Monetary Velocity and Monetary Rules

William S. Haraf

I. Introduction

The behavior of money velocity and its implications for monetary policy have a long history of analysis and debate. Lately, the debate has focused on the desirability of nominal GNP targeting. The unusual behavior of velocity in recent years has led a surprising diversity of economists to advocate that the Federal Reserve adopt a policy rule targeting nominal GNP. Since 1981, when this idea was first discussed, the literature on targeting GNP has grown enormously.

There have been important developments in our understanding of discretionary versus rules-based policies in recent years.[1] In the early debate, proponents of rules emphasized the policymaker's imperfect knowledge of the economy and the risks of an activist strategy. Defenders of discretionary monetary policy argued that binding the central bank to a rule could be costly. We are now beginning to understand that not binding the central bank to a rule is also costly, even apart from the policy errors that might take place under discretion. Support among economists for some form of monetary rule is increasing, but there remains considerable disagreement as to what form of rule is best. The principal focus of this article is on the implications of alternative rules.

I would like to emphasize at the start the limits of our knowledge regarding the behavior of the economy under alternative monetary regimes. Observed statistical relationships between monetary aggregates and nominal GNP, and between changes in nominal GNP and changes in prices and quantities would probably not remain stable if we were to move from the present discretionary monetary policy

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The author is J. E. Lundy Visiting Scholar and Director of the Financial Markets Project at the American Enterprise Institute.

[1]See Barro (1985) for an excellent survey of developments in the theory of rules versus discretion.

regime to one governed by rules in the form of targets, say, for money, GNP, or prices. In trying to bring empirical evidence to bear on the question of how the economy would behave under alternative regimes, empirical "facts" must be established that are likely to be robust in the face of fundamental changes in the conduct of monetary policy. The number and type of facts that fall in this category do not lend themselves to precise predictions.

In sections II through V of this article, I establish some basic empirical propositions about the behavior of several alternative definitions of velocity,[2] and about the general behavior of nominal GNP, real GNP, and prices. I believe these propositions are likely to be robust to changes in the monetary regime. In sections VI through IX, I consider the implications of these propositions for alternative monetary rules, focusing especially on GNP rules. Section X provides a summary and conclusion.

II. Alternative Velocity Concepts

I examined four alternative velocity measures, constructed by using two monetary variables and two measures of aggregate spending. The two monetary variables are M1 and the monetary base (MB). The two aggregate spending measures are nominal GNP and gross domestic final demand (DFD), computed as nominal GNP less the change in business inventories and less net exports.

The reason for considering a velocity definition based on DFD is that GNP may not be a good measure of the volume of transactions that is important for money demand. For example, if consumers increase their transactions balances to purchase more goods, but firms choose to liquidate inventories rather than increase production, GNP is unchanged while M1 grows and velocity defined in terms of GNP declines.[3] The same result would hold if consumers were to increase their money balances to purchase more imported goods. Similarly, if exports decline because of weak foreign demand, GNP falls while domestic money demand is relatively less affected. In other words, changes in inventory accumulation and changes in net exports may

[2]More generally, the propositions apply to the relation between nominal GNP and money.

[3]Gordon (1985) focuses attention on velocity defined in terms of final sales, that is, GNP less inventory change. He argues that the instability of velocity growth defined with GNP in the numerator is in part the result of changes in inventory. He argues that this velocity definition focuses undue attention on the short-term inventory cycle. Radecki and Wenninger (1985) illustrate that the behavior of inventories and net exports has had a significant influence on recent monetary velocity defined as GNP/M1.

not have the same effect on the demand for money as changes in the other components of GNP.

I chose to examine velocity defined in terms of the monetary base, as well as M1, because the base is sufficiently under Fed control to be considered an instrument of monetary policy. For a GNP rule to be fully specified, the rule must be defined in terms of such an instrument, and the stability of the link between the target and the instrument becomes an issue. Rules that call for manipulating the monetary base to achieve a target for GNP or DFD have operational content and improved monitoring possibilities in comparison, say, with rules that set targets for M1 based on a desired path for GNP.

The velocity concept I prefer to use lags the monetary aggregate by two quarters to approximate the lag relation between money and spending. None of the basic points I would like to make is much affected by the use of lagged as opposed to contemporaneous money.

Figures 1 through 4 plot quarterly data on the logs of the four velocity measures, along with trend lines fit over the period from 1960:1 to 1979:4. Table 1 provides summary statistics on the behavior of rates of change of the four velocity measures, as well as of the ratios DFD/GNP and M1/MB over the period from 1960:1 to 1985:3. Of course, the base velocity measures (GNP/MB and DFD/MB) can be expressed as the product of M1 velocity measures (GNP/M1 and DFD/M1) and the money multiplier (M1/MB), while the DFD velocity measures (DFD/M1 and DFD/MB) can be expressed as the product of M1 or MB velocity and the ratio DFD/GNP. The data are expressed as annualized percentage rates of change. The GNP and DFD data are from the recent benchmark revisions of the national income accounts.

Each of the velocity measures exhibited apparently trend-like behavior over the 1960–79 period (see Figures 1–4). The tendency of M1 velocity to grow at an average annual rate of 3 percent per year over that period is well known. When M1 velocity began to dip below the trend line in 1982, there was much discussion as to whether velocity would return to trend. By 1985, however, a considerable gap existed between actual and trend velocity using any of the four measures.

The statistics in Table 1 provide some interesting comparisons. The average growth rate of each of the velocity measures during the 1980s has been significantly below the rates of the 1960s and 1970s. Since 1980, however, the increase in DFD relative to GNP has caused DFD velocity to grow on average .4 percent faster than GNP velocity. Similarly, increases in the money multiplier since 1980, following declines in the 1960s and 1970s, have meant that the decline

