Review

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In This Issue . . .

For more than a third of a century, the velocity of money — the ratio of GNP to M1 — grew at a relatively stable rate of slightly more than 3 percent per year. This stable relationship contributed to the rise of monetarism and the adoption of monetary aggregate targets by the Federal Reserve. Since 1982, however, there has been a dramatic change in the behavior of velocity: it has grown more variably and, on average, has declined by more than 2 percent per year.

This dramatic and unanticipated turnaround has produced a myriad of would-be explanations. In the first article in this *Review*, "Solving the 1980s' Velocity Puzzle: A Progress Report," Courtenay C. Stone and Daniel L. Thornton evaluate the validity of the major theories about velocity's puzzling behavior in recent years. After grouping the various theories into three categories — misspecification, structural shifts and cyclical factors — the authors show that, with the possible exception of one variant of the financial innovations explanation, no single theory successfully solves the velocity puzzle. Moreover, while certain explanations in tandem appear to offer some insight into velocity's behavior, they, too, prove insufficient to solve the complete puzzle.

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The adjusted monetary base, a series published by the Federal Reserve Bank of St. Louis, is a measure of the Federal Reserve's influence on the money stock. In the second article in this issue, "A Revision in the Monetary Base," R. Alton Gilbert describes how this series was recently revised to incorporate the final phase-in of the reserve requirement structure specified in the Monetary Control Act of 1980.

The new structure of reserve requirements is used in deriving the adjusted monetary base from November 1980, when the phase-in began, to the present. Data for the prior series, which are used for periods before November 1980, are linked to the post-November 1980 data to create a continuous adjusted monetary base series.

Solving the 1980s' Velocity Puzzle: A Progress Report

Courtenay C. Stone and Daniel L. Thornton

THE velocity of money measures the relationship between nominal income and the money stock. In its simplest form, the quantity theory of money states that nominal income is equal to the money stock multiplied by its velocity. If velocity is reasonably stable, changes in the money stock have predictable consequences on nominal income; if the money stock is controllable as well, the quantity theory has useful implications for economic policy.[1] The relationship between money growth and inflation can be derived from the quantity theory framework by "breaking up" nominal income into its two components — the price level and real output. Thus, the stability of the money-price link, holding real output constant, is also related closely to the stability of velocity.

For over a third of a century — from 1946 to 1981 — the growth of the velocity of money, measured as the ratio of gross national product (GNP) to the narrow money stock (M1), was stable. Its stability contributed

to the rise of monetarism and the adoption of monetary aggregate targets by the Federal Reserve and other central banks around the world. Its stability also resulted in two empirically based rules of thumb that came to be used fairly successfully as guides to money growth's effects on income and inflation. Now, however, analysts believe that these rules have failed to explain the course of income and inflation during the 1980s, due to a relatively sudden and unanticipated drop in velocity.

Given the important role that velocity plays in economic and policy analysis, it is not surprising that considerable effort has been devoted to solving this velocity puzzle. Unfortunately, these efforts have produced a welter of competing and occasionally confusing explanations. To bring some order to this disarray, this article highlights the problems that have resulted from the puzzling behavior of velocity in recent years and examines the more prominent explanations of the velocity puzzle.

Because the concept of velocity stems directly from the theory of the demand for money, anything that affects velocity can be related to some aspect of the demand for money. (See shaded insert on the following page.) Because the demand-for-money approach is likely to be less intuitive to the general reader, however, we will discuss the various explanations of the velocity puzzle in terms of velocity itself.

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[1]The money stock need not be perfectly controllable; neither, for that matter, must velocity be constant. Movements in velocity (or its growth), however, must be explainable by the behavior of the variables that influence it. This idea, fundamental to macroeconomic policy, was developed by Friedman (1956). See Thornton (1983) for a discussion of the role of velocity for policy purposes.

Velocity and the Demand for Money

The demand for money is usually expressed as depending on GNP and various other factors, denoted by Z. That is, the demand for money can be written as:

(1) $M1 = f(GNP, Z)$.

Under certain technical conditions it is possible to rewrite (1) as:

(2) $M1 = GNP\ f(Z)$, or

(3) $M1/GNP = f(Z)$.

Since velocity is simply the reciprocal of equation 3, it can be written as:

(4) $\text{Velocity} = GNP/M1 = \dfrac{1}{f(Z)} = g(Z)$.

It is possible to characterize all "explanations" of the velocity puzzle in terms of equation 4, which is a slightly rewritten version of the demand for money. For example, suppose that equation 1 is not the correct specification of the demand for money, that instead, money demand depends on some broad transactions measure, T, rather than GNP. The true measure of velocity would not be equation 4; instead it would be:

(5) $T/M1 = k(Z)$.

If velocity as defined in equation 4 were stable for a number of years, it would imply that GNP was roughly proportional to T, or $GNP = \alpha T$, where α is a constant. Consequently, the usual measure of velocity is just α times the "true" measure, that is, $(GNP/M1) = \alpha(T/M1)$. While the *level* of the usual measure of velocity would be wrong, its movements would mimic movements in the true velocity measure. If this characterization were correct, the crucial question is not "Why did velocity decline?"; instead, it is "What caused the break in the relationship between T and GNP?"

Alternatively, GNP may be proportional to T in the long run but there may be short-run, cyclical variations in GNP relative to T. This characterizes the argument that GDFD is a better measure of transactions than GNP when there are sizable changes in net exports and inventories.

The tax-cut explanation of the decline in velocity is analogous, except that a reduction in marginal tax rates

can increase the demand for money, permanently reducing velocity. It argues that the demand for money depends on after-tax income, not on GNP. A cut in the marginal tax rates increases after-tax income and, hence, the demand for money relative to GNP. The usual measure of velocity falls, though the "correct measure," based on after-tax income, does not.

The arguments based upon the incorrect measure of money are analogous to those that contend the use of GNP is inappropriate. For example, let M^* denote the theoretically correct measure of money. If GNP is the correct scale variable, the correct measure of velocity would be:

(6) $GNP/M^* = w(Z)$.

The extent to which equation 4 is a good proxy for equation 6 depends on the relationship between M^* and M. Again, the interesting questions are "Why was equation 4 stable for so long?" and "What caused the recent shift in the relationship between M1 and M^*?"

Structural shift arguments imply that there has been a change in the functional relationship determining velocity, that is, a change in $g(\cdot)$. Such a change could be due to a number of factors. The key point is that the former relationship no longer explains velocity. The important issues are to identify the factor(s) that produced this shift and to identify the new relationship. In some sense, specification problems can be thought of as structural shifts because they are presumed to result from some shift in the underlying relationships, for example, between GNP and T or between M1 and M^*.

The cyclical explanation can be characterized by unusual movements in the factors that determine the demand for money, Z. Unusual movements in these variables can produce the appearance of unusual behavior in velocity. For example, one element of Z is the nominal interest rate. Because the demand for money is inversely related to the nominal rate of interest, a decrease in the interest rate could increase the demand for money relative to GNP, causing measured velocity to decline. For this explanation to be valid, however, there should have been a similar rise in velocity when the interest rate was rising.

WHAT WENT WRONG AND WHEN?

Two fundamental relationships between M1 and specific economic measures have been supported empirically for decades. One relationship is the link between money and GNP, a measure of total income in the economy. The second relationship is the link between money and prices. Charts 1 and 2 show the dramatic changes in these relationships that occurred during the 1980s.

Chart 1 depicts the behavior of the income velocity (GNP divided by M1) for the past 40 years; as the chart suggests, something unusual occurred to velocity around 1982. From 1946 through 1981, it rose fairly steadily at about 3.6 percent per year; since then, it has *declined* at an annual rate of about 2.4 percent.

Chart 2 shows the relationship since 1948 between annual inflation (as measured by the growth of the GNP deflator) and the average growth in M1 over a three-year period; use of M1's *trend* growth is designed to capture the long-run impact of money on prices. While the rate of inflation deviated from the trend growth of M1, sometimes substantially, from 1948 to 1981, the deviations generally were temporary. More importantly, the larger deviations were attributable to non-monetary events (for example, government mandated wage-price controls, OPEC oil price actions and the like). Since 1982, however, inflation has been substantially and persistently *below* the trend growth in M1. These deviations are not easily attributable to a specific non-monetary event.

Numerous attempts have been made to explain the recent changes in velocity. In this paper, these explanations are grouped loosely into three categories: misspecification, a portmanteau category we call "structural shifts" and cyclical factors.[2]

MISSPECIFICATION

The most widely used velocity measure, the income velocity of M1, is calculated by dividing nominal GNP by the nominal stock of M1. Both GNP and M1 are empirical counterparts to theoretical concepts that appear in various theories of the demand for money. One explanation for the shift in velocity is that GNP or

M1 or both have become less reliable proxies for their corresponding theoretical concepts. This problem is called a specification problem.[3]

GNP Vs. Transactions Measures

One specification problem could arise if money is held primarily to make daily transactions.[4] If these include intermediate and financial transactions, the usual velocity measure could vary with changes in the proportion of such transactions relative to transactions on final goods and services. Because GNP measures only *final output*, it will differ widely from the level of expenditures on *all transactions*. In this case, GNP is a useful proxy for total transactions only if the proportion of GNP to total transactions remains relatively constant.

This problem can manifest itself in several ways. For example, suppose consumers purchase more goods and, as a result, increase their money holdings in proportion to their increased desire to spend. If these newly purchased goods are imported or drawn from domestic inventories of previously produced goods, GNP will remain unchanged while the demand for money rises. Consequently, the usual measure of velocity would decline, while an alternative measure based on total transactions would remain unchanged. Thus, using GNP as the transactions measure to calculate velocity may produce sizable swings in velocity whenever there are large swings in inventories or net exports. Some analysts have argued that gross domestic final demand (GDFD), which equals GNP *minus* inventory adjustments and net exports, is preferable to GNP as the transactions proxy.[5] Unfortunately, the substitution of GDFD for GNP does not explain the velocity puzzle of the 1980s. As chart 3 indicates, this velocity measure performs essentially the same as the usual measure both before and after 1981. Consequently, simply replacing GNP with GDFD does not explain the protracted velocity decline during the 1980s.[6]

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[2]A number of these are considered in studies by Rasche (1986), Darby et. al. (1987), Hetzel (1987), Trehan and Walsh (1987) and Kretzmer and Porter (1987). The categories considered here are somewhat more general than those considered by Trehan and Walsh.

[3]See the appendix to Thornton (1983) for an illustration of the specification problem involved in finding the appropriate measure of "income."

[4]There are two distinct, though not mutually exclusive theories of the demand for money: the transactions approach and the asset approach. The asset approach emphasizes the role of money as an asset and, hence, as an alternative way of holding wealth. The transactions approach emphasizes the role of money as a medium of exchange. For a useful discussion of this distinction in relation to the velocity issue, see Spindt (1985).

[5]Radecki and Wenninger (1985).

