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WHAT WOULD NOMINAL GNP TARGETTING DO TO THE BUSINESS CYCLE?

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Many economists have recently proposed nominal GNP targetting as a new rule for monetary policy.[1] Nominal GNP targetting is typically viewed as an alternative to money-growth targetting. It prescribes that policymakers should aim to keep nominal GNP--rather than the money supply--growing along a target path. The rule seems attractive for two reasons. First, it would automatically call for an offsetting adjustment in money growth in response to velocity shocks and this should stabilize real GNP. Second, it would automatically call for a reduction in real GNP growth in response to price shocks and this should stabilize inflation.

The rule also has the virtue of simplicity. Explaining how it works to policymakers seems easy. Consider the typical explanation of the two automatic adjustments. (1) Nominal GNP is the product of money and velocity. The rule is to keep nominal GNP on a fixed target: when velocity goes down, money must be increased by an equal amount. Hence, velocity shocks are automatically offset. (2) Nominal GNP is also the product of the price

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[1]For example, see Feldstein (1984), Gordon (1983), Hall (1983), Meade (1978), and Tobin (1980, 1983). Criticisms of nominal GNP targetting are found in Brunner (1983) and Poole (1980). Bean (1983) provides a careful theoretical analysis of the implications of nominal GNP targetting in a model with sticky wages where the demand for labor depends on the real wage. His conclusion that nominal GNP targetting is preferable to money targetting if the price elasticity of aggregate demand is less than unity corresponds to section I of this paper in the case where output stability (defined in terms of the deviations of output from full information output) is the sole criterion of macroeconomic performance. If price stability is also a goal, then an extremely steep aggregate demand curve (that is, an extremely accommodative policy) might not be desirable as is shown in Section I below.

level and real GNP. With a nominal GNP rule, when the price level goes up, real GNP goes down by an equal amount. The resulting slack in the economy will then put downward pressure on the price level, and as it does real GNP will recover.

The purpose of this paper is to examine, in somewhat more detail than the previous paragraph, the effect that nominal GNP targetting would have on macroeconomic fluctuations. The paper focuses on two questions. What would nominal GNP targetting do to the *impact* of shocks that *initiate* cyclical fluctuations? What would it do to the *propagation* of these shocks that *perpetuate* cyclical fluctuations? The main point of the paper is that the propagation effect of nominal GNP targetting is at least as important for the business cycle as the impact effect. Unfortunately, the simple rationale for nominal GNP targetting described in the previous paragraph pertains almost entirely to the impact effect and is thus an oversimplification of the issues. The propagation effect is much more difficult to analyze, let alone explain in simple terms, because it involves the complex dynamic interaction between policy instruments and targets.

One of the serious dynamic problems with proposals for nominal GNP targetting is that the proposals do not come to grips with the well-known lag--emphasized by Milton Friedman (1969)--in the effect of the policy instruments on real GNP and the price level. The dynamic effects depend on whether the nominal GNP rule is of the feedback variety--as in a feedback money rule--or whether it is a more rigid k percent rule. The various proposals for nominal GNP targetting differ on whether the targets should be adjusted in response to the state of the economy. For example, Robert Hall (1983) proposes: "Once and for all, Congress would adopt a target path for nominal GNP. In the future, if nominal GNP were above path, monetary policy would be judged excessively expansionary and would be required to contract as necessary to bring nominal GNP back to path. If the economy slipped below path, monetary expansion would be called for." In reacting to Hall's proposal for nominal GNP targetting, James Tobin (1983) says, "I like it too, provided the numerical targets are subject to annual revision. Each year a five-year projection of nominal GNP, agreed upon by the administration, Congress, and the Fed, would announce the intention of policymakers. The first year of the projection would be a firm commitment. The implied one-to-one price-output tradeoff may not accord perfectly with social priorities, but its simplicity is a major compensating advantage. But let the longer-run target path be reconsidered annually in light of experience and the state of the economy."

In fact, there is even disagreement about whether nominal GNP targetting refers to the *growth rate* of nominal GNP, with full base drift, or whether it refers to the *levels* of nominal GNP along a growth path with no base drift. Yet the distinction is of enormous importance for the dynamics. In examining Robert Gordon's (1983) proposals for nominal GNP targetting, Karl Brunner (1983) assumes that it is the growth rate that is targetted with full base drift. On the other hand, Hall's proposal clearly focuses on the levels of nominal GNP along the growth path with no base drift.

