

Money Growth Variability and GNP

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RECENTLY, a number of economists have argued that sharp fluctuations in the short-run growth rate of M1 since 1979 have reduced GNP growth, raised interest rates and generated expectations of higher future inflation. Milton Friedman, for one, has concluded that variable money growth — by producing these conditions — was responsible for the shorter and more abrupt cycles in real income experienced over that period.¹ Based on slightly different analyses, Bomhoff, and Mascaro and Meltzer also have concluded that variable money growth has tended to lower the level of output.² Finally, a recent conference sponsored by The Cato Institute was devoted entirely to the adverse effects of variable money growth and methods by which money growth could be made more stable.³

Economic theory implies that variable money growth could lower the level of GNP by reducing its short-run growth rate, if this variability were associated with certain changes in money demand and velocity. This article reviews the theoretical case for such a link and provides empirical evidence on the existence of this relationship. The results support the notion that variable money growth — by increasing money demand and reducing velocity — has had significant negative effects on both the level and the growth rate of nominal GNP in recent years.

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¹Friedman (1983).

²Bomhoff (1983); Mascaro and Meltzer (1983).

³See *The Search for Stable Money* (1983).

THEORETICAL RELATIONSHIPS

The most common approach to constructing a link between variable money growth and GNP is based on intermediate relationships involving money demand. Although the theory behind these relationships suggests that more variable money growth will increase uncertainty about future economic conditions and increase the demand for money, the empirical evidence on this hypothesis has been mixed.⁴ The discussion that follows, however, proceeds with a standard model of money demand and shows how more variable money growth — by increasing uncertainty — can be linked to a decline in the level of income and, possibly, the long-run growth rate of GNP. Since the expected effects of variable money growth on inflation are assumed to be small, the conclusions that follow apply to real GNP as well.⁵

The Basic Tobin Model

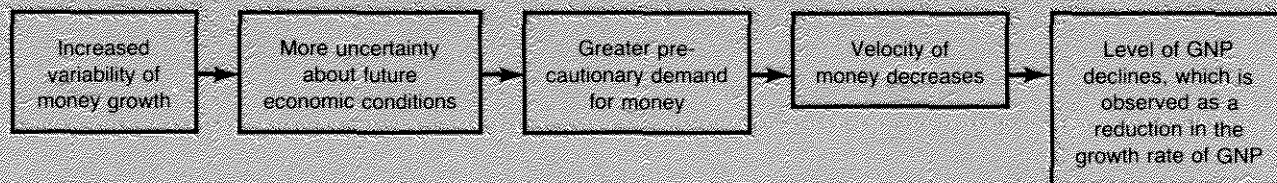
A money demand model derived by Tobin suggests that there is an explicit relationship between uncer-

⁴One statement of uncertainty's effect on money demand and interest rates is found in Friedman and Schwartz (1982), p. 39:

Another variable that is likely to be important empirically is the degree of economic stability expected to prevail in the future. Wealth holders are likely to attach considerably more value to liquidity when they expect economic conditions to be unstable than when they expect them to be highly stable. This variable is likely to be difficult to express quantitatively even though the direction of the change may be clear from qualitative information. For example, the outbreak of war clearly produces expectations of instability, which is one reason war is often accompanied by a notable increase in real balances — that is, a notable decline in velocity.

⁵For one argument to support this assumption, see Friedman.

Figure 1
The Links Between Variable Money Growth and GNP



tainty about future values of interest rates and money demand.⁶ In its most basic form, the model assumes that an individual can hold both money and government bonds in his portfolio. Moreover, if the yield on money is zero, both the expected return of the portfolio and its variance depend on only the bond yield and the proportion of the total portfolio held in bonds. Therefore, in this simple world, an individual who seeks to maximize utility by holding some combination of cash balances and bonds in his portfolio faces a tradeoff between return and risk. That is to say, he can hold more bonds and increase the return on his portfolio only at the cost of increased risk: if the interest rate rises, the value of his bonds will fall. He can reduce risk, however, only by holding more cash balances, which reduces earnings.