[6]Rasche (1986) also rejects this explanation for much the same reason.
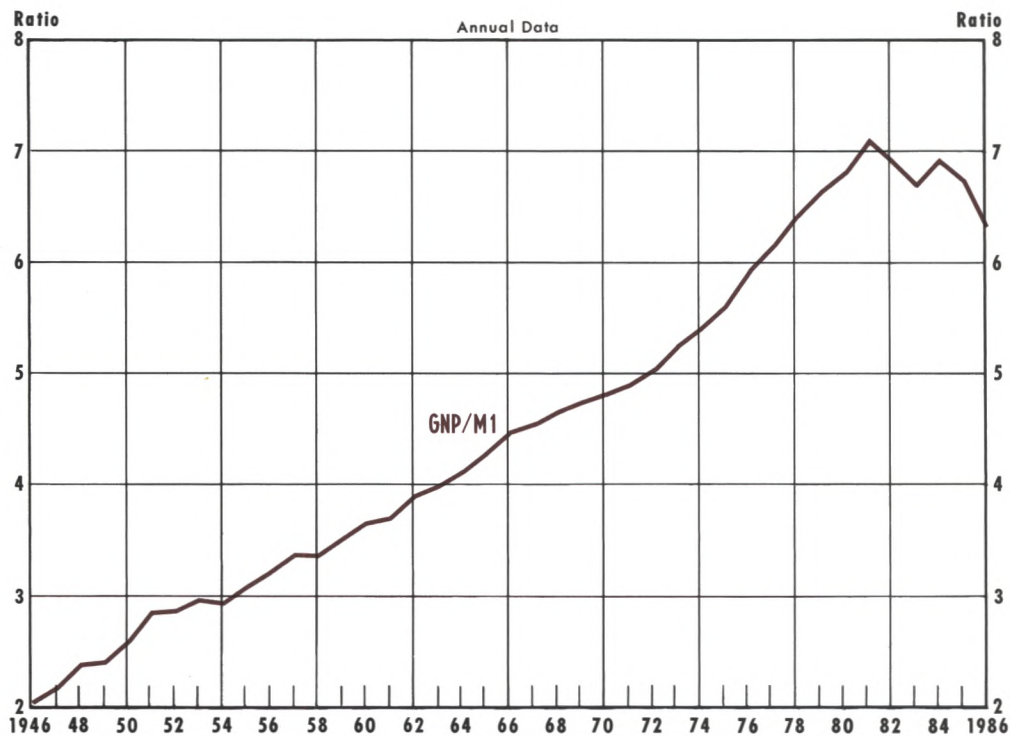
Chart 1
Velocity

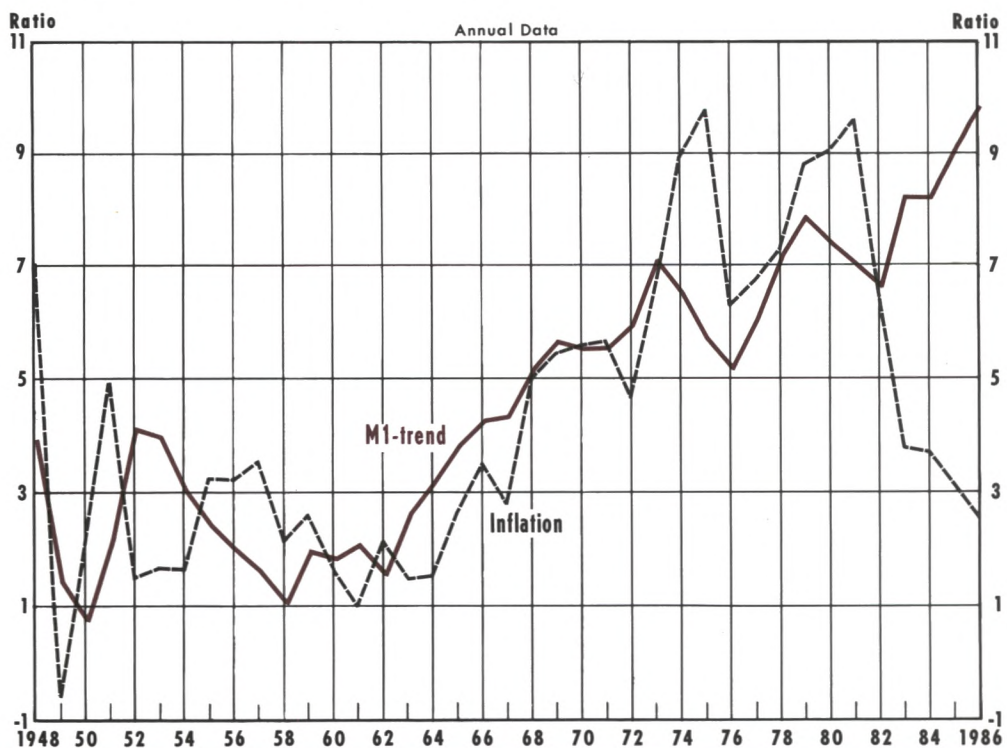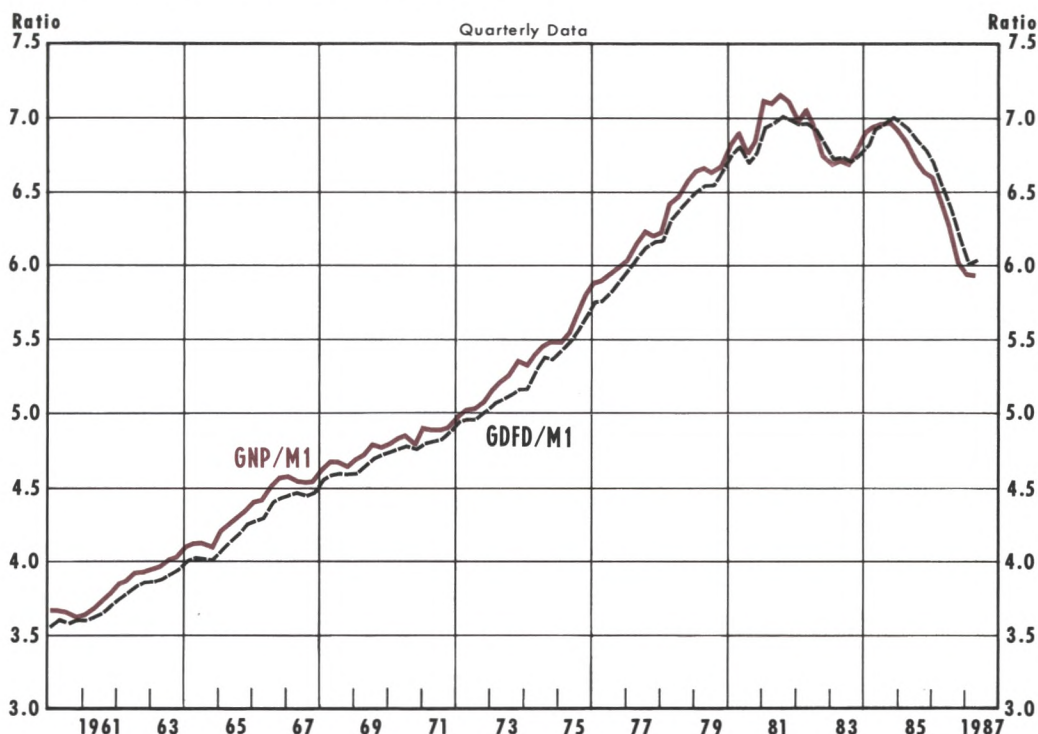Chart 2
Inflation and M1-Trend Growth

Chart 3
Velocities of GNP and GDFD

Recently, McGibany and Nourzad (1985) have of-fered another variant of the specification problem. They too argue that the demand for money is based on expenditures instead of current income or GNP. In their view, the 1980 tax cut initially increased disposable personal and business income relative to GNP and, hence, raised desired expenditures relative to GNP; consequently, the tax cut increased the demand for money, resulting in a fall in velocity.[7]

One way to evaluate this explanation is to look at the ratio of disposable personal income to GNP. If their explanation is valid, this ratio should increase when velocity is falling and decrease when velocity is rising. As chart 4 indicates, however, this has not generally happened during the 1980s. While there was an initial expansion in disposable income following the tax cut, the ratio of disposable income to GNP has generally declined since 1982.[8]

Others have argued that the recent velocity decline is related to a sharp rise in financial transactions relative to total output. According to this view, the rise in financial transactions caused an increase in the demand for money relative to GNP. One way to assess this claim is to compare velocity measures using broad measures of financial and non-financial transactions in place of GNP.[9] These alternatives are presented in chart 5. The non-financial transactions velocity measure shows the same pattern as the GNP velocity measure. Consequently, explanations of the velocity puzzle that rely on the recent slowing of GNP growth relative to the growth of more general non-financial transactions measures are implausible.

The financial transactions velocity measure does not show the downturn in the 1980s that characterizes the non-financial and GNP-based velocity measures. Nor, however, does it show substantial increases during the 1980s which would be required if the rise in financial transactions is to account for the decline in M1 velocity. In fact, the annual growth rate of the financial transactions velocity measure has averaged

[7]Recently, McGibany and Nourzad (1986) have provided estimates indicating that the demand for money is inversely related to the average tax rate.

[8]Rasche (forthcoming) rejects the tax cut hypothesis by arguing that, for it to explain the velocity decline, marginal tax rates would have had to have fallen continuously over the 1980s.

[9]These data were obtained from the Board of Governors of the Federal Reserve System.

Chart 4
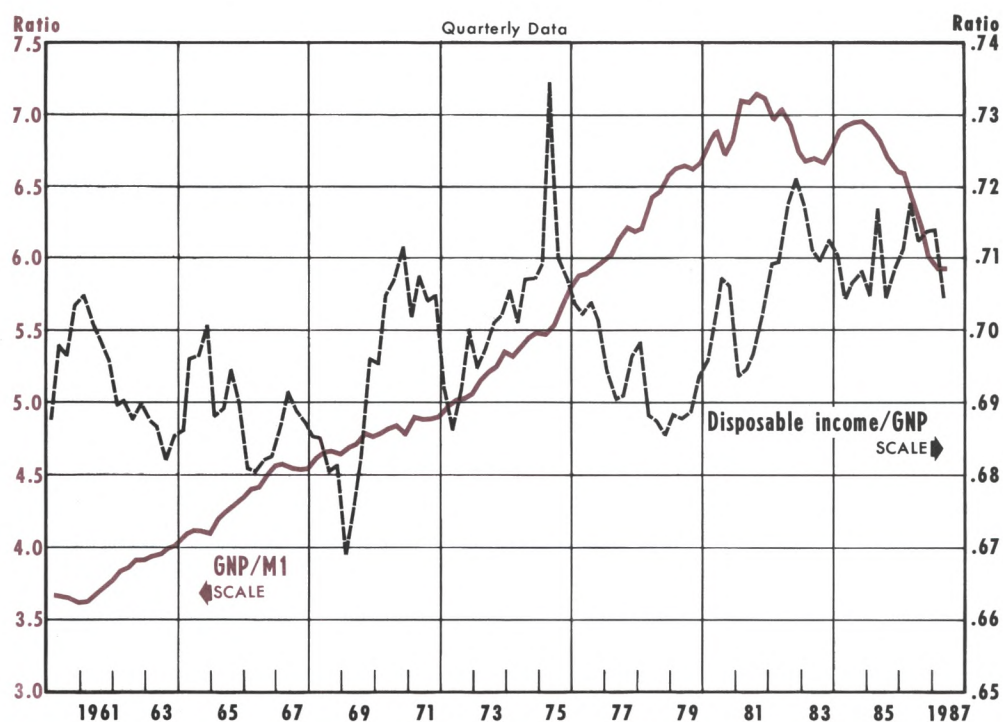## Ratios of GNP/M1 and Disposable Income/GNP

