# Inflation, Unemployment, and Money: Comparing the Evidence from Two Simple Models

KEITH M. CARLSON

TWO years ago, Professors Barro and Fischer introduced their survey of monetary theory with the following statement:

> Perhaps the most striking contrast between current views of money and those of thirty years ago is the rediscovery of the endogeneity of the price level and inflation and their relation to the behavior of money.[1]

This assessment contrasts sharply with that of the Council of Economic Advisers in their 1978 *Annual Report*.[2] In a forty-one page chapter on inflation and unemployment, there are only two oblique references to monetary policy as a contributing factor to the inflationary process.

The theory of inflation that underlies the Council's discussion is conventional — inflation is usually initiated by excess demand, but once the momentum builds up, "the rate of wage and price increase reacts very slowly to idle resources and excess supply."[3] The Council believes there is a trade-off between inflation and unemployment, but rejects the terms of the trade-off as too costly. They argue that

> . . . it would take at least 6 years of the current degree of economic slack (an unemployment rate near 6½ percent) to cut the inflation rate from 6 to 3 percent.[4]

Consequently, the Council's recommended strategy for inflation control is one of "voluntarism", jawboning, and structural improvements. Implicit in this strategy is a stabilization policy stimulative enough to propel the economy to high employment and full utilization of capacity.[5]

The Council's strategy for economic policy rests on a belief in the inflation-unemployment trade-off and a neglect of money. In particular, the apparent current policy strategy is reminiscent of that applied in August 1971 when the price-wage freeze was introduced. At that time the same thinking prevailed — hold prices down directly and reduce unemployment via expansionary monetary and fiscal policy.[6]

The purpose of this article is to demonstrate that the apparent trade-off between inflation and unemployment is in fact the result of variable monetary growth. The approach draws heavily on recent work by Professor Stein of Brown University.[7] The appearance of a trade-off results from differences in the timing of the response of inflation and unemployment to changes in monetary growth. However, the trade-off is an illusion. Unemployment responds to monetary growth in the short run, but tends towards a steady-state value in the long run. Effects of monetary growth on inflation are just the opposite; there is little effect in the short run, with the full and permanent effect coming in the long run. These processes have implications that are strongly at variance with those advocated by the Council of Economic Advisers.

## *The Relation Between Inflation and Unemployment: The Conventional View and Modifications*

The relation between inflation and unemployment is usually depicted by the Phillips curve.[8] According to this relationship, high rates of inflation are associated with low rates of unemployment; likewise, low inflation rates are associated with high unemployment rates. Within recent years, however, experience in the United States and other countries has run counter to the prediction of the original relation. In particular, there have been times that inflation and unemployment have moved in the same direction, a phenomenon that has been labeled "stagflation." Economists have reacted to this experience by augmenting Phillips curve theory with consideration of the effects of inflationary expectations.[9]

Lately, the Phillips curve discussion has taken yet another twist. Some economists have suggested that accelerations and decelerations of inflation are related

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[1]Robert J. Barro and Stanley Fischer, "Recent Developments in Monetary Theory," *Journal of Monetary Economics* (April 1976), p. 133.

[2]*Economic Report of the President*, 1978, pp. 138-78.

[3]Ibid., p. 150.

[4]Ibid.

[5]Ibid., pp. 73-75, 152-56.

[6]*Economic Report of the President*, 1972, pp. 22-27.

[7]Jerome L. Stein, "Inflation and Stagflation," forthcoming in *Journal of Banking and Finance*, and "Inflation, Employment and Stagflation," *Journal of Monetary Economics* (April 1978), pp. 193-228.

[8]The original analysis is found in A. W. Phillips, "The Relation Between Unemployment and the Rate of Change of Money Wage Rates in the United Kingdom, 1861-1957," *Economica* (November 1958), pp. 283-99.

