Monetary Growth, Inflation, and Unemployment:

Projections Through 1983

By William G. Dewald and Maurice N. Marchon *

Beginning in 1975 each Administration has published its views about the future performance of the U.S. economy. Administration budget documents have included economic assumptions and objectives and budget projections through the coming five years. However, the underlying econometric models and/or analyses used to generate the projections are not identified. Furthermore, the documents have been mute about the monetary growth that would be consistent with the stated objectives. The latest projections, presented in the *1979 Federal Budget* prepared by the Carter Administration, were issued in January 1978[1] and updated in July 1978.[2]

This article evaluates these latest Administration economic projections and determines their implications for monetary growth, using a small econometric model of the economy in which monetary growth plays a major role. The article also uses the model to analyze the implications of alternative monetary growth rates for the economy and to identify trade-offs between inflation and unemployment.

THE MODEL

The article uses a modification of the econometric model developed by the Federal Reserve Bank of St. Louis, which is a model of the aggregate demand for and supply of goods and services.[3] In the model, changes in aggregate demand and supply determine the rate of inflation, the real growth rate, the

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[1] *The Budget of the United States Government, Fiscal Year 1979* (Washington: Superintendent of Documents, U.S. Printing Office).

[2] *Office of Management and Budget, Mid-Session Review of the 1979 Budget,* July 6, 1978.

[3] Leonall C. Andersen and Keith M. Carlson, "A Monetarist Model for Economic Stabilization," Federal Reserve Bank of St. Louis *Review,* April 1970, pp. 7-25. The spending equation in the model is based on Leonall C. Andersen and Jerry L. Jordan, "Monetary and Fiscal Actions: A Test of Their Relative Importance in Economic Stabilization," Federal Reserve Bank of St. Louis *Review,* November 1968, pp. 11-24. A reestimation of the model appeared in Leonall C. Andersen and Keith M. Carlson, "St. Louis Model Revisited," *International Economic Review,* Vol. 15, No. 2, June 1974, pp. 305-27.

unemployment rate, and short-term interest rates.[4]

The aggregate demand for or spending on goods and services, measured by changes in nominal gross national product (GNP), is assumed to be determined by variables outside the model, referred to as exogenous variables. The most important exogenous variable is a monetary policy variable, which is measured by the annual growth rate of the money supply, M1, defined as currency and demand deposits held by the nonbank public. Nominal GNP is also specified to be affected by high employment Federal Government spending and by the demand for exports. The aggregate supply of goods and services is assumed to be exogenous, determined outside the model by long-run factors such as capital accumulation and population growth. It is measured by changes in high employment real GNP, as estimated by the President's Council of Economic Advisers.

The rate of inflation, measured by the per cent change in the GNP price deflator, is assumed in the model to be directly affected by expected aggregate demand for and supply of

goods and services. More precisely, the rate of inflation depends partly on current demand pressure, which is defined as the difference between the expected demand for goods and the supply of goods and services. Thus, the inflation rate is affected by those exogenous variables that affect nominal GNP, such as the growth rate in M1. The impact of M1 on inflation is indirect in that M1 affects the demand for goods and services, which affects demand pressure. Demand pressure in turn has a direct impact on inflation.

In the model, inflation also depends directly on inflationary expectations. The treatment of inflationary expectations is the most important modification of the St. Louis model. While expected inflation is assumed to be related to a weighted average of past inflation rates in both models, the St. Louis model uses weights based on an estimated relationship between long-term interest rates and inflation. This approach is built on the hypothesis of Irving Fisher that real interest rates—interest rates adjusted for expected inflation—are constant, so that variations in nominal interest rates reflect variations in expected inflation.[5] The weights used in the modified model are derived from an estimated relationship between inflation and past values of inflation, demand pressure, and international prices. This approach uses past information as it was estimated to be related to inflation. For this reason, the modified model may be said to use a rational expectations approach to the determination of inflationary expectations.[6]

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[4] An appendix lists all of the equations of the model. The complete empirical estimates are presented in a working paper, "Monetary Growth, Inflation, and Unemployment: Projections Through 1983," which is available on request from the Federal Reserve Bank of Kansas City. These estimates are also published in "Macroeconomic Goals and Prospects of the Carter Administration," *Bulletin of Business Research*, Ohio State University, November 1978. The present model grew out of earlier work as represented by William G. Dewald and Maurice N. Marchon, "A Modified Federal Reserve Bank of St. Louis Spending Equation for Canada, France, Germany, Italy, the United Kingdom, and the United States," *Kredit und Kapital* (11. Jahrgang 1978/Heft 2), pp. 194-212; and William G. Dewald and Maurice N. Marchon, "A Common Specification of Price, Output, and Unemployment Rate Responses to Demand Pressures and Import Prices in Canada, France, Germany, Italy, the United Kingdom, and the United States," *Weltwirtschaftliches Archiv* (forthcoming).

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[5] Irving Fisher, *The Theory of Interest* (New York: Kelley & Millman, 1954).

[6] Rational expectations as originally defined by Muth would require that expectations be generated by a relationship in the independent variables that actually generate the variable to be forecast. John F. Muth, "Rational Expectations and the Theory of Price Movements," *Econometrica*, July 1961, pp. 315-35. As in the case of Rutledge, and Kane and Malkiel, a weak form

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

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

The model contains one short-term interest rate—the 4- to 6-month commercial paper rate—which is assumed to depend on demand pressure and inflation. For example, increases in demand pressure or in the rate of inflation are assumed to place upward pressure on interest rates. Thus, the model exhibits a positive relationship between high inflation and high interest rates.

In summary, the model determines five major variables—changes in nominal GNP, the rate of inflation (per cent changes in the GNP deflator), changes in real GNP, the unemployment rate, and a short-term interest rate. These variables are related to variables

outside the model, such as the growth rate of M1, and by the parameters that define and measure the relationships among the variables in the model.

To use the model to make and analyze economic projections, the values of these parameters must be estimated. The parameters of the modified model were estimated by applying econometric procedures to historical data for the first quarter of 1953 through the second quarter of 1978. Given the model and the estimated parameters, projections can be made for the future behavior of the variables determined by the model. For this purpose it is necessary to make assumptions about the behavior of the model's exogenous variables, such as the M1 growth rate and the high employment GNP growth rate.

