they search over various specifications to find the equation that best fits the data. The monetary base used here is the St. Louis version. This series was chosen in order to make the results comparable with work done in other studies, and because preliminary work showed that the St. Louis base was more closely related to GNP than was the series produced by the Board of Governors. Thus, any possible bias in choice of a base series is toward choosing a series closely related to GNP.

base as an intermediate target is that the Federal Reserve has better control over the base than over the monetary aggregates. This is a valid argument, both because information is available on the base on a more timely basis than on money and because the Federal Reserve's open market operations directly affect the monetary base and only indirectly affect money.

PROBLEMS WITH USING THE BASE AS AN INTERMEDIATE TARGET

While there are some valid arguments for using the monetary base as an intermediate target, the procedure would also involve a number of problems. One problem is that the monetary base also has some unique definitional problems, most importantly the problem of adjusting the base for changes in reserve requirements. Furthermore, while single equation models suggest that the base is reasonably closely related to GNP, they also show that the base is not as closely related to GNP as is M1 or even bank reserves. Moreover, since the base is directly tied to the monetary aggregates, changes in the relationship between the aggregates and the economy will produce changes in the relationship between the base and the economy. The fact that the base is primarily composed of currency also presents some special problems in connection with the relationship between the base and the economy. Finally, while there is a well developed body of economic theory as to why the money supply and GNP should be related, the reason the monetary base is expected to be related to GNP other than through the money stock is unclear.

There are Problems in Adjusting for Reserve Requirement Changes

There is general agreement that the monetary base should be adjusted for changes in legal reserve requirements. The volume of deposits and money that can be supported by a given volume of the base depends on the level of reserve requirements. Thus, a monetary base series adjusted for reserve requirement changes summarizes the effect of Federal Reserve actions on the monetary aggregates, and eliminates the discontinuities in the series that would exist if such an adjustment were not made.

For example, suppose that the banking system has only one liability, demand deposits, that reserve requirements are 20 per cent of demand deposits, and that there are no excess reserves. Let currency be $20 billion and bank reserves $20 billion, so that the base is $40 billion. Under these conditions, demand deposits will be $100 billion, since a lower level of demand deposits would imply excess reserves, and the level of reserves will not support a higher deposit level. Under these conditions, M1 will be $120 billion—$100 billion of demand deposits and $20 billion of currency. Now suppose the Federal Reserve reduces the reserve requirement to 10 per cent, but does not want demand deposits and the money supply to increase. In this case, the Federal Reserve would drain reserves from the banking system by means of open market sales of securities so that there would be enough reserves in the system to support only the original $100 billion in deposits. The level of bank reserves would drop to $10 billion and the monetary base to $30 billion, while demand deposits would remain at $100 billion and the money supply at $120 billion. Thus, due to the lower reserve requirement, a monetary base of $30 billion would support the same level of deposits and the same level of M1 as formerly supported by the base of $40 billion.

Since the reduction in reserves through open market operations offsets the reduction in reserve requirements, it would be potentially misleading to draw conclusions about the

stance of monetary policy by looking at the decline in the monetary base. A reserve adjustment procedure adjusts the monetary base so that the adjusted base will remain unchanged when reserve requirement changes are offset by changes in reserves.

Both the Board of Governors of the Federal Reserve System and the Federal Reserve Bank of St. Louis currently publish adjusted monetary base series.[14] These procedures are conceptually quite similar, and both appear to be well conceived. The St. Louis reserve adjustment procedure results in the calculation of a reserve adjustment magnitude (RAM) which is equal to the difference between current required reserves and the reserves that would have been required under the 1929 base period reserve requirements.[15] RAM is added to the monetary base to get the adjusted base. In the case of our example, assuming the initial reserve requirement was 20 per cent, the level of RAM after the reduction in the reserve requirement would be

RAM = (0.2 - 0.1) x $100 billion = $10 billion.

When RAM is added to the monetary base of $30 billion, the adjusted base is $40 billion, the same as before the change in reserve requirements.

The procedure used by the Board of Governors differs in that it is multiplicative rather than additive and that it uses the current period as the base period when adjusting the monetary base.[16] The Board procedure involves the calculation of the ratio of required reserves under the new requirements to required reserves under the old requirements separately for demand and time deposits. The ratio thus obtained is multiplied by the levels of required reserves under the old requirements. In our example, the ratio would be 10/20 = 0.5. The adjusted monetary base for the period just prior to the change would be 0.5 x $20 billion in reserves + $20 billion in currency = $30 billion, which makes the adjusted base the same as the unadjusted base in the current period. As can be seen from this simple example, both procedures give the same result—no change in the adjusted monetary base.

