NBER WORKING PAPER SERIES

HIGH UNEMPLOYMENT IN EUROPE: DIAGNOSIS AND POLICY IMPLICATIONS

Jeffrey D. Sachs

Working Paper No. 1830

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
February 1986

Presented at the Seminar on Unemployment, sponsored by the SAF, in Yxtaholm, Sweden, in September 1985. I would like to thank Sabine Miltner for helpful discussions and excellent research assistance, and Merri Ansara and Rochelle Furman for careful preparation of the manuscript. The research reported here is part of the NBER's research program in International Studies. Any opinions expressed are those of the author and not those of the National Bureau of Economic Research.

NBER Working Paper #1830
February 1986

High Unemployment in Europe: Diagnosis and Policy Implications

ABSTRACT

Econometric evidence suggests that the non-accelerating inflation rate of unemployment (the NAIRU) has risen sharply in Europe in the past fifteen years. In the first section of this paper, I review the recent proliferation of supply-side models that say interesting things about why the NAIRU has increased so substantially in Europe. In the second section of the paper, I employ a simple example to show how aggregate demand should optimally be managed in response to transitory and permanent supply shocks, especially those shocks that cause a persistent rise in the NAIRU. Also, I discuss some policy implications of the increasingly popular "hysteresis" hypothesis, that the NAIRU itself is influenced by the time path of actual unemployment.

Jeffrey Sachs
Department of Economics
Harvard University
Littauer M-14
Cambridge, MA 02138

Unemployment continues to rise in Europe, as it has in almost every year since 1970. The unemployment rate is at double digit rates in Belgium, Italy, Netherlands, and the U.K., and is quickly approaching the double digit level in France. Very few countries in Europe (notably Austria, Sweden, and Switzerland) have been able to avoid the scourge of high unemployment, and even in those cases, unemployment has been avoided only through other costly expedients. Remarkably, even though inflation seems well under control in many high-unemployment countries (especially Germany and the Netherlands), there continues to be great pessimism in the ability of the European economies to reverse the trend of swelling unemployment.

Of course, such pessimism may prove unfounded. Continuing low rates of inflation in Germany are now provoking political pressures in that country in support of expansionary measures. Also, two favorable supply "shocks" are looming on the horizon. A sharp decline in the price of oil, or a sharp depreciation of the U.S. dollar relative to the European currencies, would offer European policymakers significant scope for expansionary actions. Also, real structural reforms in several countries have begun to lay the groundwork for sustained growth. Ironically, such reforms are most in evidence in Socialist France, where Mitterand is now valiantly reversing the lax wage policies of Giscard D'Estaing and of his own administration in its first two years.

On the darker side, however, the reasons for caution in stimulating the European economies are all too evident. Contrary to the optimism of some

American macroeconomists, such as Tobin (1984) and Gordon (1985), the warning signs against rapid expansion still abound. Consider the case of the United Kingdom for example, with the following recent pattern of inflation and unemployment:

	1983	1984	1985
Inflation (CPI)	4.6	5.0	5.1
Unemployment Rate	12.7	13.0	13.3

Source: CPI is taken from the International Financial Statistics; the unemployment rate is the standardized OECD unemployment rate for the U.K. CPI inflation for 1985 is the year-over-year inflation rate for August. The unemployment rate for 1985 is the average for January to May.

The standard Keynesian, or demand-centered analysis, would argue that unemployment rates in the range of 12 or 13 percent provide a prima facie case for expansion, particularly since unemployment averaged a "mere" 4.8 percent in the period 1970-80. But such models would also predict that the extremely high rates of the past three years should have caused a significant reduction in inflation, something that they manifestly did not accomplish! Econometric equations that I presented in 1983 (Sachs, 1983b) correctly suggested that even at very high unemployment rates in the United Kingdom, little progress in inflation could be expected in the absence of other policy reforms (which have not been forthcoming).

The data from the U.K., and from most other countries in Europe, strongly reject the key element of the demand-centered policy framework: the assumption of a stable rate of unemployment above which demand expansion is non-inflationary. This threshhold rate, long christened the NAIRU (for non-accelerating inflation rate of unemployment), has been anything but stable in the past decade. The movements of actual unemployment rates relative to historical averages, therefore, provide little direct evidence as to whether a demand expansion is warranted or is likely to be inflationary. As voluminous recent research has shown, the scope for demand expansion can be determined only after a careful analysis of the supply conditions of the economy in question.