The next section starts with a brief examination of the impact effect of nominal GNP targetting using a simple static aggregate supply-demand set-up. I then go on to set up a simple dynamic framework to examine the propagation effects of various proposals.

I. THE IMPACT EFFECTS OF GNP TARGETTING IN A TEXTBOOK MODEL

No one should be interested in the fluctuations in nominal GNP per se. The macroeconomic quantities of interest are the fluctuations in real GNP and the price level--the components of nominal GNP. In this sense nominal GNP is not a *final* target; rather, it is an *intermediate* target. Therefore, it should be evaluated as an alternative to other intermediate targets.

In this section I focus on the money supply (say M1) as the alternative intermediate target. An important difference between nominal GNP and M1 as intermediate targets is that the instruments of monetary policy--reserves, the monetary base, or the federal-funds rate--affect nominal GNP with a longer lag. In this section I abstract from this difference and focus entirely on the impact effects as if there were no difference in the time of the impact. It is assumed that nominal GNP and M1 can be controlled equally well and that the rule for policy is that each be fixed for the period of analysis. This permits the use of a simple textbook model of aggregate demand and aggregate supply.

Figure 1 shows an aggregate demand curve and an aggregate supply curve corresponding to an elementary textbook macro model. The price level P is on the vertical axis and real output Y is on the horizontal axis. The aggregate supply curve could be due either to a Lucas-type information-based theory or to a sticky price-adjustment theory. In the latter case it is misleading to refer to the curve as a "supply" curve; rather, it is

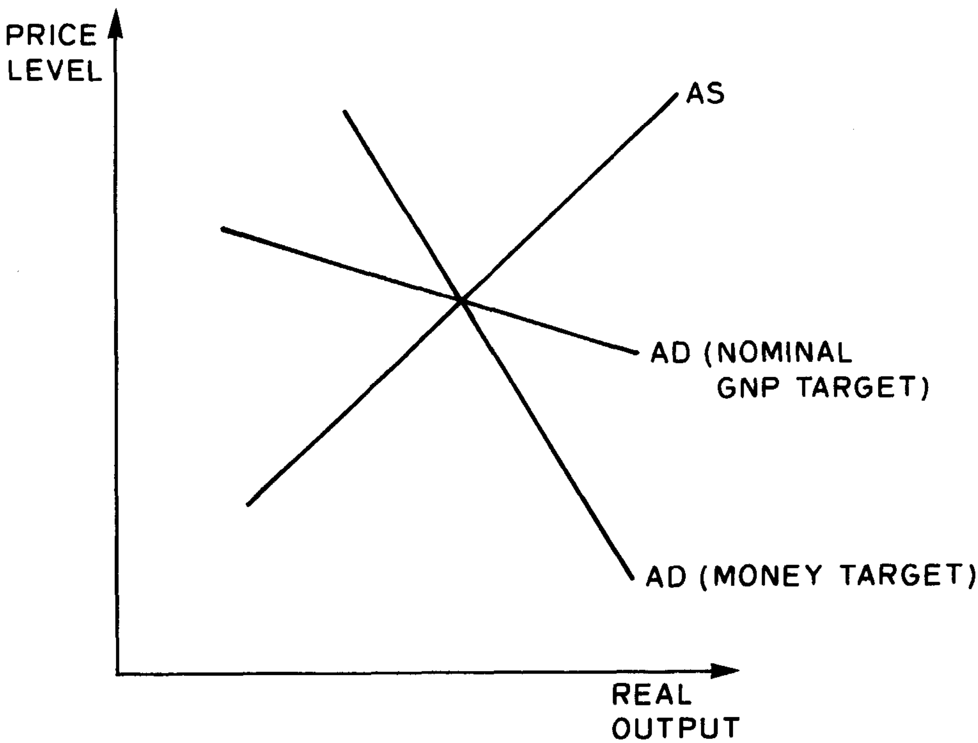
PRICE LEVEL
AS
AD (NOMINAL GNP TARGET)
AD (MONEY TARGET)
REAL OUTPUT

FIGURE 1

simply a price-adjustment curve that shows how prices adjust when real output deviates from potential output. The supply terminology is in keeping with that of existing elementary textbooks.

The *slope* and the *shifts* of the aggregate demand curve depend on whether nominal GNP or the money supply is the intermediate target. If nominal GNP is the intermediate target, then the aggregate demand curve is an hyperbola. If nominal GNP is fixed, then the aggregate demand curve never shifts. If the money supply is the intermediate target, then the slope of the aggregate demand curve depends on the elasticity of money demand with respect to interest rates and on the elasticity of real spending with respect to interest rates. A probable range of numerical values for these elasticities will be considered below. If the money supply is the target, then the aggregate demand curve will shift whenever there is a shift in velocity. In this reduced form set-up, the curve will shift when the demand for money shifts or when there is an autonomous shift in real spending.

