Institutional Factors in Domestic Inflation

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During the 1970s the inflation and unemployment rates have tended to increase together. Although to some these developments have signalled the end of the Phillips curve view of inflation, we take the opposite position. By the Phillips curve approach, we mean a downward sloping short-run tradeoff between inflation and unemployment and a vertical long-run relationship which intersects the unemployment axis at U*, the nonaccelerating-inflation rate or sustainable rate of unemployment.[1] The coincidental upward movement in unemployment and prices, which gives the appearance of an upward sloping short-run Phillips curve is due to three developments:

First, due in part to demographic changes in the population, U* has been increasing since the late 1950s and this increase has continued through the 1970s. The rise in U*, however, has not been accepted by policy-makers who continue to press for lower unemployment rates using monetary and fiscal policy. The resulting overly tight product and labor markets have led to traditional demand-pull inflation. This is especially true during the periods 1965-1969 and 1972-1974.[2]

Second, as a result of a series of adverse exogenous shocks, such as the food and fuel shortages of the early 1970s, the economy has at times been forced off its short-run Phillips curve. To prevent the price increases in these sectors from being completely built into expectations, the government (especially the Ford Administration) opted not to ratify the inflation entirely. The result was short-

The authors are respectively Professor of Economics and Associate Professor of Finance, Wharton School, University of Pennsylvania. The research was supported by grants from the General Electric Foundation and the National Institute of Child Health and Human Development. We wish to thank Costas Azariadis, Benjamin M. Friedman, Jeffrey M. Perloff and Robert Solow for valuable comments and Choongsoo Kim for extensive research assistance.

[1] The exact shape of the long-run tradeoff is not important for our purposes. This is especially the case because the nature of long-run equilibrium is unclear in an economic model where institutional change is an important factor. For example, the long-run Phillips curve may be upward sloping rather than vertical. This type of relationship appears in, among others, Ross and M. Wachter [1973] and M. Friedman [1977].

[2] See M. Wachter [1976] for the construction of the U* series utilized in this paper. The overstimulative characteristic of monetary and fiscal policy is relevant to the product market and the GNP gap as well. See Perloff-M. Wachter [1979] for the development of a lower potential output series than that currently being utilized by the Council of Economic Advisers.

run bulges in the inflation rate accompanied by increases in the unemployment rate.

Third, due to long lags in the response of inflation to tight product and labor markets, and the longer duration of recent cycles, the synchronization between movements in the inflation and unemployment rates has been broken. In the late 1940s and early 1950s the business cycle was relatively short, alternating frequently between periods of market tightness and slack. Inertia or expectational errors on the upswing were cancelled out by the effects of the recession. Without a backlog of built-in inflationary momentum, changes in product and labor market tightness were quickly reflected in inflation rate changes. The economy fluctuated along a narrow band of downward sloping short-run Phillips curves.

With the long period of slack after 1958 and the subsequent period of tightness after 1965, the long lags began to build up momentum. In this context, fixed wage and price contracts resulted in serially correlated "errors" on the part of unions and firms. The momentum of, for example, the 1965-1969 expansion carried over into the mild downturn of 1970-1971. The cyclical effect of an unemployment rate slightly greater than U* was overridden by the surfacing of inflationary pressures from the past cycle. Hence, inflation and unemployment increased together. The reverse example is provided by the recovery in late 1975 and 1976 when unemployment and inflation simultaneously declined. In this later case the major decline in the inflation rate took place after the unemployment rate had peaked.

In this paper we shall concentrate on this third factor. The rigidity in the wage and price mechanism is a response to the tendency of firms and labor unions to engage in contracting that fixes prices and wages, a process that we shall refer to as obligational market contracting.[3] The empirical manifestation of this phenomenon is long lags in the estimated wage and price equations. The main direct impact of the exchange arrangements of institutions on domestic inflation is thus to generate long, but variable lags in the inflation process.

Changes in the inflation itself, however, have important feedback effects on the institutions. More specifically, it is changes in the variance rather than the mean of the inflation rate which are likely to generate changes in the exchange relationships. But for the United States, where institutional arrangements have been structured on a near zero mean, low variance inflation rate, the increase in the inflation rate over the past decade has generated the increase in the variance. Since mean and variance effects are difficult to separate for the recent U.S. data, we shall simply refer to inflation effects on institutions.

Although largely ignored in the literature, institutional responses are a central component of the inflation process. That is, inflation can cause alterations in the method of obligational contracting, changes that imply long-run costs to the economy. In addition, the changes in the contracting mode, such as the adoption of escalator clauses, are geared to speeding-up the response of the

[3] The term is introduced and described in detail in M. Wachter and Williamson [1979]. It is summarized below.

micro actors to macro developments. That is, the lags grow shorter as the inflation rate increases.

Of prime concern are the policy implications of long lags in the inflation process. It is often argued that for the economy to climb down from its current and persistent 6 to 7 percent inflation rate would require an extended and perhaps a deep recession. Given long lags, the inflation spiral would indeed appear to unwind very slowly. In addition, the presumed nonlinear shape of the Phillips curve implies that downturns must be steeper than that original expansions which caused the upswing of inflation.

Indeed, to some researchers, this is an optimistic assessment of the problem. If the Phillips curve is flat (i.e., the coefficient on the excess demand variable is small and insignificant), then excess demand plays a minor role and the inflationary spiral cannot be stopped by running a recession. In this scenario, the onset of inflation is largely due to exogenous shocks from the international sector or from cost-push union settlements. The result is a wage-price spiral which then feeds on itself and is largely independent of aggregate demand management.[4] One way to break the inflationary spiral would be through deflationary exogenous shocks. Even this, however, seems unlikely. In part, because of political reactions, the exogenous shocks are not random with zero mean. For example, although poor harvests cause prices to rise, abundant harvests cause price supports to rise to mitigate any favorable deflationary effect. The upshot of this analysis often involves the call for wage and price controls as the mechanism for breaking the inflationary spiral.

In this paper we shall contest the view that the high inflation rate problem can only be resolved by a prolonged and/or deep recession or by wage and price controls. The institutional factors in the inflation process do give rise to long response lags. To interpret these lags as implying an ongoing wage-price spiral that is not affected by monetary and fiscal policy, however, is inappropriate. The inflation spiral necessitates validation by the monetary authorities. In this sense, the long lags may be the connecting link between past monetary growth rates and current inflation rather than between current and past inflation. Viewed in this framework, both the theory and evidence suggest two potential alternatives to the notion that a deep and/or prolonged recession would be required to slow the inflation process:

The first is that the institutional factors should adjust to higher rates of inflation by shortening the response lag. The growth of escalator clauses in union contracts and indexed price contracts for long delivery items provides an example of changes which shorten the lags. Empirical wage equations provide some econometric evidence for this proposition, although the results are not unambiguous. The coefficients on the wage equation now exhibit a higher first year response on the part of the inflation rate than they did prior to the 1970s.

The second is that the inertia or expectational elements that are the basis of the lagged response may be lowered, albeit very slowly, while the economy is

[4] See, for example, Okun [1975], Nordhaus [1976] and Perry [1978]. A similar point is made by Fair in this conference volume. One of the earliest and strongest statements of this position is Weintraub [1958].

close to U*. That is, a slowdown in the nominal level of monetary and fiscal stimulus, with a time horizon adapted to the length of the recontracting period in obligational markets, may be able to reduce inflation without leading to a severe recession. This program makes use of the widely accepted notion that over the longer run, at U*, inflation is approximately homogeneous of degree one in money growth.[5]

The economic engineering required to maintain the economy close to U* is difficult, particularly since the level of U* is a source of disagreement. The political problems of accepting a slow reduction in the inflation rate are undoubtedly great, but clearly less than the "prolonged and deep" recession which some researchers argue is implied by the data on the wage-price spiral. At worst, our argument is for "accepting" the current inflation rate and maintaining the economy close to U*. With some luck, however, the shifting coefficients and a reduction in the frequency of overstimulative monetary and fiscal policies may allow an unwinding of the inflation rate at much less real cost to the economy than anticipated by most inflation models.

Elsewhere, we have also stressed the use of structural labor market policies to reduce U*.[6] These policies should be a central component of an inflation policy and could supplement the anticipated favorable (for U*) demographic developments that should appear around 1980. A low growth economy, with a small, but positive $U > U^*$ has important income distribution effects. Improvements on the supply side of the labor market, aimed at younger and disadvantaged workers, can both neutralize the distributional effects of slow growth and lower U*, the nonaccelerating inflation rate of unemployment.

As of 1978, this proposed solution does not seem likely to be tried. Policymakers are still reluctant to accept a U* as high as the approximately 5.5 percent figure indicated by the evidence.[7] On the other hand, little policy effort is directed at lowering U* through structural policies.[8] Instead, the economy seems headed in the short run towards tighter product and labor markets and thus a renewed and significant upswing in the inflation rate.

[5] It can also be based on the findings of the rational expectations model, but where the rationality properties are determining only over the length of the recontracting period in the obligational markets.

[6] M. Wachter [1976] and Wachter and Wachter [1978].

[7] Nor are policy-makers ready to accept the relatively low GNP gap which is associated with a 5.5 percent sustainable unemployment rate. See Perloff and M. Wachter [1979]. The notion that U* is at least as high as 5.5 percent is accepted by a diverse group of economists such as Cagan [1977], Hall [1974], and Modigliani and Papademous [1975].

[8] The main effort of policy is in direct job creation or public service employment. This type of program is part of the general fiscal stimulus package and has little chance to lower U* by improving the structure of the labor market. Experiments with new types of incomes policies or attempts to resuscitate old wage and price controls are also unlikely to have a positive effect on the long-run inflation and unemployment problems.

I. The Institutional Setting

Discussions of the institutional factors in inflation have historically been concerned with oligopolies and labor unions. Although these institutions, and especially the latter, are important components of an analysis of inflation, a broader conceptual framework is necessary. In particular, many industries which are not unionized or heavily concentrated display similar pricing and wage behavior. We refer to these industries as being in the obligational market sector.[9]

The impact of institutional factors on inflation should be divided into two separate issues; the rate of inflation itself and the mechanism by which inflation is transmitted through the economy. Our position is that institutional arrangements have a very important impact on the inflation mechanism, but little or no direct effect on the rate of inflation.[10] In this sense, the private market institutions do not impart an inflationary bias to the economy.[11]

At some stage, all ongoing inflationary processes must be accommodated by the money supply. Short-run fluctuations in inflation rates and real output can proceed with adjustments in the velocity of money, but in discussing the U.S. experience of rising inflation rates between 1965 and 1978, a rising rate of growth of the money supply is a necessary component.

A. *Obligational Market Contracting*

Since the basis of obligational market contracting is described in detail by M. Wachter and Williamson [1979], we only summarize its salient implications for our topic. Obligational contracting is based on the prevalence of ongoing exchange relationships between buyer and seller (including employer and employee) and the tendency for such relationships to involve idiosyncratic features. These contracts are to be found in final product markets, intermediate product markets, and labor markets.

