HAS THE RESPONSE OF INFLATION TO MACRO POLICY CHANGED?

Recent Changes in Macro Policy and its Effects: Some Time-Series Evidence

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Has the macroeconomic policy "regime" changed in the United States in the last few years? If so, has this change had an effect on macroeconomic relationships, and, in particular, on the relationship between inflation and unemployment? These two questions have been on the minds of most macroeconomists since the October 1979 switch from interest rates to reserves as an intermediate target for the Federal Reserve and the explicit endorsement of monetarism by the Reagan Administration in early 1981. The questions are important not only for predicting the course of the economy in the future, but also for assessing the practical significance of the Lucas critique.[1] According to this critique a change in policy regime should cause changes in the way the economy operates. Comparing economic relations before and after a change in regime should provide a test of the critique.

The approach in many recent studies has been to assume that the answer to the first question is yes—that there has been a significant change in the macroeconomic policy regime—and to look for changes in the Phillips curve as a test of the Lucas critique. Thus far, the results have been mixed. Otto Eckstein (1983), Steven Englander and Cornelis Los (1983), and George Perry (1983) conclude that there has been no significant

change in the Phillips curve relationship. Phillip Cagan and William Fellner (1983) and Wayne Vroman (1983) find some evidence of a change: wage inflation has come down more quickly—especially in 1982 and early 1983—than would be predicted from a Phillips curve.

However, the assumption that there has been a regime change has received little empirical attention. The October 1979 switch from interest rate targetting to reserve targetting at the Fed is usually taken as prima facie evidence of a significant change in policy regime. But such changes in operating procedures per se do not necessarily entail a change in policy regime relevant for macroeconomic purposes. If they did, then the renewed emphasis on interest rates rather than reserves starting in late 1982 should be cited as evidence of a return to the old regime—a view which few researchers have taken. In fact, studies have shown that either interest rates or reserves can be used as intermediate targets for controlling the money supply and ultimately aggregate demand. (The choice between the two depends on whether shocks to the money markets are from the demand side or the supply side.) The issue of importance for assessing whether a regime change has taken place is how much the Fed reacts by adjusting the money supply (appropriately defined) in response to conditions in the economy. The procedure it uses to bring about this response is irrelevant.[2] Implicit in a macroeconomic policy regime is a "rule" relating the money supply to economic con-

[1] See Robert Lucas (1976). William Fellner's (1978) credibility hypothesis is similar to the Lucas Critique in this context and has been tested in similar ways.

[2] Some have argued that, for political reasons, by focusing on reserves the Fed would be able to let interest rates go higher than under interest rate targetting. With reserve targetting, Fed officials could shift the blame for high interest rates elsewhere.

ditions. The fact that the last three years are a suitable time for testing the Lucas Critique can be established only by providing evidence that this rule has changed significantly.

The aim of this paper is to use simple time-series techniques to examine whether there has been a significant change in macroeconomic policy in the special sense described above, and whether, as a result of this change, the relationship between inflation and unemployment has shifted in ways suggested by recent theories of wage and price determination. To do this a small vector autoregression is estimated and transformed into a pure moving average form in which changes in macro policy and its effects can be measured.

I. Measuring The Change in Aggregate Demand Policy

Financial innovations such as sweep accounts and the move toward deregulation of financial services have made it difficult to use any one measure of the money supply for estimating a policy rule in recent years. The relationship between money and nominal *GNP* has been even more volatile than usual as a result of these innovations and regulatory changes. An alternative aproach is needed.

The most direct way to get around the velocity shift problem is to focus on aggregate demand itself as measured by nominal *GNP*. A change in policy regime would then occur if the Fed altered its rule for adjusting its nominal *GNP* targets. In particular, the Fed would become less *accommodative* in the 1980's if it did not permit nominal *GNP* to increase as much in response to inflation shocks as it has in the past. Such a less-accommodative policy would permit real *GNP* to fall by a larger amount in response to inflation shocks. Alternatively stated, it would permit unemployment to rise by a larger amount in response to inflation shocks.

During the late 1960's and 1970's the Fed allowed the growth rate of nominal *GNP* to *rise* to about 12 percent, which accommodates a steady 9 percent inflation if potential *GNP* grows at 3 percent. If there has been a change in the policy regime it is likely to be to one in which the Fed will aim to make nominal *GNP* less accommodative to inflation. Perhaps it will eventually aim to keep the growth rate of nominal *GNP constant* at a lower level (say 5 percent) as some economists have recently proposed. These less-accommodative policies would entail larger increases in unemployment in response to inflation shocks.

A reaction function for measuring this change can be obtained by regressing the unemployment rate on past inflation rates and past unemployment rates. Adding lagged unemployment terms to the equation allows for reaction lags or other reasons for delayed response by the Fed. If the coefficients on the past inflation rates in this equation have increased in the last few years, then this would be evidence of a change toward a less accommodative policy regime.