FIGURE 1
GNP/M1

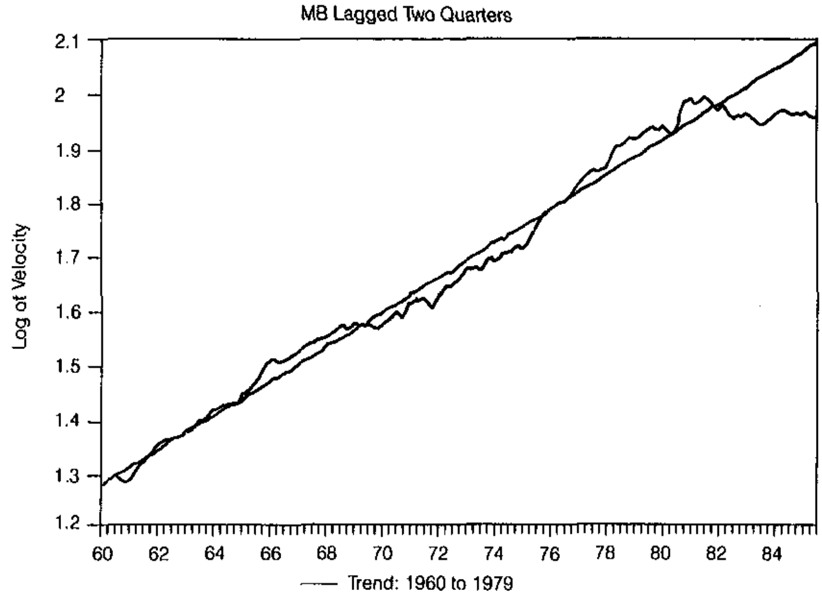


FIGURE 2
DFD/M1

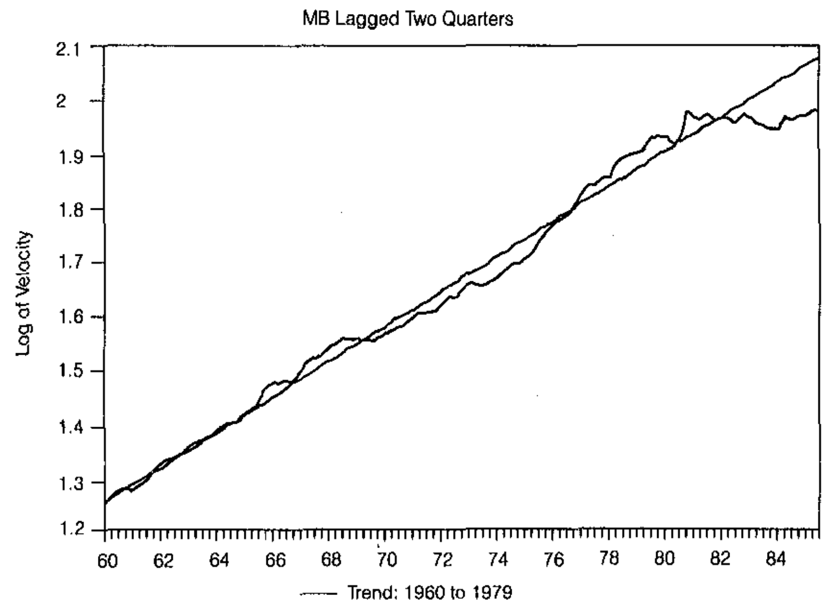


FIGURE 3

GNP/MB

MB Lagged Two Quarters

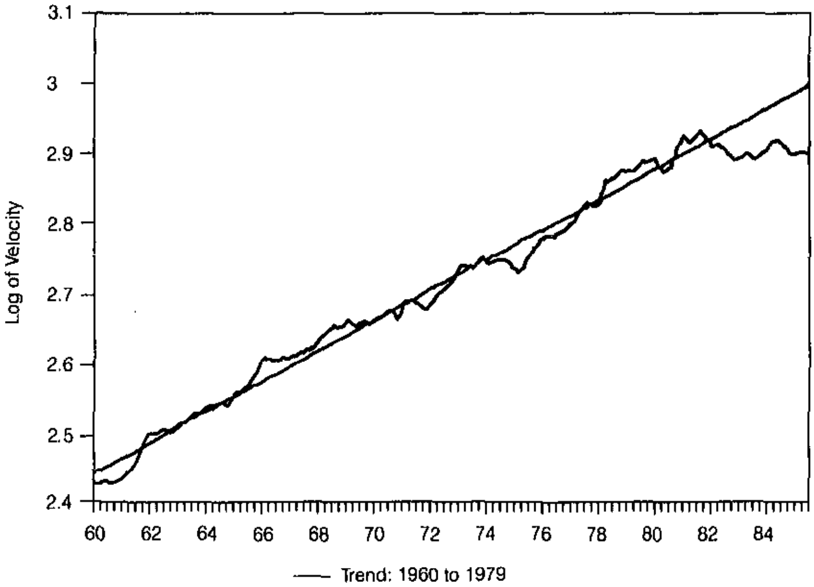


FIGURE 4

DFD/MB

MB Lagged Two Quarters

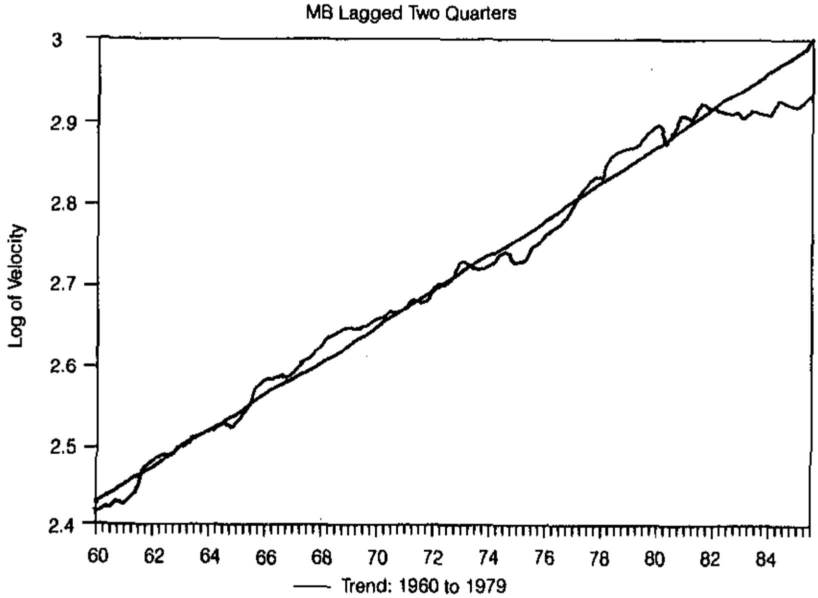


TABLE 1

VELOCITY GROWTH SUMMARY STATISTICS
(ANNUALIZED PERCENTAGE RATES OF CHANGE)

	GNP/M1	DFD/M1	GNP/MB	DFD/MB	DFD/GNP	M1/MB
Mean:						
60:1–69:4	3.0	3.1	2.4	2.5	0.1	−0.6
70:1–79:4	3.6	3.7	2.4	2.4	0.1	−1.3
80:1–85:3	0.4	0.8	0.2	0.6	0.4	0.3
60:1–79:4	3.3	3.4	2.4	2.5	0.1	−1.0
60:1–85:3	2.7	2.8	1.9	2.1	0.1	−0.7
Standard Deviation:						
60:1–69:4	3.2	2.7	3.2	2.5	2.4	1.5
70:1–79:4	4.1	3.1	4.0	3.1	2.7	1.7
80:1–85:3	5.6	5.4	5.0	4.0	3.4	3.6
60:1–79:4	3.7	2.9	3.6	2.8	2.6	1.7
60:1–85:3	4.4	3.8	4.1	3.2	2.8	2.3
Minimum:						
60:1–69:4	−3.1	−2.2	−3.0	−2.6	−5.2	−4.4
70:1–79:4	−5.1	−2.8	−5.2	−5.8	−5.9	−5.6
80:1–85:3	−7.9	−5.2	−8.7	−10.1	−6.2	−9.9
Maximum:						
60:1–69:4	9.4	10.8	9.9	9.8	6.1	2.8
70:1–79:4	13.6	10.8	13.6	10.9	5.7	1.9
80:1–85:3	20.3	19.1	10.4	9.3	6.4	6.2

NOTE: The monetary variables (M1 and MB) are lagged two quarters.

in base velocity growth has been smaller than the decline in M1 velocity growth. Nonetheless, shifts in the trade balance and in the money multiplier cannot by themselves account for the unusual behavior of GNP/M1.