[9]For a survey of the Phillips curve literature, see Robert J. Gordon, "Recent Developments in the Theory of Inflation and Unemployment," *Journal of Monetary Economics* (April 1976), pp. 185-220.

to the level of unemployment. For example, according to Modigliani and Papademos,

> . . . historical experience clearly supports the proposition that there exists some *critical* rate of unemployment such that, as long as unemployment does not fall below it, inflation can be expected to decline. . . .[10]

They go on to refer to this critical unemployment rate as the noninflationary rate of unemployment (NIRU). In this case, "noninflationary" is defined to mean that the rate of inflation, at whatever level, is not increasing.

The value of NIRU can be derived from an estimate of the following simple relation:[11]

$$p_t - p_{t-1} = \alpha_0 + \alpha_1 U_{t-1}$$

The symbol p is the year-to-year percent change in the GNP deflator and U is the unemployment rate. Using annual data from 1952 to 1976, this equation is estimated as

$$(1) \quad p_t - p_{t-1} = \underset{(1.970)}{2.463} - \underset{(-1.894)}{.453}\, U_{t-1} \qquad R^2 = .15 \quad SE = 1.41 \quad DW = 1.79$$

Since the dependent variable is a second difference, there is considerable variation in it. The unemployment rate explains only a small portion of this variation, although both the coefficients in the equation are significant at the ten percent level (t statistics are shown in parentheses).

Since NIRU is defined as that rate of unemployment which is consistent with nonaccelerating inflation, its value can be found by setting $p_t - p_{t-1} = 0$ in equation (1) and solving for U. The value of NIRU for this estimated equation is 5.44 percent.

This estimate of equation (1) is consistent with the Council of Economic Advisers' assessment of the terms of the inflation-unemployment trade-off in their 1978 *Annual Report*. A 6.5 percent unemployment rate was used as an example of sufficient slack in the economy such that a deceleration of inflation of 0.5 percent per year would be generated. Substituting 6.5 into equation (1) yields a decline in p of 0.48 percentage points per year.

By way of comment, it should be noted that this model does not indicate how a particular rate of inflation or rate of unemployment is attained. Rather, the equation simply shows how inflation will change, given the degree of slack in the economy as measured by the unemployment rate. To complete the model, an equation specifying the determination of the unemployment rate would have to be added. In this way the effect of monetary and fiscal policy could be captured via the effect on the unemployment rate.

## *The Relation Between Inflation and Unemployment: A Monetary View*

An alternate view of the relation between inflation and unemployment is that both variables are responding to the movements of a third variable. To the extent that there appears to be a relationship between movements in prices and unemployment, it is in fact a reflection of differential time responses to changes in the third variable. This is the monetary view, which stresses the long-run relation between money and prices, but also takes into account transitory effects of money on real product growth and unemployment.

According to the monetary view, shifts in the short-run Phillips curve are associated with changes in the growth rate of money. The hypothesis is that the *fundamental* determinant of the inflation rate is the rate of monetary expansion. Regardless of the initial conditions, the inflation rate will tend to converge to the rate of monetary growth, and the unemployment rate will tend toward its steady state value. This steady state value is not, however, related to the NIRU concept mentioned above. In fact, the monetary interpretation denies the validity of the NIRU argument.

In an attempt to keep the analysis simple, another single equation is specified as representative of the monetary view. Like Equation (1), the focus is on accelerations and decelerations of inflation. According to the monetary view, inflation will accelerate if money growth exceeds the ongoing inflation rate for an extended period of time (approximately one year). This simple representation of the monetary view appears as follows:

$$p_t - p_{t-1} = \beta_0 + \beta_1(m_{t-1} - p_{t-1})$$

Symbols are as defined above, with the addition of m, the year-to-year percent change in the narrowly defined money stock (M1).

Estimating this equation for the period 1954 to 1976, using annual data, yields the following:[12]

$$(2) \quad p_t - p_{t-1} = \underset{(4.106)}{.449}\,(m_{t-1} - p_{t-1}) \qquad R^2 = .43 \quad SE = 1.13 \quad DW = 1.93$$

[10]Franco Modigliani and Lucas Papademos, "Monetary Policy for the Coming Quarters: The Conflicting Views," *New England Economic Review* (March/April 1976), p. 4.