An example of obligational contracting is found in the internal labor market of the firm. In this case specific training renders jobs within a firm different from similarly named jobs at other firms. The heterogeneity of tasks means that the incumbent worker (or supplier in product markets) has an advantage over outsiders in performance. This gives rise to a gap in the workers' current and opportunity wages and the firm's current and opportunity unit labor costs. The result is that the incumbent worker is not in an external labor market and

[9] In other treatments, derived from Okun's work [1976], the term customer markets is utilized. Although the underlying framework is somewhat different for these two concepts, the industries included are largely the same. Our treatment follows the usage adopted in M. Wachter and Williamson [1979]. The importance of transactions costs in the theory of inflation and unemployment is stressed by Gordon [1976] in his review article.

[10] Changes in the institutional arrangements are, however, likely to have an indirect effect on the inflation rate. As shall be argued below, changes in inflation uncertainty cause alterations in contracting modes. This imposes a cost to the economy which reduces the supply potential and is likely to increase U* as well.

[11] Okun [1976] argues the reverse case.

individual wages in the internal labor market are buffered, in the short run, from changes in labor market conditions. Since both parties have a pecuniary interest in maintaining the relationship, care is exercised to avoid a break. This often takes the form of an implicit (or explicit, especially where labor unions are involved) governance structure which suppresses opportunities for either side to maximize individual short-run gains at the expense of mutual long-run advantage. Any change in external market conditions which raises the question of a change in internal wages can lead to a problem as to whether a new internal wage should or does alter the sharing of the benefits of the ongoing relationship. To avoid these problems, wages adjust to changing economic circumstances only with a lag and mainly to reflect long-term rather than transient labor supply conditions.

That wages adjust with a lag does not mean that they are unchanging in the short run. Wages can move continuously, or more likely in short discrete jumps, but the *rules* which govern these wage changes are invariant to short-run market conditions and can change only when the (implicit or explicit) contract is subject to renegotiation.

Some flexibility to macro shocks is built into obligational market contracting through indexing. But the extent of this indexing is severely limited; real shocks are omitted entirely and nominal shocks are only partially indexed. The reasons for this involve the costs of writing and enforcing complex contingent claims contracts.

At the heart of this problem is "bounded rationality" which may be defined as the cognitive limits of human agents in relation to the complexity of the problems that they confront. Due to these cognitive limitations, economic agents may intend to be rational, but they can achieve only a limited rationality.[12] The result is that it is not possible to identify all future contingencies and to specify, ex ante, the appropriate response. In addition, even if a complete contract or index could be written, execution difficulties exist. In particular, there is the need to declare what state of the world has actually occurred at each delivery date. The result is the development of incomplete contracting with a governance mechanism to interpret what future events have evolved and what adaptations in the wage or price contract should be made.[13]

In the short run, or more precisely, over the length of the contract period in the obligational markets, the rules which determine wage and price increases are fixed. The incomplete indexing described above is part of the fixed rule structure. Within the framework, any unresolved disputes are handled through a governance structure whose primary purpose is to maintain the relationship and

[12] The notion of bounded rationality is developed in detail in Williamson [1975]. In the macro literature on expectations, B. Friedman [1978] has stressed the limitations of the rationality concept.

[13] The development of the implicit contracting literature circumvents, in part, the problem of writing a contingent claims contract. This literature, however, cannot deal effectively with the enforcement problems that arise in executing the implicit contract. Transactions costs and not differentiated risk aversion are at the heart of the problem.

thus the long-run gains of the parties rather than to achieve equilibrium with short-run market conditions.

B. *Implications for the Inflation Equation*

The obligational markets framework is consistent with the rational expectations model, but only over the long run. The bounded rationality of the economic agents weakens the sharp distinction drawn in the rational expectations literature between preannounced policy changes and policy surprises. In part, the cognitive skills of the micro parties, ignoring the skills of the policy-makers themselves, make it difficult to translate short-run macro announcements into the proper course of action. This is not a minor point: the assumption that preannounced policies will lead to market-clearing behavior in the near term is likely to prove erroneous. This does not rest on the notion that the micro parties form expectations irrationally; rather it means that there are cognitive limitations for translating preannouncement policy changes into appropriate micro responses.

In the short run, even if economic agents formed expectations rationally, they would be constrained from making short-run adjustments by the workings of the contract. The difficulties in dealing with preannounced policy changes in the short run are related to the reasons why incomplete contracting emerges in the first place; both are reflections of the need to economize on transactions costs becuase of the inherent cognitive limitations of individuals. Only for a time horizon that is long enough for full recontracting, can the price or wage contact be fully adjusted to a rational expectations view.[14]

What constitutes the long run is, of course, an empirical issue. The popularity of the three-year contract in the labor market provides some evidence that the effect of events three years in the past may not be fully incorporated into the system. Indeed, important lagged effects are likely to extend well beyond three years. As is well known, even when management and unions renegotiate a contract at the end of the specified period, the contract is, to an important degree, not fully renegotiated. Here again, this results from bounded rationality and the problem of monitoring whether either party is seeking short-run gains at the expense of the mutual long-run benefits. One example is the fact that escalator clauses tend to be introduced and strengthened slowly over several contracts. Frequently, when either party wants to alter an important implicit or explicit contract clause, the desired change is announced at one contract renewal and then pressed for adoption at a later contract renewal date. It is for this reason that the economy can anticipate the continued growth of escalator provisions, even if the inflation rate were to remain unchanged or even fall somewhat.

The growth of escalator clauses indicates an important feature of obligational market contracting: namely, that the inflation rate has a feedback effect on the precise methods of contracting. That is, the institutions or exchange

[14] The implications of the rational expectations view are developed by Lucas [1972], Sargent [1973], [1976] and Sargent and Wallace [1975]. For a debate on the implications of rational expectations in a contracting world, see Barro [1977] and Fischer [1977].

arrangements of the economy themselves are an endogenous element. For institutions structured on a near zero mean and low variance inflation rate, the emergence of ongoing inflation of 7 percent implies an increase in the variance as well as the mean rate of inflation. This generates the need for changes in the contracting mode. These changes are costly and the costs are not recouped even if the inflation settles down to a steady state. In short, there is a permanent loss in potential output as the economy moves to a higher (unanticipated) inflation rate. As important, however, is that the very uneven speed of institutional responses to inflation implies that achieving a new steady state inflation rate is an extraordinarily lengthy procedure which leaves the economy in a prolonged state of disequilibrium.[15]

The response of obligational markets to an (unanticipated) increase in the inflation rate is likely to be lumpy or discontinuous. The adoption of escalator clauses of varying degrees of complexity and completeness does not seem to proceed continuously with the variance of the inflation rate. In addition, even where wage rates (and prices) become fully indexed, there is no implication that the complete employment relationship has become indexed. Compensation as distinct from wage rates provides an important example. Fringe benefits and pension plans in particular, respond even slower to the increase in (unanticipated) inflation. The reason again involves bounded rationality and the difficulty of redesigning complex pension plans that involve incomplete vesting, annuities fixed in money terms in earlier contracts, and unfunded actuarial obligations.

Although there is considerable set-up time in establishing the escalators, after they are in place they will remain in place over a considerable upward or downward inflation range. Once the contracting mode is changed to allow for faster responses, monetary and fiscal stimulus translates more rapidly into nominal rather than real changes in economic activity. Although the economy is now less susceptible to monetary disturbances, it is more susceptible to real disturbances.[16] Given this exposure to increased fluctuations in real variables, the next step in the response of obligational markets may be to shorten the length of the contracting period. A move to shorter contracting periods is likely to be an exceptionally costly development.

II. Empirical Results

A. *Background*

The evidence of inflationary changes is usually obtained from inspection of wage and price equations.[17] The wage equation may be written in the form

[15] The Federal Government itself is one of the larger laggards in the adoption process. Although Federal pay scales and Social Security are, in effect, nearly fully indexed over a three-year time horizon, Federal tax rates and a whole series of Federal regulations are still based on the assumption of near zero inflation.

[16] This point is developed by Gray [1976].

[17] For an overview of this type of approach, see Tobin [1972].

$$(1) \qquad \dot{w} = f_1 (UGAP, [\dot{w}_{t-i}], UNION)$$

where $\dot{w}$ is the percentage rate of change in wages, $UGAP = U_N/U$ where U_N is a normalized unemployment rate which takes account of changing demographic and structural features of the labor market, $[\dot{w}_{t-i}]$ is a vector of lagged dependent variables and UNION is a "cost-push" variable(s) to take account of changes in the degree of unionization and/or militancy of the present membership. The U_N variable is an empirical approximation of U*. See, for example, Perloff and M. Wachter [1979].

Equation (1) is similar to those found in the literature with a few notable exceptions. Some other researchers include an array of unemployment, wage, and price terms rather than the two shown above. Although it is possible to improve the $\bar{R}^2$ of equations by this technique, there is no evidence to suggest that any one such equation consistently forecasts better than any other equation in this genre. An advantage of (1) is that it is simpler to decipher the impact of policy targets or instrument variables.[18]

A union pressure variable which is generally omitted from most equations is included here. Our purpose in including that variable, however, is only to highlight the fact that we are explicitly excluding it from the empirical results. As shall be discussed below, there is virtually no evidence that unions, either through growth in new unions or changes in power or militancy, have been a significant source of exogenous wage-push pressure in the post-1954 U.S. experience. This does not mean that unions, or even labor militancy in general, could never be a factor in inflation. Indeed, it is likely that some European countries over the postwar period, for example the United Kingdom and Italy, have experienced inflation pressure from the unionized sectors.[19]

Empirical price equations, available in the literature, tend to be of the form

$$(2) \qquad \dot{p} = g(CAP\,U, [\dot{p}_{t-i}], [\dot{c}], [\dot{w}-\dot{\rho}], S)$$

where $\dot{p}$ is the percentage change in prices, CAP U is the capacity utilization rate or some other demand variable, $[\dot{c}]$ is a vector of other price changes, e.g., materials, $\dot{\rho}$ is the percentage change of productivity so that $[\dot{w}-\dot{\rho}]$ is a vector of lagged unit labor costs, and S is a cost-push variable(s) to take account of supply shocks in the product market.[20]

The problem with (2) is that it is largely an accounting identity explaining prices as a function of cost increases. To the extent that it is not an identity,

[18] R.J. Gordon [1972] takes the alternative approach in specifying relatively complicated variables in the wage equation. For example, he includes a measure of the discouraged worker effect and differentiates between product and consumer price effects on wages. For the use of lagged wages in place of prices, see Hall [1974].

[19] For an analysis of labor unions in the European inflation experience see, for example, Laidler [1976] and Schelde-Andersen [1978].

[20] For discussions of aggregate price equations see Nordhaus [1972].

