

# Inflation, Money Creation, and Capacity Utilization

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## I. Introduction

In a 1978 paper, Keith M. Carlson (2) tested two competing views of the causes of changes in the inflation rate. One view, which he considers the "conventional view," is basically a statement of belief in a short-run Phillips Curve.

High rates of inflation are associated with low unemployment rates and vice versa. An alternative statement of this that one often reads in the financial press is that as long as there is substantial unused capacity in the economy, there is no reason to be concerned about increases in the inflation rate. Carlson labels this view the "CEA view" because it is consistent with the explanation of inflationary forces in the 1978 *Annual Report* of the Council of Economic Advisers (3).

A second view is that both the rate of inflation and the unemployment rate are affected by a third variable, a change in the growth rate of the money stock. Specifically, when the rate of money growth becomes larger than the rate of inflation, the latter will increase, but there may be some transitory decreases in the unemployment rate. This view is consistent with most short run, adaptive expectations Monetarist models of the aggregate economy (4).

Carlson tested these alternative hypotheses using 1952-1976 annual data. His estimated equations are presented in Table 1.

The first equation indicates the expected negative relationship between the unemployment rate lagged one year and the change in the rate of inflation. However, the parameter is significant only at the 10 percent level and the coefficient of determination is very low. This equation does not lend much support to "CEA view" of causes of changes in inflation rates.

The second estimated equation in Table 1 is designed to be a test of the Monetarist hypothesis that inflation rates increase only when the rate of money creation exceeds the inflation rate. The estimated parameter has

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[Table 1]

| Dependent Variable   | Independent Variable |                  |   | $R^2$ | SE   | DW   |
|----------------------|----------------------|------------------|---|-------|------|------|
|                      | Constant             | $U_{t-1}$        | $(M_{t-1} \cdot P_{t-1})$ $(Y_{t-1} \cdot U_E)$ |       |      |      |
| 1. $(P_t - P_{t-1})$ | 2.463<br>(1.970)     | -.453<br>(1.894) |   | .15   | 1.41 | 1.79 |
| 2. $(P_t - P_{t-1})$ |                      |                  | .449<br>(4.106)                                 | .43   | 1.13 | 1.93 |
| 3. $(P_t - P_{t-1})$ | 0.001<br>(0.004)     |                  | .406<br>(3.301)    -.177<br>(.826)              | .45   | 1.16 | 1.99 |
| 4. $(U_t - U_{t-1})$ | 3.958<br>(5.079)     | -.721<br>(4.862) | -.380<br>(4.406)                                | .61   | .80  | 1.57 |

$P_t$  = year-to-year percent change in the GNP deflator.

$M_t$  = year-to-year percent change in the narrowly defined money stock.

$U_t$  = unemployment rate.

$U_E$  = natural unemployment rate as computed from equation one in this table. Its estimated value is 5.44 percent.

"t" statistics are in parentheses. Other notation is conventional.

the expected positive sign and is significant at the one percent level. Also, the  $R^2$  is three times as large as the  $R^2$  in equation one.

Equation three tests the hypothesis that changes in inflation rates are determined jointly by relative money growth rates and deviations of the unemployment rate from the natural rate. (Note: a natural unemployment rate of 5.44 percent calculated from equation one is used in these estimates). The estimated equation indicates that the addition of this independent variable to equation two adds little or nothing to explanatory power of the equation.

Finally, in equation four, Carlson tests the hypotheses that money growth rates in excess of inflation rates temporarily reduce unemployment rates. His estimates are consistent with this hypotheses. However, the estimated parameter for the other independent variable in equation four indicates a statistically significant and inverse relationship between the level of the unemployment rate and the change in the unemployment rate.

In summary, Carlson found the Monetarist explanation of changes in inflation rates superior to the CEA "slack in the economy" explanation. Also, he found some support for the adaptive expectations models which

predict transitory effects of monetary shocks on unemployment rates.

The objectives of the present paper are to estimate Carlson's equations using annual data through 1982, to estimate the equations with dummy variables to test for both slope and intercept changes, and to use manufacturing capacity utilization as an alternative measure of "slack in the economy."

Inclusion of data for 1977-82 needs no explanation, but some explanation of the other additions to Carlson's estimates may be in order. We believe that it is reasonable to assume shifts in short-run Phillips curves during the 1960's and 1970's as a result of changes in inflationary expectations and as a result of changes in the composition of the labor force. Also, the money growth rate—inflation rate relationship may have changed, especially during the 1970's, as a result of supply shocks. Therefore, we experiment with dummy variables for various time periods.