[11]The Modigliani-Papademos approach to estimating NIRU is much more convoluted. For a critique of the Modigliani-Papademos results, see Stein, "Inflation, Employment and Stagflation."

[12]$\beta_0$ was not significant, so the equation was reestimated without the constant.

These results indicate that inflation will accelerate by 0.45 of a percentage point in each year following that in which money growth exceeds the inflation rate by one percentage point. Based on the specification of this equation, inflation will not accelerate or decelerate if the money growth rate equals the inflation rate. Comparing the monetary equation with the conventional equation indicates that the monetary equation explains a larger proportion of the variation in $p_t - p_{t-1}$, and the standard error of the equation is reduced by 20 percent.

Suppose now that both views have merit. Can the rate of monetary expansion and the unemployment rate be used to explain accelerations and decelerations of inflation? To investigate this possibility, the following version was estimated:

$$p_t - p_{t-1} = \gamma_0 + \gamma_1 (U_{t-1} - U_E) + \gamma_2 (m_{t-1} - p_{t-1})$$

The value of the critical unemployment rate, as calculated from Equation (1), was inserted into the equation as $U_E$. Again, using annual data from 1952 through 1976, the following results were obtained:

$$(3)\quad p_t - p_{t-1} = \underset{(.004)}{.001} - \underset{(-.826)}{.177}(U_{t-1} - 5.44) + \underset{(3.301)}{.406}(m_{t-1} - p_{t-1}) \qquad R^2 = .45 \quad SE = 1.16 \quad DW = 1.99$$

For this specification of the equation, supposedly allowing for both conventional and monetary effects, neither the unemployment rate nor the constant are significant. However, the monetary variable remains significant, although the value of the coefficient is slightly less than in (2). The $R^2$ and standard error are only slightly changed from (2).

The implication of these results is that accelerations and decelerations of inflation are not systematically related to the degree of resource utilization as measured by the unemployment rate. Restricting the analysis to very simple models, changes in the rate of inflation are much more closely associated with monetary growth, with no independent effect coming from the unemployment rate.

What does the monetary view say about the determination of the unemployment rate? The monetary view recognizes short-run impacts of money on output and employment. This relationship can be specified as:

$$U_t - U_{t-1} = \delta_0 + \delta_1 U_{t-1} + \delta_2 (m_{t-1} - p_{t-1})$$

This equation is simply a distributed lag response of the unemployment rate, U, to monetary growth. There is a transitory effect of money on unemployment when monetary growth is greater or less than the inflation rate. Over the long run, however, steady monetary growth has no effect on unemployment because, according to equation (2), monetary growth and inflation are the same in equilibrium. As a result, the $m_{t-1} - p_{t-1}$ term goes to zero and the equilibrium unemployment rate is determined by $\delta_0$ and $\delta_1$.

The estimated unemployment equation for the period 1954-76 is as follows:

$$(4)\quad U_t - U_{t-1} = \underset{(5.079)}{3.958} - \underset{(-4.862)}{.721}\, U_{t-1} - \underset{(-4.466)}{.380}(m_{t-1} - p_{t-1}) \qquad R^2 = .61 \quad SE = .80 \quad DW = 1.57$$

The implied steady state value for the unemployment rate, found by setting $U_t = U_{t-1}$, is 5.49 (that is, $3.958 \div .721$), essentially the same result as in equation (1). The interpretation of this equation is that money growth in excess of the inflation rate has a temporary effect on unemployment, but this effect disappears as the inflation rate converges to the growth rate of money in the long run. The steady state unemployment rate for the monetary view differs from NIRU in that inflation can accelerate even if the unemployment rate is in excess of its critical value.