Velocity Shocks

When the aggregate demand curve shifts, there is an impact on real output and on the price level. (The shifts should be thought of as unanticipated.) It is clear therefore that in principle, nominal GNP targetting is superior to money targetting with respect to the impact effects of velocity shocks. A nominal GNP target cushions the impact of such shocks, while the money supply target provides no cushion.

Price Shocks

A "supply" shock, or a price shock, is a shift of the aggregate supply curve. The impact of such a shock depends on the slope of the aggregate demand curve. If the aggregate demand curve is very steep, then a shift in the supply curve will have a large impact on the price level and a small effect on real output. This would represent an accommodative policy. A flat aggregate demand curve would cushion prices more than real output. This would represent a nonaccommodative policy. Which intermediate target--money or nominal GNP--gives rise to the steeper aggregate demand curve?

Table 1 shows the estimates of a simple money demand function for M1 estimated in logs. According to these estimates when M1 is targetted, the slope of the aggregate demand curve measured in logs is $-(.23 - .096b)$, where $b < 0$ is the slope of the log-IS curve. The slope of the aggregate demand curve for nominal GNP targetting is -1. The aggregate demand curve

TABLE 1

Money-Demand Function

Sample: 1954-83

Dependent variable: log(M1/P)

	Coef.	t-stat
$\log(M1/P)_{-1}$	.627	4.0
log(Y)	.229	4.5
log(R)	-.097	-3.4
Constant	.408	0.4

R^2 = .92 ρ = .59 σ = .017

Note: The estimation method is two-stage least squares with a serial correlation adjustment. P is the GNP deflator, Y is real GNP, R is the six-month commercial paper rate, σ is the standard error of the regression, and ρ is the first-order correlation coefficient. All data are based on annual averages.

will have a slope of -1 for money-stock targetting if b is equal to about -8. The aggregate demand curve for money-stock targetting is steeper than in the case of nominal GNP targetting for b larger than 8 in absolute value. Equivalently stated, if the short-run elasticity of real GNP with respect to the interest rate is between 0 and -.125, then money-stock targetting is more accommodative to price shocks than nominal GNP targetting. In the short run the elasticity is bound to be within this range. In the very short run the elasticity is near 0. This is the case where the IS curve is vertical, and money stock targetting is completely accommodative. Only after a period of time would the elasticity be larger than .125 in absolute value. In any case money-stock targetting has the advantage of being more accommodative in the short run than in the long run. The impact of price shocks on real GNP is cushioned more by a money-stock target than by a nominal GNP target.

Instrument Adjustments and the Slope of Aggregate Demand

In practice the nominal GNP target could be more responsive to price shocks than this simple analysis suggests. Rather than holding nominal GNP perfectly constant, the rule would call for an increase in the interest rate, the monetary base, or reserves--whenever nominal GNP deviated from its path. For example, if the reaction occurred within the period, then the money-demand equation might be replaced by $\log(R) = g(\log(PY) - \log(N^*))$, where R is the interest rate, and N* is the target for nominal GNP. Then the slope of the aggregate demand curve is $(b-g)/g$. When nominal GNP is held perfectly fixed, g is equal to infinity, in which case the slope of the aggregate demand curve again equals -1. This special case results in the one-to-one tradeoff. For values of g smaller than this, the aggregate demand curve is steeper. Thus, the choice of the reaction coefficient g affects the amount of accommodation provided by a nominal GNP rule. A very sensitive reaction would give the one-to-one tradeoff.

Few of the proposals for nominal GNP targetting are specific about which instruments would be adjusted and by how much in response to deviations of nominal GNP from target. An interest-rate reaction rule has many of the disadvantages of any interest-rate target. To be effective the interest rate should be the real after-tax interest rate, which requires that the expected rate of inflation and the effects of taxes be taken into account.

II. PRICE AND OUTPUT DYNAMICS IN THE UNITED STATES

To examine the propagation effects of nominal GNP targetting, I first consider a simple dynamic model of output and inflation in the United States. The model is a dynamic version of the static two-equation model described in the previous section. I then examine how a nominal GNP targetting rule would affect the dynamics.