Chart 5
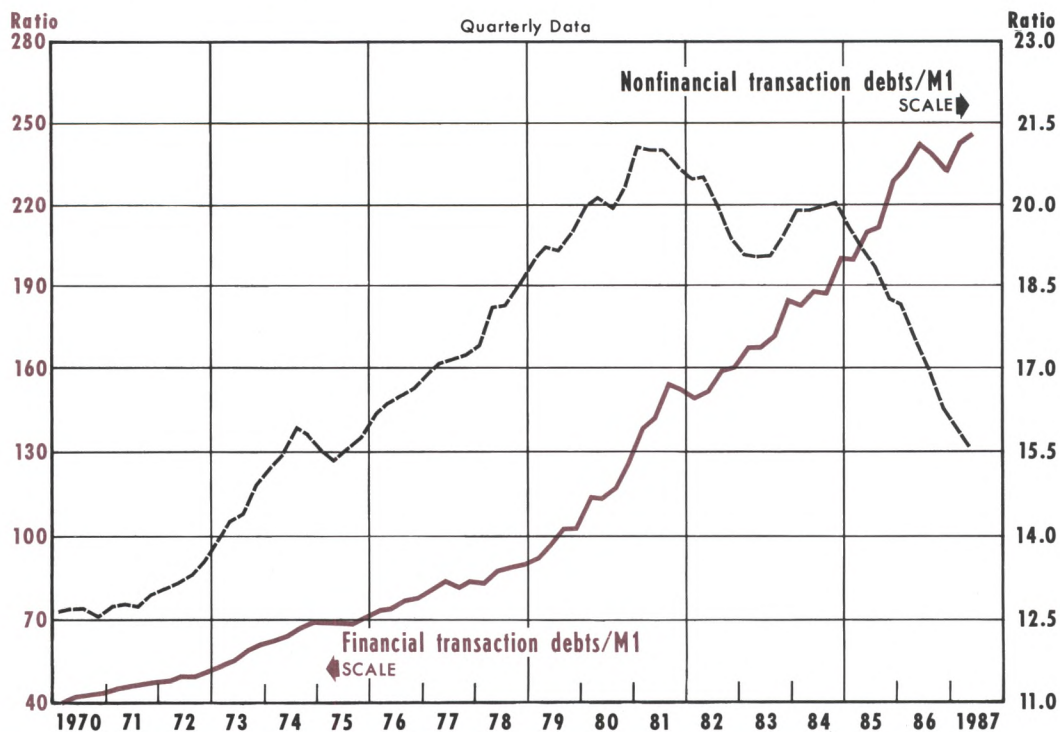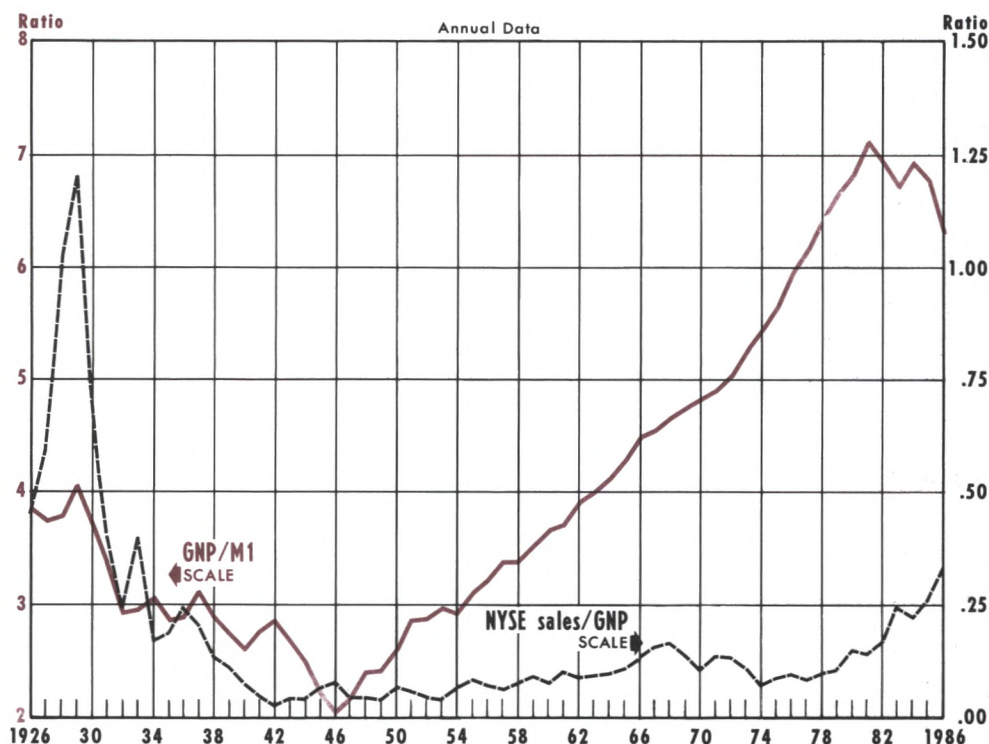## Velocities of Financial and Nonfinancial Transaction Debits

Chart 6
Ratios of GNP/M1 and NYSE/GNP

about 10 percent since 1981, somewhat below its 12 percent annual growth rate from 1970 to 1981. If this measure accurately represents total financial transactions, its velocity movement does not support the view that the velocity problem resulted from a shift from non-financial transactions to financial transactions.

A somewhat different way to assess whether a rise in financial transactions produced the fall in velocity is shown in chart 6; it compares the movement of velocity with that of the annual ratio of the value of shares sold on the New York Stock Exchange (NYSE) to GNP since 1926.[10] While the ratio of NYSE sales to GNP has risen somewhat during the 1980s, there has been no consistent relationship between this ratio and velocity over the past 60 years.

GNP Vs. Wealth

Another potential specification problem arises from the use of GNP to calculate velocity instead of using a

measure of "permanent income" or wealth. The permanent income theory of consumer demand suggests that individuals primarily base their consumption decisions on their permanent income or wealth, rather than on current income. Analogously, the demand for money may be more closely related to permanent income or wealth.[11] Panel A in figure 1 illustrates the theoretical relationship between permanent income and measured income during cyclical fluctuations. If the demand for money depends upon permanent income, it will fluctuate less than will current income over the business cycle. Thus, measured velocity will rise (fall) as measured income increases (decreases) relative to permanent income because the amount of money held will change less than measured income.

Chart 7 displays both the usual velocity measure and one based on permanent income estimates.[12] Once again, it does not appear that the velocity decline in the 1980s is explained by movements in cur-

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[10]It has been argued that the recent decline in velocity can be explained by the rise in stock market transactions, see Morgan Guarantee (1986).

[11]For example, see Friedman and Schwartz (1982, p. 38).

[12]The measure of permanent income used here was suggested by Darby (1972).

Figure 1
Cyclical Movement in Actual GNP and Measured Velocity and the Effect of a One-Time Increase in Permanent Income
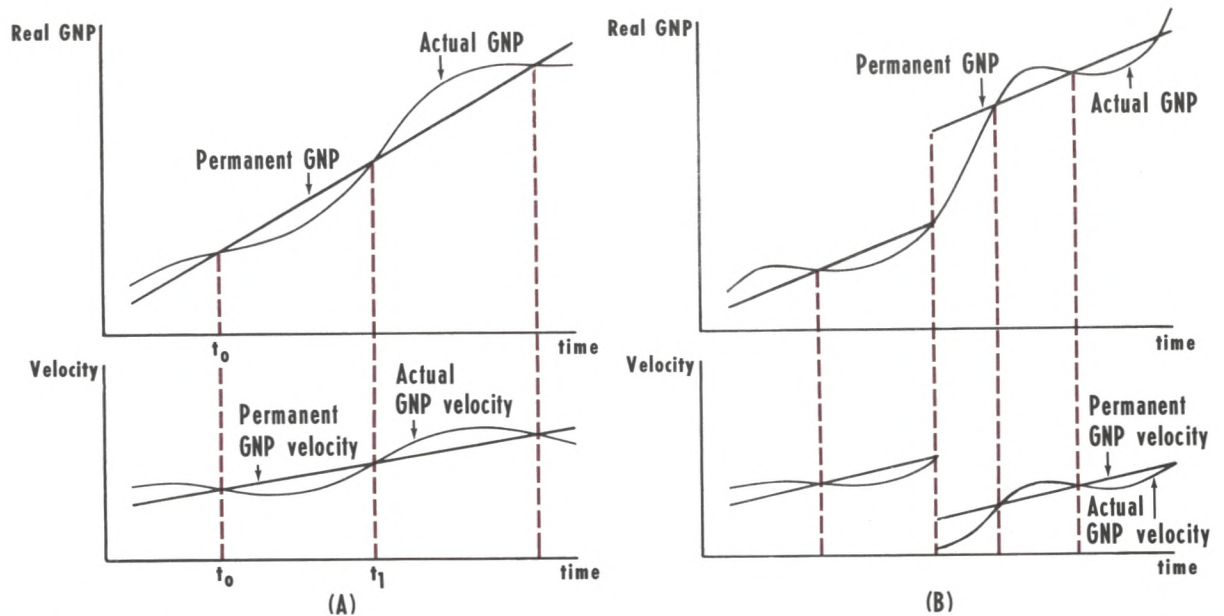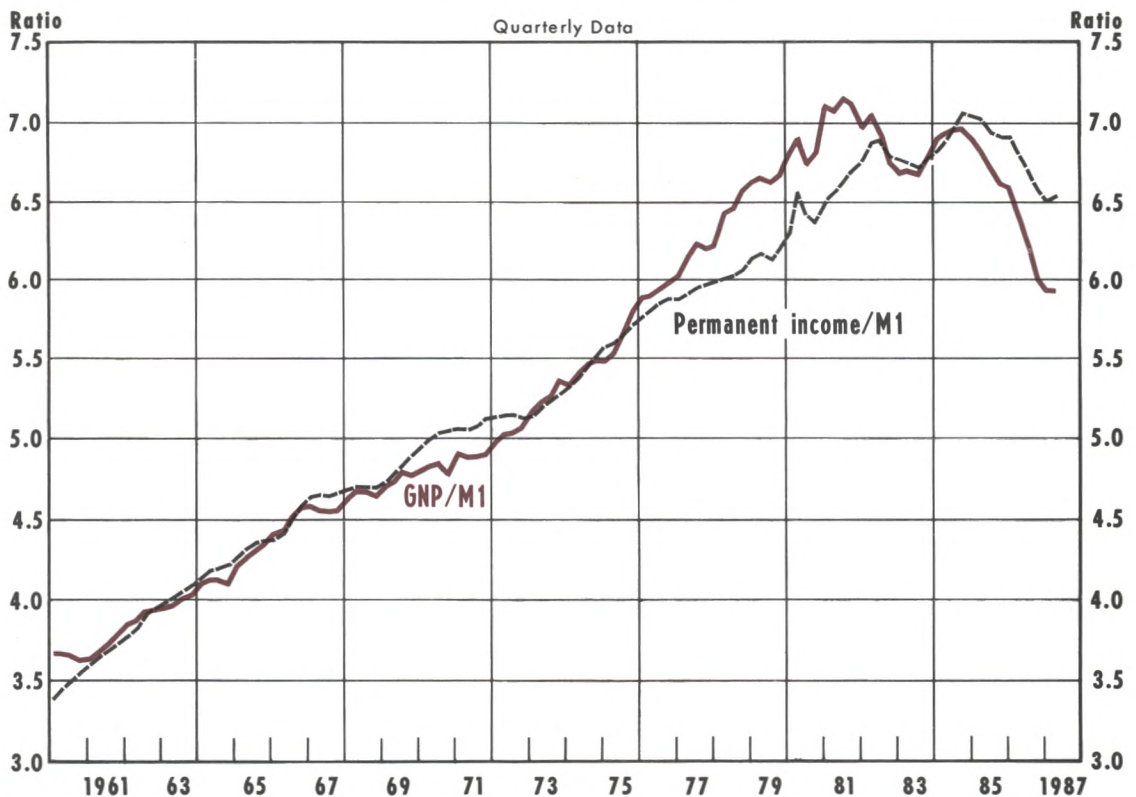

Chart 7
Velocities of GNP/M1 and Permanent Income/M1

rent relative to permanent income. Although the downturns in the permanent income velocity measure are less pronounced than those in the current income velocity measure, the general downward shift in velocity during the 1980s shows up clearly in the permanent income velocity measure.