II. Measuring Change in the Inflation Process

How would the inflation process change as a result of such a change to a less-accommodative policy? Recent research on wage and price determination (see my 1980 article for example) suggests that inflation will be less persistent (i.e., have smaller positive autocorrelation) under a less-accommodative aggregate demand policy. A shock to the inflation rate will not have as prolonged an effect on inflation with a less-accommodative policy. This research also suggests that the effect of a given level of unemployment on inflation will increase. This is due to the expectation that the Fed will not accommodate inflation in the future. Expectations of higher unemployment in the future, as well as expectations of lower inflation in the future, will tend to reduce inflation today.

These potential changes can be measured by regressing the inflation rate on past inflation rates and on past unemployment rates. If the coefficients on past inflation rates decline and the coefficients on the unemployment rates increase in absolute value, while at the same time macro policy becomes less accommodative, then we would have evidence which is consistent with this theory of wage and price determination.

III. The Evidence from Vector Autoregressions

The regressions suggested above for measuring changes in macro policy and in the inflation process can be combined to form a simple vector autoregression in which the vector of unemployment and inflation observations is regressed on past values of itself. This bivariate autoregression was estimated over two sample periods: 1954:1–1981:1 and 1954:1–1983:3. The longer sample period includes the recent disinflation period where the effects of a regime change should be noticeable. Unfortunately the period 1981:1–1983:3 is too short to estimate a vector autoregression separately.

Let $y_t = (w_t, u_t)'$ where w_t is the rate of change in average hourly earnings index (a measure of inflation), and u_t is the unemployment rate for prime age males (a demographically stable measure of unemployment).[3] The estimated equations are of the form

$$(1) \qquad y_t = \sum_{i=1}^{4} A_i y_{t-i} + \varepsilon_t,$$

and are based on quarterly observations. The moving average for this system is given by

$$(2) \qquad y_t = \sum_{i=0}^{\infty} \theta_i \varepsilon_{t-i},$$

where the θ_i matrices can be obtained directly from the A_i matrices.[4] As Christopher Sims (1980) has argued, the moving average coefficients usually show a smoother pattern than the autoregressive coefficients and are therefore easier to interpret.

The autoregressions for the two periods are reported in Table 1 and the moving average representation is shown in Figure 1. In assessing the change in macro policy and in the inflation process we can compare these two vector autoregressions and their moving

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[3] The nominal wage series prior to 1961 was provided by Robert Gordon. See his 1971 paper.

[4] The covariance matrix of the ε_t in this representation has not been orthogonalized and is equal to the covariance matrix estimated in equation (1). Sims discusses alternative ways of presenting the moving average representation.

TABLE 1—BIVARIATE AUTOREGRESSIONS FOR WAGE INFLATION AND UNEMPLOYMENT

	Lags	1	2	3	4	SSR
Sample: 1954:1–1981:1						
w-equation	w	.40	.26	.12	.22	
	u	.03	.02	.02	−.05	98.0
u-euqation	w	−.45	.56	−.51	.30	
	u	1.62	−.89	.21	−.01	11.1
Correlation of Residuals: $\rho_{wu} = -.290$						
Sample 1954:1–1983:3						
w-equation	w	.41	.26	.10	.19	
	u	.03	.01	.04	−.04	105.2
u-equation	w	−.50	.65	−.63	.28	
	u	1.66	−.88	.16	.03	13.4
Correlation of Residuals: $\rho_{wu} = -.306$						

Note: w is the percentage quarterly change in the average hourly earnings index measured at an annual rate, u is the unemployment rate for males 25 to 54; *SSR* is the sum of squared residuals for each equation; the equations were estimated with a constant term.

average representations. This procedure is not entirely satisfactory since the sample period which contains the last eleven quarters also includes the earlier period; if there has been a change in the last eleven quarters, then these estimates will be a mixture of two dissimilar periods between which a structural change has occurred. Assuming that the new policy is maintained, future studies may be able to utilize additional observations to estimate separate autoregressions and moving average representations under the new regime.

Visual inspection of the autoregressive equations in Table 1 indicates that the effect of adding additional sample points during the disinflation period has a relatively small effect on the autoregressive coefficients. The F-tests for structural homogeneity give values of .735 and 2.07 for the inflation and unemployment equations, respectively. The 5 percent significance point is 1.94. Hence there is more evidence of a structural change in the policy equation than in the behavioral equation for inflation. But neither change is dramatic.