This model implies that risk and money demand are negatively related.⁷ If more variable money growth increases uncertainty about future values of interest rates, greater money growth variability will result in an increase in money demand. This inverse relationship has been supported empirically in several studies.⁸ What remains to be seen, however, is whether this type of shift in money demand can be linked to a decrease in the level of GNP.

⁶Tobin (1958).

⁷Some economists disagree with this conclusion. For discussions of the theoretical indeterminacy of a sign relating uncertainty to money demand and supporting evidence, see Blejer (1979), Levi and Makin (1979), Smirlock (1982), Fieleke (1982), and Berson (1983).

⁸Klein (1977), Slovin and Sushka (1983), and Mascaro and Meltzer.

Money Demand, Velocity and GNP

The sequence of events depicted in figure 1 illustrates the first-round effects of greater money growth variability on uncertainty, money demand, velocity and GNP.⁹ Reading from the figure's left side, more variable money growth is hypothesized to cause greater uncertainty about future economic conditions. Increased uncertainty increases the precautionary demand for money. A higher level of money demand implies lower velocity (V). From the equation of exchange, $MV = Y$, lower velocity clearly implies a lower level for GNP (Y). Because GNP will shift to a lower level with some lag, this level shift will be observed as a temporary decline in the growth rate of GNP. After the adjustment process is complete, the growth of GNP should return to its long-run equilibrium path unless further changes in uncertainty and risk premia (or other exogenous shocks) set off another round of shifts in the levels of money demand and velocity.

Theoretical Indeterminacy: Several Paths for GNP Are Possible

Whether increased uncertainty about future money growth has any effect on GNP, however, is an empirical issue. Moreover, if increased uncertainty does have some effect on these variables, the nature of its effect could cause GNP to follow one of several different paths. For example, if the effect of greater uncertainty is a once-and-for-all shift in money demand, the level of

⁹This figure is adopted from a similar figure in Bomhoff, p. 98.

Table 1
Estimates of a Reduced-Form GNP
Equation Adding a Measure of Money
Growth Variability

$$\dot{Y}_t = a_0 + \sum_{i=0}^n b_i \dot{M}_{t-i} + \sum_{j=0}^p c_j (\dot{EP} - \dot{P})_{t-j} + \sum_{k=0}^q g_k \text{VARM}_{t-k} + d_0 S_t + e_t$$

	Sample: II/1962-IV/1983		Sample: II/1962-III/1979	
a_0	5.536	(6.06) ¹	3.002	(1.77)
b_0	0.373	(3.70)	0.448	(2.62)
b_1	0.164	(1.48)	0.244	(1.18)
b_2	0.499	(4.63)	0.347	(2.03)
$\sum b$	1.036	(0.26) ²	1.039	(0.23)
c_0	0.000	(0.00)	-0.047	(1.26)
c_1	0.064	(1.45)	0.114	(2.12)
c_2	-0.081	(1.85)	-0.085	(1.55)
c_3	-0.011	(0.28)	-0.012	(0.23)
c_4	-0.022	(0.60)	-0.007	(0.13)
c_5	0.035	(0.97)	0.035	(0.68)
c_6	0.099	(3.25)	0.059	(1.54)
$\sum c$	0.084	(2.38)	0.057	(1.28)
g_0	0.529	(1.22)	1.596	(2.05)
g_1	-0.341	(0.58)	-1.794	(1.87)
g_2	-1.675	(3.03)	-1.034	(1.16)
g_3	1.577	(2.55)	2.541	(2.76)
g_4	0.826	(1.21)	0.590	(0.58)
g_5	-2.311	(5.06)	-1.894	(2.38)
$\sum g$	-1.395	(4.75) ³	0.005	(0.00)
S	-0.621	(3.36)	-0.634	(3.05)
\bar{R}^2	0.62		0.58	
DW	2.33		2.14	
SE	2.692		2.646	

¹ Absolute values of t-statistics in parentheses.
² This t-statistic applies to the null hypothesis $\sum_{i=0}^2 b_i = 1$.
³ The F-statistic for the null hypothesis $g_0 = g_1 = \dots = g_5 = 0$ is 10.09, which is greater than the critical value of $F_{6, 69} = 2.22$.