The standard deviations of the velocity growth measures are also higher since 1980 than over the 1960–79 period. Significantly, over each of the subperiods listed in Table 1, velocity growth using DFD exhibited less variance about its mean value than did velocity growth defined in terms of GNP. The same is true for velocity growth using MB rather than M1. The DFD/MB velocity measure consistently had the lowest variance about its average growth rate. Note also that the standard deviations of changes in the DFD/GNP and M1/MB ratios are on the order of 64 percent and 52 percent, respectively, of the standard deviation of changes in GNP/M1 over the entire sample period.

III. Models for Nonstationary Time Series

The velocity charts clearly illustrate that money velocity is nonstationary. Nonstationarity refers to the tendency of a time series to move farther away from any given state over time, or, in other words, to a lack of affinity for a mean value. Most economic time series are nonstationary in this sense. There are two common ways to model this type of nonstationarity. One is to fit a trend line to the series. A nonstationary time series whose deviations from trend are stationary, or self-reversing, is said to follow a trend stationary, or TS, process. Another type of nonstationary process is the differenced stationary, or DS, process. A nonstationary time series whose first or higher order differences are stationary is said to follow a DS process. A time series following a DS process may tend to drift upward over time, but it would not exhibit trend reverting properties. The simplest and best known member of this class of processes is the random walk. Successive changes in a time series following a random walk are uncorrelated.

The two main points to emphasize concerning the difference between TS and DS models are that:

1. Shocks to a variable that follows a TS process tend to be reversed over time as the variable returns to trend. Because of this property, neither current nor past events should alter long-term expectations about the variable. In addition, the confidence regions about the long-term forecasts and the uncertainty about the behavior of a variable following a TS process are bounded, even in the indefinitely distant future.

2. Shocks to a variable that follows a DS process have a permanent effect on the level of the variable. Therefore, events will influence long-term forecasts. In addition, confidence regions about those forecasts, as well as the uncertainty about the future level of the series increases without bound as the forecast horizon lengthens.[4]

IV. Is Velocity Better Described As a TS or DS Process?

There is a simple test to determine whether a variable, Y, is better described as a TS or DS process. Run the following regression:

$$Yt - Yt-1 = a0 + a1*Yt-1 + a2*(Yt-1 - Yt-2) + a3*t.$$

The change in a variable following a TS process will depend on the level of the variable in the prior period in relation to trend, but the change in a variable following a differenced stationary process will not. Hence, a test of the DS model against the alternative of a TS model can be expressed as a test of whether the coefficients a1 and a3 are jointly zero.

As depicted in Figures 1 through 4, "trends" in velocity seemed most apparent prior to 1979. However, Table 2 contains regression results and test statistics for the DS and TS models for each of the velocity measures over the period from 1960:1 to 1979:4, prior to the apparent break in velocity behavior. The results clearly show that over this period the four velocity measures were well described as random walks with drift, the simplest member of the DS class of processes.[5]

This means that even prior to 1980, the "trends" in velocity were more apparent than real. In other words, velocity grew at an average rate of 3 percent per year over this period, but disturbances to the level of velocity tended to be permanent, and there was no tendency for velocity to return to a trend line once a shock had moved it away. Of course, the trend stationarity hypothesis is also rejected when the

[4]An appendix to this article, available from the author, elaborates on the difference between TS and DS models.

[5]In each case the a1 and a3 parameters are not jointly significantly different from zero. Moreover, the adjusted R-squares for the equations are uniformly low, and the estimated a2 parameter is small in relation to its standard error. The test statistics that are reported are not conventional F-statistics, since the conventional F-test is biased if the variable follows a DS process. The test statistic used here was developed by Dickey and Fuller (1981).

TABLE 2

REGRESSION RESULTS AND STATIONARITY TESTS
1960:1 TO 1979:4

	Dependent Variables[a]			
	GNP/ M1	GNP/ MB	DFD/ M1	DFD/ MB
Constant	0.112 (.061)	0.447 (.157)	0.073 (.050)	0.311 (.135)
Lagged Level	−0.084 (.050)	−0.182 (.065)	−0.055 (.041)	−0.128 (.056)
Trend	0.0007 (.0004)	0.0010 (.0004)	0.0005 (.0003)	0.0007 (.0003)
Lagged 1st Diff.	0.010 (.118)	0.006 (.114)	0.119 (.114)	0.091 (.114)
R-Bar Squared	0.003	0.065	0	0.027
Standard Error	0.0092	0.0090	0.0073	0.0070
Trend Stationary Test Statistic	1.42	3.58	1.08	2.41
Critical Value	6.49	6.49	6.49	6.49

[a]Each dependent variable is in log-first difference form.

additional data from 1980 to 1985 are included in the sample, since this is the period in which the departure from trend is most evident.[6]

Changes in velocity are presumably driven by a number of factors, including changes in the demand for the monetary aggregate that can result from changes in wealth, inflationary expectations, or financial innovations; changes in the expenditure function for goods and services; or changes in the composition of spending. There is no reason to believe that these factors will themselves be stationary about a trend line. It seems certain that computed confidence regions from the TS model understate our uncertainty about the long-run behavior of velocity. The broader confidence bands from the random walk model may also understate true uncertainty if the process, or the average "drift," can change unpredictably over time.

The upward drift in velocity that characterized the postwar period to 1980 has apparently ceased. Milton Friedman,[7] among others, has

[6]The observation that velocity behaves as a random walk with drift was first noted by Gould and Nelson (1974), using annual data on M1 and GNP for the period 1869–1960.

[7]*Wall Street Journal* (18 December 1985).

argued that disinflation beginning in 1980 is responsible. Other economists have focused on the effect of financial innovations. Without trying to sort out the reasons for the break in velocity behavior, perhaps the best way to characterize their effect is as a shift in the average drift in the random walk process. That is, the average growth rate of velocity appears to have declined, but successive changes in velocity are still uncorrelated. This conclusion, however, is based on limited data. As a result, "correct" confidence regions, incorporating the effect of model uncertainty, would be wider than those computed from the random walk model.

Given the nature of the factors driving velocity changes, however, I conclude that a shift to a new monetary regime involving money, nominal GNP, or price targets would not fundamentally alter the basic characteristic of non-trend stationarity of monetary velocity.

