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Federal Reserve Intermediate Targets:
Money or the Monetary Base. . . . . Page 3

Fast vs. Gradual Policies
for Controlling Inflation. . . . . Page 16

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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 shoyld 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 1% 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 7% to 10% per cent for bank credit.

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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.

variables such as bank reserves and the Federal funds rate.' 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.' 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.'] 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

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

	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—MI or the monetary base.
$\dot{E}$ = Percentage change in high employment Government expenditures.
t-statistics in parentheses.

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 19791, 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

$$RAM = (0.2 - 0.1) \times \$100 \text{ billion} = \$10 \text{ billion}.$$

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

					Level of Bank Reserves			Growth of Bank Reserves		
Period	r^D	r^T	Demand Deposits	Time Deposits	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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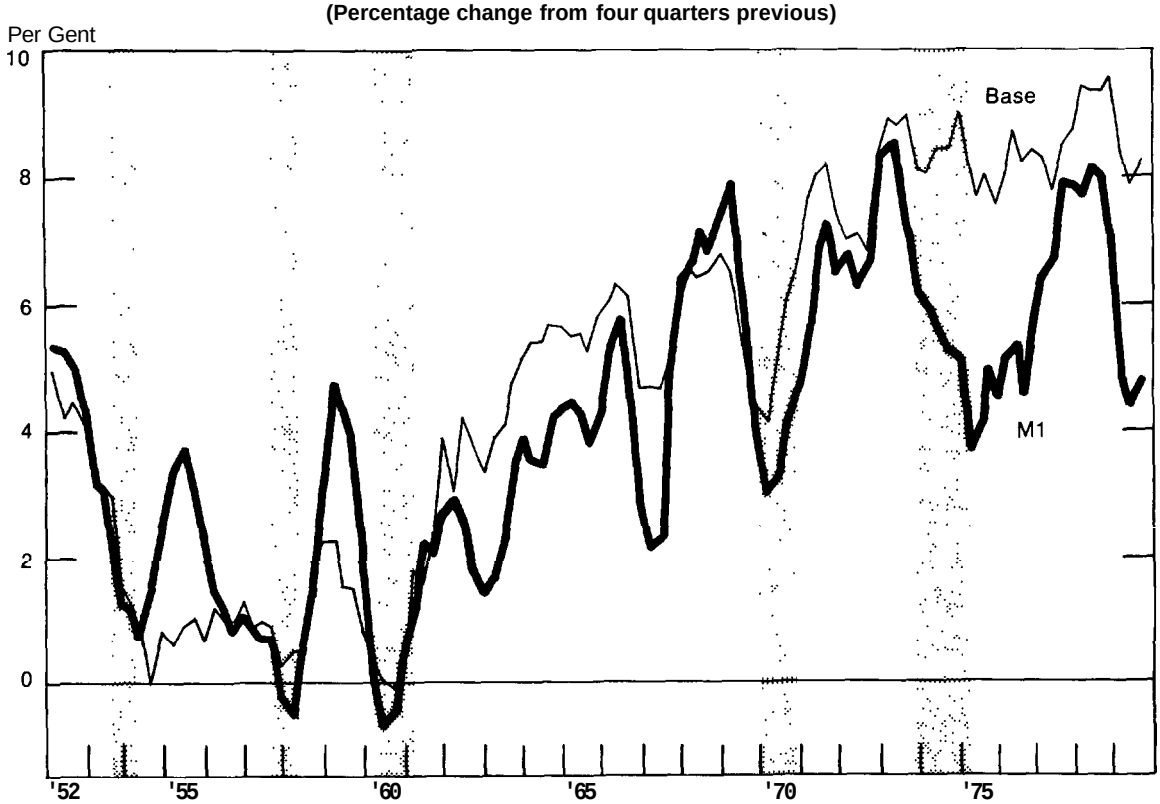
21 M1 and M2 data are from Milton Friedman ahd Anna J. Schwartz, *Monetary Statistics of the United States* (New York: National Bureau of Economic Research, 1979), pp. 25-29. The monetary base is Friedman and Schwartz's "high powered money." These data are from Friedman and Schwartz, A *Monetary History 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

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

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 monetaty 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.