Another modification of Carlson's model is the substitution of measures of manufacturing capacity utilization rates for unemployment rates. Neither is close to being a perfect proxy for the degree of excess demand in the economy. However, it is interesting to examine the possibility that Carlson's conclusions may be altered by a different measure of "slack in the economy."

## **II. Empirical Evidence**

Table 2-Table 4 in this section present the estimated equations. All equations were estimated with 1952-1982 annual data. Table 2 contains the same equations as Table 1 except we estimate them using both CPI and GNP deflator data. Carlson (2) only used the latter in his estimates. Neither the addition of 6 years of data nor the use of the CPI change Carlson's results very much. The principal differences between our results and Carlson's are lower coefficients of determination when we include the 1977-1982 data and higher natural rates of unemployment. With the GNP deflator as the measure of inflation, the natural rate,  $U_E$ , is 5.89 percent compared to 5.44 percent in Carlson's estimates. We also compute a natural rate of unemployment of 5.64 percent using the CPI. Carlson did not use the CPI in his reported results.

The estimates in Table 3 for equations 5-7 examine the hypothesis that another measure of the degree of unused capacity in the economy, other than the unemployment rate, should be considered. Table 3 contains the same equations as Table 2 except the unused capacity utilization rate in manufacturing (UC) is substituted for the unemployment rate.

[Table 2]

| Variable \ Independent<br>Dependent | Constant | $U_{t-1}$        | $(M_{t-1} - P_{t-1})$ | $(U_{t-1} - U_E)$ | $R^2$ | DW   |
|-------------------------------------|----------|------------------|-----------------------|-------------------|-------|------|
| 1'. $(P_t - P_{t-1})_G$             | 1.736    | -.294<br>(1.673) |                       |                   | .09   | 1.82 |
| $(P_t - P_{t-1})_C$                 | 2.669    | -.472<br>(1.885) |                       |                   | .11   | 1.34 |
| 2'. $(P_t - P_{t-1})_G$             | 0.084    |                  | .389<br>(3.814)       |                   | .34   | 1.96 |
| $(P_t - P_{t-1})_C$                 | 0.106    |                  | .378<br>(3.408)       |                   | .29   | 1.30 |
| 3'. $(P_t - P_{t-1})_G$             | 0.064    |                  | .375<br>(3.222)       | -0.041<br>(.242)  | .34   | 1.96 |
| $(P_t - P_{t-1})_C$                 | 0.073    |                  | .346<br>(2.684)       | -0.129<br>(.496)  | .30   | 1.25 |
| 4'. $(U_t - U_{t-1})_G$             | 3.028    | -.508<br>(4.095) | -406<br>(4.803)       |                   | .51   | 2.03 |
| $(U_t - U_{t-1})_C$                 | 3.208    | -.552<br>(4.598) | -.319<br>(5.371)      |                   | .56   | 2.51 |

The notation is the same as Table 1, except the subscript G and C on the dependent variables indicate year-to-year percent changes in the GNP deflator and the Consumer Price Index. The national rates of unemployment,  $U_E$ , are 5.89 percent when the GNP deflator is used, and 5.64 percent when the CPI is used.

Comparison of equation 5 with equations 1 and 1' indicate important differences. The estimated parameters for  $UC_{t-1}$  are significant at the one percent level for both the GNP deflator and CPI measures of inflation.

Also, the  $R^2$ 's are much higher when the unused capacity utilization rate is substituted for the unemployment rate. This lends some support to the hypothesis that the degree of "slack in the economy" does affect changes in inflation rates, independently of relative money growth rates.

Equations 6 and 7 in Table 3 indicate that an increase in the money growth rate relative to the inflation rate will increase the inflation rate in the next year and this monetary "shock" will decrease the degree of unused capacity in the economy. Therefore, expansionary monetary policy seems to have positive effects on both real output and inflation rates. A final comment on the estimated equations in Table 3 is that equation 5 allows us to compute natural rates of unused capacity utilization for both the GNP

deflator and the CPI. The rates are 17.9 percent for the former and 17.4 percent for the latter.