(2) is better viewed as a profits rather than a price equation. In many equations, the demand variable is insignificant and S is omitted because it cannot be quantified. Given a quick "pass-through" of costs into prices, all that prevents achieving an $\bar{R}^2 = 1$ is measurement errors in the cost and price variables and the cyclical behavior of profit margins. Since the cost variables are simply other prices, namely those of inputs, explaining prices as a function of costs does not deal with the inflation question. The cost equations would now become the inflation equations, unless they also are a function of $\dot{p}$ and other costs. Equation (2), however, is a reasonable way of taking account of cyclical changes in profit margins; that is, the difference between prices and costs.

In discussing changes in domestic inflation and, in particular, the institutional factors in domestic inflation, it is useful to concentrate on the wage rather than the price equation. Most important, prices are much more sensitive to international inflation than are wages. International factors affect domestic wages as well as prices, but their impact on prices is direct whereas their impact on wages is filtered through either domestic prices (if p were included in (1) in place or with $\dot{w}$) or labor market conditions (UGAP). The same argument holds for exogenous shocks in agriculture. In addition, the recent rash of government regulations concerning factors such as pollution control and product and occupational safety are likely to have a greater impact on prices than on wages. Unfortunately, these regulations are difficult to quantify. Some aspects of the new government regulation, e.g., occupational safety, are likely to alter wages directly as well as prices. We are currently attempting to study these effects on wages by decomposing recent shifts in productivity. Attempts to include a productivity variable directly into the wage equation have not yielded significant results.

B. *Wage Equation*

The results from our wage equation are shown in Table 1. In the standard equation (i) both UGAP and lagged wages are significant and the sum of the coefficients on $[\dot{w}_{t-i}]$ is close to unity. Whether the sum of the weights are somewhat above or below unity depends upon the exact specification of the independent variables and the length of the lag on $[\dot{w}_{t-i}]$. The $\bar{R}^2$ of the equation is 0.723. Adding a controls variable for the Nixon Administration's Phases I to IV results in equation (ii). Substituting lagged prices instead of wages results in equations (iii) and (iv). The qualitative nature of the results are the same among the four equations.[21]

The typical refrain in the literature is that equations such as (1) imply a wage-wage spiral in (i) and (ii) and a wage-price spiral in (iii) and (iv). The re-

[21] Given the limited variation in the data, one cannot determine whether the United States faces a wage-wage or wage-price spiral. There is some evidence that the food-fuel price explosion did not feed through directly to wages. On the other hand, it is possible that such a pass-through would have occurred if the Federal Reserve and Ford Administration had not opted for a recession in 1974.

latively small coefficient on UGAP, combined with the long lags on $\dot{w}_{t-i}$, implies a relatively small short-run payoff from running recessions to lowering the inflation rate. For example, using equation (ii), an increase in U of 2 percentage points to 7.5, given $U_N = 5.5$, implies an initial inflation reduction of 0.20 after one quarter. Thereafter the gains come even slower; that is, if U is maintained at 7.5 percent, the decline in inflation after one full year is 0.2830 and after two years is approximately 0.45.

The long and slow response of the wage or price inflation rate to a prolonged period of excess supply is found in virtually all wage and price equations similar to (1) and (2). The exact form of the demand variables and lagged wages and/or prices has little effect on the policy message.

For example, the Phillips curve is usually assumed to be nonlinear with an increasing elasticity for tighter labor markets. The empirical evidence, however, as shown in equation (i) of Table 1, cannot distinguish between the convex or linear Phillips curve.[22] Equations with UGAP or $UGAP^{-1}$ have nearly identical $\bar{R}^2$. But, given the range of UGAP over the postwar period, the difference in the inflation response to aggregate demand between the UGAP and $UGAP^{-1}$ equations is small. In any case, the UGAP coefficient only captures the short-run response of inflation. Shifts in the Phillips curve, embodied in Table 1 by the lagged wage or price terms, measure longer-run effects. For any significant change in the inflation rate, the speed and magnitude of shifts in the Phillips relationship are more important than short-run movements along the curve.

A second experiment is to measure the inertia term with lagged money supply changes in $[\dot{m}_{t-i}]$ instead of lagged wages and prices. Here again, the results are largely the same. The $\bar{R}^2$ is unchanged and the long lags are intact. Indeed, the mean length of the lag on money growth is larger than for either lagged wages or prices. This is shown in equations (vi) and (vii). The $[\dot{m}_{t-i}]$ equations, however, are open to a different interpretation than either the lagged wage or price equations.[23] This is discussed below.

That the American economy works with lagged responses surprises no one. Many large labor union contracts are for three years and this alone implies a certain rigidity to the system. Add to this the pervasiveness of obligational contracting in both product and labor markets and a long response pattern is guaranteed. But do long lags in setting relative wages and prices by the micro actors

[22] The potential importance of the nonlinear Phillips curve response to the overall inflation policy issues is stressed by Cagan [1977].

[23] For a skeptical view of the direct role of money growth in inflation equations, see Modigliani and Papademos [1975].

TABLE 1

Wage Equations, Quarterly 1954:1 – 1978:1[a]

Equation	Constant	UGAP[b]	NIXCON[c]	Lagged or Inertia Effect[d] $\sum_{i=1}^{24} X_{t-i}$	$\bar{R}^2$/DW
(i)	−0.7004 (3.65)	2.5764 (4.61)		1.1264 $[\dot{w}_{t-i}]$ (12.41)	0.723/2.01
(ii)	−0.7068 (3.94)	2.8534 (5.40)	−0.0886 (3.40)	1.07766 $[\dot{w}_{t-i}]$ (12.57)	0.758/2.14
(iii)	−0.2674 (2.03)	3.3619 (7.40)		1.0037 $[\dot{p}_{t-i}]$ (13.01)	0.778/2.09
(iv)	−0.2838 (2.16)	3.4888 (7.55)	−0.03388 (1.34)	0.9876 $[\dot{p}_{t-i}]$ (12.71)	0.780/2.01
(v)	0.6411 (4.50)	−0.1404[e] (5.46)	−0.0915 (3.92)	1.0372 $[\dot{w}_{t-i}]$ (12.39)	0.759/2.20
(vi)	−0.2091 (1.48)	0.8368 (1.29)		0.9590 $[\dot{m}_{t-i}]$ (13.33)	0.691/1.49
(vii)	−0.1909 (1.54)	0.9838 (1.72)	−0.1173 (5.24)	0.9454 $[\dot{m}_{t-i}]$ (14.92)	0.761/1.90

[a]The dependent variable is the quarterly change in the average hourly earnings index. The variable excludes compensation.

[b]UGAP is the normalized unemployment rate divided by the actual unemployment rate, multiplied by 0.25 as a scaling factor; that is, $(U_N/U) \times 0.25$. The variable is described in Wachter [1976] and has been updated for this paper.

[c]The NIXCON variable represents the controls period of 1971:3 – 1975:2. It has a mean value of zero indicating that the controls had no permanent effect on the wage level.

[d]The lagged or inertia effect variables are constructed using a third degree polynomial, 24 quarters in length and constrained to zero at the end point. The lags begin with period t−1.

[e]The UGAP variable in equation 7 is in inverse form; that is $(U/U_N) \times 4.0$.

require that it takes several years to reduce wage inflation by 1 percentage point?[24]

There is no theoretical answer to how long are the long lags. In terms of the empirical evidence, however, there are some important reservations as to the validity of the exercise which yielded a one-half percent reduction in inflation after a two-year wait. This technique for calculating a steady-state tradeoff is incorrect. Two reasons for this conclusion are discussed in the remaining part of this section.

Instability of the Coefficients of the Wage Equation

The first issue involves the pervasive instability of the coefficients in the Phillips curve-type equation. This instability is not an accidental or fortuitous event, nor is it unique to the Phillips curve. The Phillips curves, like many macro equations, are simplified dynamic relationships that are meant to represent a complex economy. Changes in the nature of policy rules, in institutional arrangements, and in the distribution of excess demand across the disaggregated units are all likely to cause shifts in the wage equation. Since many of these underlying variables, such as the changes in institutional arrangements, and many policy variables are nonquantifiable, there is a necessity for continual updating of the parameters of the relationship.[25]

In some cases, a priori evidence suggests that the coefficients may be shifting in a systematic fashion. We argue that this is the case in the wage equation and the result is that the battle against inflation need not take as much time as suggested by the equations of Table 1. As discussed in M. Wachter [1976], the coefficients on either UGAP and/or the inertia term--whether $\dot{w}$, $\dot{p}$, or $\dot{m}$--have

[24] One explanation of the long lags involves measurement errors in both dependent and independent variables. The UGAP variable, although an improvement on U alone, is still a very imperfect proxy for excess demand. Since measurement errors bias coefficients towards zero, and since the coefficient on UGAP is the key parameter in the short-run tradeoff, the immediate inflation response may be greatly understated. An additional issue involves the wage and/or price variable; both essentially reflect a list price or average price concept. In this respect Stigler and Kindahl [1970] provided strong evidence that price inflexibility was overstated because of undercutting list prices during recessions. For labor, the tendency to layoff the lowest-wage workers imparts an additional source of rigidity to the wage data which reflect average earnings rather than wage rates. Both the direction of the measurement bias and its quantitative importance are unknown.

[25] Often equations can be "patched-up" by introducing new variables to explain past shifts. Our experience, however, is that this will not improve out-of-sample predictions; each shift seems to require a new variable. The alternative is to reestimate the equations with some frequency. With shifting parameters the "simple" equations often predict as well as the "patched-up" equations with new variables. We doubt that this is a question of "Keynesian" vs. rational expectations-type equations. Either school should find it difficult to isolate stable structural forms given the limitations of the data and the complexity of the true relationships.

been increasing over the period of rising inflation.[26] Since $\dot{w}$ and $\dot{p}$ can be interpreted as distributed-lag generators for UGAP in the wage equation, increasing values on these terms imply an increasing impact of aggregate demand. In equations where UGAP and $\dot{m}$ appear, there is less difficulty in identifying the aggregate demand effects on the rate of wage inflation.

In a sense the UGAP term and the coefficients on $[\dot{w}_{t-i}]$ for low i can be interpreted as the short-run effect. As shown in Tables 2 and 3 the coefficients on UGAP and the sum of the coefficient weights over the first year on $[\dot{w}_{t-i}]$ or $[\dot{m}_{t-i}]$ imply a stronger short-run reaction in 1978 than existed in the middle 1960s.[27] The short-run aggregate demand multiplier is approximated here by $\alpha/[1 - \sum_{i=1}^{4} \beta_i]$ where α is the coefficient on UGAP and the denominator is the sum of the first four weights on the inertia effect.

The changing coefficients of the wage equation reflect the changing economic environment of the sample period. For the initial sample period, 1954–1960, of steady inflation and short, shallow business cycles, the $\dot{w}$ term can be largely explained by the constant term of the equation. The coefficient on U/U_N is very small (in absolute value) and is actually negative on $[\dot{w}_{t-i}]$. The initial lags on $[\dot{w}_{t-i}]$, however, are positive, yielding a tiny but positive multiplier $(\alpha/[1 - \sum_{i=1}^{4} \beta_i])$ of 0.0857. Expanding the sample period through 1964:4 results in a more traditional Phillips curve, with a wage inflation response multiplier of 0.0980.