V. Behavior of Nominal GNP, the Price Level, and Output

Anyone with a passing familiarity with postwar data on nominal GNP and prices will probably not need to be convinced by a formal statistical test that these time series are not trend stationary. On the other hand, it has been common practice to treat deviations of real GNP from trend as a measure of the cyclic component of real GNP.[8] Table 3 shows regression results and test statistics for the trend stationary hypothesis for the variables GNP, DFD, the implicit price deflator (P), and GNP in 1982 dollars (RGNP). In each case, the tests do not support the trend stationarity hypothesis.[9]

Charles Nelson and Charles Plosser (1982) also rejected trend stationarity of GNP, RGNP, and P using annual data over various periods starting around the turn of the century. Moreover, they showed that if we think of these time series as being subject both to permanent and transitory (including cyclic) disturbances, the observed variances seem to be dominated by permanent disturbances. Again, this conclusion may not be surprising with respect to the nominal variables DFD, GNP, and P. However, it may be surprising to those

[8]Nelson and Plosser (1982) and Nelson and Kang (1981) have pointed out the pitfalls of this approach.

[9]If the coefficients on the trend and lagged level terms are "small," but not zero, the trend reverting property imposed by the form of the equation would operate very slowly. In some previous work, I used both trend stationary and differenced stationary models to forecast real GNP (in 1972 dollars) 24 quarters ahead beginning in 1984:2. The trend stationary model produced such a gradual return to trend as to be almost nondetectable even after six years.

TABLE 3

REGRESSION RESULTS AND STATIONARITY TESTS
1960:1 TO 1985:3

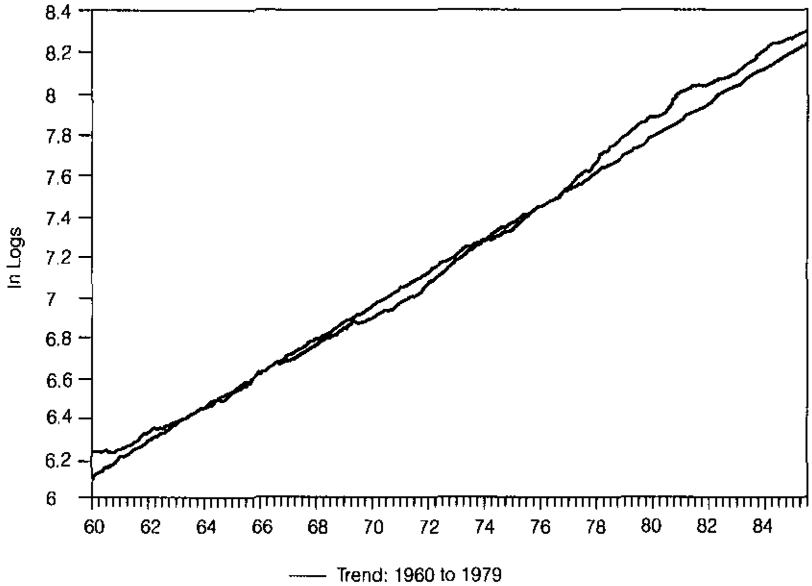
	Dependent Variables[a]			
	GNP	DFD	RGNP	P
Constant	0.391 (.121)	0.285 (.094)	0.399 (.193)	−0.023 (.008)
Lagged Level	−0.063 (.020)	−0.046 (.016)	−0.053 (.026)	−0.168 (.006)
Trend	0.0014 (.0004)	0.0010 (.0003)	0.0004 (.0002)	0.0002 (.0001)
1st Diff. Lag 1	0.174 (.097)	0.213 (.099)	0.235 (.100)	0.352 (.096)
1st Diff. Lag 2	0.117 (.099)	0.021 (.10)	0.205 (.103)	0.206 (.097)
1st Diff. Lag 3	−0.065 (.098)	−0.020 (.10)	−0.047 (.103)	0.134 (.098)
1st Diff. Lag 4	0.040 (.097)	0.057 (.10)	0.032 (.100)	0.081 (.095)
R-Bar Squared	0.14	0.19	0.10	0.66
Standard Error	0.010	0.008	0.0988	0.0042
Trend Stationary Test Statistic	5.88	5.79	2.52	4.27
Critical Value	6.49	6.49	6.49	6.49

[a]Each dependent variable is in first difference form.

who think of movements in RGNP as being dominated by the business cycle.

Figures 5 through 8 plot the levels and first differences of the logs of GNP, DFD, RGNP, and P. The charts showing levels also include trend lines fit through 1979. Although trend stationarity is rejected for all four variables, note that deviations from the estimated trend line are more persistent for P and RGNP than for GNP and DFD. Note also the relative smoothness of the inflation series in comparison with the nominal and real GNP series. Of these series, P is the only one with significantly autocorrelated first differences.

FIGURE 5
GNP


8.4
8.2
8
7.8
7.6
7.4
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7
6.8
6.6
6.4
6.2
6
In Logs
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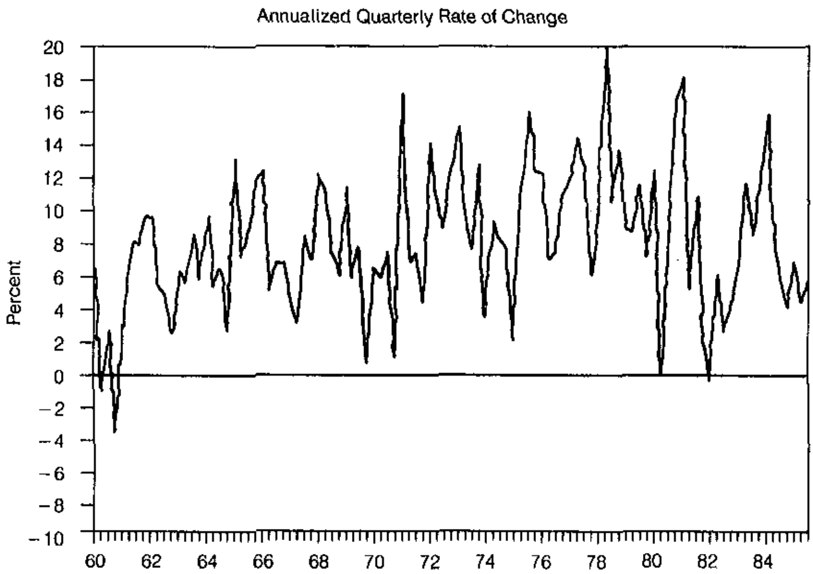
64
66
68
70
72
74
76
78
80
82
84
—— Trend: 1960 to 1979