EVALUATION OF CARTER ADMINISTRATION PROJECTIONS

To evaluate the Carter Administration projections using the modified St. Louis econometric model,[7] the first step was to determine the monetary growth rate that would be required, according to the model, to achieve the Administration's goal for real output in 1983. In determining the required monetary growth rate, it was necessary to make certain assumptions about the behavior of the exogenous variables other than money that according to the model will affect real output during the 1978-83 period. It was assumed that

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of Muth's hypothesis is used which defines expectations as rational if they fully incorporate relevant information that is available when the forecast is made including past values of the variable to be forecast. John Rutledge, *A Monetarist Model of Inflationary Expectations*, Lexington Books, 1974. Edward J. Kane and Burton G. Malkiel, "Autoregressive and Nonautoregressive Elements in Cross-Section Forecasts of Inflation," *Econometrica*, January 1976, pp. 1-16.

[7] Keith Carlson evaluated the Administration's projections in 1977 with an updated St. Louis model. Keith M. Carlson, "Economic Goals for 1981: A Monetary Analysis," Federal Reserve Bank of St. Louis *Review*, November 1977, pp. 2-7. He later examined unemployment-inflation trade-offs in "Inflation, Unemployment, and Money: Comparing the Evidence From Two Simple Models," Federal Reserve Bank of St. Louis *Review*, September 1978, pp. 2-6.

Table 1

CARTER ADMINISTRATION'S PROJECTIONS COMPARED WITH MODEL PROJECTIONS

	(Actual) 1977	1978*	1979†	1980	1981	1982	1983
Real GNP							
Level: (Billions of 1972 Dollars)							
Carter	1,333	1,392	1,453	1,512	1,576	1,640	1,706
Model	1,333	1,380	1,439	1,499	1,566	1,638	1,713
Per Cent Change:							
Carter	4.9	4.4	4.3	4.1	4.2	4.1	4.0
Model	4.9	3.5	4.3	4.2	4.5	4.6	4.6
Nominal GNP							
Level: (Billions of Dollars)							
Carter	1,887	2,095	2,330	2,576	2,838	3,107	3,383
Model	1,887	2,091	2,326	2,570	2,841	3,142	3,476
Per Cent Change:							
Carter	11.0	11.0	11.2	10.6	10.2	9.5	8.9
Model	11.0	10.8	11.2	10.5	10.5	10.6	10.6
GNP Deflator (1972 = 100)							
Per Cent Change:							
Carter	5.9	6.3	6.6	6.2	5.7	5.2	4.7
Model	5.9	7.0	6.9	6.4	6.1	6.0	6.0
Unemployment Rate (Per Cent)							
Carter	7.0	6.0	5.7	5.4	4.9	4.4	4.1
Model	7.0	6.0	6.1	6.0	5.7	5.3	5.0
Short-Term Interest Rates (Per Cent)							
Carter‡	5.3	6.5	6.6	6.6	6.3	5.8	5.3
Model §	5.6	7.4	7.6	7.4	7.6	7.9	8.3

*Actual first half as of July 31, 1978. Extrapolated second half.
†It is assumed that the annual M1 growth rate is 8 per cent; the high employment Federal Government spending growth rate, 7.8 per cent; the nominal exports growth rate, 10 per cent; the import price inflation rate, 10 per cent; and the high employment real output growth rate, 3.5 per cent. Administration projections were obtained from **The Budget of the United States Government: Fiscal Year 1979** and the **Mid-Session Review of the 1979 Budget** published by the Office of Management and Budget.
‡Three-month Treasury bill rate.
§Four- to six-month commercial paper rate.

high employment Federal Government spending will grow at a 7.8 per cent annual rate as the Administration projects. Also, it was assumed that during the projection period, exports, import prices, and high employment output will conform with recent experience, with exports and import prices increasing 10 per cent and high employment output growing at a 3.5 per cent annual rate. Given these assumptions, the model indicates that M1 will need to grow at an annual rate of about 8 per cent to achieve the Administration's real output projection of $1.7 trillion for 1983. (See Table 1.) In other words, when the model is used to project the behavior of the economy during the 1978-83 period (the projection period begins in mid-1978), under the assumption that M1 grows at a constant annual rate of 8 per cent during the period, the model projects a level of real output for 1983 of approximately $1.7 trillion, the same as the Administration's projection.

The next step in evaluating the Administration's projections was to compare the projections for variables other than real output with the model's projections for these variables, again using the assumption of an 8 per cent M1 growth rate. These comparisons indicate that within the framework of the model, the Administration's projections for real output are inconsistent with the Administration's projections for inflation. Along with the real output level of $1.7 trillion in 1983, the Administration projects an inflation rate of 4.7 per cent (Table 1). However, along with the real output level of $1.7 trillion, the model projects an inflation rate of 6 per cent, well above the Administration's projection. Stated another way, the model implies that a monetary growth rate of 8 per cent would be needed to achieve the Administration's real output goal, but that the 8 per cent money growth rate would result in considerably more inflation than projected by the Administration.

This difference in inflation rates projected by the Administration and the model is reflected in a difference in interest rate projections. The Administration projects short-term interest rates at about 6.5 per cent through 1980 and then an easing to 5.3 per cent in 1983. According to the model, though, an 8 per cent monetary growth rate would provide so much inflationary pressure that short-term interest rates would remain at about 8 per cent over the entire projection period. (See Table 1.)

The model indicates that the Administration goals for unemployment and inflation are also inconsistent. The Administration's unemployment goal for 1983 is 4.1 per cent. (See Table 1.) The model indicates that a monetary growth rate even as high as 8 per cent—the growth rate that would result in a 6.0 per cent inflation rate instead of the Administration's 4.7 per cent—would not achieve the Administration's unemployment goal. The 8 per cent monetary growth rate would result in an unemployment rate of 5.0 per cent, according to the model. A higher monetary growth rate would be needed to achieve the Administration's unemployment rate of 4.1 per cent. However, such a money growth rate would result in an inflation rate even higher than 6.0 per cent and considerably higher than the Administration's 4.7 per cent rate.