An additional major change in the wage equation occurs when the period of high inflation and low unemployment is included. Adding the years 1965 through 1969 results in an increase in the coefficient on $UGAP^{-1}$ from −0.0665 to −0.1302 and on $\sum_{i=1}^{4} \beta_i$ from 0.3214 to 0.5270. The inflation response multiplier nearly triples from 0.0980 to 0.2753. The second period of rising inflation ends in 1974:4. The wage equation estimated for 1954:1 through 1974:4 yields an increase in the long-run coefficient on $\dot{w}$ to 1.0320. The short-run inflation

[26] Given the sluggish adjustment of obligational markets, an increase in the inflation rate implies an increase in the variance of the inflation rate around the fixed rate built into the obligational contracts. The policy significance of shifting coefficients in the wage equation are emphasized by Lucas [1972] and Fellner [1976]. For evidence, across countries, that economies with greater variation in inflation rates have shorter lags see S. Wachter [1976]. Shifting parameters in employment equations, as a function of policy, are emphasized by Baily [1978].

[27] This confirms the findings in M. Wachter [1976] where a different econometric approach to this question was utilized. That is, the equation was estimated for the entire sample period with a fixed coefficient on $[\dot{p}_{t-i}]$ and a variable weight on UGAP. With that constraint, the coefficient on UGAP increased over the period.

multiplier rises moderately to 0.3135. During this second period of rising inflation, although the short-run response of inflation to unemployment increases slightly, the major change is in the long run, with the emergence of a vertical Phillips curve.

The differences between the 1954–1960 and 1954–1974 equations are dramatic. In the shorter period, the offsetting nature of the expansions and recessions resulted in a nearly constant rate of wage inflation, with seemingly little regard for short-run demand conditions. By 1974:4, after a decade of rising inflation and generally tight labor and product markets, the sluggish response of obligational markets in setting wages generated significant and quantitatively large values for the long lag terms in the $[\dot{w}_{t-i}]$ distributed lag.[28] At the same time, the obligational markets were forced to react faster and in a more systematic way to the fluctuations in demand. The adoption of escalators in three-year contracts helped to provide larger weights on $[\dot{w}_{t-i}]$ for low i.

Adding the last three years, a period of loose labor markets, results in a largely unchanged Phillips curve. The coefficients on $UGAP^{-1}$ and $[\dot{w}_{t-i}]$ are insignificantly different for 1954:1 – 1978:1 compared with 1954:1 – 1974:4. It can be argued that the 1974 to 1978 period was marked with two offsetting factors, while the continued adoption of escalator clauses and other devices acted to speed the responsiveness of the system, the unanticipated food-fuel-controls shocks helped to maintain the appearance of long lags.

The wage equations with the money supply growth as the inertia factor, also exhibit a substantial increase in the short-run responsiveness of wage inflation. The lags on $[\dot{m}_{t-i}]$, as mentioned above, are weighted towards the high values of i, even relative to the $[\dot{w}_{t-i}]$ equations. The trend towards a greater wage response to aggregate demand, in this case directly represented by money supply growth, is not only pronounced, but also continues through the most up-to-date sample period.

The pattern of changing coefficients in Tables 2 and 3 indicates the potential for a dramatic speed-up in the estimated inflation responsiveness of the system. First, a new period of excess aggregate demand would almost certainly cause a shift in the coefficient weights toward the front of the lag structure. The currently estimated long lags would be very costly for obligational market firms to maintain at higher inflation rates. Second, even without an additional increase in the mean and variance of the inflation rate, there should still be a forward shifting of the lag weights in the wage equation. New data, in a stable inflation environment, would allow the escalator clauses that were adopted in the previous period to be reflected in the coefficients. That is, the incremental data to the wage equation would no longer be affected by the slow response to the

[28] If the 1954–1960 period had been marked by the longer business cycles of the latter period, but with the same mean inflation rate, the long lags on $[\dot{w}_{t-i}]$ would probably have been significant. In a heuristic sense, the long lags on $[\dot{w}_{t-i}]$ were present even in the earlier period, but could not be measured econometrically because of the particular time path of the economy.

real food-fuel-income policy shocks of the 1970s. The predominance of surprise effects, as occurred in 1974–1978, "artificially" raised the mean length of the lag.[29]

The Impact of Money Supply Growth: The Systematic and Residual Components

The second problem concerns the variables included in the wage and/or price equations. In terms of equations (1) and (2), we are dealing with a mixed type of equation that is not meant to be a structural equation, yet it does not contain any exogenous or policy variables. To derive an empirical Phillips curve from a general macro model, it is possible to settle on a myriad of different forms along the continuum of purely structural to purely reduced form equations.

We have introduced the money supply inertia equations, shown in (v) and (vi) of Table 1, as one alternative to the wage-wage or wage-price spiral view of the world. That is,

$$(3) \qquad \dot{w}_t = f_2 \ (\text{UGAP}, [\dot{m}_{t-i}], \text{NIXCON}).$$

Our intent is not to argue that the former is the true causal mechanism, but that the wage-wage or wage-price spiral presents a one-sided picture which may severely understate the effect of aggregate demand on wage inflation rates.

As mentioned above, there is little to choose from among these equations in terms of $\bar{R}^2$; the wage-wage, wage-price, and wage-money supply connections fit about the same. In fact, in comparing Tables 2 and 3 it appears that the wage-money supply variant does slightly better than the wage-wage spiral. The comparison of $\bar{R}^2$, however, is of limited interest. First, we obviously are not attempting to obtain the wage equation with the highest $\bar{R}^2$. Since the Phillips curve is a hybrid structural-reduced form equation, a test based on highest $\bar{R}^2$ would involve including numerous other variables. The resulting best reduced form equation would vary considerably depending upon the time period and the computer resources of the researcher. It is likely that the resulting equation would contain all of these variables in a complicated package.[30] For our purposes it is useful to unscramble the reduced form equation so as to isolate the lagged m equations from the lagged $\dot{w}$ or $\dot{p}$ equations.

The lagged $\dot{m}$ in equation (3) replaces the wage-wage or wage-price spiral with a wage-money supply spiral. The lagged $\dot{m}$ equations do confirm some aspects of the alternative equations. The lags on $\dot{m}$ are very long, indeed the lag to 50 percent completion is over three years when the polynomial lag structure

[29] Of course, whether or not a forward shift actually takes place would depend upon a host of other factors including the expectations of future policy actions and the government pronouncements of future macro targets.

[30] For a discussion of macro models based on reduced form specification see Sims [1977]. His results support the importance of a direct linkage between $[\dot{m}_{t-i}]$ and $\dot{w}_t$.

TABLE 2

Wage Equations for Different Sample Intervals
Lagged Wage Change as the Inertia Variable

Sample Interval	Constant	U/U_N[a]	$[\dot{w}_{t-i}]$[b]	NIXCON[b]	$\bar{R}^2$/DW	$\sum_{i=1}^{4}$[c]	$\frac{\alpha}{1-\sum_{i=1}^{4}}$[d]
1954:1 – 1960:4	1.6121 (2.27)	−0.0775 (1.82)	−0.2313 (0.52)		0.414/2.03	0.0961	0.0857
1954:1 – 1964:4	0.5890 (1.86)	−0.0665 (1.64)	0.6180 (2.99)		0.353/2.01	0.3214	0.0980
1954:1 – 1969:4	0.8837 (4.07)	−0.1302 (4.60)	0.7287 (4.35)		0.627/1.90	0.5270	0.2753
1954:1 – 1974:4	0.6127 (3.19)	−0.1332 (4.41)	1.0320 (9.87)	−0.0959 (4.03)	0.735/2.20	0.5751	0.3135
1954:1 – 1978:1	0.6411 (4.50)	−0.1404 (5.46)	1.0372 (12.39)	−0.0915 (3.92)	0.759/2.20	0.5401	0.3053

[a]The $UGAP^{-1}$ variable is scaled by multiplying by 4. This makes it approximately equal to the unemployment rate in mean value over the sample period.

[b]Same as Table 1.

[c]$\sum_{i=1}^{4}$ is the sum of the weights on the lagged wage term, $\dot{w}_{t-i}$, for the first four quarters.

[d]The approximation of the short-run response of wage inflation to aggregate demand is calculated as the coefficient on $UGAP^{-1}$ divided by $[1 - \sum_{i=1}^{4}]$.

TABLE 3

Wage Equations for Different Sample Periods
Lagged Money Supply Changes as the Inertia Variable

Sample Interval	Constant	U/U_N[a]	$[\dot{m}_{t-i}]$[a]	NIXCON[a]	$\bar{R}^2$/DW	$\sum_{i=1}^{8}$[b]
1954:1 – 1960:4	1.5414 (3.62)	–0.1179 (2.12)	–0.1333 (0.43)		0.469/2.06	–0.4374
1954:1 – 1964:4	1.4040 (3.73)	–0.0954 (1.93)	–0.1209 (0.44)		0.446/2.04	–0.4697
1954:1 – 1969:4	0.8601 (2.59)	–0.0754 (1.64)	0.7904 (3.93)		0.589/1.47	0.1065
1954:1 – 1974:4	0.5752 (2.74)	–0.0395 (1.15)	0.9855 (11.16)	–0.1224 (5.24)	0.738/1.86	0.1495
1954:1 – 1978:1	0.5950 (3.47)	–0.0428 (1.36)	0.9525 (15.11)	–0.1175 (5.26)	0.761/1.89	0.1978

[a]Terms are defined in Table 1.

[b] $\sum_{i=1}^{8}$ is the sum of the weights on $\dot{m}_{t-i}$ or $i = 1$ through 8.

is ended after six years. This is also coupled with only a low and marginally significant coefficient on UGAP.

The differences between equations (3) and (1), however, are important. In the wage-wage model there is at least the implicit notion that the aggregate demand authorities can do little to influence the inflation rate. The equations give the appearance of an inflation process that simply builds upon itself with an occasional, but small, spike from changes in the unemployment rate. The wage-money supply equations highlight the active influence of aggregate demand forces. The autoregressive $\dot{w}_{t-i}$ terms are capturing the relationship between lagged wages and lagged money. In this framework, active control of $\dot{m}$ dominates future fluctuations in the inflation rate.

Given the fact that the inflation spiral can be significantly broken by aggregate demand policies, the next question is whether such a process requires either a long or a deep recession. Since UGAP is related to $\dot{m}$, it is not possible to arbitrarily choose numbers for these two variables without inspecting the cross equation restrictions which delineate the potential UGAP and $\dot{m}$ tradeoffs. Can $\dot{m}$ be reduced by the Federal Reserve in such a fashion as to have largely nominal rather than real effects?

The evidence on this point is mixed. Most macro models have a built-in, reduced-form relationship between U and $\dot{m}$, suggesting that changes in m are related to wide swings in U and much smaller fluctuations in p. More recent work which distinguishes between systematic and unsystematic changes in m imply a different result. For example, Barro [1977] using annual data, has suggested that only "surprises" in the $\dot{m}$ series cause changes in U, but can persist for three years.