I attempt two things in this paper. In the first section of the paper, I review the recent proliferation of supply-side models that say interesting things about why the NAIRU has increased so substantially in Europe. In the second section of the paper, I explore the design of aggregate demand management policies in response to transitory and permanent supply shocks, especially those shocks that cause a persistent rise in the NAIRU. Also, I discuss some policy implications of the increasingly popular hypothesis that the NAIRU itself is influenced by the time path of actual unemployment. Many analysts have recently suggested that when economies are run at very slack levels, the NAIRU itself is likely to rise. Unemployed workers lose the skills required to reenter the job market; old factories are scrapped rather than re-opened; new factories are not built. Eventually, it becomes difficult to move down from the high unemployment levels because the opportunities for re-absorbing the old job losers are no longer available. The high level of slack becomes the new inflation threshhold.

If this "hysteresis" (i.e. path-dependency) effect is in fact powerful, it would have subtle implications for demand management. Some have argued that such a possibility would provide a strong case of "going for growth", since the NAIRU could be sharply lowered by several years of high employment policies. The model below is not particularly supportive of this view, however. With a high NAIRU, going for growth implies going for inflation, even if the NAIRU will ultimately move down in response to strong demand conditions. The model does suggest, on the other hand, that even one-time blips in domestic inflation can cause permanent increases in the NAIRU and in the actual unemployment rate, since optimizing policymakers will want to absorb some of the inflation shock in the form of higher short-run unemployment, which in turn will cause a persistent rise in the NAIRU.

I. The Rise in the NAIRU in Europe: Empirical Evidence and Theoretical Explanations

The cornerstone of the analysis that follows is a Phillips curve equation that links current inflation, π_t, to the actual unemployment rate U_t, the NAIRU, U^*_t, and lagged or expected inflation π_{t-1}:

(1) $$\pi_t = - \phi(U \quad - U^*_t) + \pi_{t-1}$$

In wage-contracting models, and in most empirical inflation equations, π_{t-1} measures past inflation or built-in wage and price inertia. In rational expectations models, π_{t-1} should be interpreted as the (t-1)st period expectation of inflation in period t. From (1), π_t exceeds past inflation (or past expectations of inflation) π_{t-1} if and only if actual unemployment U_t is less than the NAIRU U^*_t. Assuming that demand management is feasible, so that the policymakers can select the level of actual unemployment U_t, inflation will tend to fall as long as U_t exceeds U^*_t, and inflation will tend to rise in the opposite case. In rational expectations models in which systematic demand policies are ineffective in controlling U_t, the actual unemployment rate must necessarily equal the NAIRU in expectation, since $E(\pi_t) = \pi_{t-1}$ so that $E(U_t) = U_t^*$.

Neither the standard Keynesian models nor the standard rational expectations models have much to say about the determinants of U_t^*. In Friedman's famous (1968) description of the natural rate of unemployment, U_t^* is simply the level of unemployment that "would be ground out of the Walrasian system of general equilibrium equations." In Keynesian models, U_t^* is taken as a datum, as it has been in almost all rational expectations models. In both cases the focus has been on the determinants of the gap of U_t and U_t^* and rather than on the level of U_t^* itself.

The neglect of U_t^*, or the association of U_t^* with frictional unemployment, was a pragmatic choice in the 1960's and early 1970's when the NAIRU seemed to be reasonably constant. However, since the early 1970's, policymakers and economic theorists and econometricians have had to confront the overwhelming evidence of a steep rise in U_t^* in most of the major economies of Europe. In 1979, Bruno and I argued that the scope for demand expansion in Europe was very limited. In Sachs (1979) I suggested that the differing nature of wage setting in the U.S. and Europe helped to explain why the U.S. had been able to reduce unemployment after the first OPEC oil shock. More recently, Grubb, Layard and Symons (1984) have put it this way:

> The main reason unemployment is high is that governments fear the effects on inflation if unemployment were lower...This is not of course the same as saying that governments have chosen to produce the exact levels of unemployment which we currently have. But governments do constantly say they cannot reflate without abandoning their inflation targets. We pass no judgement on whether their inflation targets are right, but we do offer support for the view that it would be impossible to reflate without a worse inflation performance (unless one had more effective incomes policies). (p.57)

A great deal of recent econometric work backs up this conclusion. Grubb, Jackman, and Layard (1982,1983) have made estimates of the changes in the NAIRU for several countries; Layard, Basevi, et. al. (1984) update these results; Coe and Gagliardi (1985) at the OECD have also offered estimates through 1983. The results uniformally show a rise over time in the rate of unemployment consistent with steady inflation. For the EC countries as a group, Layard, Basevi, et. al. have found the following:

	Actual Unemployment (EC)	Estimated NAIRU
1966-70	2.4	2.6
1971-75	3.2	5.3
1976-80	5.4	5.3
1981-83	8.8	7.6