IMPLICATIONS OF ALTERNATIVE MONEY GROWTH RATES

The model's projections for the behavior of nominal GNP, real GNP, inflation, and the unemployment rate during the period under alternative assumptions about the growth of M1 are shown in Charts 1 through 5.[8] As a

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[8] These projections assume steady monetary growth rates during the projection period. Yet, if a policy of steady monetary growth were announced and if the public expected the policy to be achieved, the relationships

point of reference, the Administration's projections for these variables are also shown. For both the Administration's projections and the model projections, under the assumption of an 8 per cent M1 growth rate, the charts show graphically the data presented in Table 1. Thus, Chart 1 shows that an M1 growth rate of 8 per cent results in the achievement of the Administration's real output projection of $1.7 trillion in 1983.

The model's projections indicate that an M1 growth rate during the projection period of 6.5 per cent—the upper limit of the Federal Reserve's long-run growth range for M1[9]—would be sufficiently low to avoid an acceleration in the 1977 inflation rate of about 6 per cent. (See Chart 2.) However, reducing monetary growth to 6.5 per cent in the 1978-83 period—compared with the 8.2 per cent rate recorded in the year and one-half ending in mid-1978—would result in a temporary slowdown in the real growth of the economy and an increase in the unemployment rate. (See Charts 3 and 4.) The model indicates that an M1 growth rate higher than 6.5 per cent would be required to avoid a temporary economic slowdown. For example, a monetary growth rate of 8 per cent would result in a growth rate in real GNP of between 4 and 5 per cent during most of the projection period. Moreover, the 8 per cent money growth rate would be associated with a decline in the unemployment rate to 5

per cent in 1983. However, the higher money growth rate would leave the inflation rate in 1983 at 6 per cent.

The model indicates that an M1 growth rate of zero would have a dramatic impact on the economy. The model implies that the appropriate monetary growth rate for long-run stable prices is close to zero. This is not surprising, since a zero growth rate is not so different from the actual experience in the 1950's following the Korean war, a period of remarkably stable prices. Under current circumstances, moreover, the model indicates that an anti-inflation policy featuring zero monetary growth would indeed eradicate inflation by 1983. However, such a policy would also produce a substantial increase in unemployment and a decline in the economic growth rate. By 1983, the unemployment rate would exceed 11 per cent and the real economy would have just started growing at a rate sufficiently strong to bring the economy out of a deep recession. Any policy of sharply reducing the monetary growth rate, short of reducing it to zero, would also have a pronounced impact on the economy. Thus, the model shows that an M1 growth rate of 4 per cent—the lower limit of the Federal Reserve's long-run growth range for M1—would bring the inflation rate down to 3.2 per cent in 1983, but would raise the unemployment rate above 8 per cent in that year.[10]

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underlying this model might be altered. The new relationships would presumably result in faster responses of the economy to monetary policy than are indicated by this model.

[9] The Federal Reserve's growth rate range for M1 has been adjusted to account for the impact of automatic transfer savings accounts introduced on November 1, 1978. Assuming an unchanged stance of monetary policy, it is necessary to reduce the M1 growth rate range as currently measured. The reduction is required because the new automatic transfer savings accounts are expected to attract funds from demand deposits and thus change the relationship between M1 and the economy.