We have conducted a limited series of tests on the notion that systematic monetary growth has little impact on unemployment. We stress that these tests are meant to be conjectural in nature and to suggest that there are alternatives to the pessimistic wage-price spiral view of the world where aggregate demand has little role in the inflation process. Using quarterly data for the period 1948-1978, we have differentiated between the systematic money supply growth, designated DMA, and the residual factor, designated DMR. A few series were constructed on the general form

$$\dot{m} = f([\dot{m}_{t-i}], [\text{Trend}]), \tag{4}$$

where $[\dot{m}_{t-i}]$ is a vector of lagged dependent variables and [Trend] is a vector of trends raised to various powers.[31]

The specific equation utilized below is of the form

[31] This differs somewhat from Barro's [1977] specification of the equation including the fact that we utilized quarterly rather than annual data. It is clear that the specification of (4) requires considerably more work than could be attempted here. We have developed this line of inquiry to be suggestive.

$$(5)\quad \dot{m} = \underset{(0.70)}{0.7612} + \underset{(7.93)}{0.6992}\,\dot{m}_{t-i} - \underset{(1.59)}{0.1823}\,\dot{m}_{t-2} + \underset{(0.71)}{0.0798}\,\dot{m}_{t-3} - \underset{(0.86)}{0.0793}\,\dot{m}_{t-4}$$

$$- \underset{(0.69)}{0.9381}\,T + \underset{(1.05)}{0.4446}\,T^2 \qquad \bar{R}^2 = 0.556 \qquad D.W. = 1.99$$

The predicted values of (5), designated DMA, are the systematic money supply increase. The residuals from (5), designated DMR, are the deviations in money supply growth.

Our equation is intentionally a simpler form than Barro's money equation. This reflects unresolved issues in the dichotomy of $\dot{m}$ into surprise and anticipated components using the methodology proposed by Barro. We have chosen to create the DMR and DMA series without utilizing cyclical variables in (5). Defined as a function of trends and autoregressive terms, the DMR and DMA variables are less sensitive to changes in the specification of the equation. The result is that positive values for DMR reflect only above trend and autoregressive growth rates of the money supply. By construction, therefore, they can only differentiate between stable (DMA) and high or low deviations (DMR) from the money supply growth rates.

The residuals of (5), DMR, by definition, capture the periods when the Federal Reserve is altering the money supply trajectory from its trend and autoregressive path. Whether these "above or below average" increases are expected or not is unclear. It is clear, however, that the positive (negative) residuals represent the short-run peaks (troughs) in monetary stimulus. In this sense, it should not be surprising, even to traditional Keynesian macro forecasters, that these periods of unusual positive or negative monetary activity feed more directly into unemployment.

Introducing DMA and DMR from equation (5) into an unemployment equation for the period 1954:1 – 1978:1 results in the following:

$$(6)\quad UGAP = \underset{(2.90)}{0.02843} + \underset{(16.05)}{1.3483}\,UGAP_{t-1} - \underset{(5.45)}{0.4578}\,UGAP_{t-2} + \sum_{i=1}^{20} \beta_i\, DMA_{t-i}$$

$$+ \sum_{i=1}^{20} \gamma_i\, DMR_{t-1} \qquad \bar{R}^2 = 0.956 \qquad D.W. = 2.06$$

The weights for β_i and γ_i are shown in Table 4. No attempt was made to experiment with the length and specification of the lag structures.

Equation (6) and the weights in Table 4 suggest that the stable component of the money supply growth (DMA) has no significant effect on explaining unemployment. The sum of the lag weights on DMA has the wrong sign and is quantitatively close to zero. On the other hand, the residual or deviation element of money supply growth (DMR) is significant and positive in the initial few

TABLE 4

Weights for UGAP Equation

t-i	*Coefficient*	*T-Statistic*
UMA (−1)	.277E-02	.72
UMA (−2)	.586E-03	.16
UMA (−3)	−.104E-02	−.30
UMA (−4)	−.217E-02	−.66
UMA (−5)	−.287E-02	−.95
UMA (−6)	−.317E-02	−1.23
UMA (−7)	−.315E-02	−1.52
UMA (−8)	−.285E-02	−1.87
UMA (−9)	−.234E-02	−2.17
UMA (−10)	−.167E-02	−1.63
UMA (−11)	−.900E-03	−.63
UMA (−12)	−.823E-04	−.04
UMA (−13)	.725E-03	.28
UMA (−14)	.146E-02	.48
UMA (−15)	.208E-02	.62
UMA (−16)	.251E-02	.72
UMA (−17)	.271E-02	.80
UMA (−18)	.262E-02	.86
UMA (−19)	.217E-02	.90
UMA (−20)	.132E-02	.95
UMR (−1)	.550E-02	2.07
UMR (−2)	.591E-02	2.04
UMR (−3)	.604E-02	1.68
UMR (−4)	.592E-02	1.43
UMR (−5)	.558E-02	1.30
UMR (−6)	.507E-02	1.22
UMR (−7)	.442E-02	1.18
UMR (−8)	.366E-02	1.16
UMR (−9)	.283E-02	1.17
UMR (−10)	.196E-02	1.11
UMR (−11)	.108E-02	.71
UMR (−12)	.244E-03	.13
UMR (−13)	−.526E-03	−.20
UMR (−14)	−.119E-02	−.35
UMR (−15)	−.172E-02	−.44
UMR (−16)	−.207E-02	−.48
UMR (−17)	−.222E-02	−.51
UMR (−18)	−.212E-02	−.53
UMR (−19)	−.174E-02	−.54
UMR (−20)	−.104E-02	−.55
	SUM OF WEIGHTS	T-STATISTIC
UMA (−1)	−.129E-02	−.22
UMR (−1)	.356E-01	1.89

periods. The long-run coefficient on DMR has the right sign and is significant at the 95 percent confidence interval.

The sum of the lagged UGAP terms in (6) is close to unity. This suggests that a positive monetary residual leads not to a once-and-for-all decrease in unemployment, but rather to an ongoing decline in the unemployment rate. This is offset, however, by the fact that the weights on DMR for high t-i are negative. The result is that the quantitative size of the coefficients on DMR is quite small. In any case, in the long run, a "continuing" positive deviation in monetary growth would not lead to a continuing reduction in unemployment since the private sector would presumably adjust to the money supply growth rule. The surprise would cease to be a surprise or, in other words, the average adjusts to the new higher growth rate. But, as was true in the Barro model, the lags in adjusting to surprises are very long and there is considerable room for monetary policy to alter the unemployment rate.

Different specifications of equations (5) and hence the DMA and DMR terms of (6) lead to somewhat varying results. At times, the results for equation (6) were insignificant for both DMA and DMR. It is worth noting, however, that we found no situations where DMA was significant and positive and where DMR was insignificant and negative. That is, depending upon the specification of (4) and the resulting definition of DMA and DMR, the results supported an insignificant DMA with a tendency towards the incorrect sign and a DMR which was most often positive and significant for the initial weights of the lag structure.

If the residuals (DMR) of the money supply equation largely affect UGAP, then it should be expected that the predicted values (DMA) should largely impact on wage inflation. This, in fact, is the case. For the period 1954:1 – 1978:1 we find

$$(7)\quad \dot{w} = \underset{(0.44)}{-0.0964} + \underset{(2.07)}{1.5140}\,\mathrm{UGAP} - \underset{(4.45)}{0.1072}\,\mathrm{NIXCON} - \underset{(0.35)}{0.1361}\,[\mathrm{DMR}_{t-i}]$$

$$+ \underset{(11.19)}{1.1741}\,[\mathrm{DMA}_{t-i}] \qquad \bar{R}^2 = 0.741 \qquad \text{D.W.} = 1.75$$

where DMR and DMA are estimated with third degree polynomial lags of 20 quarters of duration, constrained to zero at the end point. The coefficients on DMR and DMA are the long-run coefficients.

The implications of equations (4) through (7) for inflation control are suggestive. Given a long enough time horizon in adjusting monetary growth rates, a slower monetary growth rate can directly yield a lower inflation rate without necessarily requiring an extended period of high unemployment.

Lowering inflation without a recession would not be a simple task and it certainly would take perseverance. To simplify the task somewhat, set aside for the moment the difficulties in controlling monetary aggregates in offsetting exogenous shocks in the private sector that could cause cyclical changes. Given the long lags in the wage and money supply equations (equations of Table 1 and (6) and (7)), it would take several years before the inflation rate would begin to

slow. Since the wage inflation equation has a lag structure on $\dot{m}$ that is higher near the end than at the beginning, the inflation rate might even grow for several years before beginning to subside. But the possibility remains that inflation could be reduced over time without a prolonged recession.

III. Inflationary Bias

In our discussion of obligational markets in Section I, we argued that institutional arrangements have an important impact on the mechanism through which inflation is transmitted through the economy, but not a significant direct role in causing inflation. In this section we elaborate on this point.

That the private institutions in our economy are viewed as an important source of inflation is indicated daily by official public statements from various levels high in the Federal bureaucracy. In the academic literature, this position is argued on the basis of an "inflationary bias" in the private wage and price setting mechanisms.

The strawman position on inflationary bias is that oligopolists and labor unions persistently drive up prices and wages irrespective of aggregate demand. This research, which surfaces in some of the public policy literature, ignores the necessary role of validation by the monetary and fiscal authorities. For example, in the U.S. experience with ongoing inflation over the past 12 years, monetary expansion (with the likely encouragement from fiscal policy) must be part of the inflationary process.

The legitimate debate over the source of inflation and the role of institutions in the inflation mechanism begins by accepting the notion of a wage-price-money supply spiral. A wage-wage or wage-price spiral obviously cannot go very far for very long on its own. Within the monetary validation context, the inflationary bias argument is pursued along two basic lines: The first is based on the presence of certain key sectors, where wage and price decisions are made largely independent of aggregate demand. These decisions then "spillover" into the rest of the economy. The private wage and price decision makers have a higher tolerance for unemployment and unutilized capacity than the monetary and fiscal authorities so that the private decisions are essentially validated by monetary expansion. The second line is based on the notion that wages and prices have greater upward than downward flexibility. In this situation any important change in relative wages or prices necessitates general inflation to bring the relative wage and price structure back into equilibrium. Although originally stated in terms of levels, the argument can be recast in terms of inflation rates by adding an expectational mechanism with a larger and faster upward than downward response pattern.