However, when there is more than one class of deposits for reserve requirements, and when these classes of deposits are growing at different rates, the two reserve adjustment methods may give noticeably different rates of growth for the adjusted base. In fact, the two procedures have in the past given significantly different rates of growth for the monetary base. For example, in 1976, the adjusted base as published by the Board of Governors grew at an annual rate of

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14 For descriptions of the two procedures, see Board of Governors of the Federal Reserve System, "Aggregate Reserves and Monetary Base Data Adjusted for Changes in Regulations D and M" (mimeographed), and Albert E. Burger and Robert H. Rasche, "Revision of the Monetary Base," *Review*, Federal Reserve Bank of St. Louis (July 1977), pp. 13-28.

15 $RAM_t = \sum_i (r_0^i - r_t^i) D_{t-2}^i$

where r_0^i = the reserve requirement on the i-th class of deposits in 1929,

r_t^i = the reserve requirement on the i-th class of deposits in period t, and

D_{t-2}^i = deposits in the i-th deposit class at period t-2 weeks (because required reserves are held on deposits two weeks earlier).

In addition, RAM includes all vault cash at member banks, because vault cash could not be used to meet reserve requirements in 1929, and subtracts required reserves against liabilities that were not reservable in 1929.

16 The use by the Board of current period reserve requirements, and the Federal Reserve Bank of St. Louis of 1929 requirements, is similar to the difference between Paasche and Laspeyres price indexes. It is well known that neither of these indexes (nor any other index) is ideal. The Board of Governors uses separate multiplicative factors for demand deposits and for time deposits.

Table 2
AN EXAMPLE OF THE EFFECT OF RESERVE ADJUSTMENTS ON RESERVE GROWTH

Period	r^D	r^T	Demand Deposits	Time Deposits	Level of Bank Reserves			Growth of Bank Reserves		
					Unadjusted	St. Louis Adjusted	Board Adjusted	Unadjusted	St. Louis Adjusted	Board Adjusted
0	.15	.05	100.0	100.0	20.0	20.0	10.0	–	–	–
1	.10	.05	105.0	110.0	16.0	21.2	10.5	–20.0	6.0	5.0
2	.10	.05	110.2	121.0	17.1	22.6	11.0	6.7*	6.3*	5.0*
3	.10	.05	115.8	133.1	18.2	24.0	11.6	6.8*	6.3*	5.0*
4	.10	0	121.6	146.4	12.2	25.6	12.2	–33.3	6.4	5.0
5	.10	0	127.6	161.1	12.8	27.2	12.8	5.0*	6.4*	5.0*
6	.10	0	134.0	171.2	13.4	29.0	13.4	5.0*	6.5*	5.0*

r^D = the reserve requirement on demand deposits.
r^T = the reserve requirement on time deposits.
* = periods of no change in reserve requirements.

6.2 per cent, while the Federal Reserve Bank of St. Louis base grew at an annual rate of 8.4 per cent.[17]

It is difficult to develop criteria for choosing which of these or other methods for adjusting for reserve requirement changes is preferable. However, if the purpose of adjusting for reserve requirement changes is to summarize both open market operations and changes in reserve requirements in the monetary base, one reasonable criterion is that the actual and adjusted base should move in a similar fashion during periods when reserve requirements do not change. If changes in the adjusted base series are induced by the reserve adjustment procedure, rather than by factors controlled by policymakers, reliance on the adjusted base could mislead both policymakers and researchers.

Table 2 uses a simple example to show that neither the adjusted base published by the Board of Governors nor the one published by the Federal Reserve Bank of St. Louis need move in the same way as does the unadjusted base during a period without reserve requirement changes. Since currency is not affected by reserve requirements, Table 2 looks only at the reserve portion of the base. The table assumes that demand deposits and time deposits are both 100 in the initial period and then grow at constant rates of 5 per cent and 10 per cent, respectively. Given this deposit behavior, the table shows the level of bank reserves and the adjusted levels as calculated under the Board and St. Louis procedures. In addition, the growth rates for the respective series are shown. The table assumes that r^D, the reserve require-