The model is given with empirically estimated coefficients (t-values in parentheses) for the 1954-1983 sample period as follows:

$$p_t = \underset{(10.1)}{.89p_{t-1}} + \underset{(3.6)}{.25E_{t-1}y_t} + \underset{(1.3)}{.55}, \tag{1}$$

$$y_t = \underset{(-3.5)}{-1.01p_{t-1}} + \underset{(2.5)}{.69p_{t-2}} + y_{t-1} + \underset{(1.6)}{1.17}. \tag{2}$$

The variables in (1) and (2) are detrended real output (y) and inflation (p). More explicitly $y = (Y-Y^*)/Y^*$ and $p = (P-P_{-1})/P_{-1}$, where Y is real GNP and P is the GNP deflator. All data are annual. Potential output Y^* is assumed to grow at 3 percent per year, the average growth rate of real GNP during this sample period, with a level such that the average of y in the sample period is zero. The notation E_{t-1} represents the rational expectation based on information through period t-1. The numerical values shown in equations (1) and (2) were obtained by the maximum likelihood method which takes account of the cross-equation restrictions as explained in more detail in Taylor (1985). The cross-equation restrictions occur because expected output in the first equation is based on the behavior of output in the second equation.

The first equation corresponds to a *dynamic* aggregate supply function, and the second equation corresponds to a *dynamic* aggregate demand function. The aggregate supply function is essentially a Phillips curve relation with expectations of demand pressure (as measured by y) affecting price decisions. I suppose that this aggregate supply function can be taken as structural for the type of policy rule changes that we consider below.[2] Notice that this equation implies that output could be driven permanently above normal by maintaining a permanently high inflation rate. In my view the equation would shift if such a policy were instituted, but such policy intervention is not considered in this paper. Although it would be possible to constrain the coefficient of lagged inflation to be one (as in Taylor (1979)) and thereby impose a vertical long-run Phillips curve, this constraint is not consistent with the data for this sample period. Note also that I have assumed in this functional form that *current* output does not affect inflation. This corresponds with the timing assumption made in my previous work (e.g., Taylor (1979)) and captures the fact that inflation reacts to aggregate demand disturbances with a lag.

The form of the second equation was chosen simply to fit the data; a structural interpretation of the equation is given in the next paragraph. It is a second-order autoregression with certain coefficients constrained to be one or zero. In a more general second-order autoregression, output lagged two periods has a coefficient insignificantly different from zero, and output lagged one period has a coefficient insignificantly different from one. As with equation (1) it is assumed that there is no *current* relation between output and inflation in equation (2). Hence, in comparison with the simple static model, the dynamic model assumes that all interaction between output and inflation is through lags with no simultaneous effects. The static model assumes the opposite: all interaction occurs simultaneously with no lags. It would, of course, be possible to generalize the dynamic model and allow for current effects. But there are many alternative possibilities. For example, we could allow current real output in the first equation, but not allow current inflation in the second equation, or vice versa. More generally, there is a whole continuum of assumptions about how large the current impacts are in the two equations. Without knowledge of the correlation between the structural disturbances, it is not possible to identify any one value in this continuum. Rather than consider all these possibilities, I focus on the structural assumptions made above. That all the interaction occurs with a lag is a

[2] Both the coefficient of lagged inflation and the coefficient of expected demand would probably change with a change in policy regime. For example, the coefficient of lagged inflation would decline if policy became less accommodative, for then inflation would be less persistent. In this paper I do not formally model these effects.

convenient conceptual simplification and perhaps not a bad approximation. Examining the robustness of the policy results reported below to some of the alternative assumptions would be a useful extension.

The estimated aggregate demand function in equation (2) can be interpreted as a policy-reaction function in operation during the sample period. The growth rate of real GNP declines relative to trend when the inflation rate is high and declines even more when the inflation rate is rising. This strong negative reaction of real GNP growth to inflation is most likely due to the policy response of the Fed, even if it is only implicit in the nature of Fed decision-making. Examples of this type of behavior are the periods of monetary stringency in the face of inflation in 1966-67, 1969-70, 1973-74, 1979-81.

Except for the presence of the lagged inflation rate, equation (2) has the appearance of a type of nominal GNP rule: real GNP falls one-to-one with inflation in the short run, much as a nominal GNP rule would imply. But there are also other terms in the equation that affect the dynamics of aggregate demand. If a new nominal GNP targetting rule is to reduce business-cycle fluctuations, it needs to eliminate some of the dynamics implicit in this estimated reaction function.