## *Policy Implications*

The policy implications of these two views of the relation between inflation and unemployment differ substantially. The concept of NIRU suggests that policymakers need not consider inflation a problem until unemployment approaches this critical value. On the other hand, the monetary view stresses the effect of excessive monetary growth on inflation, independent of the prevailing unemployment rate. The lesson of the monetary view is that, in the long run, a steady growth of money will eventually result in a rate of inflation equal to that of monetary growth, and a rate of unemployment that will go to its steady state value. Only by constantly accelerating monetary growth is it possible to use monetary actions to reduce unemployment.

Consider the two views in terms of conditions as they exist in 1978. The inflation rate for 1977 over 1976 was 5.9 percent, and the unemployment rate in 1977 averaged 7 percent. The conventional view argues that inflation will not accelerate as long as unemployment stays above 5.44 percent. Consequently, it appears that output can be stimulated until the critical unemployment rate is reached. Then the stimulus can be reduced to a rate commensurate with long-term growth. The monetary view, on the other hand, indicates that money growth in excess of the ongoing inflation rate can lead to an acceleration in inflation

Table I

HYPOTHETICAL CASE A: CONVENTIONAL VIEW
Attempted Gradual Return to Full Employment

(1) $p_t - p_{t-1} = 2.463 - .453\, U_{t-1}$

(2) $U_t - U_{t-1} = -.412(x_t - 3.5)$

| | x | U | p | y | m |
|---|---|---|---|---|---|
| 1977 (Act.) | 4.9% | 7.0% | 5.9% | 11.0% | 7.2% |
| 1978 | 4.7 | 6.5 | 5.2 | 10.1 | 6.6 |
| 1979 | 4.7 | 6.0 | 4.7 | 9.6 | 6.1 |
| 1980 | 4.7 | 5.5 | 4.5 | 9.4 | 5.9 |
| 1981 | 3.7 | 5.4 | 4.4 | 8.2 | 4.7 |
| 1982 | 3.5 | 5.4 | 4.4 | 8.0 | 4.5 |
| 1983 | 3.5 | 5.4 | 4.4 | 8.0 | 4.5 |
| 1984 | 3.5 | 5.4 | 4.4 | 8.0 | 4.5 |
| 1985 | 3.5 | 5.4 | 4.4 | 8.0 | 4.5 |

Note: A path for U was selected and then the path of p was calculated using equation (1). The U path was used to derive the implied x (the growth rate of output), assuming potential output grows at 3.5 percent per year. The x and p paths were then used to derive y (the growth rate of nominal GNP), and then assuming velocity growth of 3.5 percent per year, the path of m was derived.

even if the unemployment rate is above its critical value.

Two different policy paths for the conventional model are shown in Tables I and II. Table I summarizes a policy directed toward a gradual return to full employment (NIRU) by 1980, and Table II shows an attempt to reach full employment quickly — in 1978. These cases were constructed by selecting a target path for unemployment and then calculating the effect of unemployment on inflation using Equation (1). An Okun's Law[13] equation (See equation (2), Table I) was added to the model to find the growth of output consistent with the unemployment path. By adding together the rates of increase in output and the price level the implied growth of nominal GNP was calculated as a step towards deriving the growth rate of money consistent with the path of the other variables.[14]

According to Table I, based on a gradual return to full employment, inflation and unemployment decline simultaneously until 1980, and then stabilize. By adding an assumption of constant velocity growth of 3.5 percent to the conventional model, steady state rates

Table II

HYPOTHETICAL CASE B: CONVENTIONAL VIEW
Attempted Rapid Return to Full Employment

(1) $p_t - p_{t-1} = 2.463 - .453\, U_{t-1}$

(2) $U_t - U_{t-1} = -.412(x_t - 3.5)$

| | x | U | p | y | m |
|---|---|---|---|---|---|
| 1977 (Act.) | 4.9% | 7.0% | 5.9% | 11.0% | 7.2% |
| 1978 | 7.4 | 5.4 | 5.2 | 13.0 | 9.5 |
| 1979 | 3.5 | 5.4 | 5.2 | 8.9 | 5.4 |
| 1980 | 3.5 | 5.4 | 5.2 | 8.9 | 5.4 |
| 1981 | 3.5 | 5.4 | 5.2 | 8.9 | 5.4 |
| 1982 | 3.5 | 5.4 | 5.2 | 8.9 | 5.4 |
| 1983 | 3.5 | 5.4 | 5.2 | 8.9 | 5.4 |
| 1984 | 3.5 | 5.4 | 5.2 | 8.9 | 5.4 |
| 1985 | 3.5 | 5.4 | 5.2 | 8.9 | 5.4 |