GNP will be permanently lower, but its growth rate eventually will return to its former path. If the shift in money demand is transitory, however, there will be a short-run decline in the growth rate of GNP, but neither the level nor the growth rate of income will be

affected permanently. A third possibility is that greater uncertainty will alter investment decisions in a manner that also changes the economy's long-run capital-labor ratio; in this case, both the level and growth rate of GNP would be permanently lower. Finally, money growth variability may have no observable effect on uncertainty, money demand and velocity; in this event, neither the level nor the growth rate of GNP would be affected. Hypotheses concerning the impact of increased money growth variability and these alternative paths for GNP are tested in the next section.

SOME TESTS OF THE HYPOTHESES RELATING MONETARY VARIABILITY TO INCOME

The effects of variable money growth on GNP can be tested by adding a measure of money growth variability to a basic reduced-form monetarist model of nominal GNP growth. The general reduced-form GNP equation to be estimated is shown at the top of table 1. This equation expresses nominal GNP growth (\dot{Y}) as a function of the growth rate of M1 (\dot{M}), the relative price of energy ($\dot{EP} - \dot{P}$), the variability of money growth (VARM) and S, a variable that denotes periods of major strikes; the strike variable is defined as the change in the quarterly average of days lost due to strikes, deflated by the size of the civilian labor force.¹⁰

The measure of money growth variability chosen is the square root of a four-quarter moving average of squared errors of money growth forecasts over the I/1950-IV/1983 sample period.¹¹ The errors then were used to construct a measure of error variability meant to represent changes in the risk or uncertainty faced by economic agents as the pattern of money growth changes. Intuitively, one might conclude that risk has

¹⁰The model chosen is discussed in Tatom (1981). The initial specification of the equation in table 1 also includes high-employment government expenditures as a right-hand-side variable. Pre-test statistics, however, indicated no significant marginal contribution to the model's explanatory power from this variable. This pre-test result is consistent with earlier studies that have found no long-run effect of government spending on GNP growth. See, for example, Andersen and Jordan (1968); Carlson (1978); and Hafer (1982). For these reasons, the variable was omitted from the equation estimated in this paper.