There is an explanation consistent with the permanent income or wealth approach to the demand for money and the observed decline in the income velocity of money in recent years. Suppose that a rise in permanent income or wealth relative to current income produced a sharp rise in the demand for money.[13] In this event, depicted in panel B in figure 1, there would be an associated drop in current income velocity.

Because wealth is the present value of the expected future net income, it will increase either if expected income increases or the expected real interest rate used to discount future income declines. If there was a rise in expected income without a corresponding increase in measured income during the 1980s, velocity would have fallen as the demand for money increased relative to GNP. Eventually, measured income will rise or expected income will decline as individuals realize that their expectations will be unfulfilled.[14] Consequently, after sufficient time has elapsed, velocity will return to its former path.

If the rise in wealth is due solely to a sharp fall in society's preference for current relative to future consumption, however, the path of measured income would be unaffected and the level of velocity would be permanently below its former path. This possibility seems unlikely, because it implies a permanent fall in the real interest rate.[15]

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[13]Rasche (1986), Santoni (1987) and Kopcke (1986) also consider the wealth explanation. Though their approaches are different, both Rasche and Santoni reject the wealth explanation for the velocity puzzle. Kopcke, on the other hand, finds evidence to support it. His wealth measure, however, includes financial assets that have offsetting liabilities; consequently, at best, it represents a proxy for financial transactions.

[14]Since wealth is the discounted present value of the stream of expected future income, an exogenous increase in wealth relative to current income can result only from a fall in the "real" interest rate or an increase in the expected future income stream. If these latter expectations are correct, measured income will eventually increase, and velocity will eventually return to its long-run level as either the nominal money stock expands or the price level falls. If the expectations prove to be wrong, this too will be discovered and velocity will rise subsequently.

[15]The permanent fall in the real interest rate necessary to explain the fall in velocity is inconsistent with recent estimates of the *ex ante* real interest rates during the 1980s. See Holland (1984).

Potential Problems with Using M1

Some have suggested that using M1 as the money stock measure when calculating velocity causes significant problems. They argue that the relevant monetary measure cannot be obtained simply by adding together the stocks of various "monetary" assets (currency, checkable deposits, and so on), because each component may provide different quantities of monetary services per unit. Consequently, critics have suggested that an index of the monetary "services" provided by the stock of all relevant financial assets is preferable to the use of M1 for evaluating the relationship between money and spending or prices.[16] If this criticism is valid, changes in "simple-sum" monetary aggregates like M1 and M2 may deviate markedly from changes in their underlying monetary services whenever substantial shifts among various monetary assets occur. In such cases, the usual measure of velocity may show sizable variations, while those based on the underlying monetary services measures should be relatively stable.[17]

Various monetary services indices (MSI) and the MQ measure have been developed; they are currently compiled and maintained by the Federal Reserve Board on an experimental basis.[18] The MSI1 measure is an index of the monetary services associated with components of the M1 money stock. The MQ measure is an index of all financial assets that can be directly used in transactions; it incorporates the components of M1 plus telephone transfers, money market mutual fund balances and money market deposit accounts. Chart 8 shows velocity measures based on the MSI1 and MQ.[19] These velocity measures show the same general pattern for recent years as the usual M1 velocity measure. Similar results hold for broader monetary services indices. Consequently, despite their theoretical appeal, substituting monetary service flows for M1 in measures of velocity does not explain the recent behavior of velocity.[20]

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[16]See Batten and Thornton (1985) for a discussion of these issues.

[17]This need not be the case, however. See Milbourne (1986).

[18]The monetary services indices originally were called Divisia monetary aggregates; they were developed by William Barnett (1980). The MQ measure was developed by Paul Spindt (1985). The current monetary services indices differ from the original Divisia measures in several respects; see Farr and Johnson (1985).

[19]These alternative money measures are only available since I/1970.

[20]This interpretation is invariant to alternative measures of income (permanent income or GDFD).

Chart 8
Velocities of Monetary Indexes MQ, MSI 1 and M1

NOTE: Data normalized first quarter 1970=1.
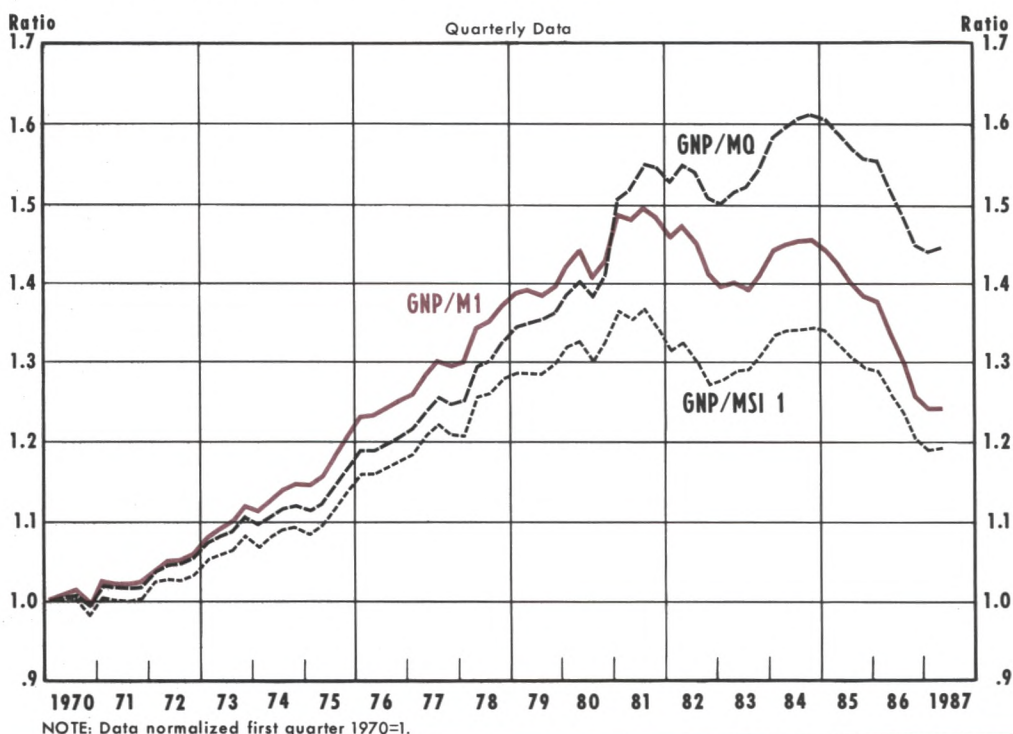
STRUCTURAL SHIFTS AND THE VELOCITY PUZZLE

Some analysts have suggested that there have been one or more structural shifts in the money/income relationship. Unlike the specification problems previously discussed, this explanation presumes that the fundamental relationship between money and income has changed even if the demand for money is correctly specified in terms of M1 and GNP.[21] (For a different structural shift argument, see shaded insert on the opposite page.

Financial Innovation and Deregulation

Several analysts have suggested that the introduction of NOWs, Super NOWs and money market deposit accounts (MMDAs) and the removal of regulation Q interest rate ceilings in recent years have produced a shift in the relationships between M1 and both spending and inflation. In particular, the redefinition of M1 to include interest-bearing checkable deposits (NOWs and Super NOWs) as well as non-interest-bearing demand deposits and currency is alleged to have altered significantly its "moneyness;" now M1 is presumed to include a significant amount of savings balances.[22] Consequently, changes in M1 resulting from changes in these savings balances are likely to have a smaller

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[21]One structural shift argument not considered explicitly in the text was presented recently by Roley (1985). He suggested that the velocity puzzle of the 1980s was actually caused by the well-documented, albeit still unexplained, structural shift in the demand for money that took place in 1974. He argues that the downward shift in velocity in the 1982–83 period is consistent with the behavior of M1 velocity from 1974 through 1981; it is inconsistent, however, with M1 velocity before 1974. Roley's observation does not solve the velocity puzzle — although about 13 years have passed, we still don't know why money demand shifted in the mid-1970s.

Furthermore, if his suggestion were valid, the mid-1970s' velocity increase should have been as dramatic as its drop in the 1980s. A glance at chart 1 shows that this is not the case. Moreover, Roley's M1 series was derived from the flow of funds accounts. When conventional money stock and money demand equations are used instead, his results are not confirmed.

[22]The reader should note the similarity between this and the specification problem. The argument here is that savings balances are now effectively hidden among transactions balances so that a given level of interest-bearing checking account balances effectively can represent different amounts of "transactions money." This is a specification problem, and results from a fundamental change in the institutional structure.

A Time Series Explanation of the Velocity Puzzle

Some analysts have argued that the decline in velocity can be explained by analyzing the statistical properties of economic time-series data. To understand this explanation for the seemingly abrupt change in velocity in recent years requires a brief discussion of the time series properties of economic variables.

The time series properties of a variable describe how it behaves over time. A variable that tends to return to its mean (average) level through time is said to be "stationary." Many economic time series are not stationary in this sense; instead, they show positive or negative growth over time. Time series that display such growth patterns are often said to be "trend stationary" and many economic series, including GNP, prices, the money stock and velocity, have long been viewed as trend stationary, or TS processes.

In addition to the TS process, there is an alternative stationary time series process that describes variables whose first- or higher-order *differences* are stationary; these are called "difference stationary (DS) processes." The simplest DS process is the well-known random walk. Unlike TS variables, a variable whose behavior fits the random walk has no trend to which it returns as it moves over time.[1]

Recently, Nelson and Plosser (1982) and Haraf (1986) have concluded that velocity is better represented by the DS than the TS model. According to this view, the recent change in velocity could have been produced by a large shock that caused velocity to wander off in a new direction; the probability it will wander back is very small.

As Rasche (1986), McCallum (1986) and others have pointed out, however, it is extremely difficult to determine whether velocity is a TS or DS process; the test used to discriminate between the competing representations is not powerful when used on time series data like velocity. Consequently, there can be reasonable disagreement about which representation is more accurate.

Unfortunately, knowing whether velocity is better characterized by a TS or DS process does not tell us what we would like to know. Suppose velocity has a DS time series. While this might indicate that an unusually large shock caused velocity to wander off in a new direction in recent years, it leaves a more interesting and more important longer-run velocity puzzle: Why was velocity's growth rate stable for the past 30 years? Is it plausible that, for such a long period, there were no shocks large enough to make velocity walk away from its apparent trend before 1982? Moreover, and more importantly, what economic factors determine velocity's DS process and what was the nature of the shock that caused velocity to walk off in a new direction? Even if economists could be completely certain about the time series process that generates velocity, these fundamental economic questions would remain.

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[1]A random walk may be said to drift; however, this drift parameter is not related to time as it would be in a trend stationary process.

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impact on output and prices than previously.[23] Specifically, there may be extended periods when significant increases in M1 produce little or no associated growth in spending or inflation; on these occasions, velocity would decline substantially.[24] Moreover, if the savings portion of M1 is related to GNP differently than its transaction components, the relationship between the growth rates of M1 and GNP may be permanently altered.

These savings balances appear only in the "other checkable deposits" (OCD) component of M1. Thus, the validity of this explanation can be examined by comparing the behavior of velocity measures using M1A (which consists of currency and non-interest-bearing checkable deposits) or currency alone with that of the M1 velocity measure during the 1980s. By increasing the cost of holding currency and demand deposits, the introduction of interest-bearing checkable deposits (NOWs and Super NOWs) should have induced a relative shift from demand deposits and currency into these new accounts; this, in turn, should produce a significant rise in currency and M1A velocity measures. Once individuals' portfolios are

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[23]From another perspective, the growth rate of old M2 velocity had a trend growth rate of zero; see Ott (1982). Some have argued that new M1 is close to old M2 — old M1 plus time and savings deposits, so perhaps the trend growth rate of its velocity, too, will be about zero. While the period since 1981 is too short to establish a trend, the growth rate of the new M1 velocity over this period has been about −2.4 percent.