Fast vs. Gradual Policies for Controlling Inflation

By William G. ***Dewald***

High rates of monetary growth and inflation in 1979 prompted the Federal Reserve to announce on October 6 a new anti-inflation policy package. Included in the package was an increase in the discount rate to a record 12 per cent, an increase in required reserve ratios on liabilities of banks previously not subject to requirements, and, most importantly, a change in operating procedures. That change promises to direct Federal Reserve open market securities transactions toward control of monetary growth directly, rather than indirectly as previously by control of the Federal funds rate. Whether or not these policies succeed, it was clear that the Federal Reserve was trying to reduce monetary growth for the purpose of damping inflation.

But how long might it take to control inflation and at what cost in economic growth and unemployment? And what are the economic consequences of taking a fast or a gradual approach to controlling inflation? The purpose of this article is to contribute to answers to these questions. The first section identifies the basic cause of inflation as excess demand propelled by rapid monetary growth. The second section presents a model of the economy that can be used to analyze alternative approaches to controlling inflation. The economic impacts of fast and gradual approaches are then evaluated in the third section.

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THE SOURCE OF INFLATION

This article adopts the view that inflation is caused mainly by excess economic demand and that rapid monetary growth is the major factor giving rise to excess demand. As to the linkage between demand and inflation, it is held that the rate of inflation in the long run reflects the growth of the nominal demand for goods and services relative to the growth of the economy's capacity to supply goods and services. For example, if nominal demand grows at a rate of 10 per cent and capacity grows at a rate of 3 per cent, the inflation rate will be 7 per cent.

It is also held that in the long run, the growth in real demand — nominal demand

adjusted for inflation—is constrained by the growth in capacity. And, because actual economic growth is equal to the growth in real demand, actual growth is equal to the growth in capacity. In the above example, real demand grows at a rate of 3 per cent (10 per cent growth in nominal demand minus 7 per cent inflation), and this gives rise to a growth in the actual output of goods and services at a rate of 3 per cent, the same as the growth in capacity.

Furthermore, because inflation in the long run reflects the growth in nominal demand relative to capacity growth, a reduction in the growth of demand will reduce inflation. Also, because inflation is reduced, the decline in the growth in nominal demand will not reduce the growth in real demand, and therefore will not reduce the growth in real output. Thus, the growth in real output will continue to equal the growth in capacity. In the example, if a decline in the growth in nominal demand from 10 to 3 per cent occurs, the rate of inflation will decline from 7 to 0 per cent. The growth of real demand and of output will remain at 3 per cent, equal to the growth rate of capacity. In the long run, then, a decline in nominal demand will reduce inflation without reducing economic growth.

In the short run, though, because wage and price contracts tend to reflect past information about economic performance, a decline in nominal demand, instead of reducing inflation, will reduce the growth of real demand and real output. As the growth of output is reduced, output will fall below capacity, growth in the demand for workers will decline, and unemployment will increase. The gap between output and capacity and the rise in unemployment will eventually lead to adjustments in wage and price contracts and to declines in the rate of inflation. As the rate of inflation declines, the growth of real demand will recover, leading to a recovery in the growth of output and in the demand for workers, and to a reversal in the upward movement in unemployment. These adjustments will continue until the growth of output is equal in the long run to the growth in capacity and the rate of inflation is equal to the growth in nominal demand minus the growth in capacity.

A reduction in the growth in nominal demand, then, will lead to economic slack in the short run and a reduction in inflation in the long run. But what determines the growth in nominal demand? Demand depends on a number of factors, including spending by the Federal Government and the demand for exports. This article, however, adopts the view that the rate of growth of the money stock is, in the long run, the most important determinant of the growth of nominal demand. It is held that there is a direct systematic relationship between the growth rate of nominal demand and the monetary growth rate.