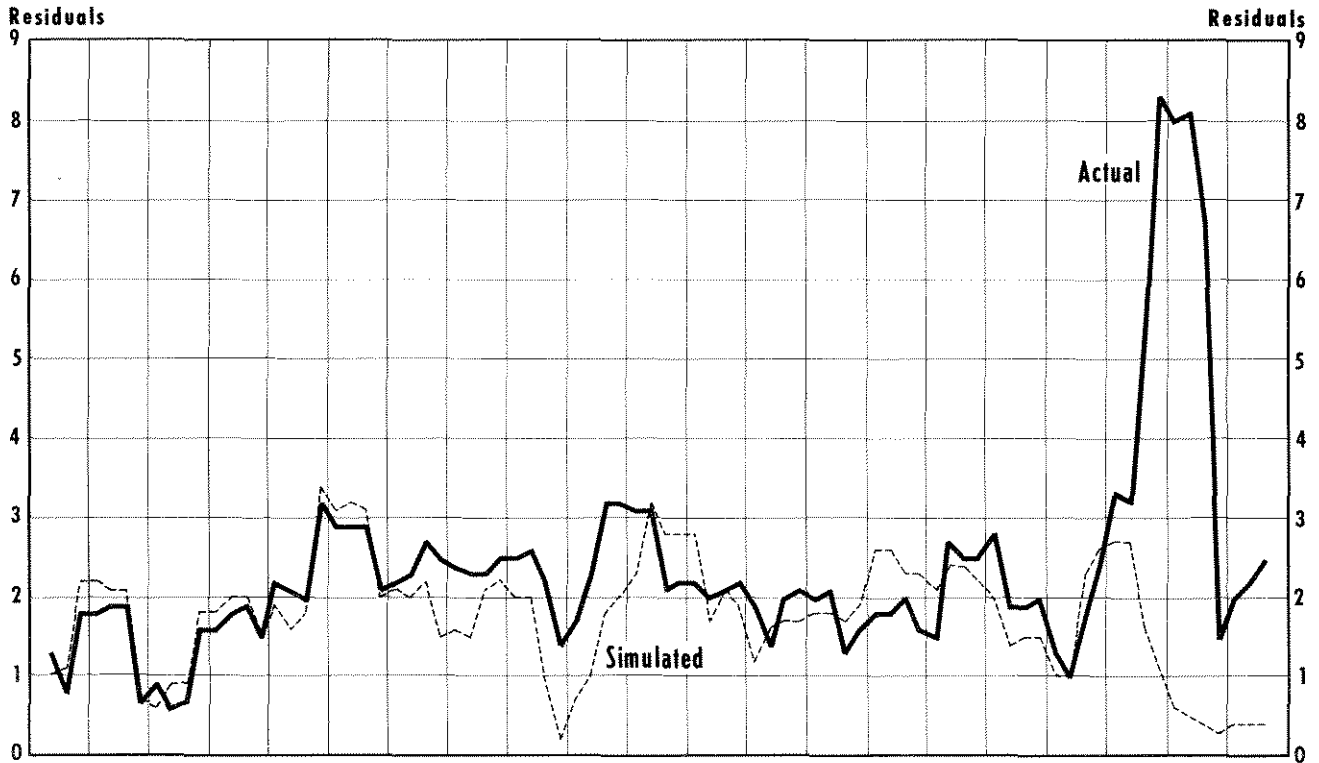
¹¹See Berson on the construction of a similar measure. The transformation is defined as:

$$[(UM_{t-1}^2 + UM_{t-2}^2 + UM_{t-3}^2 + UM_{t-4}^2) \div 4]^{1/2},$$

where UM represents unanticipated money growth, i.e., the residuals from an autoregressive model of money growth. Errors were generated by fitting a sixth-order autoregressive model to the growth rate of M1.

Chart 1

Estimates of Monetary Uncertainty Under Actual and Simulated M1 Growth



increased if forecasting errors begin to fall over an increasingly wider range. After all, the probability of making an incorrect economic decision increases with the probability of making a large forecasting error. This measure of money growth variability, represented by the solid red line in chart 1, shows that forecast errors for M1 growth have been considerably more variable since 1979.

Pre-Test Estimation and Lag Length Selection

The unknowns to be determined in this equation prior to estimation are the lag lengths for money growth, relative energy prices and money growth variability (i.e., the n , p and q shown in table 1). These values were chosen following procedures discussed recently by Batten and Thornton.¹² Pre-testing indi-

cated the use of contemporaneous and two lagged quarterly values of the growth rate of M1, contemporaneous and six lags for the relative price of energy, and contemporaneous and five lags for the measure of money growth variability.¹³

The choice of five lags for the measure of money growth variability reflects the lagged responses of money demand, velocity and GNP suggested by theory and depicted in figure 1. That is to say, increased variability in money growth is expected to affect GNP only after some lag; economic agents require sufficient time both to discover the wider band of errors on money growth forecasts and to adjust their behavior accordingly. To test whether increased uncertainty

Geweke and Meese (1981); Mallows (1973); Schwartz (1978); Akaike (1969); and Pagano and Hartley (1981).

¹³The Pagano-Hartley t-ratios, final prediction errors and Mallows' test statistic all suggested these lag lengths. These lag lengths were fitted and chosen using ordinary distributed lag models without polynomial smoothing.