Using equation (2) to substitute for $E_{t-1}y_t$ in equation (1) results in a constrained bivariate vector autoregression for real GNP and the inflation rate. This constrained vector autoregression is insignificantly different from the unconstrained vector autoregression, and in this sense the two-equation model fits the data. It is useful to look at the infinite moving average representation implied by this autoregression. The moving average representation is simply a description of how the variables respond to shocks to either the output equation or the inflation equation. It gives a characterization of the business-cycle dynamics.

Table 2 shows the moving average representation for inflation p and real output y based on the model in equations (1) and (2). The columns of Table 2 give the moving average coefficients for each year until the effect dies out or develops an obvious pattern. The column labeled "py" gives the impact of an output (equation (2)) shock on inflation, and the column labeled "yp" gives the impact of an inflation (equation (1)) shock on output. The "yy" and "pp" columns give the effect of shocks to each variable on itself. According to this characterization of cyclical fluctuations, there are two types of shocks hitting the economy. I identify one shock--that to the inflation equation--with aggregate supply disturbances, and the other shock--that to the real output equation--with

TABLE 2

Moving Average Representation for Inflation and Output,

1954-83

pp	yp	py	yy
1.00	.00	.00	1.00
.64	-1.01	.24	1.00
.32	-.97	.40	.75
.08	-.86	.49	.51
-.11	-.71	.51	.29
-.23	-.54	.48	.12
-.30	-.38	.42	-.02
-.33	-.24	.35	-.11
-.32	-.11	.27	-.17
-.29	-.02	.19	-.20
-.24	.06	.11	-.21
-.19	.10	.05	-.19
-.14	.13	.00	-.17
-.09	.14	-.03	-.14
-.05	.13	-.05	-.10

Standard deviation of

inflation shocks = 1.0 percent

output shocks = 2.1 percent

Correlation between shocks = .23

aggregate demand disturbances. The standard deviations and correlation between the two shocks are shown at the bottom of Table 2. There is some positive correlation between the shocks. Demand shocks have a larger standard deviation than inflation shocks.

The four columns of moving average coefficients can be given the following interpretation: (1) positive shocks to inflation are persistent but not permanent; eventually the effect of an inflation shock overshoots and then returns to the mean; (2) positive shocks to output cause inflation to rise due to the positive effect of tight markets on prices; (3) positive shocks to inflation cause output to fall because the Fed does not fully accommodate the inflation; (4) positive shocks to output cause a boom but eventually lead to a slump because the inflation caused by the boom requires a subsequent recession to get rid of the inflation.

It is tempting to call the dynamics in the first two columns of Table 2 a "supply-shock theory" of the cycle: supply shocks cause inflation which in turn causes a recession as the Fed tries to get rid of inflation. Similarly, the last two columns can be thought of as a "boom-bust theory" of the cycle in which positive shocks to aggregate demand--due perhaps to money shocks--eventually bring about a recession as the Fed reacts to the inflation originally caused by the boom. During this sample period, the boom-bust theory accounts for a larger fraction of the variability of output and inflation than does the supply-shock theory. This is primarily because the standard deviation of supply shocks is about half as large as the standard deviation of demand shocks.

III. THE EFFECT OF ALTERNATIVE NOMINAL GNP TARGETS ON THE CYCLE

In this section I examine the effect of alternative nominal GNP targetting rules on the business cycle. This is done simply by replacing the historical policy rule in equation (2) with alternative nominal GNP rules. I then look at the effect on the dynamics of the cycle by examining how this replacement affects the infinite moving average representation.

Growth-Rate Rules

Consider first the case where the growth rate of nominal GNP is targetted each year at a constant rate, regardless of conditions at the start of the year. There is no correction for mistakes in the previous year. Suppose that the rule stipulates that nominal GNP will grow at 3 percent each year. This rule is consistent with an average inflation rate of zero since potential real GNP grows at 3 percent per year. The algebra of this rule is

$$y_t = y_{t-1} - p_t. \tag{3}$$

Because y is the proportional deviation of real GNP from a 3 percent growth trend, the change in y plus 3 gives the growth rate of real GNP. The growth rate of nominal GNP is therefore equal to the change in y plus 3 plus the rate of inflation p. The 3 percent per year target for nominal GNP therefore implies equation (3).

Table 3 shows the moving average representation for output and inflation when this rule is used. As before, we consider unit shocks to each of the two equations to trace out the dynamics. Comparing Table 3 with Table 2 gives an estimate of how a nominal GNP growth-rate rule would work. The comparison implicitly assumes that price setting is unaltered by the change in the rule. The size of the demand shocks is also assumed to remain unchanged, so that the nominal GNP rule is not getting credit for possibly reducing the size of the shocks to the aggregate demand curve in this comparison.