[10] If by some good fortune, productivity increased so that potential real output grew at an annual rate of 4 per cent rather than 3.5 per cent as has been the average experience, the inflation rate would drop about 0.4 percentage points but the unemployment rate would increase by 0.4 percentage points in 1983 relative to the simulated outcome with unchanged potential growth and 6.5 per cent money growth. Given the other assumptions a decrease in import inflation from 10 to 5 per cent would decrease domestic inflation by 0.6 percentage points and the unemployment rate, 1.1 percentage points relative to what would otherwise occur in 1983.
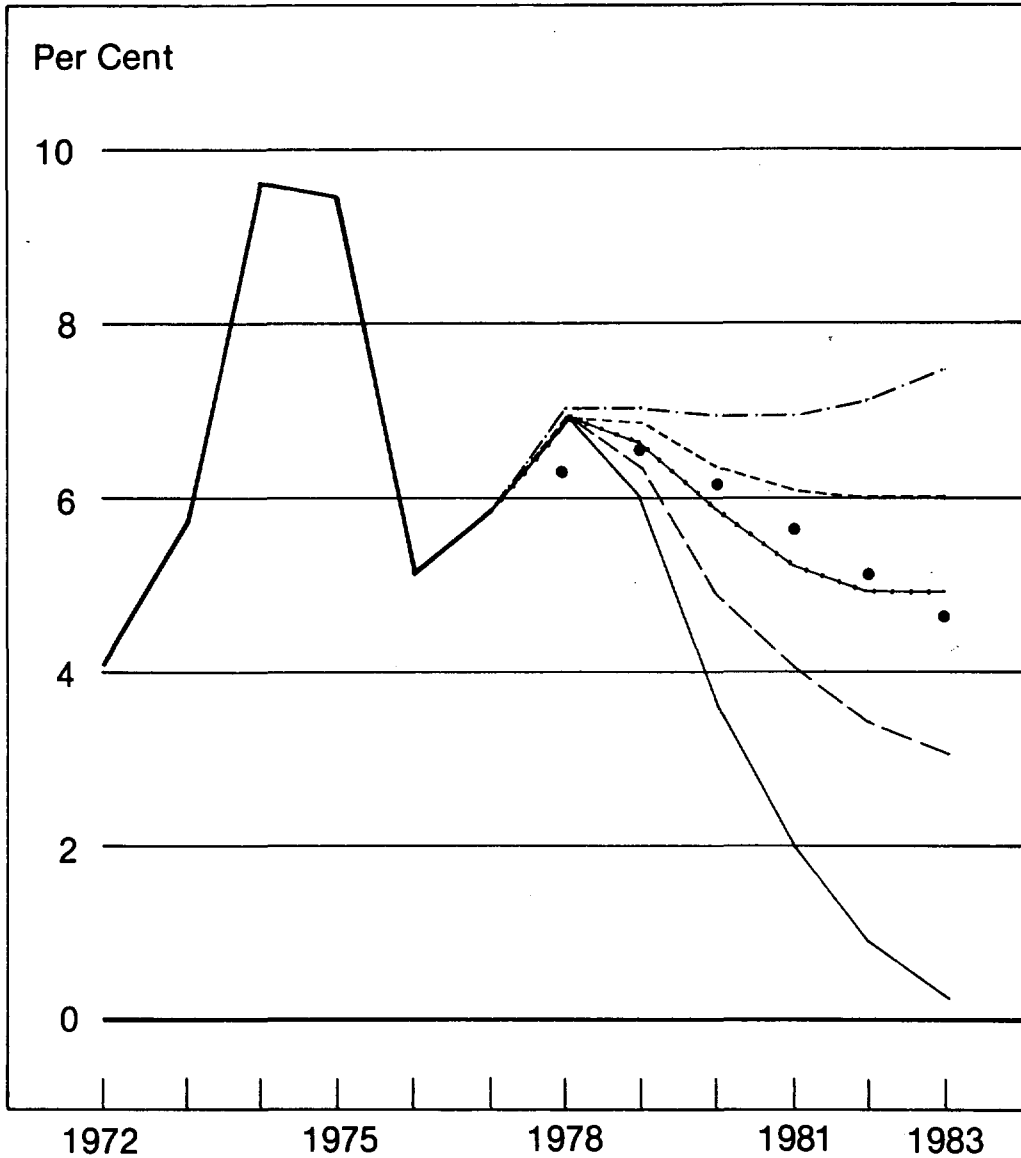
Chart 1
REAL GNP PROJECTIONS FOR ALTERNATIVE M1 GROWTH RATES
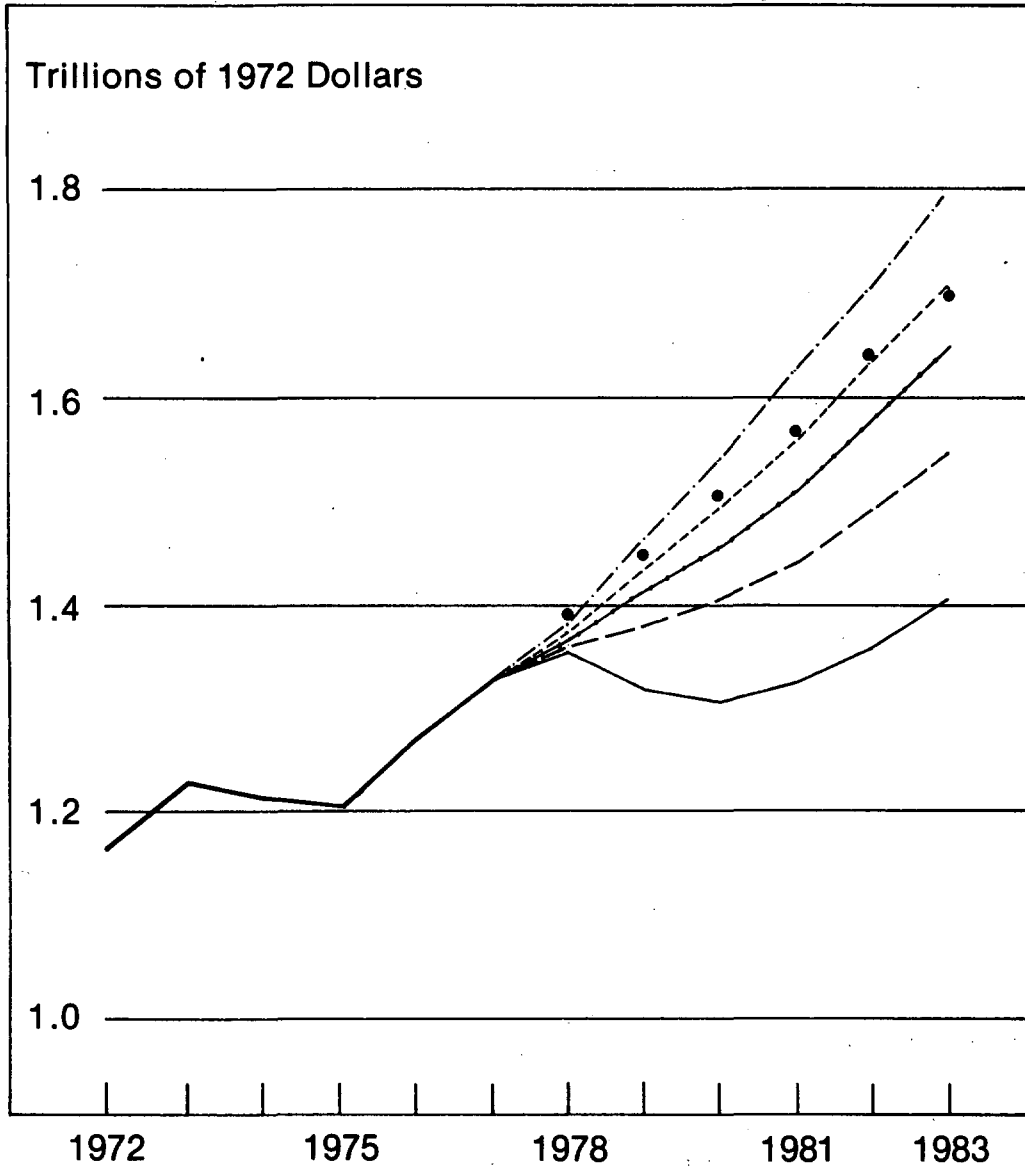
Trillions of 1972 Dollars

1.8

1.6

1.4

1.2

1.0

1972   1975   1978   1981   1983

Projections for M1 growth rates:
10 per cent —·—·—·—·—   4 per cent ——————
8 per cent --------------   0 per cent ————————
6.5 per cent ·•·•·•·•·•·   Administration • • • • •