[24]While the experimental monetary aggregates should reduce or eliminate such problems, this does not seem to be the case. See Batten and Thornton (1985, pp. 32–33) for a discussion of this point.

Chart 9
Velocities of GNP/M1 and GNP/M1A
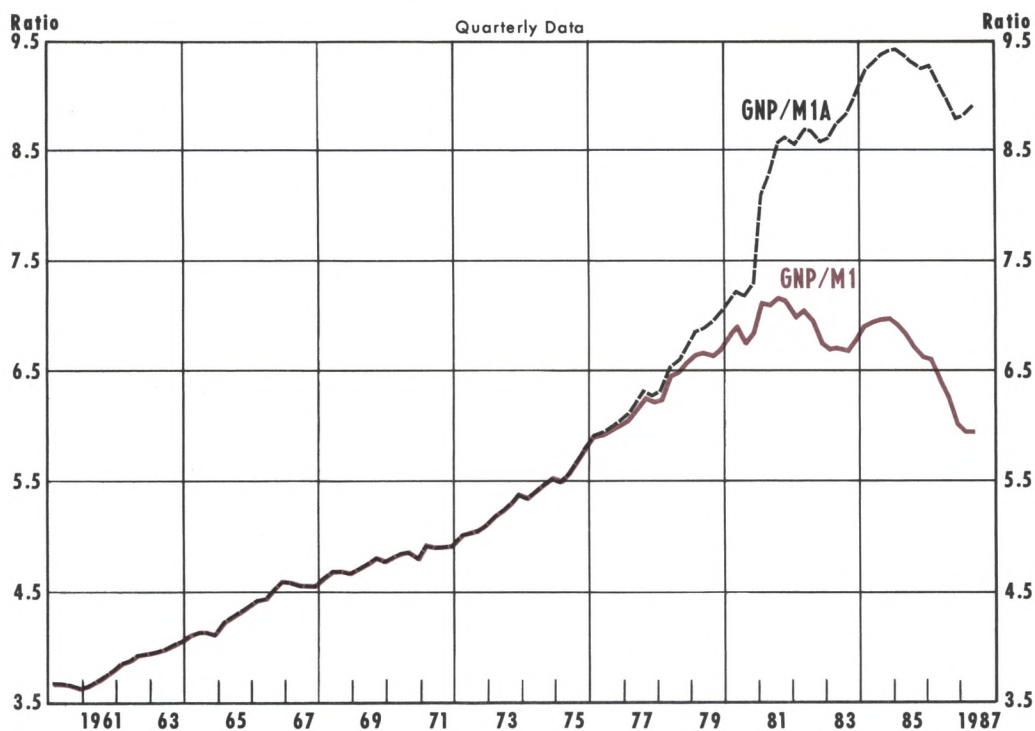
realigned, however, the prior currency and M1A veloc-ity relationships should be restored.

Charts 9 and 10 show the M1A- and currency-velocity measures. The M1A-velocity measure and, to a lesser extent, the currency-velocity measure rose sharply in the first quarter of 1981 when NOWs were introduced nationwide. Contrary to this structural shift explanation, however, both measures subse-quently declined.[25]

Another explanation for the change in M1 velocity is an increased responsiveness of various M1 compo-nents to changes in the interest rate. According to this explanation, the financial innovations of the 1980s did not necessarily cause a downward shift in velocity due to a shift of savings balances into transactions ac-counts; instead, they altered the sensitivity of M1 bal-ances to interest rates. Since the demand for money is inversely related to the interest rate, a decline in the

interest rate will cause the demand for money to rise relative to GNP and, hence, velocity will decline.

The theoretical basis for this argument stems from basic consumer demand theory, which argues that the responsiveness of the demand for a commodity to changes in its price increases with the number and closeness of substitute goods. The financial innova-tions of the 1980s produced new and close substitutes for traditional demand deposit and currency compo-nents of M1. While the interest rate is not the price of money, it represents a significant opportunity cost for holding it. Consequently, the financial innovations of the 1980s should have increased the responsiveness of some of the components of M1 to changes in the interest rate. The "other-checkable-deposit" compo-nent of M1 bears interest, and the interest rate paid on these deposits is now free to change with market rates.[26] Consequently, this component of M1 should be

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[25]This is the basis for Rasche's (1986) rejection of this explanation. The introduction of these new accounts, however, may have increased the interest elasticity of the demand for the M1A components.

[26]Businesses cannot hold interest-bearing checking accounts. See Gilbert and Holland (1984) for a summary of the major innovations and deregulations of the 1980s. Also, the currency component of M1 generally is more closely tied to real income than to interest rate movements.

Chart 10
Velocities of GNP/M1 and GNP/Currency
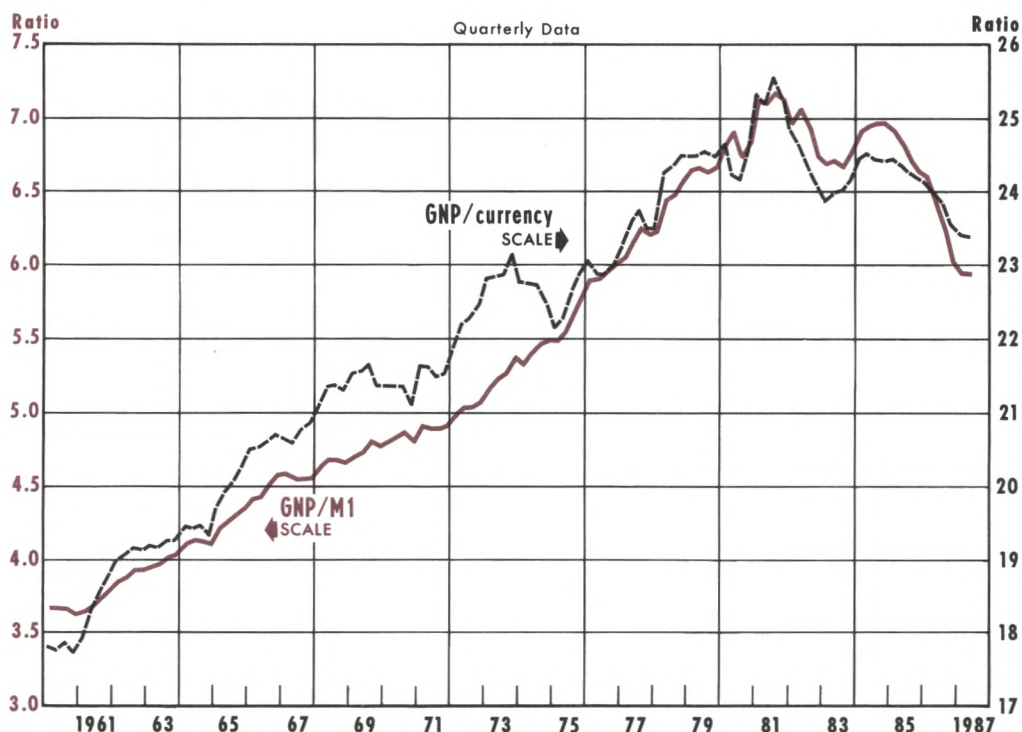
relatively unresponsive to interest rate movements. This could be mitigated by the fact that rates on these deposits appear to have been slow to adjust to changes in other market interest rates.

This view suggests that the relationship between velocity and interest rates should have strengthened since the financial innovations of the 1980s. Indeed, this pattern is reflected in Chart 11, which shows M1 velocity and the three-month Treasury bill rate. Prior to 1981, velocity appears to be unrelated to movements in the T-bill rate. Since 1981, however, the two have similar patterns. This is consistent with a number of studies which report an increased interest sensitivity of M1 balances during the 1980s.[27] (Additional analysis is provided in the appendix.) It remains to be seen whether the apparent change in M1's interest sensitivity alone can account for the aberrant behavior of M1 velocity.

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[27]For example, Hetzel (1987), Trehan and Walsh (1987) and Rasche (1986). Rasche reports mixed results and concludes that this argument needs further study and analysis.

CYCLICAL EXPLANATIONS OF THE VELOCITY PUZZLE

Until now, we have assumed implicitly that the supply of money passively expands to meet society's demand. Another interpretation argues that substantial exogenous changes in the supply of M1 can induce cyclical swings in measured velocity because of their lagged effect on the economy. For example, an acceleration in the growth rate of M1 initially may produce a less than proportionate rise in the level of nominal GNP, and, thus, an initial decline in velocity. Eventually, however, when the monetary change has worked its way throughout the economy fully, the longer-run relationship between M1 growth and the rate of spending is reestablished, and velocity returns to its long-run path.

This analysis can explain a continuous fall in velocity relative to its underlying trend only if M1 growth is continuously accelerating. The "ever-and-ever-faster M1 growth" explanation for the velocity decline in the

Chart 11

Velocity of GNP/M1 and the Three-Month Treasury Bill Rate
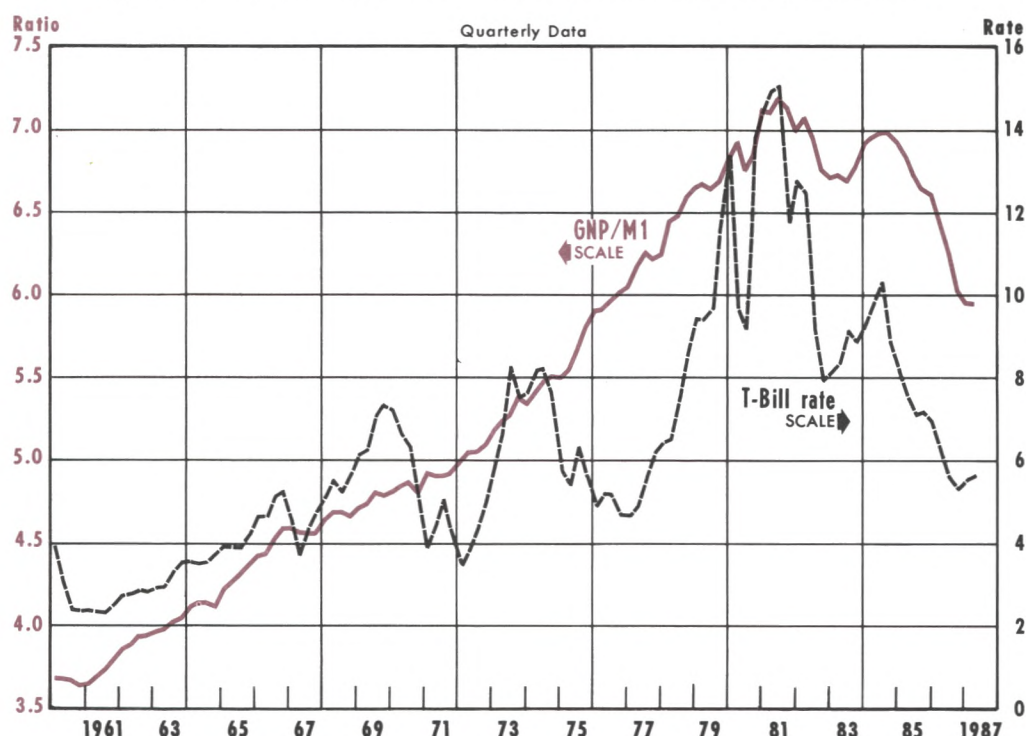
1980s is examined in chart 12. Although money growth has been rapid since 1982, it does not appear to have been accelerating fast enough relative to previous years to produce the recent sharp decline in velocity.[28]

Expected Inflation and Velocity

Another explanation is that velocity's recent behavior results from changes in the public's expectations of inflation. According to this view, the demand for money is inversely related to the expected rate of inflation. Thus, when inflation (and presumably inflationary expectations as well) is declining, the demand for money should rise, and the velocity of money should fall. Since the nominal interest rate can be thought of as composed of the real rate plus a premium for the expected rate of inflation, this explanation is closely aligned to the interest sensitivity argument. The principal difference between them is that proponents of the expected-inflation explanation do not argue that the relationship has undergone a structural change.[29] Judd (1983), Tatom (1983a, 1983b) and Friedman (1983) have argued that the decline in velocity in the 1981–83 period can be attributed primarily to disinflation and the associated decline in market interest rates that substantially lowered the opportunity costs of holding money relative to GNP.