Compared to the actual policy, the nominal GNP rule reacts more quickly and by a larger amount to price shocks (the yp column). Note that part of this reaction comes in the year of the shock, as the increase in inflation immediately reduces real output by the same amount. Again, this is the one-to-one price-output tradeoff implicit in a nominal GNP rule. Overall, the nominal GNP rule is less accommodative to price shocks than the historical policy. There is also a larger overshooting of the inflation rate, which indicates that there is an over-reaction to this type of nominal GNP rule. The boom-bust cycle (yy) is also larger for the nominal GNP rule. The nominal GNP rule does not do much to improve the business-cycle dynamics.

An alternative to the GNP rule in equation (3) would have real GNP react to the lagged inflation rate rather than to the current inflation rate. That is,

$$y_t = y_{t-1} - p_{t-1}. \tag{3a}$$

This might be one way to model lags in the effect of policy. It also provides an interesting comparison with the estimated reaction-function for

TABLE 3

Cyclical Behavior of Inflation and Output

When a Nominal GNP Growth Rule is Used

pp	yp	py	yy
1.00	-1.00	.00	1.00
.51	-1.51	.20	.80
.06	-1.57	.30	.50
-.27	-1.30	.32	.18
-.45	-.85	.26	-.08
-.49	-.36	.17	-.25
-.42	.07	.07	-.32
-.29	.35	-.01	-.31
-.13	.49	-.07	-.24
.00	.39	-.10	-.14
.10	.24	-.10	-.04
.15	.09	-.08	.04
.13	-.04	-.05	.08
.08	-.12	-.02	.10

Note: The columns are the infinite moving average representation of the model obtained by replacing equation (2) with equation (3).

policy: to get this rule we simply omit the second lag in inflation in equation (2). The effect of this rule on the business cycle is shown in Table 4.

The economic dynamics in Table 4 are considerably worse than those in Table 2 and Table 3. The swings from boom to bust are larger and the recessions following an inflation shock are also larger. Overall, the business-cycle fluctuations are larger under a nominal GNP rule of this type than under the policy-reaction function used in the 1954-83 period. It would certainly not be a good idea to target nominal GNP in this way. The dynamic properties of the current system are much better.

A Modified GNP Rule

The problem with growth-rate rules for nominal GNP is that they overshoot the final equilibrium after supply or demand shocks. Such dynamics are an important disadvantage of these types of nominal GNP rules. An alternative rule would have the *level* of real GNP relative to trend (rather than the growth rate of real GNP) react to inflation on a one-to-one basis. One such rule would keep the inflation rate plus the proportional output deficiencies constant; that is,

$$y_t = -p_t \quad (4)$$

where the constant is omitted. Note that this is a modified nominal GNP rule because inflation rather than the price level is on the right-hand side. Its dynamic properties are better than a nominal GNP rule (assuming that the price-adjustment equation (1) is accurate) as we indicate below.

Table 5 shows the moving average representation for the case of (4), assuming again a unit price and demand shock. Note that this rule does not generate any boom-bust cycle. An unanticipated temporary shock to output does not increase inflation because inflation depends only on expected output. If actual output appeared in equation (1), the demand shock would show more persistence. This rule does not generate overshooting of inflation or output after inflation shocks. The one-to-one output-price movement is evident throughout the period of the decline in inflation.

Alternatives to the Modified One-to-One Rule

The modified nominal GNP rule in equation (4) moves real output on a one-to-one basis with inflation. A more general version of the modified nominal GNP rule breaks this one-to-one relation. That is,

TABLE 4

Cyclical Behavior of Output and Inflation
with a Nominal GNP Rule Based on Lagged Inflation

pp	yp	py	yy
1.00	.00	.00	1.00
.64	-1.00	.25	1.00
.16	-1.64	.41	.75
-.31	-.84	.45	.34
-.65	-.06	.37	-.11
-.78	.65	.21	-.48
-.70	1.12	.01	-.69
-.47	1.26	-.16	-.70
-.13	1.06	-.28	-.54
.19	.62	-.31	-.26
.44	.08	-.27	.05
.55	-.43	-.16	.32
.50	-.77	-.02	.48
.34	-.88	.11	.49
.11	-.76	.19	.39

Note: The columns are the infinite moving average representation of the model obtained by replacing equation (2) with equation (3a).