Note: See Table I.

of monetary growth and inflation are also derived. These steady state rates appear little different than those for the monetary model. However, the path to this equilibrium differs substantially.

According to Table II, also based on the concept of NIRU, there appears to be no obstacle to returning to full employment quickly. The difference between the results in Tables I and II is that a quick return to full employment "locks" the model in at a higher growth rate of money and inflation than does the gradual approach. The reason for this disparity of results for the conventional model is that the attempted quick return to full employment allows the effect of unemployment on inflation to operate for only one year.

Table III

HYPOTHETICAL CASE A: MONETARY VIEW
Attempted Gradual Return to Full Employment

(1) $p_t - p_{t-1} = .449\,(m_{t-1} - p_{t-1})$

(2) $U_t - U_{t-1} = 3.958 - .721\, U_{t-1} - .380\,(m_{t-1} - p_{t-1})$

| | x | U | p | y | m |
|---|---|---|---|---|---|
| 1977 (Act.) | 4.9% | 7.0% | 5.9% | 11.0% | 7.2% |
| 1978 | 3.4 | 5.4 | 6.5 | 10.1 | 6.6 |
| 1979 | 2.9 | 5.4 | 6.5 | 9.6 | 6.1 |
| 1980 | 2.9 | 5.6 | 6.3 | 9.4 | 5.9 |
| 1981 | 2.0 | 5.7 | 6.1 | 8.2 | 4.7 |
| 1982 | 2.4 | 6.1 | 5.5 | 8.0 | 4.5 |
| 1983 | 2.8 | 6.0 | 5.0 | 8.0 | 4.5 |
| 1984 | 3.1 | 5.8 | 4.8 | 8.0 | 4.5 |
| 1985 | 3.2 | 5.7 | 4.7 | 8.0 | 4.5 |

Note: The path of m was taken from Table I and the path of p was calculated from equation (1). Given m and p, the U path was then calculated from equation (2). The y path from Table I and the p path were used to calculate an implied x.

[13]Arthur M. Okun, "Potential GNP: Its Measurement and Significance," *The Political Economy of Prosperity* (Washington, D.C.: The Brookings Institution, 1970), pp. 132-45.

[14]This is based on the following:

$$m + v = p + x$$

where m: rate of increase in money
v: rate of increase in velocity
p: rate of increase in the price level
x: rate of increase in output.

Compare these results with those implied by the monetary model of inflation and unemployment. Using the growth rates of money derived for the conventional model in Tables I and II, the paths for inflation and unemployment for the monetary model are traced out in Tables III and IV. According to Table III, attempting a gradual return to full employment can be accomplished, but in the early stages there is an acceleration of inflation rather than the deceleration predicted by the conventional model. In 1980, inflation decelerates in response to the slowing in the growth rate of money. However, unemployment also rises again before the steady state is finally approached in 1984 and 1985.