¹²Batten and Thornton (1983a, b) summarize an approach to the selection of lag length and polynomial degree based on the work of

Table 2
Implications of Alternative Pairs of Test Results for Estimated Coefficients on Monetary Variability

Practical Implication	Individual Coefficients	Sum of Coefficients
1) Neither the level nor the growth rate of GNP is affected	each equals zero	equals zero
2) The level of GNP is temporarily or permanently lower but its long-run growth rate is unaffected	some initial coefficients are significantly negative	equals zero
3) Both the level and long-run growth rate of GNP are permanently lower	some initial coefficients are significantly negative	is significantly negative

has an effect on the level of income, the relevant null hypothesis is $g_0 = g_1 = \dots = g_5 = 0$, as shown in table 2. Failure to reject this hypothesis would imply that money growth variability had no effect on GNP.

If one or more individual coefficients indicate a statistically significant *negative* relationship between GNP growth and money variability, the second issue of interest is whether this effect on the level and the growth rate is transitory or permanent. In other words, it is important to know whether greater money growth variability causes a temporary or permanent reduction in the level and growth rate of GNP. This result can be

determined by testing the null hypothesis that $\sum_{k=0}^5 g_k = 0$. If this sum is not significantly different from zero but some individual coefficients are significantly negative, the results would imply a transitory decline in the growth rate of GNP and either a temporary or permanent reduction in its level. If this hypothesis also is rejected, however, it can be determined that both the level and growth rate of GNP are permanently lower. Implications of possible test results are summarized in table 2.

TESTING THE IMPACT OF VARIABLE MONEY GROWTH

The results of estimating the augmented GNP equation over the II/1962–IV/1983 sample period are given in the first column of table 1. The results reject each of the null hypotheses discussed above: some initial individual coefficients for money growth variability are significantly negative and their sum is significantly nega-

tive. Within the context of the specified equation, these results indicate that greater short-term variations in the rate of money growth tend to increase uncertainty and money demand; as a result, permanent reductions in both the level and the growth rate of nominal income are produced.

It also is important to note that the sum of the coefficients on money growth ($\sum_{i=0}^2 b_i$) is not significantly different from one after the addition of a direct measure of money growth variability. This shows that the one-to-one long-run correlation between the growth rates of money and nominal GNP remains, even after the effect of variable money growth is directly taken into account.¹⁴

The significance tests on the other variables included in the regression indicate that the strike variable has negative effects on income growth. Also, changes in the relative price of energy have exhibited some significant positive long-run effects on GNP growth. This latter result is not surprising; the impacts of short-run changes in relative energy prices are usually measured as changes in inflation. Thus, the relative energy price effect shows up in nominal GNP (via the price change); and this explains the positive sum coefficient for relative energy prices in this model.

¹⁴These results hold for a variety of variability measures, including a moving standard deviation of money growth, squared money growth rates and a multi-state Kalman filter estimate of the variance of errors associated with one-quarter-ahead forecasts of money growth. Unlike the criticisms of Allen with regard to uncertainty results for money demand, these results for a GNP equation appear to be robust with respect to the measurement of money growth variability. See Allen (1982).

Robustness

As a check of the model's robustness, the equation in table 1 was re-estimated over a shorter II/1962–III/1979 sample period. This period was chosen for two reasons. First, the Federal Reserve changed its operating procedures in October 1979. Second, as shown in chart 1, there was a sharp increase in money growth variability after IV/1979. The results of re-estimating the GNP equation over the shorter sample period with new values for VARM are given in the second column of table 1.¹⁵

The results for the shorter estimation period still indicate that variable money growth temporarily lowers the growth rate of GNP. The long-run impacts on the level and growth rate of GNP, however, are no longer significantly different from zero. Apparently, the considerably lower variability of money growth that existed prior to 1980 did not produce any long-run impact on the growth of GNP. Or, viewed differently, even though variable money growth has a significantly negative effect on GNP in both periods, permanent reductions in its level and growth rate are found only after 1980, when the variability of money growth tripled.