TABLE 5

Cyclical Behavior of Inflation and Output
with a Modified GNP Rule

pp	yp	py	yy
1.00	-1.00	.00	1.00
.71	-.71	.00	.00
.51	-.51	.00	.00
.36	-.36	.00	.00
.26	-.26	.00	.00
.18	-.18	.00	.00
.13	-.13	.00	.00
.09	-.09	.00	.00
.07	-.07	.00	.00
.05	-.05	.00	.00
.03	-.03	.00	.00
.02	-.02	.00	.00

Note: The columns are the infinite moving average representation of the model obtained by replacing equation (2) with equation (4).

$$y_t = -\beta p_t, \tag{4a}$$

where the special case of $\beta = 1$ is the one-to-one rule. This rule will have the same general features as the one-to-one rule, but it can be made more or less accommodative by changing the value of β. Hence, if the modified nominal GNP rule is thought to lead to output fluctuations that are too large, β can be reduced below one. The effect of this rule on output and price fluctuations in the economy is most easily described by calculating the steady-state variance of output and inflation when the rule is being used and the shocks are drawn from a distribution with covariance equal to the estimated sample covariance. The formulas for the steady-state variances are easy to derive. They indicate that as β increases the variance of inflation decreases, and the variance of output increases. Hence, there is a trade-off between inflation and output fluctuations, as in the model of Taylor (1979). The choice of β for the modified GNP rule in (4a) thus depends on a value judgment about the relative importance of inflation and output fluctuations.

IV. FORECASTING VELOCITY SHOCKS

Any nominal GNP rule requires that the Fed offset shifts in the velocity of money. If velocity shocks were unanticipated and temporary, this would not be possible. In fact, velocity shocks show a great deal of serial persistence, so that it is possible to forecast velocity and thereby calculate the appropriate setting of the money supply. During the period from 1954 through 1983, M1 velocity followed a random walk with drift. That is,

$$\log(GNP/M1)_t - \log(GNP/M1)_{t-1} = 2.6 + e_t \tag{5}$$

where the residual e_t is serially uncorrelated with mean zero and standard deviation 1.7 percent. If this behavior of velocity continues, then the best policy to target the level GNP is to set the money supply for period t according to the following rule:

$$\log(M1)_t = -\log(v)_{t-1} - 2.6 \tag{6}$$

where v is velocity. According to equation (5), this would reduce the standard deviation of nominal GNP to about 1.7 percent. The money supply is set so that it offsets the change expected in velocity during the next period. The best forecast of next period's velocity is last period's velocity, when velocity takes a random walk. Hence, the optimal rule is to set the money supply in proportion to velocity in the previous period.

Brunner (1983) shows that the best policy to keep the growth rate of nominal GNP constant is to keep the growth rate of money constant when velocity takes a random walk. The reason that the feedback policy is optimal here is that we are targetting the level of nominal GNP rather than its growth rate. As was shown in the previous section, targetting the growth rate of nominal GNP with no correction for past mistakes leads to overshooting and a continuation of existing business-cycle dynamics.

In practice, when forecasting velocity shocks the Fed takes other factors into account, such as changes in the technology and regulation of the financial system. The targets for the monetary aggregates and the spread of the target cones are greatly influenced by these factors. To the extent that the Fed adjusts the monetary targets to offset these factors it is implicitly focusing on nominal GNP in its current operating procedures. The simple extrapolation method implied by equation (5) could in principle be improved by using such information. However, these adjustments are difficult and subjective. The danger of these adjustments is that they permit the Fed to take more discretion about changing monetary targets for reasons other than offsetting velocity, while stating that it is velocity that is motivating the change. Such discretion can lead to changes in Fed behavior that are aimed at short-run goals that sacrifice long-run goals.

Thus far I have focused on monetary policy as the main instrument of policy. Fiscal policy can also affect total spending, and therefore it is necessary to take account of fiscal actions when forecasting velocity in order to choose the appropriate settings for the money supply to target nominal GNP. It is better to do this by coordinating monetary policy and fiscal policy than by choosing monetary policy to offset the change that fiscal policy has on velocity, much as any other velocity shocks.

V. LAGS IN THE EFFECT OF MONETARY POLICY

The most difficult problem with nominal GNP targetting is that the instruments of policy affect the components of nominal GNP--real GNP and inflation--with a lag. The lag is longer for inflation than for output and occurs whether the monetary base, a higher monetary aggregate, or the real interest rate is used as a policy instrument. During the last 15 years, for example, it appears that money growth (M1) leads changes in output by about one year and leads inflation by about two years.