Chart 2
GNP DEFLATOR GROWTH RATE PROJECTIONS FOR ALTERNATIVE M1 GROWTH RATES

Per Cent

10

8

6

4

2

0

1972   1975   1978   1981   1983

Projections for M1 growth rates:
10 per cent —·—·—·—·—   4 per cent ——————
8 per cent ------------------   0 per cent ——————
6.5 per cent •—•—•—•—•—•   Administration • • • • •
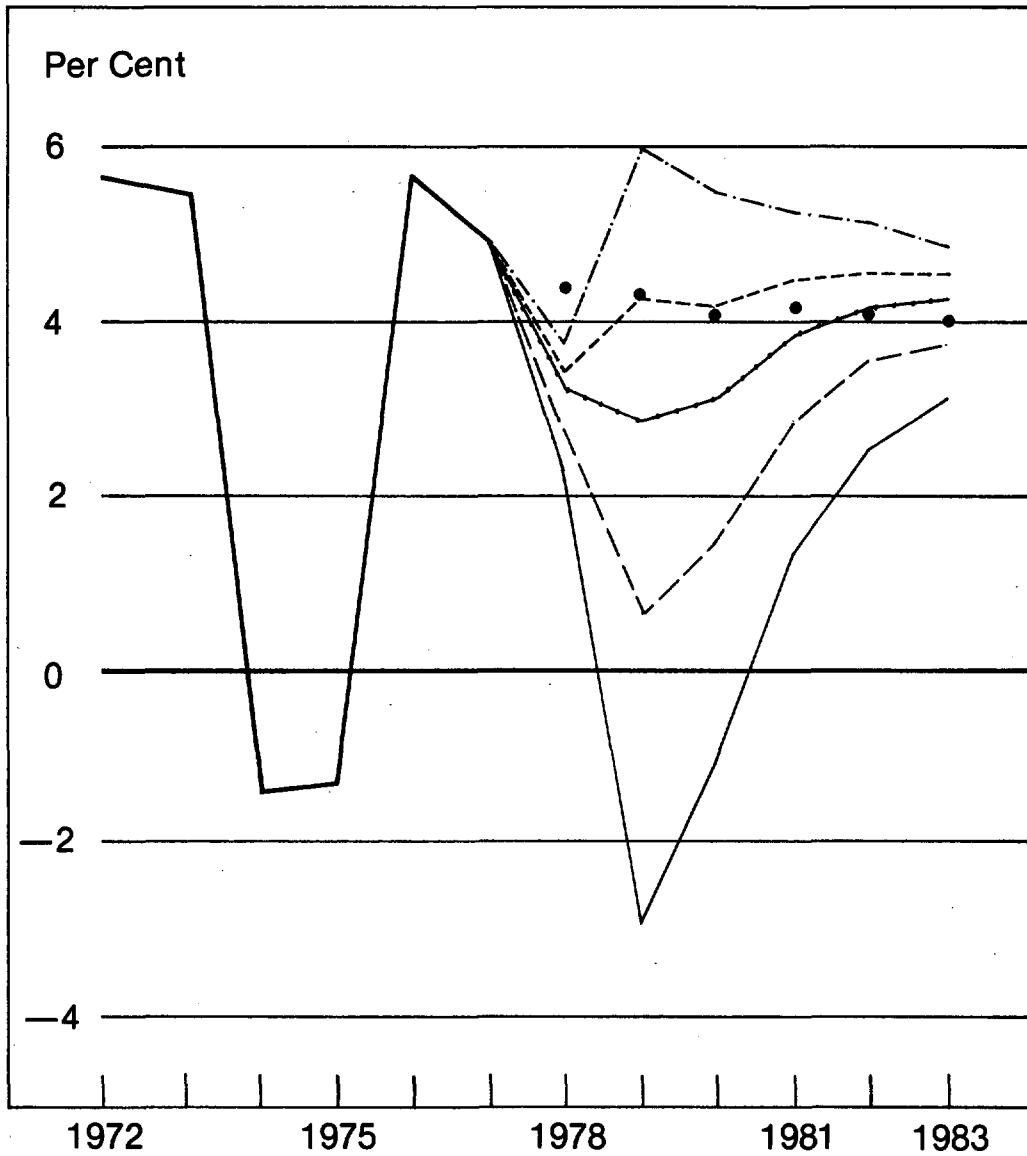
Federal Reserve Bank of Kansas City

Chart 3
REAL GNP GROWTH RATE PROJECTIONS FOR ALTERNATIVE M1 GROWTH RATES

Projections for M1 growth rates:
10 per cent —·—·—·—·—   4 per cent —————
8 per cent ----------------   0 per cent ————————
6.5 per cent •—•—•—•—•—   Administration • • • • •

Chart 4
UNEMPLOYMENT RATE PROJECTIONS FOR ALTERNATIVE M1 GROWTH RATES
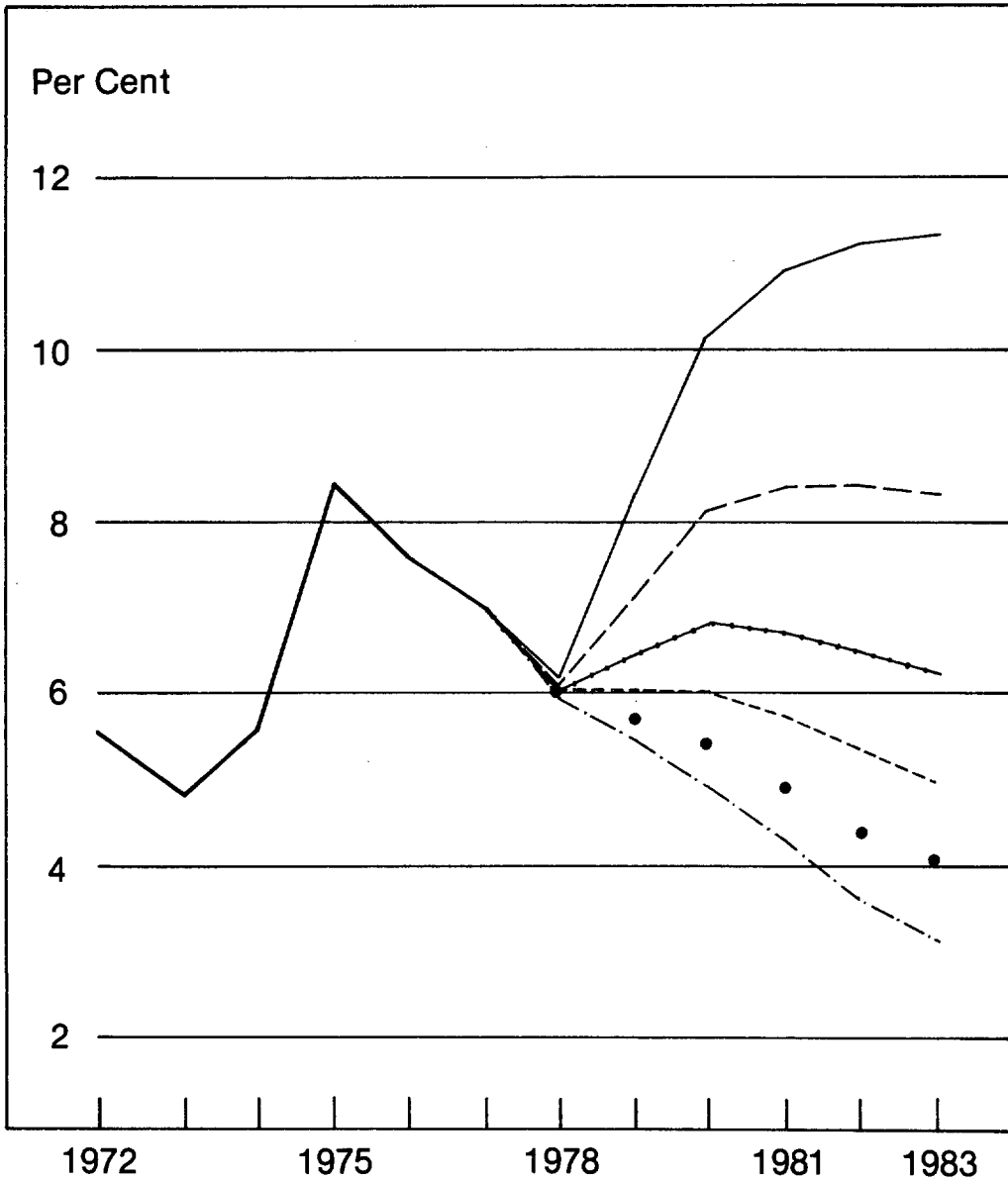
Per Cent