The effects of money growth and relative energy prices also follow lag patterns similar to those for the longer sample period. However, the long-run effect of relative energy prices is no longer significantly positive.

The only other apparent change from the full period estimation to this restricted one is a decline in the estimated growth rate of velocity (the model's constant term) to 3.0 from 5.5. However, since the growth rate of

velocity in this model is really $a_0 + \sum_{k=0}^5 g_k$, the implied

velocity growth for the full-sample model is actually 4.14, which is not significantly different from 3.0.¹⁶ In all other respects, the results for both models are qualitatively similar and would seem to indicate that the addition of a money variability measure is robust with respect to choice of sample period.

¹⁵To reflect the less volatile pattern of money growth that prevailed prior to 1980, the autoregressive model of money growth used to generate values for the money variability measure was re-estimated. An AR(1) model was found to whiten the residuals for a model of money growth estimated over the pre-1980 sample.

¹⁶The F-statistic for $H_0: a_0 + \sum_{k=0}^5 g_k = 3.0$ is 1.83, less than the critical value for $F_{1, 60} = 4.00$.

SOME IMPLICATIONS OF REDUCED MONETARY VARIABILITY FOR MONETARY POLICY

The estimates reported in table 1 support the hypothesized negative relationship between variable money growth and GNP discussed elsewhere.¹⁷ However, the statistical measure of money growth variability is not expressed in units that have a clear economic meaning. Therefore, the results in table 1 may be difficult to interpret directly, especially for policy purposes. It may be useful to illustrate more intuitively why some economists are concerned about the potential negative effects of money volatility. This is done below by using the equation in table 1 to repeat an experiment recently suggested by Friedman.¹⁸

Friedman asked what the path of GNP would have been in recent years if the money stock had grown at the following rates over these intervals: 7.1 percent from III/1979 to III/1980; 6.1 percent from III/1980 to III/1981; and 5.1 percent from III/1981 to III/1982.¹⁹ The 6.1 percent three-year average growth rate described above is equal to its actual average over the same period. The plots of both actual M1 growth and Friedman's smoothed money path are shown in the upper panel of chart 2.

While maintaining the same average growth rates of money over four quarters, the Friedman scenario significantly reduces the large quarter-to-quarter variations in M1 growth that actually occurred over this period. This result is shown clearly by the sharp decline in money growth variability that is generated by these data; this new measure of monetary uncertainty is represented by the dashed line in chart 1. Over the III/1979–III/1982 period, the more stable path of M1 growth would have produced — in terms of Friedman's analysis — a longer but less severe recession in 1980 and, beginning around mid-1981, an expansion typical of the postwar period (lasting about three years). The projected path of GNP under stable M1 growth is contrasted in the lower panel of chart 2 with the projected path of GNP under actual money growth.

The solid black line in the lower panel of chart 2 is the path of GNP produced by a simulation of the model reported in the second column of table 1 based on the

¹⁷For example, Friedman and Schwartz (1963b); Friedman; *The Search for Stable Money*.