Annualized Quarterly Rate of Change
20
18
16
14
12
10
8
6
4
2
0
−2
−4
−6
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Percent
60
62
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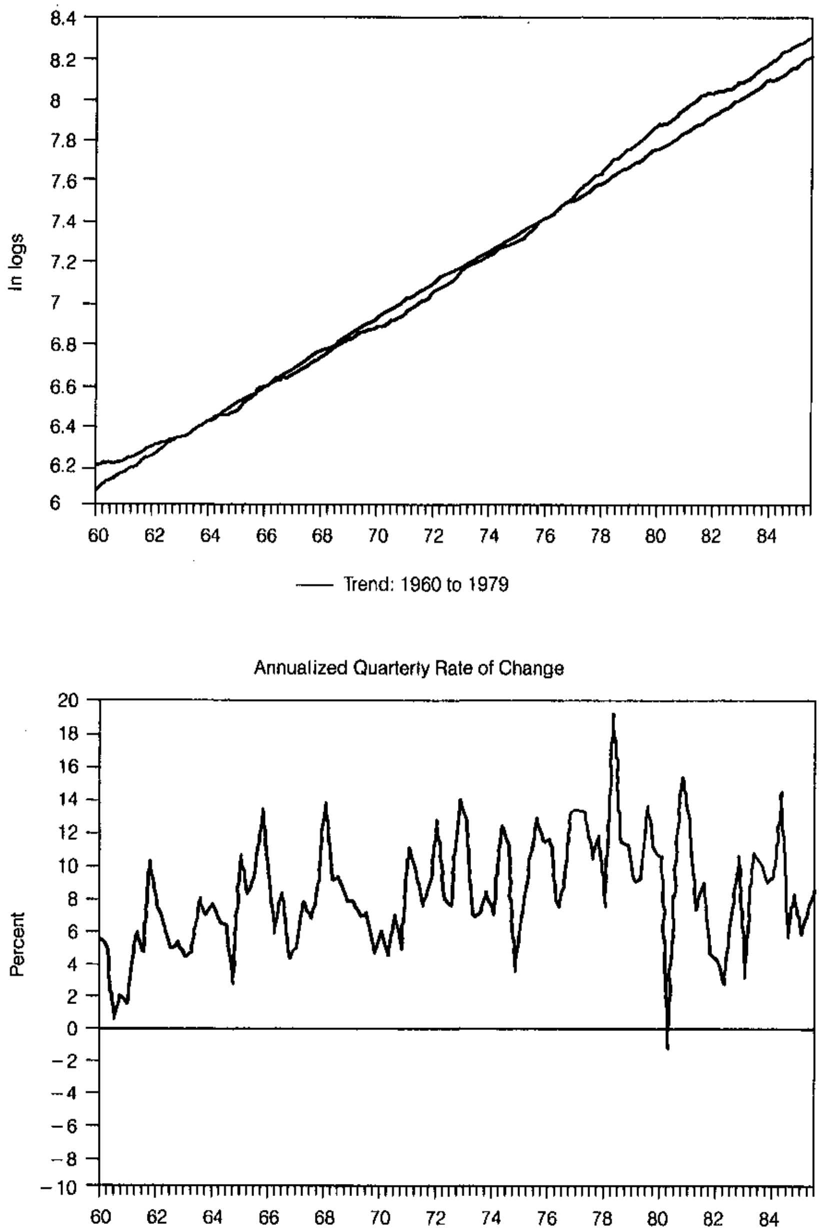
84

FIGURE 6
DFD


In logs
8.4
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60 62 64 66 68 70 72 74 76 78 80 82 84
Trend: 1960 to 1979
Annualized Quarterly Rate of Change
Percent
20
18
16
14
12
10
8
6
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60 62 64 66 68 70 72 74 76 78 80 82 84

FIGURE 7
DEFLATOR

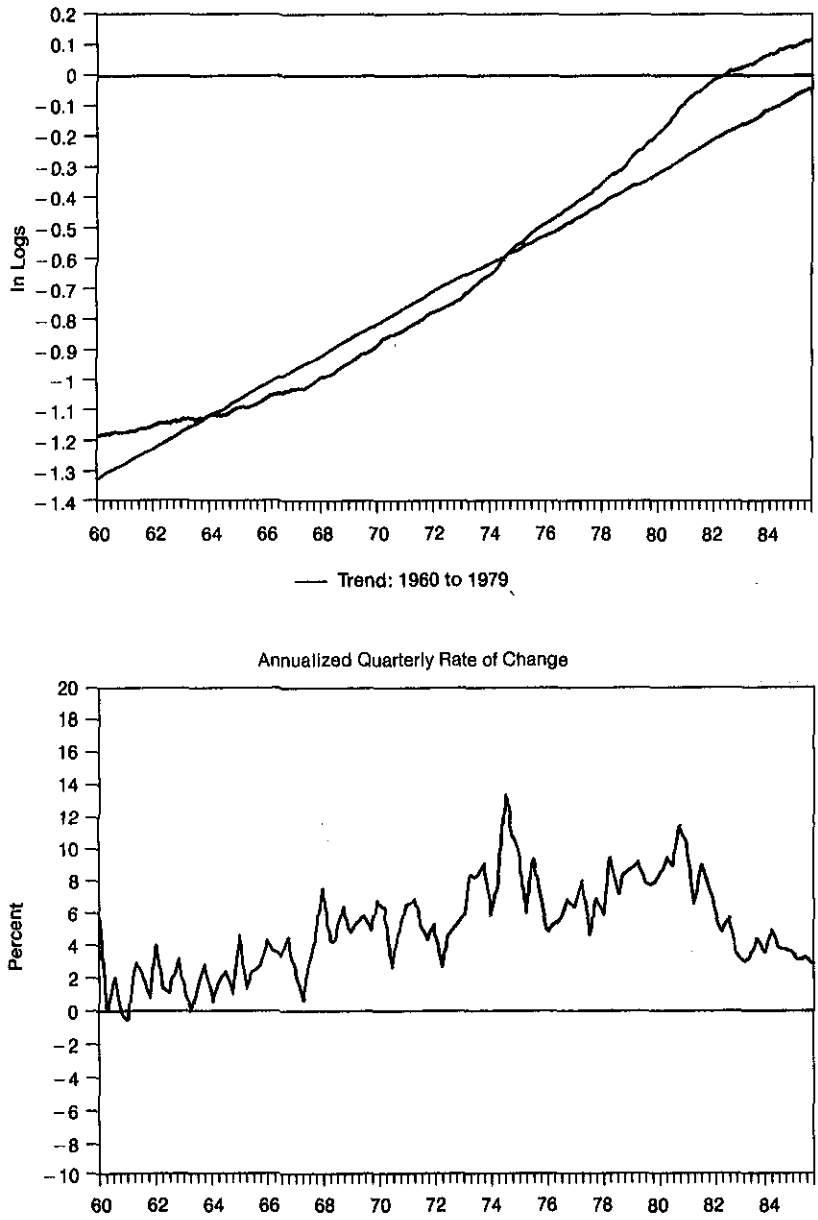
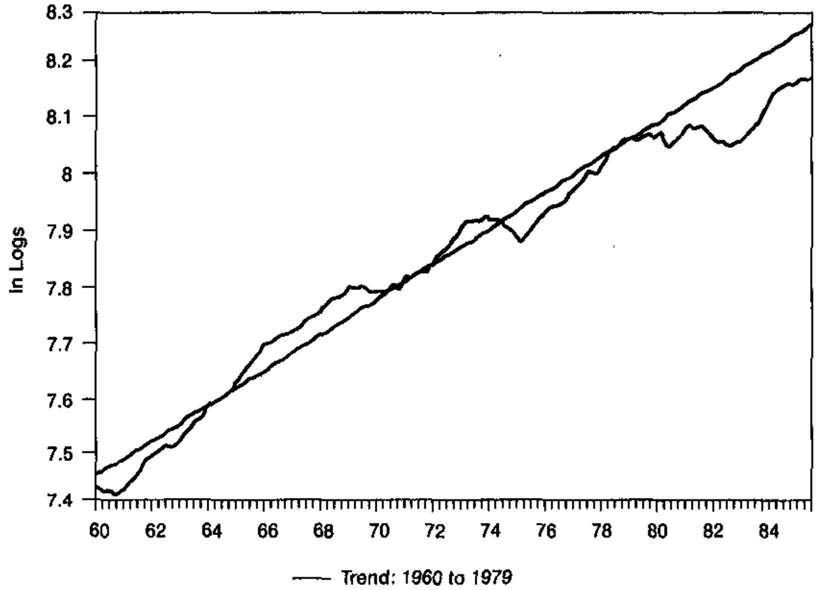
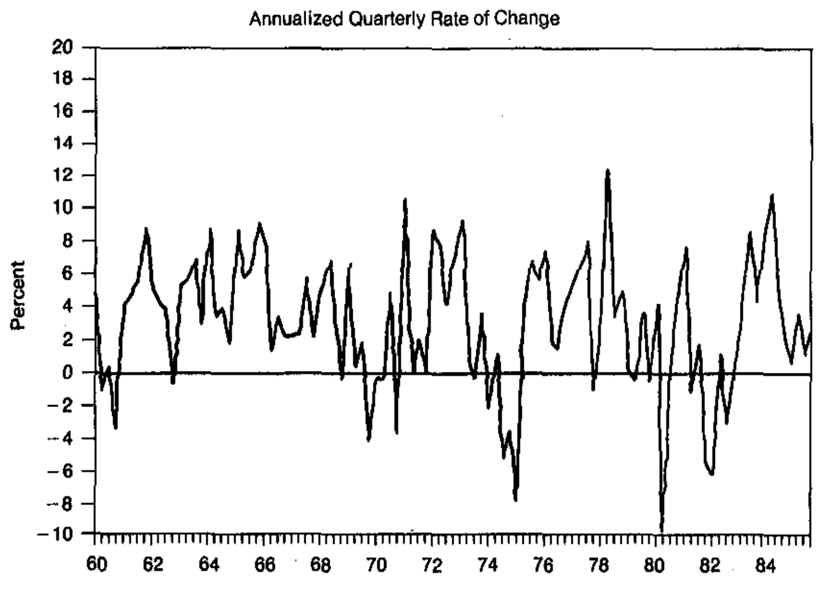