Source: Layard, Basevi, et. al. (1984), p.18

The data are interesting for two reasons. First, of course, is the sharp upward trend in the NAIRU. According to these estimates, of the 6.4 (8.8-2.4) percentage point rise in average unemployment from 1966-70 to 1981-83, fully 5.0 (7.6 - 2.6) percentage points are attributable to a rise in the natural rate, and only 1.4 percentage points are therefore attributable to an increasing gap of U_t and U_t^*. Cumulatively, unemployment is wholly attributable to the NAIRU, in the sense that the cumulative sums of actual and NAIRU unemployment rates are both 19.8 percentage points over the period 1966-83. On average, actual unemployment has equalled the inflation-threshhold unemployment. The excess of recent unemployment above the NAIRU is merely serving to reduce the inflation built into the EC economies during the episode of 1971-75 when actual unemployment was far below the NAIRU.

There are two interpretations as to why the actual and the NAIRU rates have moved rather closely together. Most obviously, policymakers have kept actual U_t near to the rising U_t^* in order to keep inflation from rising even more than it did in the 1970s. Alternatively, the causality could be in the reverse direction, with the sharp increases in actual unemployment raising the NAIRU, as the hysteresis hypothesis suggests. Causality is difficult to establish; it is reasonable to believe that both effects have played a role.

Individual country estimates show a rather similar pattern. The estimates of Coe and Gagliardi, and of Layard, Basevi, et al., are reproduced in Table 1. In Germany, France, the U.K. and the Netherlands, there is evidence in both studies of sizable upward shifts in the NAIRU, and of close movements through time of the actual unemployment rates and the NAIRU rates. Interestingly, there is little apparent rise in the NAIRU in the U.S., Italy, and Austria.

In view of the traditional link of U_t^* with "frictional" unemployment, it might seem fruitful to try to explain the rise in U_t^* with variables that can shift the frictional rate. Such candidates include: (1) a demographic shift in the labor force, such a rising proportion of young workers, who have high rates of unemployment even when the aggregate unemployment rate is low; or (2) job mismatch, as evidenced by an outward shift in the Beveridge curve, that links vacancies and unemployment rates. A large number of studies have now tracked down these possible culprits, and the results have been negative

Table 1. Estimates of the NAIRU in Europe and the U.S.

	Time Period	Average Unemployment Rate	NAIRU Estimates (1)	(2)
Germany	1967-1970	1.0	0.7	1.3
	1971-1975	1.8	3.3	1.2
	1976-1980	3.6	2.4	3.5
	1981-1983	6.3	3.6	6.2
France	1966-1970	2.1		2.2
	1971-1975	2.7	4.5	3.3
	1976-1980	5.2	4.8	5.2
	1981-1983	8.3	7.7	6.9
United Kingdom	1967-1970	2.2	7.1	2.4
	1971-1975	3.0	4.2	4.0
	1976-1980	5.4	7.6	4.7
	1981-1983	10.6	9.4	9.2
Italy	1966-1970	5.5	7.5	7.8
	1971-1975	5.8	5.4	6.6
	1976-1980	7.1	5.2	6.5
	1981-1983	9.1	5.4	7.5
Austria	1969-1973	1.4	1.1	
	1974-1979	1.8	1.4	NA
	1980-1983	3.0	2.4	
Netherlands	1969-1973	2.5	3.0	
	1974-1979	5.2	4.5	NA
	1980-1983	9.3	8.7	
United States	1961-1963	4.7		5.9
	1967-1969	3.6	5.4	5.9
	1970-1981	5.4	5.4	5.8
	1974-1981	6.9	6.5	7.1
	1982-1983	9.7	6.1	6.8

Source: Coe and Gagliardi (1985, Table 11) -

(1) NAIRU estimates given in Column (1) are those shown as column (a2) in Coe and Gagliardi.

(2) For the United States the source is Braun (1984), "Productivity and the NAIRU (and other Phillips Curve Issues)," Working Paper No. 34, Board of Governors of the Federal Reserve System. For the other countries the source is Layard, et al. (1984) as cited in Coe and Gagliardi.

on the whole. Simple tests by Layard, Basevi, et al. actually showed a declining trend of mismatch (by occupation, by region, and by both together) in the U.K., and no strong trends in the rest of Europe. Several recent country studies presented at an L.S.E. Conference on the Rise in Unemployment (May, 1985), concurred in that negative finding. On the whole, the European economies adapted well to structural and occupational change in the 1960s, and there is no strong evidence that the pace of change has accelerated in the 1970s.