12

10

8

6

4

2

1972   1975   1978   1981   1983

Projections for M1 growth rates:
10 per cent —·—·—·—   4 per cent ——————
8 per cent ----------------   0 per cent ————————
6.5 per cent •••••••••   Administration • • • •

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Chart 5
NOMINAL GNP GROWTH RATE PROJECTIONS FOR ALTERNATIVE M1 GROWTH RATES

Per Cent

Projections for M1 growth rates:

10 per cent —·—·—·—   4 per cent —————
8 per cent ---------------   0 per cent ————
6.5 per cent •—•—•—•—•   Administration • • • • •
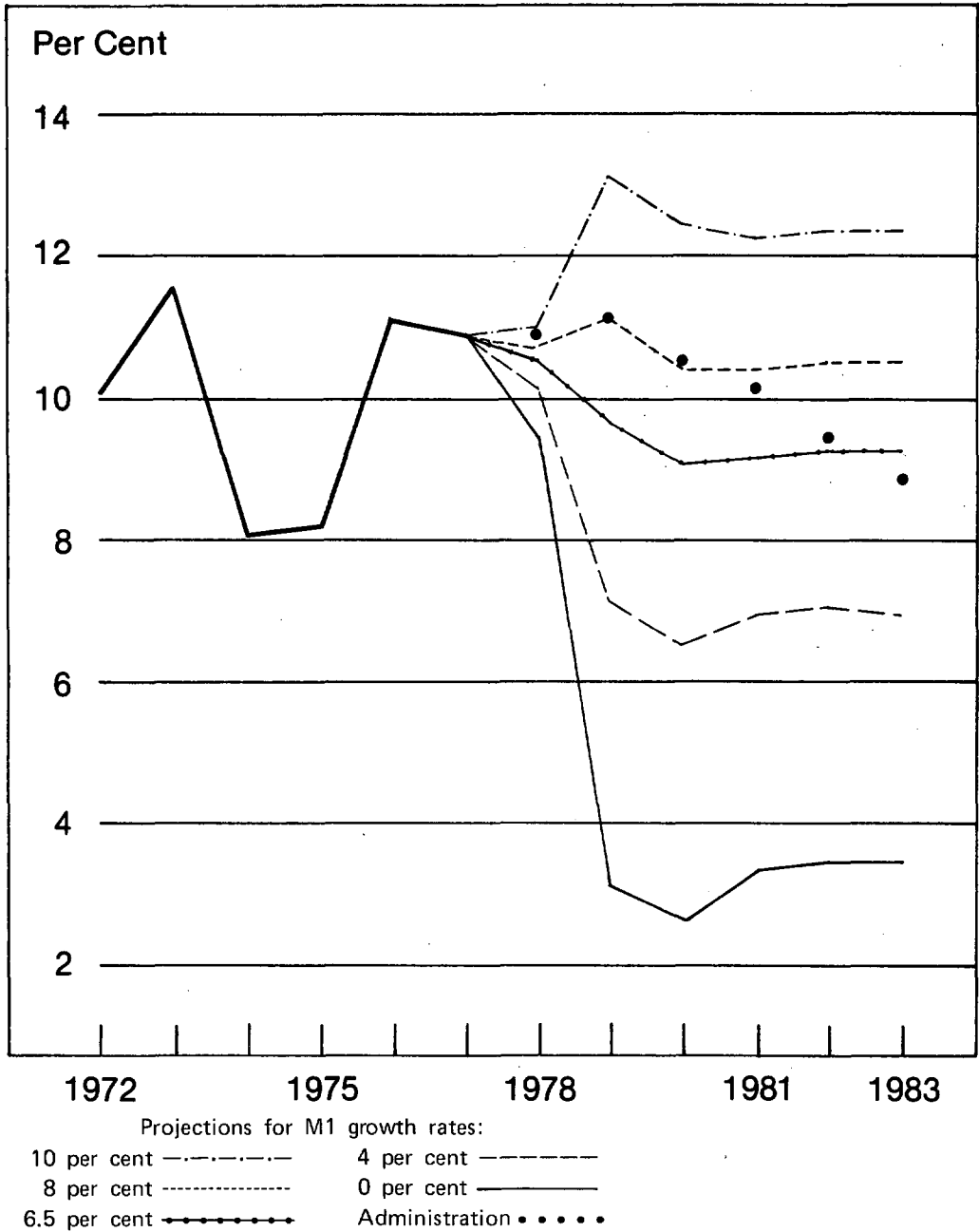
INFLATION AND UNEMPLOYMENT TRADE-OFFS

The foregoing analysis implies a significant short-run trade-off between the goals of containing inflation and maintaining a low level of unemployment. In 1958 the late A. W. Phillips estimated a negative relationship between the British unemployment rate and wage inflation over nearly a century.[11] Ever since, relationships between inflation and unemployment have been called "Phillips curves." Soon after Phillips' seminal work, Paul Samuelson and Robert Solow[12] were able to identify a Phillips curve in U.S. data, although the simple version of this relationship was not stable except for the postwar period through the 1950's.