FIGURE 8
GNP (CONSTANT $)





VI. Implications of Nonstationarity of Nominal Variables

What does all this have to do with nominal GNP targeting? Non-trend stationarity of nominal GNP or prices imparts a high degree of uncertainty about the level of future nominal incomes or prices that is both costly and entirely avoidable. It is, perhaps, the principal failure of discretionary monetary policy. Benjamin Klein (1975) contrasted price level uncertainty under a monetary standard with no nominal anchor to one with a nominal anchor. Under the strict gold standard from 1880 to 1915, for example, the price level fluctuated substantially from year to year. But periods of inflation alternated with periods of deflation because important self-correcting forces were put in motion by changes in the price level. As a result, uncertainty about the price level in the distant future was bounded, so long as the relative price of gold was stable. The shift to a discretionary monetary policy environment with no nominal anchor was accompanied by a change in the character of price and GNP fluctuations that substantially increased uncertainty about future nominal values.

There is a danger in asking the Fed to do more than it can consistently be expected to accomplish; for example, the Fed may not be able to control closely nominal variables from quarter to quarter. But no one doubts that the Fed can control nominal variables over a period of years. The Fed should be able to adopt a policy rule that would make GNP, DFD, or some price index behave like a trend stationary process. Such a rule might specify a path for the level of GNP or DFD allowing, say, for 6 percent growth per year. Deviations from the desired path would trigger a change in the growth of the monetary base. Alternatively, the rule might be specified in terms of a path for the price level. The price level path might call for zero long-run inflation, or possibly some positive inflation associated with an optimal rate of seigniorage. Either type of rule would reduce significantly the degree of long-run nominal uncertainty in the economy, provided that the commitment to the rule was credible. As Robert Hall (1981) puts it: "The social benefits of price stability come from reliable planning in dollars over a ten or twenty year period, not so much from year to year. The goal of price stability is well met if prices fluctuate above and below a stable long-run level."

Several conclusions about alternative nominal rules can be drawn from the empirical results that have been presented thus far. First, if the behavior of velocity would continue to approximate a random walk under a regime of GNP or DFD targeting, the "optimal" targeting rule would take a particularly simple form. In that case, differences between velocity growth in a given quarter and its average rate of growth should generate an equiproportionate change in the growth of the monetary base. It is not "futile to offset every quarterly wiggle in velocity," as Robert Gordon (1985) has argued, since disturbances to the level of velocity are permanent. Moreover, there is no point in basing the rule on forecasts of GNP as Gordon suggests, because all deviations from average velocity growth are unpredictable. (Some qualifications to this argument are discussed in section VIII.)

Second, the random walk property of monetary velocity implies that a constant money growth rate rule would not have the virtue of making nominal GNP or prices trend stationary. If velocity continued to behave as a random walk under such a rule, GNP would also behave as a random walk.[10] The variance of changes in GNP would be at an irreducible minimum, but velocity disturbances would have a permanent effect on the level of GNP. Hence, the problem of unbounded long-run confidence regions would still apply under a constant money growth rule.

Third, if a nominal spending rule were adopted, such a rule should target DFD rather than GNP. There are good theoretical reasons to think that monetary policy can be more successful in controlling DFD than GNP. Some confirming evidence for this belief is provided by the smaller variance of DFD velocity, and by regression evidence that suggests a closer link between DFD and the monetary base than between GNP and the base.[11] Moreover, evidence suggests that DFD is a better predictor of inflation.[12] If the objective of this type of targeting is to "tie down" the price level, then DFD serves this purpose better.

Fourth, even if a GNP or DFD rule were adopted and we could confidently expect that GNP would behave as a TSG process, we could not expect that the price level would behave as a TS process. The reason is that RGNP is not trend stationary; that is, permanent shocks to the level of RGNP under a GNP rule would have a permanent effect on the price level. Hence, a GNP rule would not "tie down" or provide a nominal anchor for the future price level in a way that would place a bound on long-run uncertainty about the price level. Consequently, if P is the ultimate objective of monetary

[10]More generally, if velocity continues to be non-trend stationary, so does GNP.

[11]This evidence is admittedly weak. Smaller regression standard errors do not necessarily mean greater control could be achieved.

[12]Of course, regression relations between DFD or GNP and P would probably not remain constant under a GNP or DFD targeting regime.

policy, using GNP as an intermediate target will not be fully satisfactory. This leads one to consider rules that directly target the price level.