A second obvious culprit is a change the unemployment benefits system in the direction of greater subsidization of unemployment and job search. Here too, the evidence is not strongly supportive. To summarize a complex record across countries, there is indeed evidence that unemployment systems are extremely generous in many countries, with benefits replacing a high fraction of net-of-tax earnings of job losers, and with the benefits lasting for several years. However, in most countries there has not been a notable rise in the benefits ratio since the early 1970's, so that the change in NAIRU can not be easily correlated with a change in the benefits system. Moreover, in the case of the U.K., extensive cross-sectional work has been undertaken to measure the responsiveness of unemployment durations, and hence aggregate unemployment rates, to changes in the benefits ratio. While such responsiveness is clearly evident, the magnitudes seem to be too small to account for much of the U.K.'s large rise in the NAIRU.

The inability of standard frictional variables to account for much of the increase in the NAIRU in Europe has led to a significant re-thinking of the macroeconomic model in the European context. The frictional variables all stress the traditional emphasis of labor economics and macroeconomics on the "representative household" making labor supply decisions on the basis of a labor-leisure tradeoff. However, only a small fraction of employment relations in Europe involve labor contracts directly between an employer and an individual. The labor-leisure choice is almost everywhere mediated through trade unions or through labor-market regulations set by the government. The crucial realization of the new literature is that even when workers want to supply labor inelastically at whatever wage is available in the labor market, the trade unions properly representing the interests of those workers will not choose to offer labor inelastically at the market-clearing wage. Rather, optimizing unions may choose to respond to adverse shifts in labor demand by protecting real wages at the expense of higher unemployment, even though each individual worker would desire to work at a lower wage. Corden has dubbed the basic situation as household-involuntary, union-voluntary unemployment.

This new approach stresses the following three conditions in European labor markets in the 1970s. First, a large number of factors conspired to shift the labor demand schedule inward throughout the past decade. That is, the amount of labor that firms would like to hire at any given real wage has not been rising as rapidly as in the 1950s and 1960s. Factors which have shifted the labor demand schedule adversely include the oil price increases, which may be likened to negative productivity shocks (see Bruno and Sachs, 1985, ch. 2, for the formal analogy); a sharp, and largely unexplained, slowdown in technical productivity growth; and a rise in indirect and labor taxes, which drive a wedge between the labor costs to the firm and the workers' real take-home pay. Second, the response of optimizing trade unions is to accept the adverse labor-demand shifts partly in the form of lower employment, and only partly in the form of lower real wages. And third, the responsiveness of the economy in absorbing unemployed workers (either the union job losers, or non-union new entrants to the labor market) is extremely slow, in part due to restrictive legislation that prevents active competition of non-union firms with union firms. An example of such restrictions is the German practice of "extension" of the union wage to cover all workers, whether union or non-union, in a given sector. Under such conditions, it is virtually impossible for new, non-union firms to provide jobs for the unemployed.

We now turn to the theoretical models, and then to the empirical evidence in their support.

A. Models of Union Wage Setting

A typical model of union wage setting is provided by MacDonald and Solow (1981). Consider a monopoly union with N members, negotiating wages with a competitive industry that produces output Q using capital K and labor input L, (with $L \leq N$). The production function of the sector is given as $Q = AF(K,L)$ with K fixed in the short run. The variable A is a productivity shift variable, which can represent pure technical change, or changes in real prices of other inputs, such as oil. The union is assumed to set the wage W, at which level the firm may freely hire its desired input of workers. Short-run profit maximization requires that W be equated with $PAF_L(K,L)$. As is well known, this relation yields a local log-linear approximation of the form:

$$(2) \quad \ell = - \beta(w - p - a) + k$$

$$\text{where } \beta = \sigma\alpha/(1 - \alpha)$$

where a=log(A), l=log(L), w=log(W), etc. Here, α is the share of labor in value added at the point of linearization, and σ is the (local) elasticity of substitution between capital and labor. If the underlying production relation is Cobb-Douglas, then equation (2) holds at all points, with σ=1 and with α equal to a constant share of labor in total value added.

Using equation (2) we can determine the level of real wages (w - p) that is consistent with full employment in the sector. Denote this level as w_f^p Inverting (2) we find that w_f^p equals $(k - \ell^f)/\beta + a$. The percentage deviation of the actual real wage from the full-employment real wage is termed the "wage gap" in the literature. Later, I will discuss empirical estimates of the wage gap for several countries in Europe.