In one sense, this explanation is specious or, at the very least, suspicious if extended to velocity movements in more recent years. If inflationary expecta-

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[28]There is a 4 percentage point spread between peak trend-M1 growth in the 1980s and the late 1970s. Hence, even if there were no nominal output response to the more rapid M1 growth over the entire period, the acceleration in M1 growth, at most, could account for a 4 percentage point decline in trend velocity growth; that is, from about 3 percent to about −1 percent. In addition, this explanation implies a significant lengthening in the estimated lag on money growth in the St. Louis equation during the 1980s, which has not been confirmed.

Another cyclical explanation not considered explicitly in the text has been suggested by Friedman (1983), Mascaro and Meltzer (1983) and Tatom (1983a, 1983b); in their view, an important influence on the demand for money is monetary uncertainty. Suppose that people increase their money holdings relative to their current income when they become more uncertain about their future incomes. If monetary uncertainty increased sufficiently in recent years, this could explain the velocity puzzle.

[29]The expected rate of inflation also could have an independent effect on the demand for money, e.g., $m^d = f(i, \pi^e)$, where π^e is the expected rate of inflation. This issue has not been resolved.

Chart 12
Short-Run and Trend Growth of M1
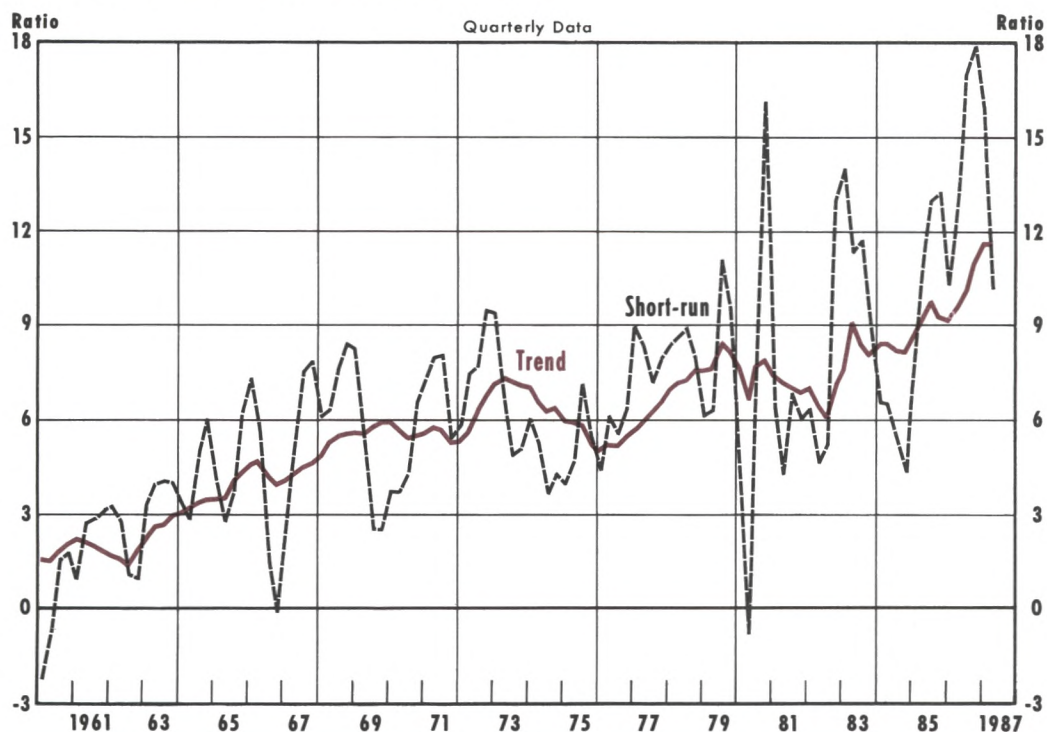
tions have fallen over the past five years, they must have done so for *non-monetary* reasons; as chart 2 shows, trend M1 growth has risen rapidly since 1983. These non-monetary factors must have been sufficiently powerful to have swamped the usual influence that rapid trend money growth has on inflation and inflationary expectations.

Furthermore, if disinflation and declining nominal interest rates caused velocity to decline, then, by the same argument, velocity should have risen sharply when inflation accelerated and nominal interest rates rose during the 1970s. Unfortunately, this is not the case. Chart 13 shows M1-velocity and the *ex post* inflation rate. While velocity moves with the inflation rate after 1981, it does not appear to be affected substantially by the inflation rate over the pre-financial-innovations period. Velocity growth during the 1970s is not rapid enough to support this explanation.

Hetzel and Mehra (1985) suggest that the demand for money balances varies positively with the real value of the dollar in foreign exchange markets. Their explanation is based on the currency-substitution hypothesis, which states that different currencies are close substitutes for each other. In this explanation,

the rise in the real exchange value of the dollar during the early 1980s made holding dollars relatively more attractive, increasing the demand for money relative to income and reducing velocity.[30] Since the real exchange value of the dollar has generally moved with changes in the U.S. inflation rate, this argument is closely related to the inflation argument.

This explanation is examined in chart 14, which shows the movements in velocity and the nominal trade-weighted exchange rate since 1973. The nominal rather than the real exchange rate is used for two reasons. First, movements in the nominal exchange rate are more appropriate in assessing the relative returns on two different monies. Second, movements in the nominal and real trade-weighted exchange rates have been highly correlated since 1973. Thus, the

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[30]This argument does not seem firmly based in either the transactions or asset approaches to the demand for money. Except for some border situations, there is very limited substitutability between two currencies for transactions purposes. On the other hand, money balances, even interest-bearing checking accounts, are dominated on a risk-adjusted return criterion by other non-money assets. Consequently, it is unlikely that foreign money is held as an asset in portfolios.
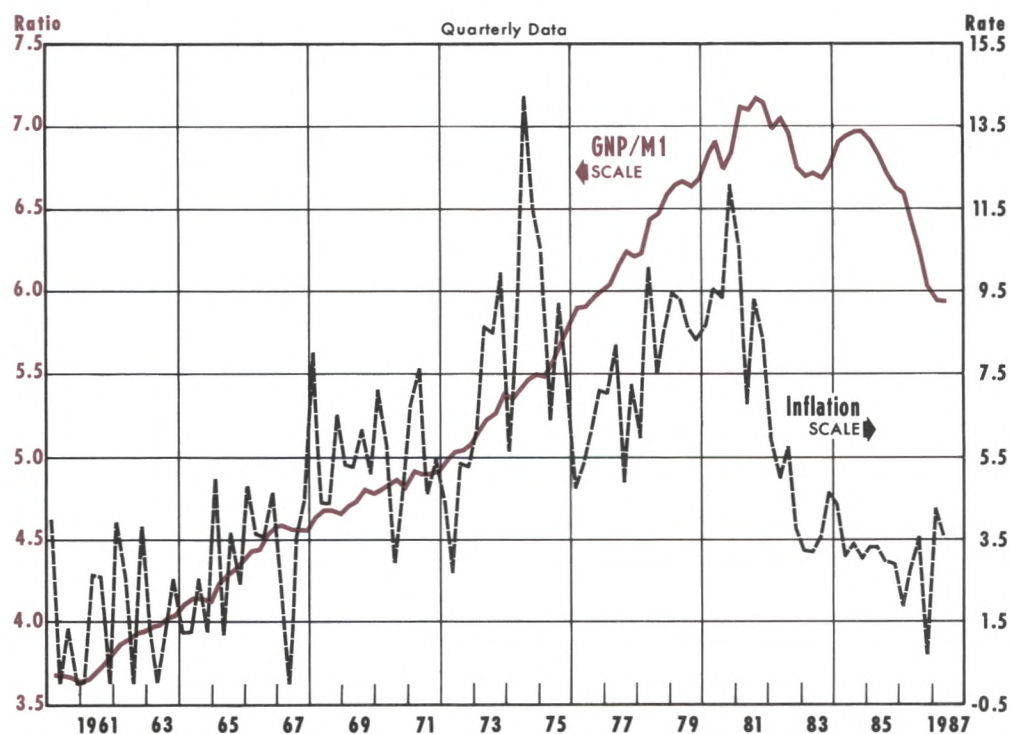
Chart 13

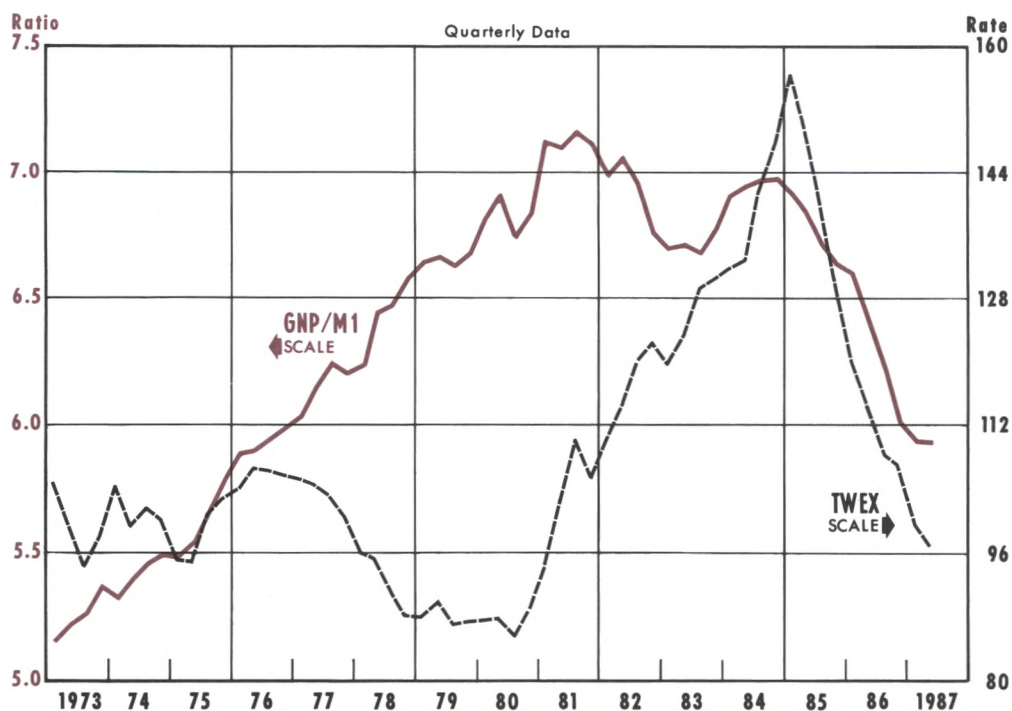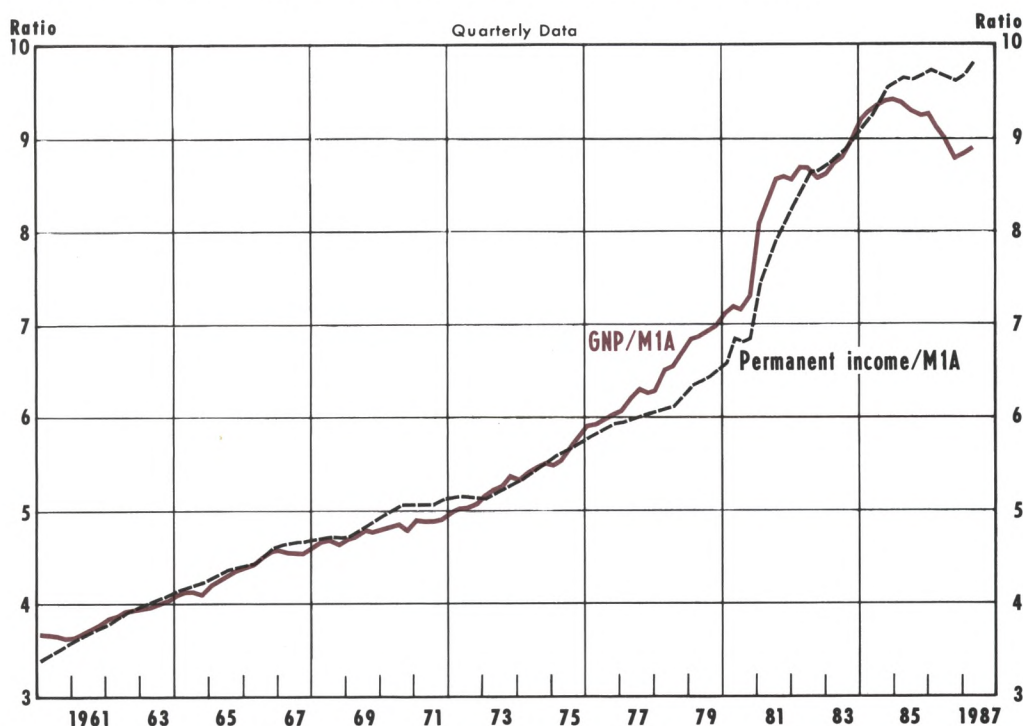## Velocity of GNP/M1 and Inflation