[17] One reason for these differences may be the fact that movements of demand deposits between banks with different reserve requirements have no effect on the Board of Governors' adjusted base series, but do affect the Federal Reserve Bank of St. Louis RAM. While the two series vary in a number of ways other than their procedures for adjusting reserve requirements, these other differences do not appear to have been important causes of differences in their growth rates. Two ways in which the series differ are in the level of aggregation at which seasonal adjustment takes place and the way in which member bank vault cash is treated. See Albert E. Burger, "Alternative Measures of the Monetary Base," *Review*, Federal Reserve Bank of St. Louis, 61 (June 1979), pp. 3-8.

ment on demand deposits, decreases in period 1, and that r^T, the reserve requirement on time deposits, decreases in period 4. There are no reserve requirement changes in periods 2 and 3 nor in periods 5 and 6. The table shows that reserves adjusted for reserve requirement changes grow at different rates under the St. Louis procedure than do actual reserves during every period. The Board procedure produces different rates of growth for the actual and adjusted base in periods other than those with the same reserve requirements as in the final period.[18]

In general, under the Board procedure, because the adjusted and unadjusted base are the same for the current period (and all other periods with the same reserve requirements as exist currently), the current rate of growth will be the same for both adjusted and unadjusted series.[19] However, the rates of growth in earlier periods may differ between the adjusted and unadjusted series. Under the St. Louis procedure, there is no reason to expect the adjusted and unadjusted series to show the same rates of growth.

The Board procedure is appropriate if the objective is to know how the monetary base would have behaved if reserve requirements had always been what they are currently, while the St. Louis procedure is appropriate if the objective is to know how the base would have behaved if reserve requirements had been constant from 1929 onward. However, users of either series should recognize that both reserve adjustment procedures can give rise to differences between the growth rates of the adjusted and unadjusted base in the absence of changes in reserve requirements.

The problem noted here is not simply an academic one. Legislation pending in Congress would abolish required reserves on time and savings deposits. If this legislation were to pass, conditions similar to that in periods 4 to 6 of Table 2 would exist. If time and savings deposits continue to grow faster than demand deposits, as has been the case throughout most of the last 35 years, the St. Louis adjusted base, which would presumably continue to rely on the 1929 reserve requirements, would show a higher rate of growth than would the actual base. The Board of Governors series would implicitly assume that there had never been reserve requirements on time and savings deposits, so that for periods prior to the elimination of requirements on time deposits, the Board adjusted series would grow less rapidly than the unadjusted series.

Neither of these procedures for adjusting for reserve requirement changes is clearly superior to the other.[20] It would seem that the Board of Governors series is preferable for policy purposes, since the actual and adjusted base do not differ materially in the current period. However, preliminary work suggests that the St. Louis base may be somewhat more closely related to both money and GNP. In any case, the existence of alternative procedures for adjusting the base shows that this variable has a potentially serious definitional problem.

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18 While the example compares the growth rates of adjusted and unadjusted base series, a similar conclusion would be reached by looking at changes in the levels of the series.

19 Since reserves were imposed on increases in managed liabilities in October, there is a slight discrepancy between the Board of Governors' adjusted and unadjusted base series for the current period, as required reserves against managed liabilities are excluded from the adjusted base.

20 It would appear that an "ideal" reserve adjustment procedure would take an approach similar to those used in price indexes—periodic revision of the reserve requirement base period. While it is not clear how such a procedure should best be formulated, both the Board procedure of always using the current reserve requirements and the St. Louis procedure of always using 1929 requirements have difficulties.

The Base is Less Closely Related to the Economy than are Other Variables

While regression analysis demonstrates a statistically significant relationship between the monetary base and GNP, this relationship is not as close as the relationship between M1 and GNP. Table 1 shows the relationship between rates of change of GNP and of M1 and the monetary base during 1953-78, with the R^2's showing that 44 per cent of the variation in percentage change in GNP was "explained" by the M1 equation and 35 per cent by the monetary base equation.

The fact that the monetary base is less closely related to the economy than is money can also be seen by examining the cyclical behavior of the two variables. The most extreme example of this is the period between July 1929 and April 1933. During this period of severe economic contraction, M1 declined by 35 per cent and M2 by 33 per cent, but the monetary base actually rose 11 per cent.[21] The Federal Reserve has been severely criticized for allowing the decline in the money supply that occurred over this period. It seems quite likely that a monetary policy that focused on the monetary base would also have allowed a decline in money during this period.