A. *The Wage (Price) Leadership Case*

The issue of wage leadership was debated in the industrial relations literature in the 1950s.[32] In this model a few key unions, largely ignoring market

[32] For a comprehensive discussion of these issues and an updating of the evidence see Burton and Addison [1977] and Mitchell [1977].

conditions, would negotiate settlements that would then become the "pattern" for other unionized industries. As a consequence of the "threat effect," this pattern would be adopted by the nonunion sectors. In a similar fashion, certain key industries in the input-output array could have an excessive impact on overall prices. The wage (and/or price) leadership model is particularly receptive to arguments for wage (and/or price) controls. A central argument against controls is administrative feasibility. In this case, by close enforcement of a few large offenders, the wage leaders, the inflation process can be controlled at low administrative cost and with little interference to the market in the great bulk of industries.[33]

The wage leadership model has empirical problems. Whereas the model seems to argue for a fixed group of leaders, the labor relations research has not been able to isolate such a group. Rather the leadership role, to the extent that it can be identified, shifts over time. This raises the question of whether the so-called key industries are simply those that, at a given period of time, are enjoying the most favorable excess demand positions. More generally, there is the question of whether the observed spillovers represent similarly shared excess demand conditions rather than an institutional mechanism of wage leadership. The econometric research to date, controlling for aggregate demand forces across industries, finds little evidence of institutional spillover.[34]

The Wage Contour Approach

An alternative to wage leadership is the wage contour approach.[35] In this case, the unionized sector itself is segmented into a series of contours. Wages are set in each contour or segment with substantial independence from the other contours. There is some degree of spillover among contours and between the union and nonunion sectors, but this receives less emphasis. An important variant of this model allows for the possibility of wage contours outside of the union sectors. These contours are formed along product market lines and are national or regional in scope depending, in part, upon the scope of the product market.

A major difference between the wage leadership and contours models is that the loci of decision-making is narrow in the first and relatively broad in the second. The greater the number of segments or contours, the more decentralized the wage decision-making process. In addition, market forces are viewed as having a larger role in the wage-setting process within contours.

Our view is that the wage-contour model is similar in spirit to the obligational market framework that we presented above. These wage (and price) contours define the institutional arrangements that exist as a result of established

[33] Presumably, the jaw-boning approach to wage controls is based on this view of the economy.

[34] One of the best econometric papers to focus specifically on spillovers is by Mehra [1977]. Burton and Addison [1977] and Mitchell [1977] provide a broad summary of the evidence on spillovers.

[35] See Dunlop [1957] for an original formulation of the problem.

relationships between buyers and sellers and among competitors. As we have stressed elsewhere, this version of labor (and products) markets is antithetical to a general wage and price controls policy. Although there is a range of indeterminancy in wages and prices in these markets, the observed wages and prices reflect the allocation of transaction cost savings. Macro tampering with relative wage and price structures can cause serious efficiency and allocation loss. That is, the existence of a micro discrepancy between own wages (prices) and opportunity or market wages (prices) does not indicate slack in the system that can be costlessly erased by macro controllers. Furthermore, in the relatively atomistic obligational market-wage contour framework, it is more difficult to argue that a few key private decisions establish a pattern for exogenous inflationary pressure.

The "appearance" of cost-push inflationary pressures arises because of the fact that obligational markets, of which unions and oligopolies are an important subset, tend to have above average wage and price increases during recessions. This however, is the lagged response of obligational markets to excess demand forces and not an independent source of inflationary pressure.

As shown elsewhere, the relative wage structure within manufacturing varies in a systematic way over the cycle.[36] A new development since this earlier work has been the widespread adoption of escalator clauses. This should lead to a difference in the response of relative wages to inflation prior to and after 1970. The result is confirmed in equations (1) – (3) of Table 5 where $\dot{p}_{1947-1969}$ is the inflation variable for the 1947-1969 period (zero elsewhere) and $_{1970-1977}$ is the inflation variable for the 1970s. Whereas higher inflation as well as tighter labor markets would reduce the wage spiral prior to 1970, escalator clauses now enable the high wage unionized sector to keep up with inflation. Deviations of U from U_N now cause the most significant and systematic changes in the real wage structure. In short, indexing has helped to buffer nominal but not real fluctuations in the economy.

Although the complex lagged behavioral response of obligational markets is not a cause of inflation, it may give rise to policy errors which can result in additional inflation. The tendency of the monetary and fiscal authorities to misinterpret lagged wage and price increases as cost-push can lead to inappropriate responses. A prime historical example was the widespread view that unions and oligopolies were engaging in cost-push inflation during the 1970-71 recession; a position which led to adoption of wage and price controls to restrain the "bad actors" while the monetary and fiscal authorities pursued an expansionary policy. On the other hand, the lags in the obligational markets encourage the monetary and fiscal authorities to overshoot supply constraints during expansions. For example, the sluggish response of union wages and oligopoly prices during the late 1960s misled the monetary and fiscal authorities to understate the inflationary pressures that were building in the economy.

[36] See, for example, M. Wachter [1976]. Before the widespread adoption of escalator clauses, the coefficients on $\dot{p}$ were significant over the entire sample period, for example, 1947 through 1973. The few degrees of freedom after 1973 suggest some skepticism in interpreting the division of the inflation variable into pre- and post-1970 components.

TABLE 5

Coefficient of Variation Equations, Annual 1947 – 1977[a]

Equation	Constant	$\dot{p}_{1947-1969}$[b]	$\dot{p}_{1970-1977}$[c]	UGAP[d]	KD[e]	NIXCON	$\bar{R}^2$/DW
1	0.2226 (33.21)	−0.4370 (3.67)	0.1555 (2.44)	−0.1898 (5.87)			0.921/0.995
2	0.2188 (41.76)	−0.2249 (2.07)	0.2113 (4.06)	−0.1861 (7.37)	−0.0140 (3.80)		0.952/1.644
3	0.2223 (43.95)	−0.1872 (1.86)	0.2713 (4.95)	−0.2057 (8.31)	−0.0125 (3.64)	0.0028 (2.21)	0.960/2.128

[a]The dependent variable is the coefficient of variation, which is constructed as an unweighted average of the 21 manufacturing industries in the SIC. (The original series are adjusted for overtime. Since no overtime earnings series is available for printing, the industry is omitted.)

[b,c]The variable [$\dot{p}$] is the rate of change of the CIP. The [$\dot{p}$] variable is divided with the first term, superscript b, equal to $\dot{p}$ through 1969 and zero elsewhere. The second term, superscript c, is equal to $\dot{p}$ 1970 through 1977 and is zero prior to 1970. For both b and c, third degree polynomial, five-year length of lag, and constraints zero at t = −4 were imposed.

[d]Third degree polynomial, five-year length of lag, and constraint zero at t = −4 were imposed.

[e]Korean War Dummy. It has a value of one for 1950–1953 and zero elsewhere.

B. *Asymmetry Between Upward and Downward Relative Wage Movements*

The asymmetry argument has been stressed by a number of economists.[37] A useful and broad statement of the problem is given by Duesenberry [1975]:

> In fact, however, there appears to be an asymmetry in the response of prices and wages to market imbalances. Price makers who have market power tend to increase prices more readily in response to cost increases and strong demand than to decrease them in response to cost reductions or weak demand. In competitive sectors, producers often successfully appeal to government for protection when competitive forces tend to drive down prices. There is clearly great resistance to absolute reductions in wages even in the face of high unemployment. Beyond that there are strong wage linkages so that upward demand pressure on wages in one labor market can pull up wages in related markets with no labor shortage or even a surplus. These tendencies are, of course, fortified by trade unions – strong defenders of wage linkages – and by the market power of employers which permits them to recoup increased costs by raising prices. The result of this inflationary bias is that the average price level tends to rise even when there is substantial underutilization of resources.

There is evidence of this asymmetric pattern in the relative wage data. One major indicator is that whereas a few industries have succeeded in achieving an improvement in their relative wage position, none have suffered a significant decline. Specific examples over the past two decades are Federal Government wages, state and local wages (to a lesser extent), contract construction, and transportation. Most recently coal and steel wages have pulled ahead. All of these industries have experienced improvements in relative position in excess of cyclical factors.[38]

An examination of the characteristics of the industries involved in these relative wage increases is informative. First, many have had large increases in employment during their period of increasing wages. Government employment and contract construction are examples. In both of these cases, however, their recent employment growth has become depressed, partly in response to their wage changes. This, in turn, has led to a reversal in relative wage trends. Second, a number of these industries are subject to government regulation and/or controls which act to buffer or support high levels of employment. Government employment is the most obvious example. The role of government regulation in construction (Davis-Bacon) and in transportation, as well, as the special labor

[37] One of the earliest treatments is by Schultze [1959]. More recently the topic has been explored in depth by Tobin [1972].

[38] The product market data are less clear. Whereas there have been some chronic inflationary sectors, for example, health care, a number of industries have experienced dramatic price declines. The high technology area is the most often cited example of relative and even absolute price declines of considerable magnitude.

legislation in this latter area, appears to be important.[39] Third, short-run factors in collective bargaining, such as the experimental no-strike clause in steel, and the increased product demand and intra-union political problems in coal, are factors in creating relative wage gains in these area. Barring government interference with international trade, steel wages will probably fall somewhat back into line at the next negotiating round. Mining wages, on the other hand, may continue to grow if demand for eastern coal continues to increase. Mining is a clear example of an "inferior" occupation that requires increasing relative wages to attract additional workers.

The purpose of this brief review of the relative wage problem areas is to suggest a potential remedy for the problem. In general, to the extent that asymmetric upward movements in wages (or prices) are the source of the inflationary bias, an appropriate government anti-inflation response would be to adopt a sector-specific approach to the problem areas. That is, rather than reacting with generalized wage and price controls (whether in the form of freezes, jaw-boning or tax-based controls), the sector-specific issues should be addressed. This type of approach is not novel and has long been advocated by labor specialists such as Dunlop [1966], [1977].

A sectoral approach has a number of advantages. First, it saves on transaction costs (bounded rationality problems) which render all general control schemes largely unworkable. Second, it has the equity advantage of dealing only with those sectors where relative wages are showing very large increases. Third, it can be easily turned on and off since the bureaucratic apparatus is small and there should be no post-controls wage explosion. This is especially true since, as indicated above, the upward relative wage movements have self-limiting properties. The purpose of the sector approach is to reinforce the market forces which tend to hold the relative wage structure together. Finally, and most important, if done properly, it can actually deal with the true underlying inflationary biases.[40] It recognizes that overall controls are no solution to an overexpansionary monetary and fiscal policy mix.

IV Conclusion

We have argued that the emergence, during the 1970s, of rising inflation coincidental with rising unemployment is due to three factors: a persistent failure on the part of the Federal Government to recognize the supply constraints of the economy (i.e., the rise in U^* and the associated decline in the growth rate of potential output); exogenous inflation shocks stemming from OPEC oil increases, a series of poor harvests, and an ill-conceived wage and price

[39] For a systematic treatment of structural problems in the construction industry, see Mills [1972]. He places less stress on Davis-Bacon as a problem area.

[40] See M. Wachter [1976]. The overall controls program suffers from attempting to hold down general wages and prices while the government is pursuing an overly expansionary policy.

controls program; and finally, long lags in the obligational markets in the response of inflation to aggregate demand pressures. This paper focuses on the latter issue.