Chart 14

Velocity of GNP/M1 and Trade-Weighted Exchange Rate

Chart 15
Velocities of GNP/M1A and Permanent Income/M1A

general pattern of exchange rate movements is the same whether the nominal or real exchange rate is used.

Chart 14 shows that the exchange rate explanation does not provide a satisfactory answer to the velocity puzzle. From 1973 to 1981, exchange rate movements appear to have no influence on velocity. While velocity did decline from 1981 to 1983, when the exchange rate was rising, it also fell sharply in 1985 and 1986 when the exchange rate was plummeting.

TWO EXPLANATIONS MAY BE BETTER THAN ONE

Darby, Mascaro and Marlow (1987) have recently suggested that the velocity puzzle of the 1980s is a product of financial innovation *and* cyclical effects in measured velocity. Incorporating both effects, chart 15 compares the usual velocity measure with a measure derived by dividing permanent income by M1A. There is a sharp rise in the permanent income/M1A velocity measure beginning with the nationwide introduction of NOW accounts. The movement in this measure

following that event is consistent with a gradual adjustment to the initial and subsequent innovations that increased the cost of holding M1A, such as the introduction of Super NOWs in January 1984 and the reduction of the minimum balance requirements on these accounts in January 1985.

The permanent income/M1A velocity measure, unlike virtually all velocity measures shown in the previous charts, does not decline during the bulk of the 1980s. This measure does not decline until the last three quarters of 1986; however, it turns up again during the first half of 1987. Darby, Mascaro and Marlow suggest that the 1986 decline can be explained by the extremely rapid M1A growth during the last three quarters of the year. Consequently, a combination of the effects of financial innovations, cyclical movements in GNP and sharp acceleration in M1A growth could account for much of the velocity puzzle of the 1980s.

SUMMARY AND CONCLUSIONS

This article reviews a number of suggested explanations of the puzzling downturn in M1 velocity during

the 1980s and attempts to assess the credibility of each. Alone, none of these explanations can account for the behavior of M1 velocity. Perhaps, instead, several influences have combined to produce the anomalous velocity behavior that has puzzled many researchers.

If there are several influences at work, financial innovations and cyclical variations in measured income seem to be among the best candidates. This combination works well in explaining the velocity puzzle through the first quarter of 1986. When combined with cyclical variation in velocity induced by rapid money growth, it may explain the behavior of velocity through last year. Another explanation that deserves further scrutiny is the possible increased interest sensitivity of M1 balances as a result of monetary innovations during the 1980s.

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Appendix

To examine whether velocity has become more interest sensitive in the 1980s, the growth rate of M1 velocity was regressed on distributed lags of its own past growth rate and changes in the three-month Treasury bill rate for three alternative periods from I/1960 to II/1987. The results are presented in table 1. The lag length was determined separately for each period using the final prediction error criterion; see Thornton and Batten (1985). The maximum lag length considered was 12 for the two longer periods and four for the shorter one. The pre-1980 results indicate that neither its own past growth nor that of short-term interest rates significantly influenced M1 velocity growth. The lag lengths selected were zero for velocity growth and the contemporaneous and first lag for the change in the Treasury bill rate. However, even though the lag coefficient on the change in the T-bill rate is both positive as expected and statistically significant at the 5 percent level, the hypothesis that the contemporaneous and lag coefficients are jointly insignificant cannot be rejected at the 5 percent level.

A considerably different result emerges when the regression is extended to include the 1980s. The lag-length selection procedure now chose a sixth-order lag for velocity growth and a fourth-order lag for the change in the T-bill rate. Moreover, the hypothesis that these coefficients are jointly insignificant is rejected at the 5 percent level; contemporaneous and past changes in the Treasury bill rate exert a significant influence on current M1 velocity growth.

When the equation is estimated only for the period of the 1980s, there is again evidence of a statistically significant effect of interest rates on M1 velocity. Indeed, the sum of the distributed lag coefficients on the Treasury-bill rate is positive and significant, indicating a longer-run positive relationship between M1 velocity and interest rates that does not appear to have existed in the prior period. Hence, these results are consistent with the hypothesis that the interest sensitivity of M1 balances changed significantly following the monetary deregulation and financial innovations of the 1980s. It will take more research, however, to determine how much of the velocity puzzle can be attributed to this factor.

Table 1

Estimates of a Velocity Growth Rate Equation[1]

	I/1960–IV/1979	I/1960–II/1987	I/1980–II/1987
Intercept	3.138* (7.36)	0.378 (0.71)	−0.217 (0.31)
VDOT-1		0.262* (2.70)	0.512* (3.07)
VDOT-2		−0.019 (0.20)	
VDOT-3		0.132 (1.32)	
VDOT-4		0.214* (2.34)	
VDOT-5		−0.095 (1.06)	
VDOT-6		0.202* (2.31)	
ΔTBR-0	−0.025 (0.04)	0.740 (1.58)	0.889 (1.73)
ΔTBR-1	1.579* (2.07)	2.999* (6.16)	3.066* (5.88)
ΔTBR-2		−1.354* (2.28)	−1.775* (2.35)
ΔTBR-3		0.774 (1.35)	0.806 (1.65)
ΔTBR-4		−1.117* (2.01)	
ΣΔTBR	1.554 (1.80)	2.041 (1.83)	2.987* (2.25)
$\bar{R}^2$	0.033	0.418	0.711
SEE	3.759	4.014	3.747
F-VDOT	—	4.204*	9.437*
F-TBR	2.359	11.315*	15.710*
DW	1.998	2.029	2.096

[1] | t | statistics in parentheses.
*Indicates statistical significance at the 5 percent level.

A Revision in the Monetary Base

R. Alton Gilbert

THE Monetary Control Act of 1980 mandated a substantial change in the structure of reserve requirements faced by depository institutions. The reserve requirement structure was phased in over a seven-year period from November 1980 to September 1987.

The adjusted monetary base, a measure of the Federal Reserve's influence on the money stock, has been revised to reflect this new structure. This article explains why the base series was revised and describes the difference between the previous and revised series.

THE ADJUSTED MONETARY BASE: PURPOSE AND COMPOSITION

The adjusted monetary base (AMB) is designed to be a single measure of all Federal Reserve actions that influence the money stock, including changes in reserve requirements. It is equal to the source base plus the reserve adjustment magnitude (RAM).

The source base consists of total currency outstanding (held by the public and in the vaults of depository institutions) plus the reserve balances of depository institutions at Federal Reserve Banks.[1] The level of the money stock (currency in the hands of the public plus checkable deposits) that can be supported with a given level of the source base depends on reserve requirements. If required reserve ratios are reduced,

for example, a given level of the source base can support a higher level of the money stock.

RAM is specified in terms of the reserve requirements in effect in a base period. It equals the reserves that would be required (given current deposit liabilities) if the reserve requirements of a base period were in effect minus the reserves that are actually required. RAM rises (falls) if reserve requirements are lowered (raised). Including RAM in the AMB removes the effects of reserve requirement changes from the relationship between the money stock and the AMB, even though such changes affect the relationship between the money stock and the source base.

THE IMPLICATIONS OF RESERVE ACCOUNTING FOR AN APPROPRIATE MEASURE OF RAM

The money stock is the product of the monetary base multiplier and the AMB. The issues involved in developing an appropriate measure of RAM can be analyzed in terms of the determinants of the monetary base multiplier. This section discusses the relationships between the structure of reserve requirements, the equations for measuring RAM, and the determinants of the AMB multiplier. The appendix presents the specific equations used for measuring RAM and derives the determinants of the AMB multiplier associated with each specification.

The AMB measures all three policy actions that influence money growth: open market operations, discount window lending and changes in reserve requirements. The monetary base multiplier reflects the effects that choices of both depository institutions and the public have on the money stock. The determinants

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[1]Reserve balances of depository institutions included in the source base are net of required clearing balances and balances held to compensate for float.

of the multiplier include the ratio of currency in the hands of the public to checkable deposits, the composition of deposits and the excess reserves held by depository institutions.

These determinants depend on how RAM is measured. The appropriate specification of RAM, in turn, depends on the structure of reserve accounting in effect. This principle can be illustrated for two features of reserve accounting: the reserve requirements of members and nonmembers and those on time and savings deposits.

Prior to 1980, only banks that were members of the Federal Reserve were subject to the Fed's reserve requirements; nonmember institutions were exempt from these requirements.[2] Thus, shifts of deposits between members and nonmembers affected the level of deposits that could be supported by a given level of bank reserves. Also, since there were reserve requirements on the time and savings deposits of member banks, shifts of deposits between demand deposits and time and savings deposits at member banks affected the amount of checkable deposits that could be supported by a given level of bank reserves. Because these deposit shifts represented the public's rather than the Federal Reserve's actions, the AMB series was constructed so that the deposit shifts affected the AMB multiplier; the effects of these shifts are demonstrated algebraically in the appendix. This AMB series was appropriate for periods before 1980.[3]

The Monetary Control Act of 1980, however, imposed identical reserve requirements on both member and nonmember institutions. With the new structure of reserve requirements fully phased in, as of September 1987, a deposit shift between members and non-

members no longer affects the amount of checkable deposits that can be supported with a given amount of reserves.[4] Maintaining the old RAM measure would continue to make the money multiplier a function of the distribution of deposits between member and nonmember institutions; this distinction, however, has no relevance under the current system of reserve accounting. Thus, the current measure of RAM must be changed to make the AMB multiplier invariant to these deposit shifts.

Under the new structure, the only categories of time and savings deposits subject to positive reserve requirements are Eurodollar liabilities and nonpersonal time and savings deposits with initial maturities of 18 months or less.[5] With these exceptions, shifts of deposits between checkable deposits and time and savings deposits do not affect the amount of checkable deposits that can be supported with a given amount of reserves. In the new equation for RAM, the base period reserve requirement on all time and savings deposits is zero. This feature removes the ratio of time and savings deposits to checkable deposits as a determinant of the money multiplier.

There is a problem, however, with the use of this new equation for RAM in measuring the AMB before 1980. The new equation eliminates as determinants of the AMB multiplier the distribution of deposits between members and nonmembers and the distribution of deposits at member banks between demand deposits and time and savings deposits. This produces an undesirable revision in the time series relationship between the money stock and the AMB prior to 1980.