To see the magnitude of the problem this causes, I estimate in this section a simple equation relating output y to money growth m. In other words, rather than using an aggregate demand function with the policy instruments implicit, as in equation (2) above, I look explicitly at an instrument of policy, in this case the money supply (M1) denoted by m. The effect of m on inflation is then assumed to work through the price adjustment equation (1).

I focus on the sample period from 1967 to 1981. One output equation with a particularly simple form is:

$$y_t = \underset{(8.0)}{.707}(m_{t-1} - p_{t-1}) + \underset{(5.4)}{1.2}, \quad D.W. = 1.92, \quad R^2 = .83 \tag{7}$$

where t-values are reported below the estimated coefficients. The equation simply states that an increase in the rate of growth of money relative to inflation affects real GNP with a one-year lag. With annual data, the timing cannot be made more precise than this. (A quarterly equation was used in Taylor (1979).) The current value and longer lags of real money growth had small and insignificant coefficients and were omitted from the equation to get the simple form in (7). When combined with a price-adjustment equation like (1) and a policy rule for m, the three-equation model generates the behavior of p, y, and m. To see the effect of alternative parameter values, let the coefficient of the first term on the right-hand side of (7) equal α rather than the particular value .707. Substitute (7) into (1) and multiply the resulting equation by β; add this to equation (7). This gives (omitting the constants)

$$y_t + \beta p_t = (.65\beta-\alpha)p_{t-1} + \alpha(1 + .25\beta)m_{t-1}, \tag{9}$$

which implies that to minimize the fluctuations in $y + \beta p$ the growth rate of money should be equal to

$$m_t = (\alpha-.65\beta)/(\alpha(1+.25\beta))p_t. \tag{10}$$

This rule for the money supply incorporates the effect of the lagged relation between output and inflation. For the case where $\alpha = .7$ and $\beta = 1$, there is a slight increase in money growth when inflation increases but the coefficient is very small. The essential point here is that a nominal GNP rule that calls for an increase in monetary stringency (say a reduction in m) whenever y + p grows above target would not necessarily look like the policy in (10) that takes explicit account of the lags in the effect of monetary policy.

VI. CONCLUDING REMARKS

The following conclusions summarize this analysis of the effects of GNP targetting on the business cycle:

(1) In evaluating the effects of nominal GNP targetting on the economy, it is important to examine the dynamic effects of the procedure. Nominal GNP rules that focus solely on the growth rate could worsen business-cycle fluctuations by always causing the economy to overshoot its equilibrium after-shocks.

(2) During much of the postwar period, the Fed can be interpreted as having used a type of nominal GNP rule. It is a growth-rate rule which reacts to lagged inflation and lagged changes in inflation. This rule, when combined with a simple price-adjustment equation, has contributed to the cycle by causing overshooting and "boom-bust" behavior.

(3) A new policy rule must prevent this overshooting and "boom-bust" cycles if it is to reduce the amplitude and length of business-cycle fluctuations. One such rule is a modified nominal GNP rule that keeps constant the sum of the inflation rate and the proportional deviations of real output from trend. This rule involves the *level* of real GNP and the *change* in the price level. The rule can be generalized to permit less than, or more than, one-to-one reactions of real GNP to inflation, depending on the relative welfare significance of output fluctuations versus inflation fluctuations.

(4) The actual instrument adjustments necessary to make a nominal GNP rule operational are not usually specified in the various proposals for nominal GNP targetting. This lack of specification makes the policies difficult to evaluate because the instrument adjustments affect the dynamics and thereby the influence of a nominal GNP rule on business-cycle fluctuations.

(5) Many proposals for nominal GNP targetting do not deal explicitly with the lags in the operation of monetary policy. Such lags require a different procedure for setting the instruments of monetary policy than is implicit in some of the proposals.

As is evident from these conclusions, this paper has emphasized the difficulties with recent proposals for nominal GNP rules and has attempted to point out problems that have not usually come up in simple explanations of the proposals. As indicated in the paper, several of these problems can be dealt with by modifying the proposals to take account of lags in the economy. But whether a nominal GNP rule, another rule, or even no rule at all is instituted, focussing policy discussions on nominal GNP would in my view greatly improve policy performance. The aims of policymakers would be much easier to interpret if their goals for nominal GNP were clearly stated. The Fed in conjunction with the Congress and the administration should state realistic forecasts of nominal GNP growth conditional on their intended plan for monetary and fiscal policy.

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