In the early post-World War II period, the business cycle was relatively short. Expectational errors and/or inertia effects had no chance to accumulate, so that increases in excess aggregate supply and unemployment were quickly reflected in decreases in inflation. After the long period of slack between 1958 and 1964, followed by a decade of near uninterrupted tightness (or very mild recession), serially correlated expectational errors and inertia effects became built into the obligational markets. Consequently, the mild period of slack between 1970–1971 did not reduce the inflation rate: catch-up inertia effects dominated the upward course of the inflation rate. Hence, unemployment and inflation increased together. Only after the prolonged and deep recession of 1974 to 1977 did the long lags in the obligational markets allow the downward push of unemployment on inflation to outweigh the now reduced lagged effects of past inflation. By this point in the cycle, however, the recovery had already begun. Markets were still slack, but a declining unemployment rate coincided with a declining inflation rate.

For institutional contracting modes, based on a near zero inflation rate, the emergence of ongoing inflation of 6 to 7 percent implies an increase in the variance as well as the mean rate of inflation. This requires costly changes in the contracting arrangements, costs that are not recouped even if the inflation settles down to a new steady state. The potential output of the economy suffers at least a once-and-for-all reduction. The highly uneven speed of institutional responses to inflation is a lengthy procedure which leaves the economy in a prolonged state of disequilibrium. Indeed, the "benefits" of a high pressure, low unemployment economy can be generated, in part, because of the ponderous adjustment process of the obligational markets.

But once the economy has managed to build in a 6 percent or higher rate of inflation, what solutions can be offered? We suggest the following points: First, with the widespread adoption of escalator clauses and other such devices, obligational markets may now respond more rapidly to excess demand than they did a decade ago. We believe that the empirical wage equations overstate the length of the lags.

Second, if a long enough time horizon is adopted, fitted to the workings of obligational contracting, policy-makers using relatively stable rules may be able to translate a program of reduced money supply growth rates more directly into inflation rather than real output changes. That is, there is at least the potential of slowing inflation while maintaining the economy close to its U* or potential output constraint.

The evidence to support the notion of a slowly declining inflation rate, while maintaining the economy close to U*, is conjectural. In addition, the issue raises theoretical and empirical problems. Will a democratic government be able to adopt a planning horizon which is long enough to allow for recontracting? How will real shocks be accommodated? Holding to a targeted slow reduction in money supply growth rates, in an environment with real shocks,

can lead to substantial fluctuations in real output in the short run. Can fluctuations in U* be measured and used to retarget general monetary and fiscal policy?

Given these problems, the "fall-back" position is to accept the current inflation rate and attempt to at least equalize the odds between upward and downward changes in the inflation rate. A clear policy commitment to the twin goals of using monetary and fiscal policy to avoid overheating the economy coupled with avoiding a further acceleration in the inflation rate is needed. With equally weighted policy goals between maintaining U* and nonaccelerating inflation, exogenous shocks may actually become random with zero inflation mean. That is, not every potential downward price supply shock would be met by special legislation to maintain prices.

Third, the asymmetric tendency of relative wages (and prices) to move ahead in some sectors, without corresponding declines elsewhere, should be handled by sector-specific policies and not general controls. Often these relative wage (and price) adjustments are due to changes in the collective bargaining structure, government regulations (unconnected with inflation policy) and/or longer-run changes in relative demand and cost conditions. In these cases, sector-specific, anti-inflation policies can provide a mediation or arbitration role with respect to the institutional arrangements that prevents or buffers the relative wage or price changes from occurring or from feeding into inflationary expectations.

Fourth, policy should be devoted to reducing U* and raising the growth rate of potential output. These can only be accomplished through structural, supply-side policies. The issue of structural policies aimed at U* and potential output, however, are beyond the scope of this paper.

The changes in the economy brought about by a decade of increasing inflation have a pessimistic side. The micro actors in the obligational markets are still relatively sluggish, but the speed of their response to the next period of tight product and labor markets will be different than it was in the inflation of the 1960s. The increasing responsiveness of inflation to excess demand pressures and the associated more "direct" feed-through of money growth rates into inflation suggests the potential for rapidly rising inflation in the coming decade without the benefit of relatively low levels of cyclical unemployment.

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Discussion

Martin N. Baily

Before I comment on the specifics of the Wachters' paper, let me say a few words about rational expectations. It is generally useful to know what a model that assumes rational maximizing behavior has to say about an economic issue. But that does not mean that such models are always the best ones for the purposes of prediction or policy formulation. Of course one can often rescue rationality by specifying imperfect information or the costs of decision-making, but that is not the point. Good models are those that are based upon empirically supported stable behavioral rules, whether or not such rules can be rationalized. Such rules are hard to find, but then so are good models.

To assume that all expectations are totally rational is a very strong assumption. Critics of its use are usually told that their criticisms are analogous to those made in the past of the assumption of utility maximization. Now I am not sure that even this assumption has been validated all that overwhelmingly. The evidence that individuals rationally allocate consumption so as to maximize their lifetime utility is quite weak. Prior to the existence of the Social Security System many persons saved almost nothing for retirement and deeply regretted their decision in later life. One can define such behavior as rational on the grounds that whatever people do is what they want to do, but that makes the theory a tautology.

But suppose we accept, as I basically do, that utility and profit maximization are useful assumptions to make. This does not say people have rational expectations. Remember that argument by analogy is not proof. The testing of individual subjects has shown that people frequently fail to follow efficient strategies in stochastic environments. It is very hard to make rational decisions under uncertainty, if being rational includes using stochastic information efficiently. Not only that, but advocates of rational expectations take the breath-taking additional step of assuming that people have an intuitive grasp of the whole economic system. They go well beyond any assertion that people know what they like.

Let me now turn to the Wachters' paper. In answer to the questions posed by this conference: what do we do after the Phillips curve? The Wachters give the following answers. The Phillips curve should not be abandoned, they argue. It is basically stable, but people haven't been looking at it correctly and it has been knocked around a little by food and fuel. On the policy implications, they suggest we should hang in there with a high unemployment rate, and try to

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convince the private sector of the seriousness of our intentions in order to bring down the expected rate of inflation as fast as possible.

On the stability of the Phillips curve, they suggest that the rate of unemployment consistent with no acceleration of inflation is much higher than had been thought – closer to 6 than to 5 percent at the present time. If this is correct, it means that during periods we thought were deflationary the labor market was actually in equilibrium or even in a state of net excess labor demand. I am not sure if they are correct about this; the evidence is murky. But I fear that there is indeed a lot of structural unemployment around and, if so, it points up for me an urgent need for measures to help the disadvantaged workers, the hard-to-employ and teenagers in order to lower the long-run sustainable unemployment rate. I would also advocate reform of some of our income security programs, although not the abandonment of these programs.

The next main point they argue concerning the Phillips curve is that the lag in the response of wages to demand conditions is very long indeed. This means, for example, that the period of low unemployment in the late 60s was still pushing wages in the early 70s. The overwhelming inertia or momentum in the inflationary process is indeed impressive. Inflation accelerated very slowly during the mid-60s and has been dampened very slowly indeed by the mid-70s recession.

The insensitivity of the rate of wage inflation to short-run variations in aggregate demand is, of course, a basic tenet of post-Keynesian macroeconomics, a tenet strongly reinforced by the experience of the 70s. Explaining this insensitivity, or the inertia in wage inflation, has been a major issue for decades. The Wachters look for an explanation in economic institutions. They emphasize long-term fixed wage contracts and argue that such contracts are not arbitrary or irrational, but are optimal in the context of "obligational markets" and "idiosyncratic exchange." I am certainly sympathetic to the stress on wage contracts. I have argued in my own work that wage contracts are an important element in the inertia of wage inflation. I also think that the importance of institutions is being understated in our rush towards a super-rational economic theory. To say that institutions do adapt to a changing economic environment does not imply that the institutions are irrelevant to the response of the economy. Thus the work of the Wachters, together with that of their colleague Oliver Williamson, is very valuable and I urge them to press on with it.

Somewhat more negatively, however, I wonder if they have, as yet, been able to focus on the specific features of institutions that are the most important for wage behavior and to show that these features are also consistent with other observations. Specifically, they say that personnel arrangements represent "a governance structure whose primary purpose is to maintain the relationship and thus the long-term gains of the parties, rather than to achieve equilibrium with short-run market conditions." That sounds fine on the face of it as an explanation of wage stickiness, but let's remember what happened during 73-75. The year-to-year rates of growth of average hourly earnings in manufacturing were:

73 over 72	6.0%
74 over 73	8.6%
75 over 74	9.9%

At the same time the rates of change of employment of production workers in manufacturing were:

73 over 72	5.8%
74 over 73	−1.0%
75 over 74	−10.6%

Thus, between 1973 and 1975 the rate of wage inflation accelerated by over 50 percent while employment dropped by 11.5 percent, a reduction of 1.7 million production workers. It is not obvious that dumping 1.7 million workers onto the streets while stepping up wage increases is so consistent with "a governance structure whose primary purpose is to maintain the relationship." One might wonder about more wage and hours flexibility in order to maintain the employment relationship and preserve the firm-specific human capital.

My own view (expressed in the 1976 No. 2 *Brookings Papers*) is that the observed response represents a structure whose purpose is to preserve the position and living standards of a subset of the workers. There is a buffer zone of younger workers and recent hires who are laid off. These employees, plus entrants and reentrants to the labor force, are the workers that bear most of the costs of employment variations. The "permanent" employees are sometimes put on temporary furlough, where they are protected reasonably well by unemployment insurance, and are recalled within a short period of time. Firms acquiesce in this kind of arrangement partly under duress and partly because it may have long-run profit advantages – for reasons discussed by the Wachters.

The Wachters then go on to present empirical evidence that the insensitivity of wages to demand in the short run reflects adjustment lags not a fundamental wage rigidity. The long-run elasticity of inflation to unemployment is high, they say, in fact the infinite elasticity of the long-run vertical Phillips curve. The length of the distributed lags they use is indeed astonishing. But I might have expected more in the way of statistical tests of alternative lag specifications. Does adding the fourth, fifth and sixth year of lagged wages or prices really improve the fit of the equation? I suspect that the quagmire of collinearity makes it hard to be sure.

On one small point: they mention productivity effects. Any wage equation with price inflation feeding back into wage inflation does contain a productivity effect. Let $\dot{w} = a + \frac{b}{U} + \dot{p}$ and $\dot{p} = \dot{w} - \rho$, where $\dot{w}$ and $\dot{p}$ are the rates of wage and price inflation, U is the unemployment rate and ρ the rate of productivity growth. Then if U* is the unemployment rate consistent with nonaccelerating inflation, the arithmetic makes U* a decreasing function of ρ. Of course, these equations are pretty simplistic, but the same idea will hold in more realistic formulations.