THE SOLUTION: LINK TWO DIFFERENT AMB SERIES TOGETHER

The major challenge in revising the AMB series is creating a continuous series while maintaining the determinants of the AMB multiplier that are appropriate for periods both before and after November 1980. The solution is to link together, at the week ending November 19, 1980, two series based on different equations for RAM. (November 19, 1980, was the first reserve

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[2]Before 1980, state-chartered nonmember banks were subject to the reserve requirements of the state in which they were chartered. For information on the levels of the state reserve requirements and their effects, see Gilbert and Lovati (1978) and Gilbert (1978).

[3]Given the nature of the prior measure of RAM, some actions of the public, such as shifts of deposits among banks, did not affect the multiplier. The structure of reserve requirements on member bank deposits in effect prior to November 1972 was based on the location of member banks. Shifts of deposits among member banks in cities of different size changed the average reserve requirement on member bank deposits, but did not affect the AMB multiplier.

Under the structure of reserve requirements adopted in November 1972, there was a graduated structure of reserve requirements on demand deposits at member banks. Shifts of demand deposits between large and small member banks changed the average reserve requirement on member bank demand deposits. Changes in the average reserve requirement on member bank demand deposits did not affect the multiplier.

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[4]One exception involves nonmember institutions in Hawaii that were in operation on or before August 1, 1978; their reserve requirements will be phased in through January 1993.

[5]Also subject to reserve requirements are nonpersonal ineligible acceptances and obligations of affiliates with initial maturity greater than seven days.

settlement week under the reserve requirements specified in the Monetary Control Act.) Using seasonally unadjusted observations for that week, the value of the AMB derived from the new equation for RAM is divided by the value based on the prior equation for RAM; that ratio equals 0.9704. The AMB for each period through November 12, 1980, based on the prior equation for RAM, is then multiplied by that ratio.[6] This adjustment leaves unchanged the growth rates of the AMB series between any two points in time prior to November 1980; it also adjusts the level of the AMB series prior to November 1980 to avoid a break in the series on that date due to the change in the equation for RAM.

The new measure of RAM alters the seasonal patterns in the AMB. The revised series is not seasonally adjusted as one continuous series. Instead, the data through October 1980 are seasonally adjusted without incorporating data with the new measure of RAM, and the data since November 1980 are seasonally adjusted with observations based entirely on the new measure of RAM.

THE DATA

Table 1 presents quarterly growth rates of these series from 1981. As the table shows, the growth rates of these series generally rise and fall together. On average, the new series grew slightly faster than the old series over this period. Data are not presented for periods prior to November 1980, since the construction of the revised series keeps the growth rates unchanged.

CONCLUSIONS

The revision of the adjusted monetary base (AMB) involves a new equation for the reserve adjustment magnitude (RAM), the component of the AMB that reflects the effects of changes in reserve requirements. The new measure of RAM reflects the structure of reserve requirements specified in the Monetary Control Act of 1980, which were phased in between November 1980 and September 1987.

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[6]For a discussion of this method of linking together distinct measures of the AMB, see Tatom (1980).

Table 1

Quarterly Growth Rates of the Adjusted Monetary Base (compounded annual rates of change, seasonally adjusted)

Quarter	Old series	New series
1981 1	2.9%	2.4%
2	6.5	7.9
3	4.7	3.8
4	3.9	3.2
1982 1	8.6	8.4
2	8.5	6.7
3	6.8	5.8
4	8.8	9.6
1983 1	11.7	12.0
2	11.3	12.2
3	7.3	8.3
4	7.9	8.5
1984 1	9.0	9.8
2	8.1	7.1
3	6.8	5.6
4	5.4	4.6
1985 1	8.0	7.7
2	7.3	7.5
3	9.0	10.4
4	7.3	8.9
1986 1	7.3	7.0
2	8.2	9.7
3	8.8	10.6
4	9.7	11.2
1987 1	10.5	11.3

Data prior to November 1980 are calculated using the prior measure of RAM. In this revision of the AMB, therefore, the series through October 1980 is distinct from the series from November 1980 to the present. The two distinct series are linked together in November in a way that makes the revised AMB one continuous series. The prior measure of RAM is used for periods prior to November 1980 to retain the determinants of the monetary base multiplier (M1 ÷ AMB) that are appropriate for the reserve requirement structure then in effect.

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Appendix
Two Equations for the AMB and the Corresponding Monetary Base Multipliers

This appendix presents the equation for the AMB adopted in 1980 and the new equation that is now used to measure the AMB for the period from November 1980 to the present. The determinants of the AMB multiplier are derived for each measure of the AMB. See table A1 for definitions of the terms used in specifying the AMB and its money multiplier.

OLD MEASURE OF THE AMB

In a revision of the monetary base in 1980, the AMB was measured as follows:

$$(A1) \quad AMB_t = SB_t + 0.12664 \, (TDM)_{t-14}$$
$$+ \, 0.031964 \, (TSM)_{t-14} - RR_t$$

The deposit data, which are for member banks only, are lagged 14 days to reflect the fact that the required reserves for each week were based on deposits of two weeks earlier. The weights on the transaction deposits of member banks (0.12664) and the time and savings deposits of member banks (0.031964) are the average reserve requirements on these categories of deposits in the period from January 1976 through August 1980.[1]

In deriving the multiplier associated with the AMB series specified in equation A1, the time lags on the deposit data are ignored to simplify the equation. The first step in deriving the multiplier involves expressing the source base as the sum of its components.

$$(A2) \quad SB = CP + RR + E$$
$$AMB = SB + RAM$$
$$= CP + RR + E + 0.12664 \, (TDM) +$$
$$0.031964 \, (TSM) - RR$$
$$(A3) \qquad = CP + E + 0.12664 \, (CDM + FM + GM)$$
$$+ \, 0.031964 \, (TSM)$$

Total checkable deposits, the deposit component of M1, equals the checkable deposits of members plus those of nonmembers. Using lower case "n" as the fraction of checkable deposits at nonmembers, the components of the AMB in equation A3 can be respecified as follows:

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[1] See Gilbert (1980) for a description of this measure of the AMB.

Table A1

Terms Used in Specifying the Adjusted Monetary Base and the Monetary Base Multiplier

Term	Description
AMB	Adjusted monetary base
SB	Source base
RAM	Reserve adjustment magnitude
CDM	Checkable deposits of member banks
FM	Demand deposits of member banks due to foreign banks and official institutions
GM	Demand deposits of member banks due to the U.S. Treasury
TDM	Transaction deposits of member banks $= CDM + FM + GM$
TSM	Time and savings deposits of member banks
RR	Required reserves
CP	Currency in the hands of the public
E	Excess reserves, including the vault cash of nonmember banks
n	Share of total checkable deposits at nonmember banks
CD	Total checkable deposits — those at members and nonmembers
k	$CP \div CD$
e	$E \div CD$
fm	$FM \div CD$
gm	$GM \div CD$
tm	$TSM \div CD$
F	Demand deposits of all depository institutions due to foreign banks and official institutions
G	Demand deposits of all depository institutions due to the U.S. Treasury
TD	Transaction deposits at all depository institutions $= CD + F + G$
f	$F \div CD$
g	$G \div CD$

$$(A4)\ AMB = CD\,(k + e + 0.12664\,(l - n + fm + gm)$$
$$+\ 0.031964(tm)\,)$$

The AMB multiplier can be specified as follows:

$$(A5)\ \frac{M1}{AMB} = \frac{l + k}{k + e + 0.12664(l - n + fm + gm) + 0.031964(tm)}$$

Thus, given the equation for the AMB adopted in 1980, the AMB multiplier is a function of:

1. the ratio of currency in the hands of the public to checkable deposits (k),

2. the ratio of excess reserves to checkable deposits (e),

3. the fraction of checkable deposits at nonmember institutions (n),

4. the ratio of the demand deposits of member banks due to foreign banks and official institutions divided by total checkable deposits (fm),

5. the ratio of the demand deposits of member banks due to the U.S. Treasury divided by total checkable deposits (gm), and

6. the ratio of time and savings deposits at member banks to checkable deposits (tm).

The revised measure of the AMB prior to November 1980 is obtained by multiplying the measure described above by a specific ratio; this ratio is the level of the new measure of the AMB divided by the level of the prior measure for the week ending November 19, 1980. Multiplying the AMB specified above by this fixed ratio alters the *level* of the AMB multiplier for periods prior to November 1980; however, this procedure leaves both its determinants and its growth rate unchanged.

THE NEW MEASURE OF THE AMB

Reserve Accounting

The timing of data in the new equation for calculating the AMB is different for the periods under lagged and contemporaneous reserve requirements. For the periods under lagged reserve requirements, that is, for the weekly reserve maintenance periods through the week ending February 1, 1984, the AMB is calculated as indicated in equation A6.[2]

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[2]The deposit component of equation A6 is transaction deposits of all depository institutions for the week ending on a Wednesday, 14 days before the end of the current maintenance period. Historical data are no longer available on transaction deposits for weeks ending on Wednesdays. When the Federal Reserve adopted contemporaneous reserve requirements in February 1984, the weekly data series on deposits, currency and vault cash of depository institutions were converted from averages for weeks ending on Wednesdays to averages for weeks ending on Mondays. It is possible to derive a series for deposits in weeks ending on Wednesdays (TD_{t-14}) from the data on transaction deposits for weeks ending on the surrounding Mondays (TD_{t-16} and TD_{t-9}), as indicated in the following equation:

$$TD_{t-14} = (5/7)\,TD_{t-16} + (2/7)\,TD_{t-9}.$$

Data on transaction deposits derived in this manner are used in the calculation of the AMB through February 1, 1984.

$$(A6)\ AMB_t = SB_t + (0.12)\,TD_{t-14} - RR_t$$

The base period reserve requirement on transaction deposits, 12 percent, is the marginal reserve requirement on most of the transaction deposits of depository institutions under the new structure of reserve requirements.

Contemporaneous reserve requirements became effective the week ending February 8, 1984. The method for calculating the AMB in this period is presented in equation A7.[3]

$$(A7)\ AMB_t = SB_t + (0.12)\,TD_{t-2} - RR_t$$

Seasonal Adjustment

Contemporaneous reserve requirements altered the seasonal patterns of the AMB. In a previous revision of the AMB, Gilbert (1985) described a method for deriving seasonal factors for the period after February 1984. That method is applied to this new series on the AMB. It involves developing a counterfactual series for weeks prior to February 1984 that reflects estimates of the seasonal patterns in the AMB if contemporaneous reserve requirements had been in effect. The counterfactual series is calculated for the period January 1975 through January 1984. Observations for that series are combined with actual values of the AMB for the period since February 1984 to derive seasonal factors that are used for seasonally adjusting the AMB data for the period since February 1984.

The New AMB Multiplier

Using steps similar to those in equations A2 and A3, the new measure of the AMB can be specified as follows:

$$(A8)\ AMB = CP + E + 0.12\,(CD + F + G)$$

The AMB multiplier can be expressed as follows:

$$(A9)\ \frac{M1}{AMB} = \frac{1 + k}{k + e + 0.12\,(1 + f + g)}$$

The AMB multiplier, based on the new equation for the AMB (equations A6 and A7), is a function of:

1. the ratio of currency in the hands of the public to checkable deposits (k),

2. the ratio of excess reserves to checkable deposits (e),

3. the ratio of demand deposits of depository institutions due to foreign commercial banks and official institutions to checkable deposits (f), and

4. the ratio of U.S. Treasury deposits at depository institutions to checkable deposits (g).

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[3]For a description of contemporaneous reserve requirements, see Gilbert and Trebing (1982). For an earlier discussion of the implications of contemporaneous reserve requirements for the measurement of RAM, see Gilbert (1984).