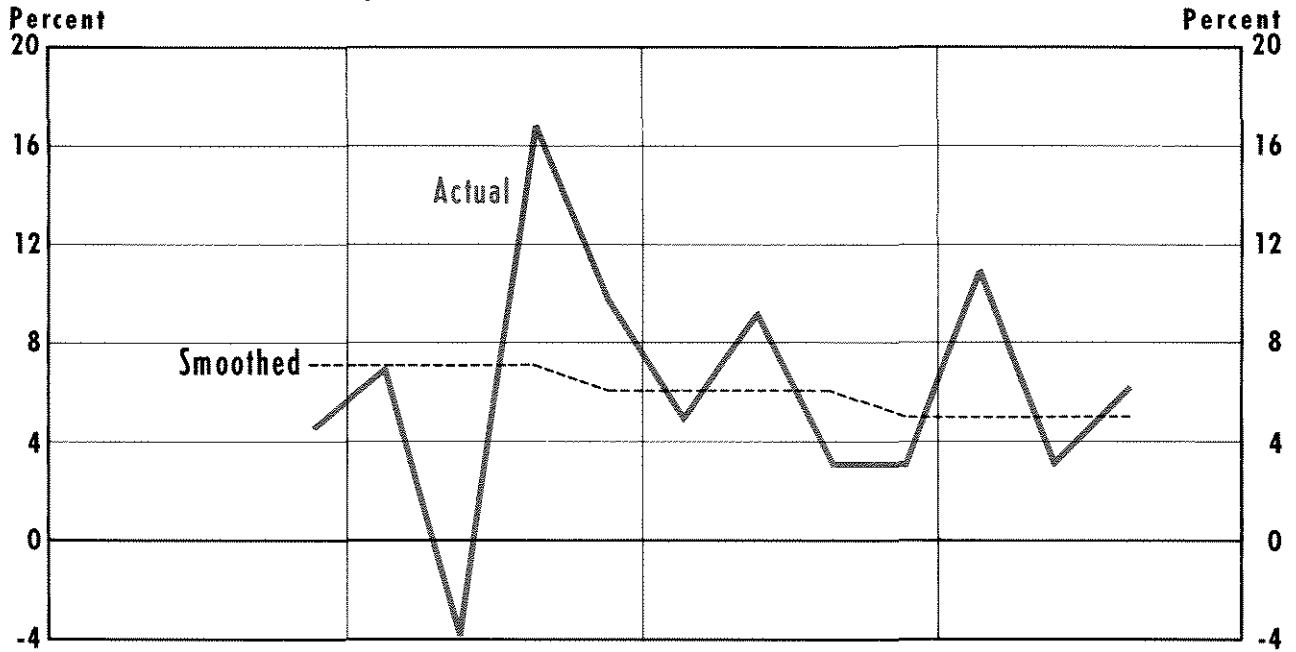
¹⁸Friedman.

¹⁹The experiment stops at this point because money growth accelerated sharply and varied substantially over subsequent quarters.