Due to the relationship between demand and money, the inflation rate can be reduced by reducing the rate of growth in the money stock. A reduction in the monetary growth rate, however, will be accompanied by a period of economic slack and rising unemployment. The length and severity of this period of economic slack will depend in part on the approach that monetary authorities adopt to reducing the monetary growth rate. This article analyzes and compares the potential results of two alternatives—a fast approach and a gradual approach. To undertake the analysis, the article utilizes a small model of the economy that is based on the theory that inflation is determined by demand and supply and that the money stock is an important determinant of demand.

THE MODEL

The article uses a modification of the quarterly econometric model developed by the Federal Reserve Bank of St. Louis, which is a

model of the aggregate demand for and supply of goods and services. In the model, changes in aggregate demand and supply determine the rate of inflation, the real growth rate, the unemployment rate, and interest rates.

The aggregate nominal demand for goods and services, measured by changes in nominal gross national product (GNP), is assumed to be determined by variables outside the model, referred to as exogenous variables. The most important exogenous variable is monetary policy, which is measured by the annual growth rate of the money supply, M1, defined as currency and demand deposits held by the nonbank public. Nominal GNP is also specified to be affected by high-employment Federal Government spending and by the demand for exports.

The aggregate supply of goods and services is assumed to be exogenous, determined outside the model by long-run factors such as capital accumulation and population growth. It is measured by changes in high-employment real GNP, as estimated by the President's Council of Economic Advisers.

The rate of inflation, measured by the percentage change in the GNP price deflator, is assumed in the model to be directly affected by expected aggregate demand for and supply of goods and services. More precisely, the rate of inflation depends partly on current demand pressure, which is defined as the difference between the expected demand for goods and services and the supply of goods and services. Thus, the inflation rate is affected by those exogenous variables that affect nominal GNP, such as the growth rate in M1. The impact of M1 on inflation is indirect in that M1 affects the demand for goods and services, which affects demand pressure. Demand pressure in turn has a direct impact on inflation. In the model, inflation also depends directly on inflationary expectations. This reflects the view that in making decisions about wages and prices, economic units make their calculations in real rather than nominal terms.

Changes in the actual real output of goods and services, measured by changes in real GNP, are assumed in the model to be determined by estimated changes in both nominal GNP and the inflation rate. Since nominal GNP is assumed to depend solely on exogenous variables, such as the money supply, the model manifests one-way causality, or recursiveness. That is, changes in nominal GNP affect changes in real GNP and/or inflation, but there is no feedback effect on nominal GNP.

The unemployment rate is assumed to be determined by the percentage gap between high employment output and actual output. The unemployment rate is indirectly affected by the M1 growth rate. That is, M1 affects nominal GNP directly, which, in turn, can affect real GNP in the short run and, therefore, the gap between high employment output and actual output.

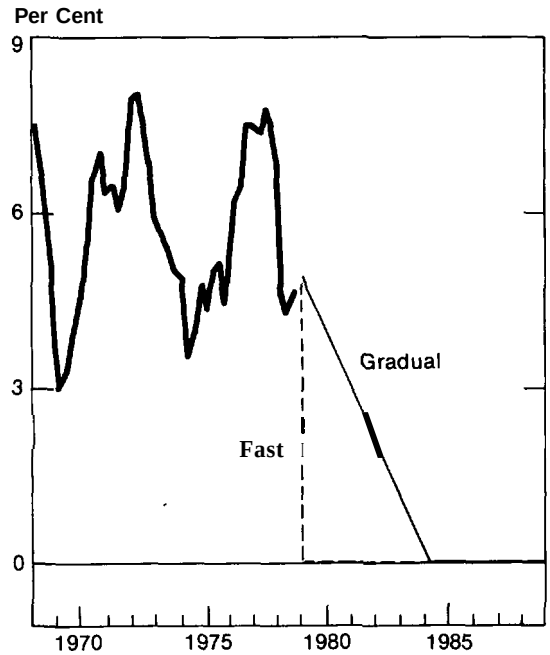
The model contains one short-term interest rate—the 4- to 6-month commercial paper rate—which is assumed to depend on demand pressure and inflationary expectations. Increases in demand pressure or in inflationary expectations are assumed to place upward pressure on short-term interest rates. The model contains a long-term interest rate—the Aaa corporate bond rate—which depends directly on inflationary expectations. Thus, the model exhibits a positive relationship between high inflation and high interest rates.