Now suppose that the union selects a wage W in order to maximize the expected utility of a representative worker, calculated as follows. Suppose, for simplicity, that employment is distributed randomly among the union members, with each having the probability L/N of receiving employment, and (N-L)/N of not receiving employment. If the worker is employed, the utility of the labor income is given by U(W/P). If the worker does not receive a job in the sector, it is assumed that his utility is given by a value U_0 which reflects the combination of real unemployment benefits, the real wage levels in other sectors where jobs might be available, leisure time, search costs, etc. Evidently, the representative member's expected utility is:

$$(3)\quad EU = (L/N)\, U(W/P) + [(N-L)/N]\, U_0$$

By the institutional assumption that the union selects the wage while the firm then selects the level of employment based on (2), MacDonald and Solow state the union's problem as maximizing EU subject to (2). At the optimum, of course, d [E(U)]/d W = 0, which upon straightforward differentiation yields the following optimum condition for the union:

$$(4) \quad -\beta(U - U_0) + (W/P)[dU/d(W/P)] = 0$$

In the case that the utility function is logarithmic, condition (4) reduces simply to:

$$(4') \quad U - U_0 = 1/\beta \qquad \text{or} \qquad W/P = \exp[U_0 + 1/\beta]$$

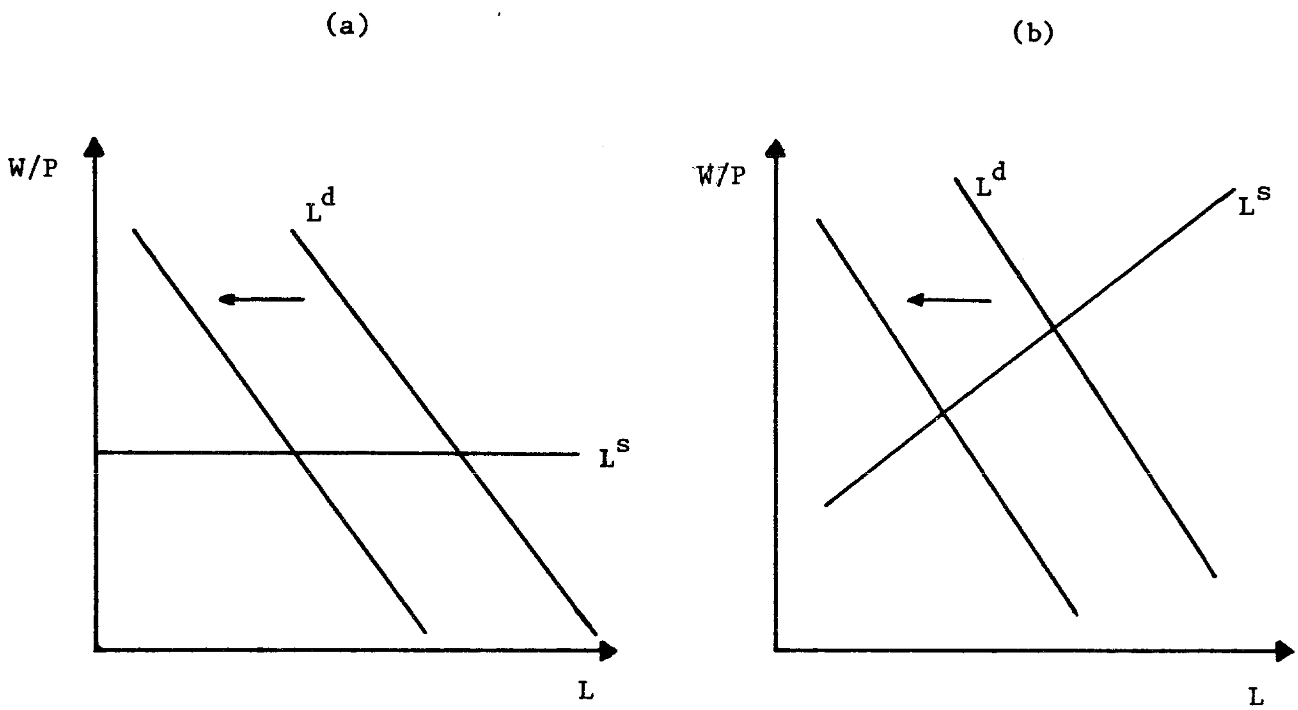
Like a good monopolist, the union sets the wage as a markup over U_0, with the markup depending on the elasticity of labor demand, β. A high elasticity leads to a low W/P, a low elasticity leads to a high W/P.