[TABLE 3] GILBERT AND LEE

| Dependent Variable                                    | Independent Variable |                    |                                    |  | R <sup>2</sup> | DW   |
|---|----------------------|--------------------|------------------------------------|--|----------------|------|
|   | Constant             | UC <sub>t-1</sub>  | M <sub>t-1</sub> -P <sub>t-1</sub> | (UC <sub>t-1</sub> -UC <sub>CE</sub> ) |                |      |
| 5. (P <sub>t</sub> -P <sub>t-1</sub> ) <sub>G</sub>   | 2.677                | -14.933<br>(2.805) |                                    |  | .22            | 2.05 |
| (P <sub>t</sub> -P <sub>t-1</sub> ) <sub>C</sub>      | 4.701                | -27.050<br>(3.849) |                                    |  | .35            | 1.27 |
| 6. (P <sub>t</sub> -P <sub>t-1</sub> ) <sub>G</sub>   | 0.018                |                    | .310<br>(2.713)                    | -7.707<br>(1.402)                      | .39            | 2.09 |
| (P <sub>t</sub> -P <sub>t-1</sub> ) <sub>C</sub>      | 0.020                |                    | .239<br>(2.113)                    | -19.776<br>(2.113)                     | .44            | 1.14 |
| 7. (UC <sub>t</sub> -UC <sub>t-1</sub> ) <sub>G</sub> | 0.160                | -.901<br>(5.552)   | -.016<br>(5.002)                   |  | .58            | 1.89 |
| (UC <sub>t</sub> -UC <sub>t-1</sub> ) <sub>C</sub>    | 0.153                | -.872<br>(5.388)   | -.012<br>(4.885)                   |  | .57            | 2.10 |

Notation in this table which have not been used previously are UC<sub>t</sub> and UC<sub>E</sub>. UC<sub>t</sub> is an annualized unused capacity utilization rate in manufacturing. It is computed as one minus the capacity utilization rate as reported by the Board of Governors of the Federal Reserve System. UC<sub>E</sub> is the "natural rate" of unused capacity computed from equation 5. It is .179 when the GNP deflator is used and .174 when the CPI is used.

Table 4 contains the same equations as Tables 2 and 3 with the addition of dummy variables for slope and intercept changes in the estimated equations. We estimated every equation in Table 2 and 3 with every possible combination of a dummy variable for the constant terms and/or the independent variables. We also experimented with three different subperiods in our tests for structural changes. The parameters in all of our equations should be sensitive to changes in how rapidly people adjust their expectations to changes in actual rates of inflation. They should also be sensitive to the "supply side" shocks of the 1970's.

These hypotheses caused us to choose the following subperiods: 1952-1965, 1966-1982; 1952-1967, 1968-1982; 1952-1972, 1973-1982. In each of these three divisions, the dummy variables were set equal to zero in the first segment of the 1952-1982 period and one in the second segment of the

[Table 4]