There were, of course, unusual factors at work during the 1930s—most importantly the high number of bank failures during the period. In the post-World War II period, however, the monetary base also has not moved as closely with economic activity as has M1. This is the meaning of the regression results reported in Table 1. It can be seen from Chart 1 that movements in the monetary base have been poorly related to economic fluctuations since 1973. During the 1973-79 period, the base moved within a relatively narrow range and its movements reflected neither the severe recession of 1974 nor the acceleration of the economy during the 1975-79 period.

While the monetary base has been less closely related to GNP than has M1 during the post-World War II period as a whole, this might no longer be true. Financial innovations have reduced the closeness of the relationship between GNP and M1. It is possible that this relationship is now less reliable than the base-GNP relationship. For example, in light of the effect of ATS accounts on M1 in 1979, it might be thought that the M1-GNP equation would do a poorer job of forecasting GNP during 1979 than would the base-GNP equation. However, this is not the case. Simulations of the M1 equation do a slightly better job of predicting GNP during the first three quarters of 1979 than do simulations of the base equation.[22] Moreover, it would not be surprising if the base equation continues to predict more poorly than the M1 equation. This is because any innovation that changes the relationship between the economy and the monetary aggregates (as conventionally measured) can normally be expected to change the relationship between the base and the economy. Such a change can be expected, because the base is tied to monetary aggregates through reserve requirements.

The tie between the aggregates and the base may be show as an equation:

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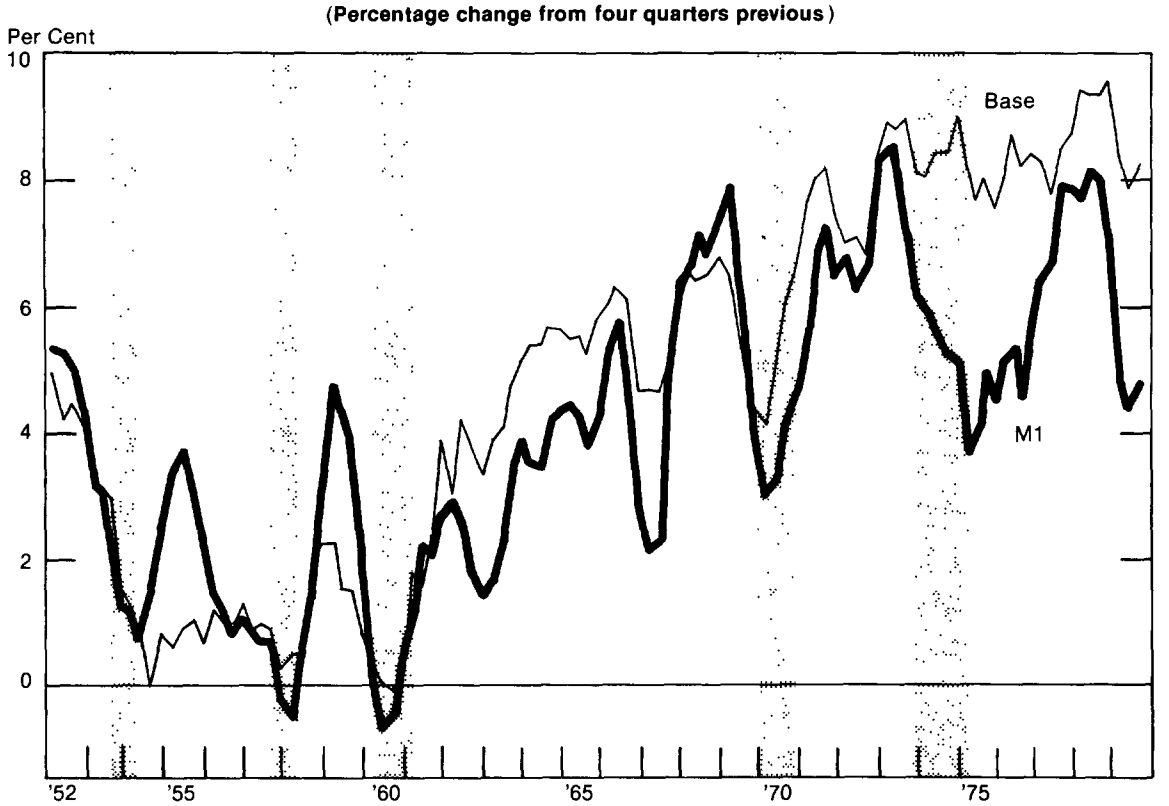
21 M1 and M2 data are from Milton Friedman and Anna J. Schwartz, *Monetary Statistics of the United States* (New York: National Bureau of Economic Research, 1979), pp. 25-29. The monetary base is Friedman and Schwartz's "high powered money." These data are from Friedman and Schwartz, *A Monetary History of the United States 1867-1960* (Princeton, N.J.: University Press, 1963), pp. 803-04.