In summary, the model determines six major variables-changes in nominal GNP, the rate of inflation (per cent changes in the GNP deflator), changes in real GNP, the unemployment rate, and two interest rates. These variables are related to variables outside the model, such as the growth rate of M1 and high-employment output, and to the parameters that define and measure the relationships among the variables in the model.

ECONOMIC IMPACT OF ALTERNATIVE APPROACHES

To use the model to analyze the impact on the economy of fast and gradual approaches to reducing inflation, the first step was to estimate the values of the model's parameters.[1] The parameters were estimated by applying econometric procedures to historical data for the first quarter of 1953 through the third quarter of 1979. Given the model, the estimated parameters, and assumptions about the behavior of the model's exogenous variables, the next step in the analysis was to simulate the model under alternative assumptions about the approach adopted to reduce inflation.[2] The model was simulated for the period beginning in the fourth quarter of 1979 through the fourth quarter of 1989 under assumptions of fast and gradual approaches. Both approaches assumed a decline in the M1 growth rate, which was about 5.0 per cent during the year ended in the third quarter of 1979. The fast approach was defined as a monetary policy of reducing the M1 growth rate to zero in the fourth quarter of 1979 and maintaining it at that level throughout the simulation period. The gradual approach was defined as reducing Ml's growth rate by one-quarter percentage point each quarter until zero growth is reached, and then maintaining the M1 growth rate at zero through the remainder of the simulation period. (See Chart 1.)

Chart 1
THE MONEY SUPPLY, M1
Actual 1969-79,
Model Assumptions 1980-89
(Per cent change from year earlier)



The final step in the analysis is to examine and compare the results of the simulations. The results, which show the potential impact on the economy of the two alternative monetary growth rates, support the view that a reduction in the monetary growth rate will reduce inflation. As shown in Chart 2, the rate of inflation declines under both the fast and the gradual simulations. Under the fast simulation, a zero inflation rate is achieved by mid-1984, while the gradual simulation does not completely eliminate inflation until late 1985.

It may be noted that, under both the fast and gradual simulations, the inflation rate overshoots the zero rate and then moves into the negative area.[1] In both cases, however, the inflation rate eventually moves back toward

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[1] An appendix lists all of the equations of the model. The complete empirical estimates are presented in the author's article, "Fast and Gradual Monetary Policies to Curb Inflation," *Bulletin* of Business Research. The Ohio State University, Vol. 14, No. 7 (July 1979), pp. 1-7.

[2] The assumed values of the exogenous variables for the simulation beginning with 1979: IV are the following annual growth rates: High-employment real GNP, 3 per cent; high-employment Federal Government spending, 4 per cent; exports, 4 per cent; imports deflator, 10 per cent; M1, 0 per cent. The high-employment unemployment rate is 5.1 per cent.

Chart 2
THE RATE OF INFLATION
Actual 1969-79, Model Simulation 1980-89
(Change from year earlier In GNP price deflator)