Economists disagree on whether economic policymakers can depend on a stable trade-off between inflation and unemployment. Some argue that, in the long run, the unemployment rate is not affected by inflation, but is related to the normal dynamics of labor markets. Milton Friedman[13] made such an empirical judgment about the long run in his Nobel lecture in 1976, along lines developed earlier by Friedman and by others such as Edmund Phelps,[14] and Robert Lucas and Leonard Rapping.[15] These economists argue that there

is no long-run trade-off between inflation and unemployment. Friedman has also argued that in the 1970's even the short-run trade-off between inflation and unemployment disappeared due to inflation-induced production disincentives and inefficiencies. But whether or not there is a short-run trade-off, it is important to mention that the same short-run trade-offs are not generally available year after year. Though the analysis undertaken for this article supports the view that there is a short-run trade-off today, it is not nearly so favorable as a decade ago. What happened to the trade-off in the face of persisting inflation was an upward shift that has raised the inflation rate associated with every unemployment rate.

The nature of the present trade-off is summarized in Chart 6.[16] The line in the chart shows the model estimates of combinations of the unemployment rate and the inflation rate that would occur in 1983 as a result of M1 growing from mid-1978 through 1983 at alternative constant rates of change. For example, a 10 per cent M1 growth rate would result in an unemployment rate of 3.2 per cent and an inflation rate of 7.5 per cent. Lower monetary growth rates would result in lower inflation and higher unemployment. Thus, a zero monetary growth rate would produce an unemployment rate of 11.4 per cent and an inflation rate of 0.3 per cent in 1983.

Chart 6 assumes that monetary policymakers follow a policy of maintaining a constant growth rate in M1. Of course, policymakers may not follow such a policy, and such a policy

[11] A. W. Phillips, "The Relation Between Unemployment and the Rate of Change of Money Wage Rates in the United Kingdom, 1862-1957," *Economica,* November 1958, pp. 283-99.

[12] Paul A. Samuelson and Robert M. Solow, "Analytic Aspects of Anti-inflation Policy," *American Economic Review, Papers and Proceedings,* May 1960, pp. 177-204.

[13] Milton Friedman, "Nobel Lecture: Inflation and Unemployment," *Journal of Political Economy,* June 1977, pp. 451-72.

[14] Edmund S. Phelps, *Inflation Policy and Unemployment Theory* (New York: W. W. Norton and Co., Inc., 1972).

[15] Robert E. Lucas, Jr. and Leonard A. Rapping, "Real Wages, Employment, and Inflation," *Journal of Political Economy,* September/October 1969, pp. 721-54.

[16] These are not strictly Phillips curves which would represent the most efficient trade-offs. However, as Chow and Megdal showed, the constant monetary growth trade-offs in the St. Louis model are very close to the most efficient trade-offs. Gregory C. Chow and Sharon B. Megdal, "An Econometric Definition of the Inflation-Unemployment Tradeoff," *American Economic Review,* Vol. 68, No. 3, June 1978, pp. 446-53.
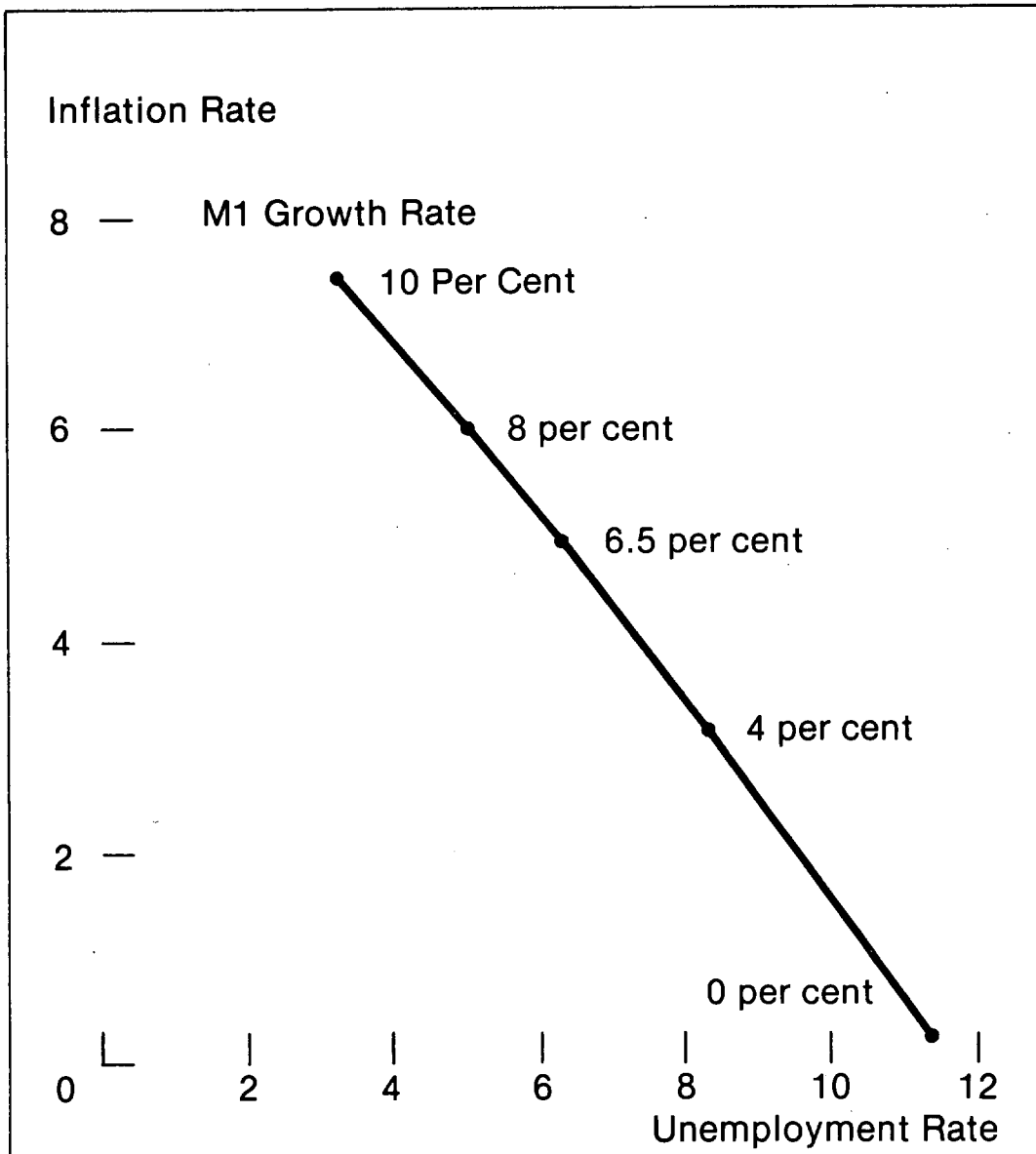
may not be the most desirable. Some observers have suggested a gradual reduction in the monetary growth rate. For example, Congressman Parren J. Mitchell, chairman of the Subcommittee on Domestic Monetary Policy of the House Banking Committee, proposed bringing the annual monetary growth rate gradually down to 3 per cent and then maintaining it indefinitely at this level.[17] The impact of Congressman Mitchell's proposal on the economy may be analyzed with the econometric model. The analysis indicates that implementing his proposal would cause results similar to an immediate reduction in the monetary growth rate to around 4 per cent. Gradually reducing monetary growth would result in 1983 in an unemployment rate of 8.2 per cent and an inflation rate of 3.4 per cent. Similarly, a steady 4 per cent M1 growth rate would yield in 1983 an unemployment rate of 8.3 per cent and an inflation rate of 3.2 per cent. However, the lower long-term monetary growth rate of 3 per cent in Congressman Mitchell's proposal implies eventually an inflation rate nearly 1 percentage point lower than would be associated with steady 4 per cent annual monetary growth.