Note that the changes in the coefficients do indicate a shift to a less-accommodative policy, and that the effects of this change are exactly as predicted above. The sum of the coefficients on lagged wages in the unem-
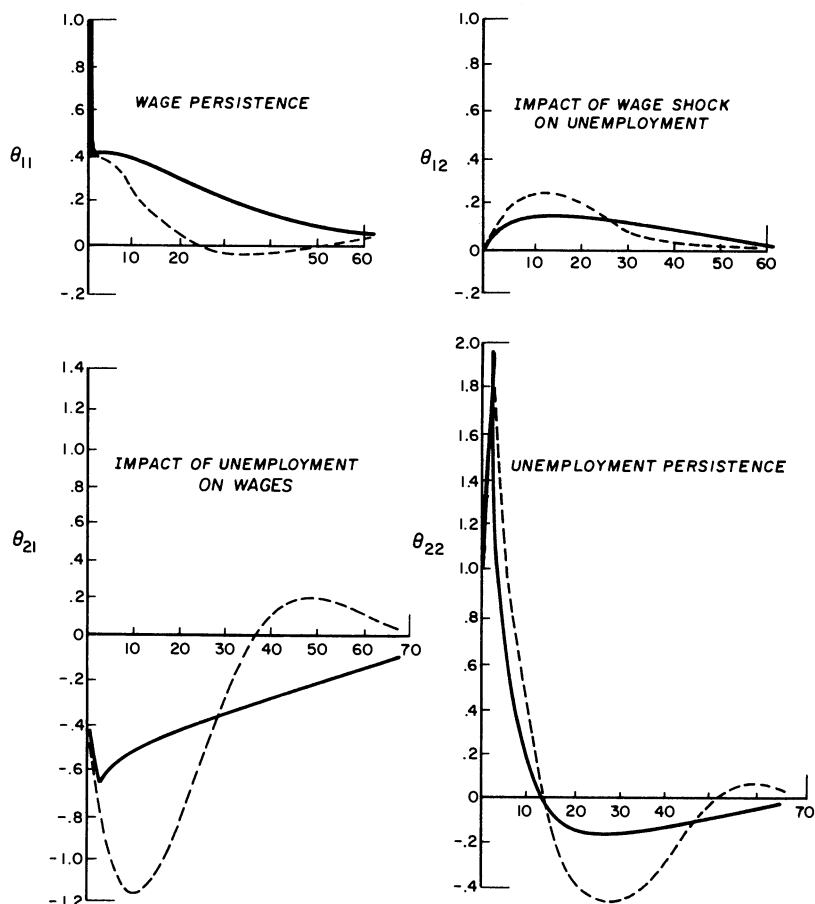
FIGURE 1. MOVING AVERAGE REPRESENTATIONS FOR WAGE GROWTH AND
UNEMPLOYMENT

Note: 1954:1–1981:1 ——; 1954:1–1983:3 – – –

ployment equation increases, the sum of the coefficients on lagged wages in the wage equation declines, and the sum of the coefficients on unemployment in the wage equation increases in absolute value.

It is likely that the lack of strong statistical significance in these equations is due to the small number of observations in the post-1980 period and the resulting low power of the structural homogeneity tests at conventional significance levels. If so, then if policy remains less accommodative in the future, the additional observations will strengthen the statistical significance. The striking fact

that the direction of the changes correspond to what would be predicted from a less-accommodative policy is suggestive that this may be the case.

The moving average coefficients shown in the four charts in Figure 1 suggest the same interpretation as the simple comparison of the sum of lagged coefficients. They also provide information about how the dynamics of the economy have changed. The charts in Figure 1 are normalized so that zero is the steady-state value for each variable. For example, the normal level of the unemployment rate is zero.

The chart in the upper right-hand corner of the figure shows that the initial impact of a wage shock on unemployment is larger for the sample that includes the post-1980 data. The impact remains larger for 25 quarters, but eventually the response of unemployment falls below that in the earlier period. According to these estimates, policy seems to have become less accommodative, not only by responding by a larger amount to inflation shocks, but also by responding more quickly. This policy would generate recessions which are larger than under the old policy, but which do not last as long.

Examining the upper left-hand portion it is clear that wage inflation is much less persistent for the sample that includes the last three years. The impact of any shock to wages deteriorates more rapidly than in the pre-1980 sample. Finally the impact of unemployment on inflation is shown in the lower left-hand corner of the figure. The initial and medium-term impacts of unemployment on wage formation are larger for the sample which includes the last three years. Eventually, however, the effect of the unemployment shock is smaller.

IV. Concluding Remarks

The purpose of this paper has been to look for changes in the behavior of macroeconomic policy and the relation between inflation and unemployment during the last three years using time-series techniques. There is evidence that the policy "rule" has changed in the direction of a less-accommodative policy and that the inflation process has become less persistent. Under the less-accommodative policy, the increase in unemployment caused by inflation "shocks" is larger but less prolonged.

The results, however, are based on a relatively small number of observations during the new regime and are not strongly significant statistically. While the results are in general agreement with recent theories of the effect of macro policy on wage and price formation, they must therefore be viewed as tentative.

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