22 Errors in both equations are large. For the M1 equation, the root-mean-square error is 2.68, while the mean absolute error is 2.45. For the base equation, the root-mean-square error is 3.34, while the mean absolute error is 3.13.

Chart 1
GROWTH RATES OF MONEY AND THE MONETARY BASE
(Percentage change from four quarters previous)



(1) $B = C + r^D \bullet D + r^T \bullet T + E$[23]

where

- B = the monetary base,
- C = currency in the hands of the nonbank public,
- r^D = the average reserve requirement on demand deposits,
- r^T = the average reserve requirement on time deposits,
- D = the quantity of demand deposits,
- T = the quantity of time deposits, and
- E = the quantity of excess reserves.

The equation shows that the monetary base can be viewed as a type of monetary index, with weights of 1.0 on currency and weights on demand and time deposits equal to the average reserve requirements on these deposits. Since excess reserve holdings are very small, less than 0.2 per cent of the monetary base, they can be ignored. Average reserve requirements were estimated by means of regression analysis to be $r^D = 0.085$ and $r^T = 0.03$.[24] Thus, when the

[23] This equation ignores required reserves on nondeposit sources of funds and several other technical complications.

[24] The values of r^D and r^T are not simply the average level of member bank reserve requirements, since deposits are partially in nonmember banks which are not subject to these requirements.

monetary base is viewed as an index of various monetary components, currency has a weight of 1.0, demand deposits of 0.085, and time deposits of 0.03.[25] It is clear then that financial innovations that affect the demand for currency or deposits will necessarily affect the demand for the base. For example, a reduction in the demand for deposits will tend to be accompanied by a reduction in the demand for the base.

The Problem of the Currency Component

The substantial role of currency in the monetary base—$106 billion of $152 billion in late 1979—is one of the reasons that the base is less closely related to GNP than is M1. Currency is not closely related to GNP. The relatively close relationship between the base and GNP is due to a close relationship between bank reserves and GNP. As Table 3 shows, a regression with current and lagged values of bank reserves as independent variables has a higher R^2 (0.42) than does the monetary base equation in Table 1 (0.35).[26] Moreover, when bank reserves and currency are separately included in regression analysis, changes in currency do not have a statistically significant effect on GNP. Thus, the inclusion of currency makes the base do a poorer job of predicting

Table 3
RESERVE SPENDING EQUATION
1953-72

$$\dot{Y}_t = k + \sum_{i=0}^{4} \rho_i \dot{R}_{t-i} + \sum_{i=0}^{4} e_i \dot{E}_{t-i}$$

ρ_0	0.02	(0.24)
ρ_1	0.21	(3.71)
ρ_2	0.34	(4.63)
ρ_3	0.31	(5.34)
ρ_4	0.15	(1.67)
$\Sigma\rho_i$	1.04	(6.77)
e_0	0.07	(1.69)
e_1	0.05	(2.01)
e_2	0.00	(0.04)
e_3	−0.05	(−2.02)
e_4	−0.07	(−1.83)
Σe_i	−0.00	(−0.02)
k	2.66	(3.30)
R^2	0.42	
$\bar{R}^2$	0.38	
S.E.	3.81	
D.W.	1.77	

$\dot{Y}$ = Percentage change in nominal GNP at an annual rate.
$\dot{R}$ = Percentage change in bank reserves at an annual rate.
$\dot{E}$ = Percentage change on high employment Government expenditures.
t-statistics in parentheses.

25 Alternatively, one can determine the contribution of the growth of currency, demand deposits, and time deposits to the growth of the base:

$$g_B = \frac{C}{B} \cdot g_C \cdot g_C + r^D \cdot \frac{D}{B} \cdot g_D + r^T \cdot \frac{T}{B} \cdot g_T$$

where

g_B = the growth rate of the monetary base,

g_C = the growth rate of currency,

g_D = the growth rate of demand deposits, and

g_T = the growth rate of time deposits.

Using the r^D and r^T obtained in the regression analysis, the weight for currency growth is 0.72, for demand deposit growth 0.15, and for time deposit growth 0.13.