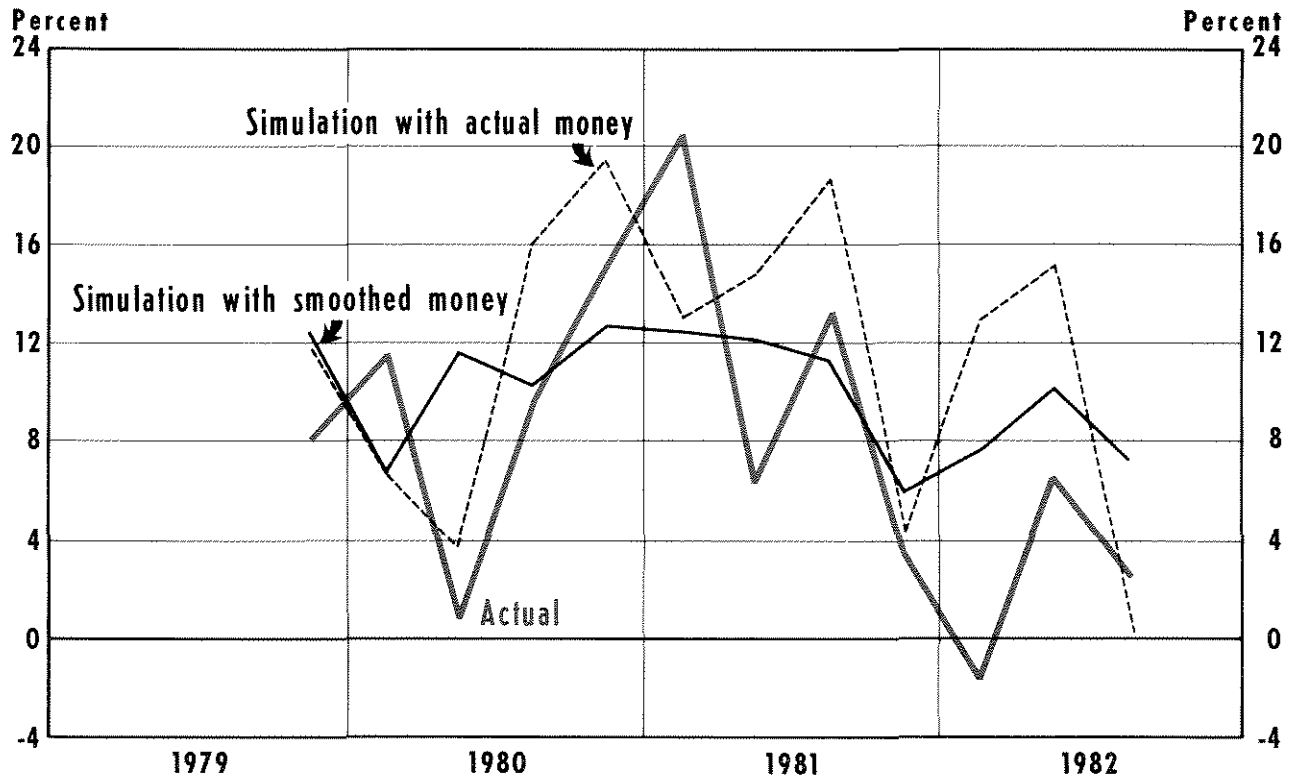
Chart 2

GNP Growth and Alternative Money Growth Paths

Actual and Smoothed Money Series



Actual and Smoothed Paths of GNP Growth



smoothed money growth figures listed above.²⁰ The results are quite similar to Friedman's conjecture; moreover, they depict clearly what some economists claim are the prospective benefits of more stable money growth. The simulated path of GNP growth — under reduced quarter-to-quarter variation in M1 growth — shows higher average growth and much narrower variation than does actual GNP growth over this period. For example, actual GNP growth ranged between -2 and 20 percent; under more stable money growth, however, the simulated rates of growth in GNP vary between 7 and 12.5 percent. Moreover, while simulated GNP growth using actual money growth rates fell to zero in III/1982 and was 5 percent or below in three of the 12 quarters shown, the simulated path of GNP growth under less variable money growth fell below 7.5 percent on only one occasion. In summary, the contrasting results shown in chart 2 suggest that more stable money growth could promote a higher average level of GNP growth and reduce the range in which GNP growth fluctuates.

CONCLUSIONS

A number of recent studies have argued that variability in the quarter-to-quarter growth rate of money has increased money demand and, therefore, decreased the growth rate of GNP in the short run. This article investigates the link between variable money growth and GNP by adding a measure of money growth variability to a specific model of GNP.

The results suggest that increased quarter-to-quarter variation in the growth rate of M1 has some transitory negative effects both on the level and growth rate of nominal GNP; moreover, in more recent years, when the variation in money growth has increased nearly threefold, there is some evidence that the effects on the level and growth rate of GNP have been permanent reductions. If the effect of money variability on inflation is small, as is generally thought, these results imply a permanently lower level and, perhaps, smaller growth rate of real GNP.

²⁰The dashed line was derived by using actual money growth rates and the errors from an autoregressive model fit to actual money data. These data provided the basis for projected GNP growth from III/1979–III/1982 under actual monetary conditions. Actual M1 data then were replaced with Friedman's figures for the III/1979–III/1982 interval. The autoregressive model for money growth then was re-estimated over I/1960–III/1982 to generate a new error series and a new measure of money growth variability. The coefficient estimates reported in the second column of table 1 were used to re-simulate GNP growth over 1979–82 in an environment of more stable money growth. These simulated results are shown by the solid black line in chart 2.

A simulation experiment based on these results illustrates the potential benefits of more stable money growth. Within the context of the model used, growth in nominal GNP would have been higher, on average, and more stable since 1979 if the quarter-to-quarter growth in M1 had been substantially less variable than it actually has been since then.

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