The interesting question for European unemployment is how such a union is likely to respond to adverse labor demand shocks, proxied here by a downward shifts in A or K. In general, one can trace out the response of W/P to shifts in these variables, and calculate a wage-offer function, of the form W/P = W/P (A,K). By substituting this wage offer function into the labor demand equation, we can also calculate the implied labor supply of the union as a function of A and K. Denote this function as $L^S = L^S(A,K)$. Consider one important special case first. Suppose that the elasticity of demand for labor, β, is a constant (as in the Cobb-Douglas case, and nearly so for CES production functions with σ close to 1.) Then, remarkably, the first-order conditions in (4) can be solved for W/P independently of A and K. In other words, the union will set a fixed real wage W/P no matter what the level of labor demand is at that wage level! All adverse shocks to labor demand are absorbed through employment reductions, and not at all through real wage cuts! This case is depicted in Figure 1a. More generally, the optimum conditions induce a wage - employment locus that is upward or downward sloping, so that adverse demand shifts affect both L and W/P, as is depicted in Figure 1b.

Many other authors have elaborated similar models. In some cases, the union is assumed to care about the representative member's utility EU, but also about the magnitude of total employment, so that the union maximizes a function V = V(EU, L). Grossman (1984) and others have allowed for seniority rules and internal union politics to affect probabilities that particular members will or will not have jobs in the event of workforce reductions. Still others have allowed for more complicated bargaining models, in which the union does not unilaterally set W/P, but must extract a wage settlement based on bargaining power vis-a-vis the employers. In general, such models all deliver the key result that adverse shocks should be absorbed partially or fully by a decline in employment, and only partially (if at all), by a real wage reduction.

In a recent paper, Lawrence and Lawrence (1985) use the same framework to show that adverse shocks might plausibly be met by real wage increases rather than decreases, so that the proportionate drop in employment can even exceed the initial inward shift of the labor demand schedule! Their reasoning is as follows. In a dynamic model, the firm's investment decisions will be a function of the real wage levels that the union sets today and is anticipated to set in the future. The factor price frontier suggests that the (log)

Figure 1. Shifts in Labor Demand



quasi-rents to capital are a decreasing function of real wage and an increasing function of the productivity shift variable, a: $r = -b(w-p) + \gamma a$ (see Bruno and Sachs, ch. 2-3, for a thorough discussion of the factor price frontier, and its implication for investment behavior). Most models of firm-level investment link changes in K to the level of r relative to the cost of capital. In general, a rise in $(w - p)$ should be expected to reduce r and thereby reduce investment. Lawrence and Lawrence point out, however, that in very depressed sectors, for which r is already extremely low, firms may already be in the position of making no gross investment. For such depressed industries, the elasticity of response of investment to the wage will be zero.

Now consider the implications of these observations for optimal union wage policy. To introduce investment but keep the model static, let us write the size of the capital stock k as a function of r. Moreover, assume that the capital stock is variable for r above a minimum $\bar{r}$, but that for r below $\bar{r}$, the capital stock is fixed:

$$(5) \qquad k = -\delta(r-\bar{r}) + k_0 \qquad \text{for} \quad r > \bar{r}$$

$$= k_0 \qquad \text{for} \quad r \leqslant \bar{r}$$

$$r = -b(w-p) + \gamma a$$

By subsituting (5) into (2), we see that the overall elasticity of employment with respect to the real wage includes both the direct effect of wages on ℓ, given k, and the indirect effect on k as well. The overall elasticity equals $\beta + \delta b$ when $r > \bar{r}$, and the overall elasticity equals β for $r < \bar{r}$.

Now to the punch line. Suppose that an adverse shock deals a sharp blow to a sector that initially has $r > \bar{r}$. With productivity declining, and wages rigid, the firm enters the region in which investment is no longer profitable. At that point, the elasticity of demand for labor falls from $\beta + \delta b$ to just β, since the capital stock becomes insensitive to the real wage level. But we have already noted that the union's optimal wage demand depends <u>inversely</u> on the elasticity of demand for labor. Once the adverse shock pushes the sector into the region of no gross investment, the union should optimally respond by raising the real wage! The simple point is that in a declining sector, quasi-rents to capital become pure rents and therefore an attractive bundle of resources to be grabbed by a union that no longer has to worry about disincentives to future investment policy.

Lawrence and Lawrence apply this story to the U.S. steel sector, where a decade of supply shocks and intense foreign competition has been met by constantly increases in real wages that have outpaced almost every other sector. Not surprisingly, steel industry employment has plummeted. As Solow stated in his discussion of the Lawrence and Lawrence model, their interpretation is an effective explanation of what must otherwise be written off as a death-wish of the United Steel Workers union. Application of the model to European industries has not yet been attempted, but my hunch is that it will prove an effective vehicle of explanation.