26 Since the Federal Reserve Bank of St. Louis seasonally adjusts the total monetary base rather than its components, bank reserves are not directly available. The series used here for bank reserves is the difference between the monetary base and currency in the hands of the nonbank public. Thus, the bank reserves series includes nonmember bank vault cash.

changes in GNP than can be obtained by using either bank reserves alone or M1.

The level of currency outstanding is one of the most puzzling of the monetary variables. Since there seems to be almost universal agreement that very little of currency in circulation in the United States is in the hands of businesses (at least legitimate taxpaying entities), the $475 per capita outstanding must be in the hands of households, illegitimate businesses, or foreigners. While there have been numerous attempts to explain currency outstanding on the basis of "the underground economy," none of the proffered explanations seems satisfactory.[27]

Currency and Controlling the Base

While currency behavior has been relatively stable and predictable in recent years, there are month-to-month fluctuations in currency demand, even when seasonal effects are adjusted for. Under current monetary arrangements, the banking system and the Federal Reserve provide the public with all the currency demanded—there is no way to ration currency at bank windows if demand is unexpectedly high, or force it out if demand is unexpectedly low. Thus currency outstanding is, in the short run, independent of monetary policy. Since $1 of the monetary base can support roughly $12 of demand deposits or $33 of time deposits, but only $1 of currency, a policy that required that the behavior of the monetary base be invariant to random changes in currency demand could force sharp changes in the level of deposits. This would not be true, incidentally, of a policy that focused on bank reserves.

The Absence of a Theoretical Foundation

The rationale for expecting a close relationship between money and the level of economic activity is extremely well developed in economic theory. The quantity theory of money goes back hundreds of years, and money also plays an important role in Keynesian and post-Keynesian models. In these models, changes in the monetary base would be expected to affect the economy only to the extent that they induced changes in the money stock.

It is difficult to think of models where the monetary base plays a role independently of money. One possibility that does come to mind is the set of models in which net wealth plays a crucial role. In these models, only "outside money"—that is, money that is not a debt of one of the economic agents in the model—plays a role.[28] The monetary base is outside money. However, the proponents of using the monetary base rather than the money stock do not appear to have relied on outside money models. Furthermore, in the net wealth models, the appropriate monetary base variable would be the unadjusted base rather than the base adjusted for reserve requirement changes. Since reserve requirement changes do not create or

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[27] Much of the discussion of the large quantity of currency and its relation to the underground economy is based on the assumption that the growth in currency in recent years indicates that there has been a growth in the importance of underground economic activity. However, the ratio of currency to GNP has been declining at a fairly steady rate. The ratio now stands at about 0.043, as compared with 0.057 in 1960. Thus, the currency puzzle is not so much of the rate of growth of currency, but rather of the absolute level.

[28] The classic net wealth model is found in Don Patinkin, *Money, Interest, and Prices*, 2nd ed. (New York: Harper & Row, 1965).

Another argument for monetary policy focusing on the base can be found in the work of James Tobin, who has emphasized that the monetary base is, like the money of economic theory, an "outside" asset and noninterest bearing. However, Tobin's framework is fundamentally different from that of other advocates of the base. See James Tobin, "A General Equilibrium Approach to Monetary Theory," *Journal of Money, Credit, and Banking*, 1 (February 1969), pp. 15-29. In this article, the monetary base is termed "the demand debt of the government."

destroy wealth, they would appear to be irrelevant to these models.

SUMMARY AND CONCLUSIONS

The case for using the monetary base as an intermediate target, at least during a period of rapid financial innovation, has a superficial plausibility. It is true that innovations have created definitional problems for the monetary aggregates, that the base is closely related to the economy, and that the base can be controlled by the Federal Reserve. However, on closer examination, the case for using the base as an intermediate target seems weak. There are problems in defining the monetary base as well as in defining money. The problems of the base involve adjusting the base for reserve requirement changes. Furthermore, since the base is tied to money through reserve requirements, changes in the demand for money are automatically translated into changes in the demand for the monetary base. Moreover, the monetary base does not appear to be as closely related to GNP as is M1.

A major drawback to using the monetary base as an intermediate target is that the largest portion of it is in the form of currency. Currency demand is poorly understood, at best, and changes in currency appear to be very poorly related to changes in economic activity. Finally, the theoretical basis for replacing money with the monetary base is unclear, while there is a well established theoretical basis for using money as an intermediate target.

The only way in which the monetary base appears to be superior to money as an intermediate target is that it would be somewhat easier to control. In light of its other drawbacks, this would not appear to be sufficient reason for substituting the monetary base for money as an intermediate target of monetary policy.