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[17] Speech to the Graduate School of Banking, Madison, Wisc., August 21, 1978. Mindful of costly dynamic adjustments that would need to be made, Congressman Mitchell also proposed selective Federal expenditures to ease the burden of those most likely to experience prolonged layoff.

CONCLUSION

A small "mainly monetarist" model of the U.S. economy was used in this article to evaluate the Carter Administration's economic projections through 1983, published in July 1978. According to the model, which stresses the importance of monetary growth, an M1 growth rate of about 8 per cent—the growth recorded during the six quarters ending in mid-1978—would be needed to achieve the Administration's goals for real GNP in 1983. However, an 8 per cent monetary growth rate would keep inflation from declining by 1983 to the 4.7 per cent projected by the Administration. The model implies that the inflation rate would be 6.0 per cent in 1983 if M1 grows at the 8 per cent rate. Thus, according to the model, the Administration projections are inconsistent.

The model suggests that a significant reduction in inflation would require a long period of economic slack. By 1983, inflation could be eliminated by reducing M1 growth to zero. But zero M1 growth would cause a very substantial decline in real output growth and a rise in unemployment to over 11 per cent. These results are disheartening but not surprising. Any change in a monetary growth rate that the economy has come to expect affects real output and unemployment first (and quickly), and inflation second (and only slowly). Extricating the economy from high built-in inflation is very costly.

APPENDIX
The Model
1953 Q1 to 1978 Q2

Equations:

$$1. \ \dot{Y}_t = 2.91 + \sum_{i=0}^{5} m_i \dot{M}_{t-i} + \sum_{i=0}^{5} e_i \dot{EF}_{t-i} + .03 \dot{EX}_t.$$
$$\quad\quad (3.71) \quad\quad\quad\quad\quad\quad\quad\quad (1.69)$$

$$\Sigma m_i = .89 \quad \Sigma e_i = .04$$
$$\quad (4.79) \quad\quad\quad (.55)$$

$$R^2 = .52$$
$$SE = 3.46$$
$$DW = 1.97$$

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

3. $\dot{P}^a_t = \underset{(2.40)}{.88} + \sum\limits_{i=1}^{4} d_i D_{t-i} + \sum\limits_{i=1}^{8} p_i \dot{P}_{t-i} + \sum\limits_{i=1}^{4} w_i \dot{W}_{t-i}$.

$\quad\quad\quad R^2 = .75$
$\quad\quad\quad SE = 1.46$
$\quad\quad\quad DW = 1.86$

$\quad\quad\quad \Sigma d_i = \underset{(.72)}{.05} \quad\quad \Sigma p_i = \underset{(6.72)}{.73} \quad\quad \Sigma w_i = \underset{(2.64)}{.09}$

4. $\dot{P}_t = \underset{(.19)}{.05} + \underset{(17.28)}{1.01 \dot{P}^a_t} + \underset{(1.00)}{.04 D_t}$.

$\quad\quad\quad R^2 = .76$
$\quad\quad\quad SE = 1.37$
$\quad\quad\quad DW = 1.86$

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

6. $G \equiv (XF - X)/XF$.

7. $U = \underset{(33.79)}{4.41} + \underset{(1.47)}{.07 G_t} + \underset{(5.70)}{.30 G_{t-1}}$

$\quad\quad\quad R^2 = .69$
$\quad\quad\quad SE = .29$
$\quad\quad\quad DW = 1.91$
$\quad\quad\quad \rho = .76$

8. $R_t = \underset{(.74)}{4.20} + \sum\limits_{i=0}^{4} b_i G_{t-i} + \sum\limits_{i=0}^{6} r_i \dot{P}_{t-i}$.

$\quad\quad\quad R^2 = .27$
$\quad\quad\quad SE = .63$
$\quad\quad\quad DW = 1.60$
$\quad\quad\quad \rho = .995$

$\quad\quad\quad \Sigma b_i = \underset{(4.71)}{.61} \quad\quad \Sigma r_i = \underset{(2.16)}{.38}$

Definitions of Symbols:

Y   = GNP.
M   = money stock (M1).
EF = high employment Federal
        Government spending.
EX = exports.
D   = demand pressure.
P   = GNP deflator.
XF = high employment real GNP.
W   = imports deflator.
X   = Y/P = real GNP.
G   = real output gap.
U   = unemployment rate.
R   = 4- to 6-month commercial
        paper rate.

t   = quarter.
ln   = natural logarithm.
•   = annual rate of change.
a   = anticipated.
Lower case letters = coefficients.
Upper case letters = variables.
R^2 = coefficient of determination.
SE = standard error of estimate.
DW = Durbin-Watson statistic.
ρ = serial correlation coefficient.
t-values are in parentheses.