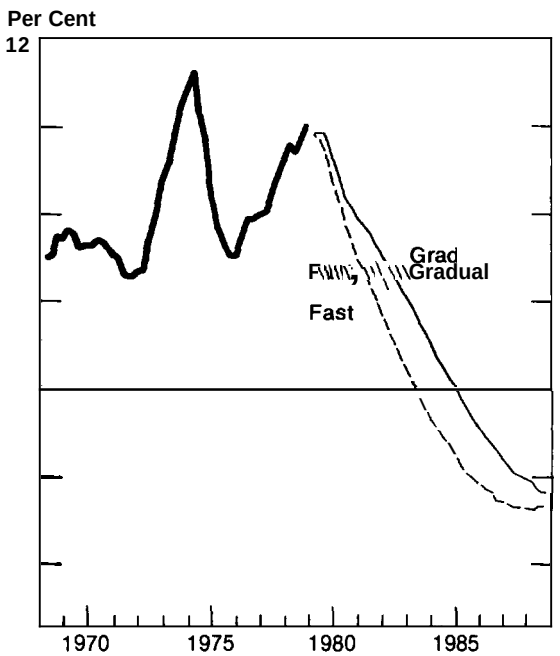
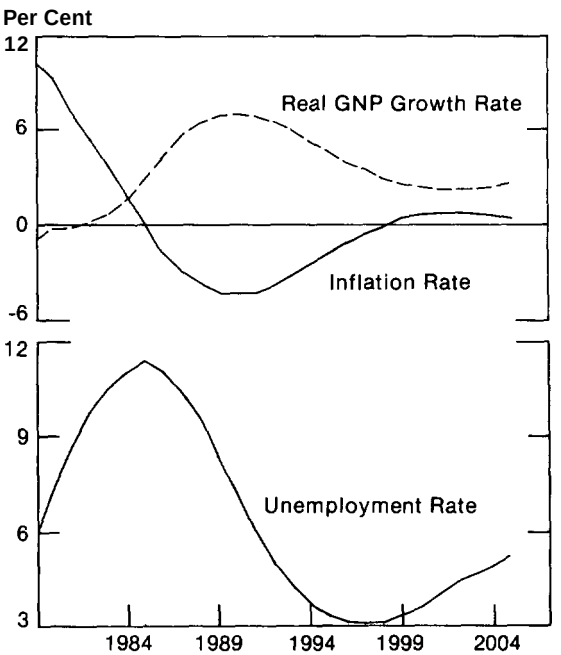


Chart 3
INFLATION RATE, REAL GNP GROWTH RATE AND UNEMPLOYMENT RATE 1980-2005
(Model Simulation of Gradual Approach)



zero, and in long-run equilibrium, remains at zero—the rate of growth of the money stock, M1. The long-run convergence of the inflation rate toward the zero point is shown for the gradual simulation in Chart 3. A similar result holds for the fast simulation. It may also be noted that, as with the inflation rate, the short- and long-run interest rates converge in the long run toward equilibrium levels significantly lower than prevailed in 1979. The long-run values are 3.4 and 4.5 per cent, respectively, for the short- and long-term rates.

The simulation results also support the view that reducing the monetary growth rate to reduce inflation will give rise to a period of economic slack. Both the fast and gradual simulations produce a period of slack during which the economic growth rate is negative and the unemployment rate increases. Under the fast simulation, the economy experiences a deep recession, with real GNP declining for several quarters at year-over-year rates of around 5 per cent. (See Chart 4.) Also, the

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[3] Though the model is stable in the sense that highly restrictive monetary policies will eventually be fully reflected in inflation and not in real output or unemployment, the model exhibits considerable instability in the sense that large disturbances have long-lasting effects on real variables as well as on inflation. This is due both to the estimated small contemporaneous effect of demand pressure on inflation and to the estimated long lag in the effect of past inflation on inflationary expectations. Though the model is specified so that there is no long-run tradeoff between inflation and unemployment, there is a short-run tradeoff.

unemployment rate increases to over 10 per cent by mid-1981 and remains over 10 per cent for a period of six years until mid-1987. (See Chart 5.) The gradual simulation, on the other hand, shows a less pronounced recession, with real GNP declining at rates of only around 1 per cent, and with the unemployment rate remaining below 10 per cent until mid-1985 and remaining above 10 per cent for a period of five years until mid-1988.

Under both the fast and gradual simulations, the economy recovers from recession at about the same time, in late 1982, when, in both cases, the real GNP growth rate moves from the negative into the positive area. During the recovery period, though, the economy grows more rapidly under the fast than under the gradual approach. Moreover, during the recovery period, the unemployment rate begins to decline earlier, declines more rapidly, and, after a time, is lower under the fast compared to the gradual simulation. In other words, while during the slack period the performance of the economy, as measured by economic growth and unemployment, is worse in the fast than in the gradual simulation, the economy's performance is better in the fast simulation during the recovery period. Thus, when taking account of performance during both the slack and the recovery period, neither the fast nor the gradual approach can be said to result in better economic performance than the other.