The union wage model helps to explain a shift in employment in response to adverse supply shocks. A small extension can transform it into a model of the Phillips relationship in (1). Almost all authors have taken the position that the union wage model describe the target level of employment of the unions, L^S, rather than the actual level of employment period to period. Slippage between L^S and actual L can come from lags in wage contracting, mistakes in inflation expectations, the unwillingness of firms to turn away customers at prices which are posted before the exact level of demand is known, etc. The union is therefore assumed to adopt an error-correction mechanism in its wage setting, with real wages rising when actual employment exceeds desired employment. Specifically, let L now represent total employment (aggregated over all sectors), and N represent the total labor force. Log(L/N) equals -U. Define $\mathrm{Log}(L^S/N)$ as -U*. Now assume that nominal wages are changed as a function of expected or lagged inflation, π_{t-1}, and the percentage gap of actual over desired employment, $\mathrm{Log}(L/L^S)$. Since $\mathrm{Log}(L/L^S)$ equals U* - U, we can write:

$$(6) \quad \pi^w_t = -\phi(U - U^*) + \pi_{t-1}$$

Here, $\pi^w_t = w_t - w_{t-1}$.

From (2), we can write current price change, π_t as a function of current wage change, π^w_t, current employment change, and current changes in technical technical productivity and the capital stock, which I will summarize by a parameter ψ. Thus, $\pi_t = \pi^w_t - \theta(U_t - U_{t-1}) - \psi$.[1] Substituting this expression into (6), we get a standard Phillips curve of the form:

$$(7) \quad \pi_t = -\phi(U_t - U^*_t) - \theta(U_t - U_{t-1}) - \psi + \pi_{t-1}$$

This equation differs from the one at the beginning of this section only by allowing for productivity change to affect inflation (the ψ term), and by allowing <u>changes</u> in unemployment to affect π_t. The crucial fact from our point of view is that supply shocks which cause L^S, and therefore U*, to change, will cause shifts in the Phillips curve of the sort that have been observed in the past decade.

The models so far fill in a large part of the explanation of the rise in the NAIRU in Europe. They reconcile two apparently contradictory notions: the cross-sectional evidence that household labor supply (especially of prime-age males) is fairly inelastic, so that households should in principle be willing to accept real wage cuts in order to protect employment; and the macroeconomic evidence that real wage reductions only occur slowly, if at all. However, a more complete explanation must also consider why union workers who lose their jobs, and non-union workers who can't get union jobs, are not absorbed in non-union sectors. Various ideas are circulating as to how to close the model. Minford (1983), for example, has argued that a competitive non-union sector in fact exists and could absorb the unemployed, but that the ratio of unemployment benefits to non-union wages are simply too high to make those job prospects attractive. Nickell (1984) has disputed this interpretation, by arguing that even with respect to non-union wages there has not been a significant increase in the unemployment benefits ratio. Other authors, particularly in Germany, have argued that the non-union sector is itself so hampered by regulation that it cannot be a vigourous absorber of the unemployed. Two types of restrictions are stressed. In the non-union parts of the industrial sectors, union wage levels generally apply to the non-union firms. The employers confederations that bargain with the unions find it in their interest to police the extension of union wages to non-union firms. According to some analysts, non-union firms that attempt to shirk, by paying below union scale, can find themselves blacklisted by their suppliers, who do pay union wages. In the non-industrial, service industries, various guild-type regulations allegedly hamper the possibility of a rapid expansion. Finally, in France (until very recently) and some other countries, the pressure for general wage increases came not only through unions, but also through an active public sector wages policies, which acted to maintain an across-the-board increase in real incomes for those individuals lucky enough to have jobs (in France, the minimum wage, known as the SMIC, has been an important instrument of that wage policy).

B. Empirical Evidence on the Union-Wage Model

Testing of the union-wage framework has developed along three lines. First, various investigators have examined the real wage-employment link in (2), which is a crucial aspect of the model. Second, various studies have examined wage determination, to see whether real wages decline sufficiently in the face of supply disturbances, or whether, as in the model, real wages remain high (above full employment levels) when supply shocks occur. Third, direct econometric estimates of the Phillips curve have included supply-side variables, to see whether the observed shifts in the Phillips curve can indeed be linked up with variables that are identified as important in the union-wage model.

(1) The Real Wage - Unemployment Link

After decades of work on the cyclical behavior of real wages in the United States, a consensus had emerged in the early 1970s that contrary to the implications of neoclassical labor demand equations, high unemployment is associated with low rather than high real wages. It has turned out, however, that those results were specific to the U.S. A great deal of recent work, with carefully specified labor demand functions, has found that real wages are a significant determinant of labor demand, at least in the manufacturing sector, for which most of the analysis has been made.