Table V

ALTERNATIVE CASES: MONETARY VIEW
Rapid Return to Steady Money Growth

(1) $p_t - p_{t-1} = .449\ (m_{t-1} - p_{t-1})$

(2) $U_t - U_{t-1} = 3.958 - .721\ U_{t-1} - .380\ (m_{t-1} - p_{t-1})$

| | 2% Money Growth | | 4% Money Growth | | 6% Money Growth | | 8% Money Growth | |
|---|---|---|---|---|---|---|---|---|
| | p | U | p | U | p | U | p | U |
| 1977 (Act.) | 5.9% | 7.0% | 5.9% | 7.0% | 5.9% | 7.0% | 5.9% | 7.0% |
| 1978 | 6.5 | 5.4 | 6.5 | 5.4 | 6.5 | 5.4 | 6.5 | 5.4 |
| 1979 | 4.5 | 7.2 | 5.4 | 6.4 | 5.9 | 5.7 | 7.2 | 4.9 |
| 1980 | 3.4 | 6.9 | 4.8 | 6.3 | 5.9 | 5.5 | 7.5 | 5.0 |
| 1981 | 2.8 | 6.4 | 4.4 | 6.0 | 5.9 | 5.5 | 7.7 | 5.2 |
| 1982 | 2.4 | 6.1 | 4.2 | 5.8 | 6.0 | 5.4 | 7.9 | 5.3 |
| 1983 | 2.2 | 5.8 | 4.1 | 5.6 | 6.0 | 5.5 | 7.9 | 5.4 |
| 1984 | 2.1 | 5.7 | 4.1 | 5.6 | 6.0 | 5.5 | 7.9 | 5.4 |
| 1985 | 2.1 | 5.6 | 4.0 | 5.6 | 6.0 | 5.5 | 7.9 | 5.4 |

Examination of the other case (Table IV) — an attempted quick return to full employment — indicates severe oscillations in inflation and unemployment before the steady state is approached. The unemployment target is overshot, and the rapid growth in money in 1978 has its effect on the inflation rate for several years.

To explore in greater depth the implications of the monetary view, alternative simulations of steady growth rates of money are shown in Table V. In each case, the steady-state rate of monetary growth is begun in 1978. According to these simulations, there appears to be little prospect for reducing the inflation rate from its 1977 value without incurring a period of rising unemployment during the interim. However, the policies of inflation control (2 and 4 percent money growth) show that once the period of rising unemployment is weathered, both inflation and unemployment decline from their 1977 values toward their steady-state values.

Table IV

HYPOTHETICAL CASE B: MONETARY VIEW
Attempted Rapid Return to Full Employment

(1) $p_t - p_{t-1} = .449\ (m_{t-1} - p_{t-1})$

(2) $U_t - U_{t-1} = 3.958 - .721\ U_{t-1} - .380\ (m_{t-1} - p_{t-1})$

| | x | U | p | y | m |
|---|---|---|---|---|---|
| 1977 (Act.) | 4.9% | 7.0% | 5.9% | 11.0% | 7.2% |
| 1978 | 6.1 | 5.4 | 6.5 | 13.0 | 9.5 |
| 1979 | 1.0 | 4.3 | 7.8 | 8.9 | 5.4 |
| 1980 | 2.1 | 6.1 | 6.7 | 8.9 | 5.4 |
| 1981 | 2.6 | 6.1 | 6.1 | 8.9 | 5.4 |
| 1982 | 2.9 | 6.0 | 5.8 | 8.9 | 5.4 |
| 1983 | 3.1 | 5.8 | 5.6 | 8.9 | 5.4 |
| 1984 | 3.2 | 5.6 | 5.5 | 8.9 | 5.4 |
| 1985 | 3.2 | 5.6 | 5.5 | 8.9 | 5.4 |

Note: See Table III except that the paths for m and y are taken from Table II.

## *Conclusions*

The Administration has taken an approach to controlling inflation that is predicated on the assumption that economic slack is a factor in determining the inflation rate. In particular, the direct approach to inflation control has been chosen by the Administration because the terms of the trade-off between inflation and unemployment are deemed unacceptable.

Policy based on this type of reasoning is potentially disruptive. According to the simple monetary model used here, attempts to stimulate output with expansionary monetary policy will have accompanying effects on inflation, despite apparent slack in the economy. Even though there is a similarity in long-run targets, substantially different paths to this equilibrium are derived, depending on which model is used and how fast the policymakers hope to achieve their targets.