| Independent Variable                                 | Dependent Variable |                  |                   |                 |  |                 |                   |                    |                    |                    | R <sup>2</sup> | DW   |
|--|--------------------|------------------|-------------------|-----------------|--|-----------------|-------------------|--------------------|--------------------|--------------------|----------------|------|
|  | Constant           | D                | U <sub>t-1</sub>  | D               | (M <sub>t-1</sub> - P <sub>t-1</sub> ) | D               | U <sub>E</sub>    | D                  | UC <sub>t-1</sub>  | D                  |                |      |
| 1'. (P <sub>t</sub> -P <sub>t-1</sub> ) <sub>c</sub> | 4.048<br>(2.693)   | 1.774<br>(1.954) | -0.839<br>(2.762) |                 |  |                 |                   |                    |                    |                    | .22            | 1.34 |
| 2". (P <sub>t</sub> -P <sub>t-1</sub> ) <sub>c</sub> |                    |                  |                   |                 | n                                      |                 |                   |                    |                    |                    |                |      |
|  | -0.515<br>(1.382)  | 1.837<br>(2.609) |                   |                 | .532<br>(4.549)                        |                 |                   |                    |                    |                    | .44            | 1.45 |
| 3'. (P <sub>t</sub> -P <sub>t-1</sub> ) <sub>c</sub> | -0.947<br>(2.390)  | 2.678<br>(3.554) |                   |                 | .464<br>(4.108)                        |                 | -0.567<br>(2.266) |                    |                    |                    | .53            | 1.36 |
| (P <sub>t</sub> -P <sub>t-1</sub> ) <sub>c</sub>     | -0.533<br>(1.407)  | 3.045<br>(4.492) |                   |                 | .415<br>(4.107)                        |                 | -0.159<br>(0.608) | -1.325<br>(2.879)  |                    |                    | .65            | 1.44 |
| (P <sub>t</sub> -P <sub>t-1</sub> ) <sub>c</sub>     | -0.680<br>(1.684)  | 2.710<br>(3.765) |                   |                 | .213<br>(1.239)                        | .402<br>(1.873) | -0.569<br>(2.384) |                    |                    |                    | .59            | 1.46 |
| 4'. (U <sub>t</sub> -U <sub>t-1</sub> ) <sub>c</sub> | 3.697<br>(5.363)   | 0.958<br>(2.479) |                   |                 | -0.386<br>(4.959)                      |                 |                   |                    |                    |                    | .60            | 2.10 |
| (U <sub>t</sub> -U <sub>t-1</sub> ) <sub>c</sub>     | 3.811<br>(5.167)   |                  | -.714<br>(4.801)  | .142<br>(2.211) | -0.378<br>(4.733)                      |                 |                   |                    |                    |                    | .58            | 2.09 |
| 5'. (P <sub>t</sub> -P <sub>t-1</sub> ) <sub>c</sub> | 2.576<br>(2.092)   | 8.535<br>(3.571) |                   |                 |  |                 |                   | -15.571<br>(2.117) | -43.590<br>(3.310) |                    | .57            | 1.70 |
| 6'. (P <sub>t</sub> -P <sub>t-1</sub> ) <sub>c</sub> | -0.601<br>(1.827)  | 1.835<br>(2.967) |                   |                 | .393<br>(3.494)                        |                 |                   |                    | -19.751<br>(3.002) |                    | .58            | 1.29 |
| (P <sub>t</sub> -P <sub>t-1</sub> ) <sub>c</sub>     | -0.423<br>(1.506)  | 1.816<br>(3.494) |                   |                 | .345<br>(3.613)                        |                 |                   |                    | -9.099<br>(1.435)  | -37.805<br>(3.436) | .72            | 1.66 |

Notation in this table is the same as in Tables 1-3 with the addition of the D's in the heading. The D immediately to the right of the constant term is the dummy variable for changes in the intercept term. The other D's are dummy variables for slope changes for the independent variable to the left of each D.

period. The best results were found for the 1952-1972, 1973-1982 division. These results are reported in Table 4.

The results indicate a shift in the intercept term for equations 1-6. There is no measured shift in either the intercept or slope in equation 7. These results suggest that after 1972, there were larger changes in the rate of inflation at each rate of unemployment and larger changes in the rates of inflation for increases in money growth rates relative to existing rates of inflation. One should note that, in general, these conclusions hold for the CPI as the measure of inflation, not the GNP deflator.

Additional examination of the results in Table 4 suggests that after 1972, reductions in the unemployment rate or the unused capacity utilization rate below their respective natural rates, will result in larger increases in inflation rates than before 1972. Also, in all cases, addition of the dummy variables results in sizable increases in the coefficients of determination. Finally, there may be reason to be concerned about first order autocorrelation problems. In six of the ten estimated equations reported in Table 4, the DW statistics are small enough that the tests for first order autocorrelation are not conclusive.

### III. Summary and Conclusions

This paper is an attempt to update and modify an earlier study by Carlson which tested the hypothesis that changes in the rate of inflation can be explained by the lagged unemployment rate, the money growth rate relative to the rate of inflation, and the difference between the natural rate of unemployment and the lagged unemployment rate. Also, an excess of the money growth rate over the inflation rate is expected to reduce the unemployment rate. Our results, which included more recent data, confirmed Carlson's conclusions that the relative money growth rate explains a larger percentage of changes in inflation rates than the lagged unemployment rate. Also, we like Carlson, found evidence that an increase in money growth relative to inflation rates will reduce the unemployment rate. The main differences in our results are that we found, as expected, higher natural rates of unemployment when more recent data are included and we found that the estimates are sensitive to how we measure the general price level.

We also found that the unused capacity utilization rate in manufacturing explains more of changes in inflation rates than the unemployment rate. This causes us to conclude that the merits of alternative hypotheses of

causes of changes in inflation rates depend on what measure of "slack in the economy" is chosen.

Finally, our estimates which include dummy variables suggest that there have been structural changes in the economy in the post 1972 period. There is a larger change in the inflation rate associated with each rate of unemployment, with each deviation of the money growth rate from the natural rate, and with each deviation of the actual unused capacity utilization rate from the natural rate.

### References

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