The simulation results show also that both the growth rate of real GNP and the unemployment rate, as is the case for the inflation rate, overshoot their long-run

Chart 4
THE ECONOMIC GROWTH RATE
Actual 1969-79, Model Simulation 1980-89
(Per cent change from year earlier in real GNP)

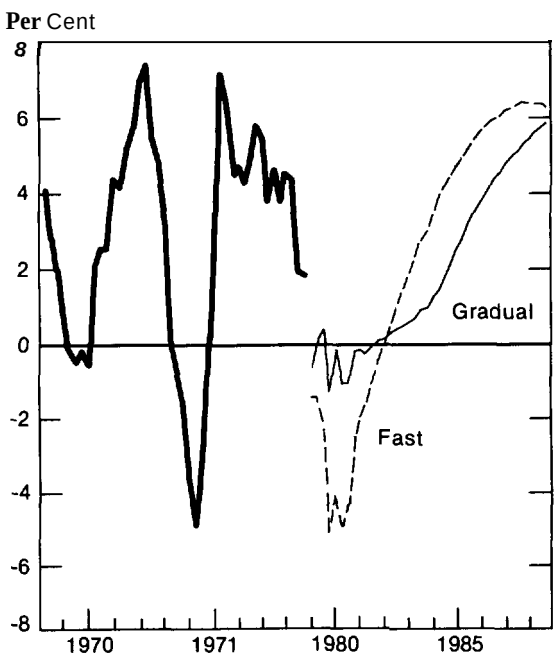
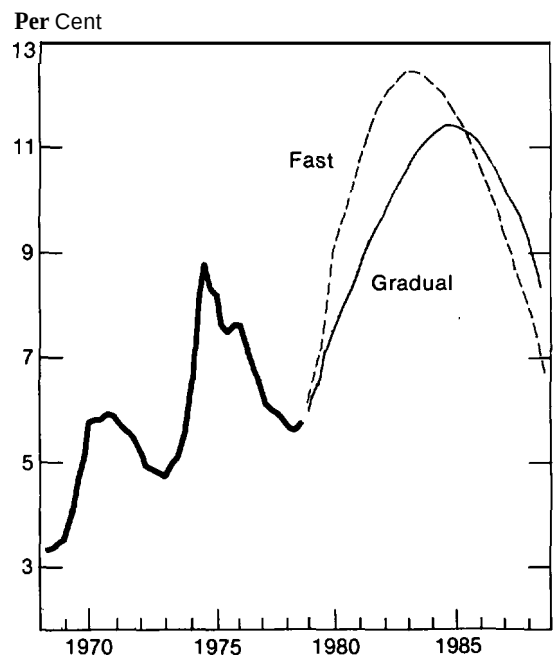


Chart 5
UNEMPLOYMENT RATE
Actual 1969-79,
Model Simulation 1980-89



equilibrium values. However, the results show that, as is the case with the rate of inflation, the economic growth rate and the unemployment rate converge in the long run to their equilibrium values. (See Chart 3.) The long-run equilibrium value of the economic growth rate is around 3.0 per cent, the assumed growth rate of the economy's capacity to produce goods and services. The long-run value of the unemployment rate is 5.1 per cent, the assumed "full employment" unemployment rate.

SUMMARY AND CONCLUSIONS

This article argues that inflation is caused mainly by excess economic demand and that rapid monetary growth is the major factor giving rise to excess demand. Thus, it is held that the inflation rate can be reduced by reducing the rate of growth in the money stock. A reduction in the monetary growth rate, however, would be accompanied by a period of economic slack and rising unemployment. The nature of this period of economic slack would depend in part on the approach that monetary authorities might adopt to reducing the monetary growth rate. The article uses a small econometric model to analyze the potential results of two alternative approaches—a fast and a gradual approach. The fast approach is defined as a monetary policy of immediately reducing the monetary growth rate to zero. The gradual approach is defined as gradually reducing the monetary growth rate to zero.