VII. Stabilizing Properties of Alternative Rules under Nominal and Real Shocks

The focus thus far has been primarily on the nominal implications of nominal rules in the face of nominal shocks. Macroeconomics is weakest in analyzing the division of changes in GNP between output and inflation components. Analyzing the real implications of nominal shocks under nominal rules, and the real and nominal implications of real shocks under nominal rules, therefore, is more problematic.

Some advocates of targeting nominal GNP have argued that such a rule would have important short-run stabilizing effects on real variables.[13] The logic of the stabilization argument goes as follows. A velocity shock that changes GNP will ultimately change P approximately equiproportionately, but this change may take place with a long lag. In the meantime, a purely nominal disturbance has undesirable real effects. If the Fed reacts to a velocity disturbance as soon as it is observed, it can damp down the output response as well as the price response to the shock. Consequently, a nominal GNP rule stabilizes both output and prices.

There are two potential problems with this argument. The first problem is that our understanding of how real variables would react under such a rule is quite limited. Evidence suggests that the effect of changes in nominal variables on real variables depends on the extent to which they are anticipated. There are, however, important unresolved questions about the timing of expectations when compared with realizations. If velocity is a random walk and monetary policy follows a constant money growth rate rule, all changes in nominal GNP (apart from expected drift) would be unanticipated. Under a GNP or DFD rule, some changes in GNP would be anticipated, since money growth would respond predictably to past velocity disturbances. It is possible that the predictable changes in GNP that occur as a result of monetary responses to prior velocity shocks would have little or no effect on real variables.

The second problem has to do with real shocks. If nominal velocity shocks were the only type of disturbance to be concerned with, a GNP rule might very well dominate a P rule, even if the price level

[13]See, for example, Gordon (1985), Hall (1981), and McCallum (1984, 1985). Cagan (1985), on the other hand, makes the opposite argument, namely, that a GNP rule would be destabilizing.

is the ultimate objective of policy. The advantage of a GNP rule is that it would react more quickly to velocity disturbances than a rule that reacted to past price changes. As a result, the price level would return to trend more quickly after such a shock. However, real shocks also have price level effects.[14] Moreover, the evidence is consistent with the view that the behavior of RGNP is dominated by permanent rather than transitory shocks. As a result, there is a trade-off to be evaluated in considering GNP versus P rules. The trade-off depends on the relative importance of nominal and real shocks, and the value that is attached to the increase in price level predictability under a P rule compared with a GNP rule.

How alternative rules respond to real shocks depends on whether real shocks are correlated with measured velocity. If they are not correlated, then the relation between GNP and RGNP (and also P), is recursive, that is, changes in GNP affect RGNP (and P), but there is no feedback from changes in RGNP (and P) to GNP. This is the stochastic structure underlying the St. Louis model of the economy. The evidence is clear that changes in RGNP and P have very weak feedback effects on GNP in subsequent quarters.[15] However, it is impossible to infer the extent to which real shocks affect GNP contemporaneously.[16] James Tobin (1985) argues that the "main problem with targeting [GNP] comes from supply-related price shocks."[17] Under such a rule, he says, P shocks reduce RGNP equiproportionately. The weaker the contemporaneous correlation between real shocks and velocity, however, the more this result is approximated irrespective of the monetary rule. What is correct about Tobin's statement is that real shocks destroy the long-run equivalence of GNP and P rules.

VIII. Specifying a GNP or DFD Rule

The argument made in section VI about the optimality of a simple rule is subject to at least two caveats. For one, although changes in velocity apart from drift may not be predictable on the basis of past velocity, it is possible that a forecasting model incorporating other

[14]To my mind some unfortunate terminology has crept into the literature. What some economists refer to as "price shocks" are in fact real shocks that may sometimes take the form of shocks to prices of factors of production.

[15]See Nelson (1979) for an analysis. This result was also confirmed by tests I performed using vector autoregressive models.

[16]Over the period from 1969 to 1985, the correlation between quarterly changes in GNP and P was .37, while the correlation between changes in GNP and RGNP was .92.

[17]See supra, n. 14.

information may be exploited for improved prediction and control of GNP or DFD. Benjamin Friedman (1984), for example, uses a macroeconomic model to compute the rate of growth of bank reserves that the Fed should implement to make the conditionally expected nominal income equal to some desired level. Robert Gordon's (1985) rule calls for feedback from a moving average forecast of nominal final sales.

I believe there is great virtue, however, in a simple rule that is easily understood, easily implemented, and easily monitored. This is particularly true when credibility is an issue, as when a rule is adopted following a period of discretionary policy making. A simple rule is also more likely to be robust in the face of economic change. These considerations must be weighed against hypothetical reductions in variance that may result from following a more ambitious form of feedback rule.

The second caveat concerns errors in early information about GNP. William Poole's (1985) critique of GNP targeting held that revisions of GNP data complicate the problem of specifying a satisfactory feedback rule for the monetary policy instrument. Should the money stock respond to preliminary estimates of GNP or to more complete data? Should the money stock respond to revisions in the data? The answers to these questions depend on the error structure of early information about GNP. If the preliminary estimate of GNP is an unbiased predictor of "true" GNP, then the optimal rule should react both to early information about current GNP and to revisions of GNP.[18]

X. Summary and Conclusion

The principal findings of this article can be summarized as follows:

1. Neither monetary base velocity nor M1 velocity is trend stationary. In fact, both velocity measures closely approximate random walks over the sample period. GNP, DFD, RGNP, and P also do not appear to be trend stationary processes.
2. Lack of trend stationarity in a variable means that the degree of uncertainty about its future value increases without limit as the forecast horizon lengthens. In formal statistical language, forecast confidence regions increase without bound.
3. The Fed could target GNP, DFD, or P in such a way as to make one of them trend stationary. In so doing, long-run uncertainty

[18]An appendix to this article, available from the author, simulates a model with a GNP rule that responds both to velocity shocks and to errors in preliminary estimates of GNP in order to evaluate the practical importance of Poole's (1985) critique.

about the future value of the target variable would be significantly reduced.

4. A constant money growth rule would probably not make GNP, DFD, or P trend stationary because of the character of velocity fluctuations.
5. Real shocks destroy the long-run equivalence between GNP (or DFD) rules and P rules. Because the variance of RGNP is dominated by permanent shocks to its level, a GNP (or DFD) rule would not make P trend stationary.
6. The automatic stabilizing properties of GNP or DFD rules for real variables may be exaggerated.

There are good reasons to believe that a rule-based policy regime would be preferable to a discretionary policy regime in terms of the long-run operating characteristics of the economy. The analysis in this paper suggests that the choice among alternative nominal rules is less clear. I would like to conclude by offering my views on this choice.

A monetary policy designed to make the price level trend stationary would have clearly defined economic benefits, primarily associated with an improved environment for long-run planning and contracting in nominal terms. The economic benefits from making nominal income trend stationary are less obvious. However, a policy rule producing such a result would, I believe, have value in comparison with a discretionary policy regime in which no nominal variables are trend stationary. Nominal GNP and domestic final demand are not best thought of as final targets of monetary policy, but rather as intermediate targets. Their value as intermediate targets depends on the extent to which purely nominal velocity shocks dominate real shocks, and on the lag in the effects of nominal shocks on the price level.