Let me give a few reflections on the Phillips curve in theory and practice. I am not at all convinced that we are telling the correct or complete stories about the process of wage inflation. Search theory, contract theory and obliga-

tional markets can all give us insights into certain aspects of the process. But a convincing dynamic analysis that will track the data remains elusive. I think we probably have to disaggregate, to distinguish workers in unions or who work for large corporations from self-employed workers and employees of small companies. The high-wage/union workers appear to have wage scales that are almost totally unresponsive to short-run demand conditions, even when those wage scales are reset or renegotiated. The rest of the work force has wages that are somewhat responsive to demand, with a downside rigidity linked to unemployment insurance and the minimum wage, at least for some jobs.

Of course in practice there is a spectrum of workers between these two extremes and there is a relative wage structure across the spectrum that changes over the cycle, but which always acts as a link among markets. Some of Mike Wachter's early work on the cyclical behavior of relative wages has been very informative in this area.

The next main part of the paper is an application of the Barro approach of dividing monetary changes into anticipated and unanticipated components. In the context of the Wachters' paper, the idea is that some part of the lags described by the empirical work is attributable to the slow adaptation of expectations about inflation. If this is so, it may be possible to reduce the rate of wage inflation without incurring all of the heavy price, in terms of unemployment, that their equations suggest. There may be something to this approach, but I do not think that the Barro methodology is valid.

Let me first comment on what Barro did and then on the Wachters' version. I will use the Barro analysis of real output movements from his forthcoming *JPE* paper. Equation 1 is intended to model the way in which expectations about money growth are formed.

Equation 1: The determinants of the rate of change of M_1

$$\underset{}{DM} = \underset{(0.27)}{0.082} + \underset{(0.14)}{0.41}\ DM_{-1} + \underset{(0.12)}{0.21}\ DM_{-2} + \underset{(0.16)}{0.072}\ FEDV + \underset{(0.009)}{0.026}\ UN_{-1}$$

$DMR = DM - \widehat{DM}$ 1941–76 Annual Data

Standard errors in parentheses.

Variables:

- DM = change in the log of M_1,
- FEDV = real Federal expenditure less a distributed lag of past real Federal expenditure,
- UN = the log of the unemployment rate divided by one minus the unemployment rate,
- $\widehat{DM}$ = the fitted values from equation 1. Called the anticipated part of money growth.
- DMR = the residuals from equation 1. Called the unanticipated part of money growth.

According to Barro it is only the unanticipated part of DM, i.e., DMR, that influences real output. This is tested by equations 2 and 3.

Equation 2: Real output determined by DMR and MIL

$$\log y = \underset{(0.14)}{2.95} + \underset{(0.21)}{1.04}\,DMR + \underset{(0.22)}{1.21}\,DMR_{-1} + \underset{(0.21)}{0.44}\,DMR_{-2} + \underset{(0.16)}{0.26}\,DMR_{-3}$$

$$+ \underset{(0.09)}{0.55}\,MIL + \underset{(0.0004)}{0.0354}\,t$$

R^2 = relative to trend 0.82, 1946–76.

Equation 3: Real output determined by DM and MIL

$$\log y = \underset{(0.08)}{3.13} + \underset{(0.26)}{0.95}\,DM + \underset{(0.26)}{0.53}\,DM_{-1} - \underset{(0.23)}{0.20}\,DM_{-2} - \underset{(0.16)}{0.27}\,DM_{-3}$$

$$+ \underset{(0.16)}{0.31}\,MIL + \underset{(0.0007)}{0.0335}\,t$$

R^2 = relative trend to 0.70, 1946–76.

y = real GNP.

MIL = ratio of military personnel to male population 15–44. Set equal to zero 1970–76.

t = time.

These show that DMR gives a better fit to output fluctuations and has a stronger significance test performance than DM. The real question, however, is: does it make sense to describe DMR as the unanticipated part of money growth? If not, what is it? and why does it fit pretty well to GNP movements? Consider the last part of this first. Substitute equation 1 into equation 2. This gives the following table of coefficients:

Implied Coefficients from Equation 2

	DM	UN	FEDV
t	1.04	--	–0.075
t-1	0.784	–0.027	–0.087
t-2	–0.275	–0.032	–0.032
t-3	–0.175	–0.011	–0.019
t-4	–0.199	–0.007	–
t-5	–0.055	–	–
Sums of Coefficients	1.12	–0.077	–0.21

First notice that the coefficients from equation 2 imply a pattern of coefficients on DM that are very much like the coefficients on DM in equation 3. But the fit

of equation 2 is helped out by having two additional variables. We know that GNP and unemployment are linked through Okun's Law. We also know that unemployment is correlated with its own lagged values. So the UN variables will help the fit. FEDV is a more complicated variable. It marks *shifts* in total real Federal expenditures. It has been very high during war years and this might have led us to expect a positive correlation between FEDV and y. But with MIL in the equation (and also DM itself, which is high in war periods) there is an effective control for this factor. The other force driving FEDV is the impact of the automatic stabilizers. When output falls, transfer payments rise, and so does FEDV. Thus, given MIL and DM, the presence of FEDV with a negative coefficient will help the fit of equation 2. Just to check this out I ran equation 2 without the constraints on the coefficients of DM, UN and FEDV that are implied by equation 1. The resulting sums of coefficients were:

Sums of Coefficients on DM, UN and FEVD when included separately in equation 2, rather than constrained in the form implied by DMR:

DM	1.49	(0.58)
UN	−0.068	(0.030)
FEDV	−0.281	(0.19)

These are quite close to those given above.

None of this refutes Barro's interpretation of his findings. But it does suggest an alternative explanation for the statistical results. Are there other reasons for thinking that Barro's interpretation is doubtful? There are several.

(i) The Federal Reserve did not follow a stable rule for determining M_1 over the period 1941-76. In fact it did not use M_1 targets at all until quite recently. It used interest rate targets.

(ii) Persons acting before 1976 could not have known the parameters of equation 1. These are based on information available only after 1976. In fact one might have expected Federal Reserve behavior in the 30s and 40s to be the main guide to expected money growth in the 50s.

(iii) Equation 1 assumes people know, say, the 1975 value of FEDV when forming their anticipated value of money growth for 1975. Figures on M_1 are available weekly while FEDV is uncertain right through the year.

(iv) If DMR really is the unanticipated part of money growth, why is it affecting GNP after three whole years? Between (iii) and (iv), the process of information diffusion that is assumed is very odd indeed.

This was a long digression on Barro, but I have been increasingly concerned by the widespread acceptance of the idea that only unanticipated money movements influence real output, and the Wachters seem to be going along with this view. To give them credit, they do point out that most macroeconomists would agree that changes in money growth relative to its recent trend influence real output. But the reasoning behind this needs stress. Compare two cases. In case one, inflation has been running at around, say, 7 percent a year and money

growth at around 11 percent a year. This is roughly consistent with real GNP growth at 4 percent a year in line with potential GNP. In case two, inflation has been at, say, 1 percent a year and money growth at 5 percent a year. If in both cases the rate of money growth is now set at, say, 8 percent a year, then it will lead to real contraction in case one and real expansion in case two. But it is the inertia in the inflation rate in both cases that is at work, not whether or not the change was anticipated.

I shall now comment on the Wachters' version of Barro's procedure. From Equation 5 we have:

$$DM = \sum_{j=1}^{4} \lambda_j DM_{-j} + \text{time variables.}$$

This gives the determination of anticipated and unanticipated money growth analogous to Barro's equation 1 above. The fitted values (they call these values DMA rather than the $\widehat{DM}$ of Barro's terminology) and the residuals (DMR) from this equation are used to explain UGAP, the Wachters' cylical variable. Their equation 6 is of the form:

$$UGAP = \sum_{i=1}^{20} \beta_i DMA_{t-i} + \sum_{i=1}^{20} \gamma_i DMR_{t-i} + \text{lagged UGAP.}$$

They find that DMR, the so-called unanticipated part of money growth, performs more strongly as a determinant of changes in UGAP (i.e., changes in real output and employment) than does DMA – although actually neither variable does that well.

In equation 7 the Wachters included DMA and DMR in their Phillips curve regression instead of wage or price feedbacks. They find the opposite of the results on UGAP, i.e., that DMA, the anticipated part of money growth, performs much more strongly than DMR as a determinant of wage inflation.

What explains these results? The Wachters' procedure lacks the additional identifying variables that Barro used and thus consists basically of juggling distributed lag coefficients. Since DM = DMA + DMR, their UGAP equation is simply:

$$\begin{aligned} UGAP &= \sum_{i=1}^{20} \gamma_i DM_{-i} + \sum_{i=1}^{20} (\beta_i - \gamma_i) \left[\sum_{j=1}^{4} \lambda_j DM_{-j}\right] + \ldots \\ &= \gamma_1 DM_{-1} + [\gamma_2 + \lambda_1(\beta_1 - \gamma_1)] DM_{-2} \\ &\quad + [\gamma_3 - \lambda_1(\beta_2 - \gamma_2) + \lambda_2(\beta_1 - \gamma_1)] DM_{-3} + \ldots . \end{aligned}$$

The implied coefficients on DM (I only computed the first three) were 0.0055 DM_{-1} + 0.0040 DM_{-2} + 0.0028 DM_{-3} + ... Thus the regression simply shows a rather conventional declining distributed lag on DM. The Wachters'

procedure attributes all of the coefficient on DM_{-1} to DMR and most of the coefficient on DM_{-2} to DMR also.

The finding that recent values of DM are the ones with the largest impact on real output changes is a familiar one. So too is the finding that recent values of DM have very little impact on wage inflation, but that a long-run distributed lag of money growth is highly correlated with inflation.

Thus the real story being told by these regressions does not, in my view, have anything to do with anticipated versus unanticipated money changes. The real story relates to the one given earlier. The current rate of inflation is largely insensitive to short-run demand conditions. Real output responds to aggregate demand changes and money is certainly an important influence on aggregate demand (there may also be some reverse influence of output on M_1). In an economy that remains reasonably close to full employment, the arithmetic of money demand ensures a long-run relation between inflation and money growth. Either the inflation rate adjusts over the long run, or the monetary authorities accommodate the inflation rate in order to maintain full employment (or both).

Where does one come out on the policy question after all this? The Wachters suggest that "policy makers using preannounced rules may be able to translate money supply growth rates directly into inflation rather than real output changes. That is, there is at least the potential of slowing inflation while maintaining the economy close to its U* or potential output constraint." My preceding discussion suggests that I do not regard any current empirical work as convincing evidence for the usefulness of splitting money growth changes into anticipated and unanticipated components. Nevertheless, there is nothing wrong with trying to convince the private sector of the facts of life in order to give anti-inflation policy the best possible chance. The Open Market Committee of the Federal Reserve Board has shown over the past few years a determination to hold down money growth rates. We should certainly try to educate everyone to realize that this must inevitably lead either to a reduction in the rate of wage increase or recession (or both). If the impact of this educational effort were simply to discourage needed capital accumulation rather than to encourage wage restraint, then I would rather see direct intervention in wage and price setting than another period like 1975.

Finally, let me say that there were many things in this paper that were insightful and that I agreed with. I have concentrated my discussion, in the traditional way, on the points of disagreement.