The econometric analysis supports the view that a reduction in the monetary growth rate would reduce inflation. It indicates that inflation would be eliminated more quickly under the fast than under the gradual approach. The analysis also supports the view that reducing the monetary growth rate would give rise to a period of economic slack. Under the fast approach, the economy would experience a deep recession, with the economic growth rate declining sharply and the unemployment rate increasing sharply and remaining high for an extended period of about six years. The gradual approach would produce a somewhat less pronounced recession. In both cases, the economy recovers from recession at about the same time. During the recovery period, though, the economy grows more rapidly under the fast than under the gradual approach, and the unemployment rate declines earlier and more rapidly. Thus, while during the slack period the performance of the economy, as measured by economic growth and unemployment, is worse under the fast than under the gradual approach, the economy's performance is better under the fast approach during the recovery period. Therefore, when taking account of performance during both the slack and the recovery period, neither approach can be said to result in consistently better economic performance than the other.

The findings of this article are not optimistic. They indicate that even a gradual approach to eliminating inflation would result in an extended period of economic slack and high unemployment. These results arise from the assumptions, supported by the article's econometric analysis, that on-going inflation reflects, to a large extent, inflationary expectations, which in turn reflect past experience with inflation. Because the U.S. economy has experienced high and rising inflation for an extended period, people expect inflation to continue. Countering the impact of these expectations on on-going inflation requires a high degree of economic slack for an extended period of time.

Some economists have argued that inflationary expectations would be sharply and quickly reduced if the monetary authorities were to publicly announce a policy of gradually reducing the monetary growth rate. If such an

announcement were made, and if the public believed it, inflation could in fact be eliminated *faster and with less cost in terms* of economic slack and unemployment than is implied by this article's findings. Based on past experience, however, it is unlikely that the public would believe the announcements of policymakers in the absence of firm evidence that monetary growth and inflation were actually being reduced.

APPENDIX
The Model
1953:I-1979:III

Equations:

1. $\dot{Y}_t = \underset{(3.28)}{2.38} + \sum_{i=0}^{4} m_i \dot{M}_{t-i} + \sum_{i=0}^{6} e_i \dot{EF}_{t-i} + \underset{(2.34)}{.04} \dot{EX}_t$

   $\sum m_i = \underset{(6.19)}{1.03} \quad \sum e_i = \underset{(.22)}{.02}$

   $R^2 = .52$, SE = 3.28, DW = 1.90

2. $D \equiv \ln(Y/P^a) - \ln(XF)$

3. $\dot{P}^a_t = \sum_{i=1}^{2} d_i D_{t-i} + \sum_{i=1}^{12} p_i \dot{P}_{t-i} + \sum_{i=1}^{7} w_i \dot{W}_{t-i}$

   $\sum d_i = \underset{(.20)}{.01} \quad \sum p_i = 1.00 \quad \sum w_i = .00$

   $R^2 = .81$, SE = 1.33, DW = 2.06

4. $\dot{P}_t = \dot{P}^a_t + \underset{(1.28)}{.04} D_t$

   $R^2 = .81$, SE = 1.20, DW = 2.03

5. $\dot{X} \equiv \dot{Y} - \dot{P}$

6. $U_t = UF_t - \underset{(-7.82)}{.20} D_t - \underset{(-6.38)}{.16} D_{t-1}$

   $R^2 = .72$, SE = .28, DW = 2.05, $\rho = .73$

7. $R_t = \underset{(.04)}{4.28} + \sum_{i=0}^{11} b_i \dot{P}_{t-i}$

   $\sum b_i = \underset{(5.18)}{.37}$

   $R^2 = .26$, SE = .18, DW = 1.42, $\rho = 1.00$

Definitions of Symbols:

Y = GNP.
M = money stock (M1).
EF = high employment Federal Government spending.
EX = exports.
D = demand pressure.
P = GNP deflator.
XF = high employment real GNP.
W = imports deflator.
X = Y/P = real GNP.
U = unemployment rate.
UF = high employment unemployment rate.
R = Moody's Corporate Aaa Bond Rate.
t = quarter.
In = natural logarithm.
= annual rate of change.
a = anticipated.
Lower case letters = coefficients.
Upper case letters = variables.
R^2 = coefficient of determination.
SE = standard error of estimate.
DW = Durbin-Watson statistic.
p = serial correlation coefficient.
t-values are in parentheses.

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