I believe that the probable non-trend stationarity of the price level under a GNP or DFD target makes the case for targeting the price level directly. The principle objection to direct targeting of the price level has been related to historically long lags between changes in the monetary base and the price level. A rule linking growth in the money base to observed price level changes would, it is said, produce long departures of the price level from its target. However, the length of this lag is not likely to be policy invariant. Under a price rule, if prices rise above the target path, people will come to expect that monetary actions will bring them back down. This will increase money demand, and therefore work to bring prices down more quickly than would happen in the absence of such expectations.

The random walk process for velocity suggests a particularly simple form for a GNP or DFD targeting rule. A price level rule could take a number of different forms, but this is an area for further study.

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VELOCITY AND THE CHOICE OF POLICY REGIMES

Robert H. Rasche

The program of every recent conference on monetary economics and/or monetary policy contains at least one paper, if not more, devoted to the topic of monetary velocity. Thus the subject of William Haraf's (1986) paper is not at all unusual. What is rather unusual about his paper is that it really gives little attention to the behavior of velocity since 1980. All the statistical work he presents deals with sample periods that end in the fourth quarter of 1979. The sole characterization of the past five years is the author's statement that "[w]ithout trying to sort out the reasons for the break in velocity behavior, perhaps the best way to characterize their effect is as a shift in the average drift in the random walk process" (p. 650).

The real subject matter of Haraf's paper is the question of what kind of rule is appropriate for the conduct of monetary policy. In particular, is a rule that involves a feedback relation from newly observed behavior of nominal income preferable to a rule that eschews any feedback (for example, a constant money growth rule)?

It is important to recognize the role that the statistical analysis of velocity plays in the analysis of the choice between such policy regimes. At first glance the issue of whether velocity is a "trend stationary" (TS) or a "differenced stationary" (DS) process may not seem particularly relevant. Indeed, some analysts appear inclined to take the position that any such discussion is irrelevant and that all discussion of velocity might be appropriately characterized as "BS."

There are two contexts in which discussion of velocity arises. The first concerns the long-run behavior of an economy, in particular, how an economic system is likely to respond to maintained changes

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The author is Professor of Economics at Michigan State University and Research Associate at the National Bureau of Economic Research. The views expressed here are solely those of the author.

in the growth rate of money. For a large class of models, the long-run or steady-state, reduced-form relationship between money and nominal income or the inflation rate is usefully summarized by the velocity concept, and those models suggest that a constant (perhaps zero) growth-rate assumption for velocity across such states is an appropriate working hypothesis.

The second context in which velocity is introduced is the one at hand, namely, the appropriate design of policy rules. The analysis of such policy rules requires a statement of the rule and a specification of the short-run (dynamic) reduced-form relationship that would prevail between money and the economic measure policymakers are trying to influence under the chosen rule. The characterization of velocity as a DS process in this study is an assumption about the short-run (dynamic), reduced-form relationship between nominal income and the money stock (or, alternatively, the monetary base). This is seen most clearly by writing the velocity equation in terms of its components:

$$\ln Y_t - \ln Y_{t-1} = a_0 + \ln M_{t-2} - \ln M_{t-3} + \epsilon_t,$$

recalling that Haraf allows for a two-quarter lag in the money stock in constructing his velocity measures.

The appropriateness of the feedback rule for monetary policy depends critically on the accuracy of the assumed reduced-form relationship between money and nominal income. Haraf's statistical analysis is directed to the narrow question of whether it is more appropriate to use a DS reduced form or TS reduced form. He rejects the latter in favor of the former. The problem with this is that we have little evidence on the robustness of this assumption on the reduced form relative to other untested hypotheses about the reduced form between nominal income and the money stock (or the monetary base). For example, the above equation resembles the well-known St. Louis reduced-form relations, although the St. Louis model specifies a distributed lag between percentage changes in the money stock (or the monetary base) and nominal income rather than the discrete lag postulated by Haraf. The St. Louis model also allows for transitory fiscal policy effects on nominal income.[1]

Haraf never tests his reduced form against the St. Louis-type alternative, nor is it clear how robust his assumed reduced form is to changes in the length of a discrete lag between nominal income and money; he simply asserts that the major conclusions of his study

[1]See Andersen and Jordan (1968) and Andersen and Carlson (1970) for an analysis of the St. Louis model.

would not be significantly affected by the use of lagged rather than contemporaneous money. There is also evidence that alternative forecasting models, with considerably different reduced-form implications, perform comparably to the DS model (Hein and Veugelers 1983).

It is also not clear whether Haraf's assumed relationship for the 1960–79 sample period is robust to the type of alternative hypothesis that he introduces to account for the post–1979 behavior of velocity. If it is appropriate to consider a shift in the drift parameter in 1979, then why not consider other shifts, such as in 1966, 1969, and 1974? A cursory examination of Haraf's charts showing velocity behavior over the entire 25-year period suggests that it would be extremely difficult to distinguish between a DS process with several discrete shifts in the drift parameter and a TS process with a broken trend at those points where the drift parameter was assumed to shift. The point here is not to argue for either of these alternative models. Rather, it is to illustrate that it is easy to be misled into accepting one hypothesis rather than a plausible alternative hypothesis once a discrete point for a parameter change can be arbitrarily selected. If the DS hypothesis were tested against the entire 1960–85 sample period, with no allowance for parameter shifts, it would be strongly rejected. Without prior evidence to explain the shift in the drift parameter in 1980, the DS hypothesis has to be regarded as suspect.

Haraf's argument in favor of the nominal income targeting rule is that it would establish a "nominal anchor" for the financial system. The "nominal anchor" characteristic that he finds desirable is the property that under such a rule the variance of the expected price level remains finite as the price level is projected infinitely into the future. A constant money growth rule cannot produce such a "nominal anchor" for the economy if the reduced form between nominal income and the money stock is not trend stationary.[2] Under such conditions, the best that a constant money growth rule can do is to produce a finite variance for the expected inflation rate as it is projected infinitely into the future.

The fundamental question posed by Haraf's paper concerns the consequences of adopting his proposed feedback rule for monetary policy *if his characterization of the reduced form between nominal income and the money stock is wrong*. This is an important issue since Haraf can only provide an estimate for his reduced form; he can never know it with certainty. His reduced form is therefore

[2]A constant money growth rule would not produce a nominal anchor if the St. Louis model were an appropriate characterization of the reduced-form relationship.

subject to specification and sampling errors. If the assumed reduced form is wrong, will the "nominal anchor" be preserved? This seems unlikely. Will the variance of the expected inflation rate remain finite over all horizons under such specification errors? If not, what is the probability that the variance will become unbounded under likely alternative specifications for the true reduced form? If there is a high probability that specification and estimation errors could cause such a result, then no-feedback rules, while not producing the best of all possible economies, may be able to minimize the probability that policymakers will badly foul up.

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