Examples of such findings are Bruno and Sachs (1985), Ch. 8, where it is shown that in 8 of the 9 OECD economies that we examined (all countries tested except the U.S.), the real product wage in manufacturing has a strong and significant negative effect on manhours in the manufacturing sector. The average elasticity of demand for manhours with respect to the real wage in the short run is estimated to be about -0.50, and to be about -1.0 to -1.5 in the long term. Several other recent studies have also estimated neoclassical labor demand schedules, again with successful results. Symons and Layard (1984), Grubb, Layard and Symons (1984), and Newell and Symons (1985) have made careful cross-country comparisons of the labor demand equation. In the Newell and Symons study of 16 OECD economies, the real wage is negatively signed 13 of 16 times, with an average t-statistic of 1.7. On average, the estimated long-run elasticity of labor demand is found to be about -0.9, slightly lower in absolute value than in Bruno and Sachs. Several recent studies for the U.K. all find a highly significant real wage effects. Such studies include Nickell and Andrews (1983), Symons (1985), Beenstock, Warburton, Lewington, and Macromatis (1983) and Layard and Nickell (1984). All of these studies find a statistically significant long-run real wage elasticity of employment in the neighborhood of -1.0. Unfortunately, similarly detailed studies have not yet been carried out for most of the other European economies.

The fact that high product wages (or at least product wages that are high relative to a slowing trend of productivity) can track the decline in labor inputs in the OECD economies in the 1970s is consistent with (indeed, nearly the same as) the finding in a large number of studies of a continuing real wage gap in the European economies. Remember from the earlier discussion that the real wage gap attempts to measure the deviation of actual real wages from the level of real wages that would be consistent with labor demand equalling full-employment labor supply. Essentially, the comparison is between the actual level of real wages and the level of the marginal product of labor when measured at full-employment levels. Bruno and Sachs (1985, Ch. 9) offer several measures of wage gaps, and a detailed discussion of the difficulties in calculating the wage gap. Some wage gap measures based on the procedures in Bruno and Sachs (1985) are shown in Table 2. They suggest that the wage gap remains high in most European economies.

A more powerful procedure is to estimate the relevant production functions from which the labor demand equation can be derived. Knowledge of the production function permits a direct estimation of the marginal product of labor at any given level of employment. Artus (1984) provides the single study to date that applies this ambitious methodology. His findings offer strong support to the view that real wages continue to be above market clearing levels in the major European economies. Indeed the magnitudes of the estimated gaps are very close to those found by Bruno and Sachs.

One area of controversy in this literature is whether demand variables in addition to supply variables show up in the labor demand equation. In other words, controlling for real wages, the capital stock, and the real prices of other variable inputs, is labor demand also a function of the state of aggregate demand? The Keynesian approach would predict yes (indeed, it often ignores the role of the supply variables), while a thoroughgoing neoclassical approach would predict no. Unfortunately the evidence is split. In Sachs

Table 2. Adjusted Wage Gaps, 12 OECD Countries, 1965-1983

(1964-69 ≡ 0.0)

	1965	1970	1973	1976	1979	1981	1982	1983
U.S.	0.2	0.1	6.0	2.9	6.8	8.1	8.6	8.4
Canada	-1.9	1.9	-0.5	3.3	0.8	2.2	2.9	3.5
Europe								
U.K.	-2.0	2.2	4.6	11.0	16.4	24.1	25.0	26.4
Belgium	2.1	-0.8	13.6	30.2	37.2	40.7	35.2	-
Denmark	-2.3	2.5	8.1	13.0	17.6	16.4	13.7	9.2
France	0.0	-3.4	-0.4	7.9	10.7	14.3	17.4	-
Germany	2.0	1.5	7.2	13.0	15.3	19.1	15.9	12.9
Italy	2.3	6.4	15.4	19.5	11.8	9.1	7.6	5.9
Norway	-2.5	-4.3	-1.3	13.9	17.3	7.7	6.4	6.2
Sweden	2.7	-1.1	-5.2	3.7	-1.6	-4.0	-7.1	-9.6

Source: Bruno (1985). Note that I do not report the results for the Netherlands because of a severe data problem regarding the value added deflator used by Bruno in his original calculations.

(1983a), Bruno and Sachs (1985), and Bruno (1985), we have found that monetary variables, and occassionally fiscal variables, can help to explain labor demand in addition to the supply variables. Similar results have been found by Grubb, Layard, and Symons (1984), and by Layard and Nickell (1984). On the other hand, Newell and Symons (1985) have been unable to find a significant added role for demand variables, except in France and the United States. It is not easy at this point to account for these discrepancies.

(b) Real Wage Determination

The second leg of the union-wage model is the presumption that adverse supply shocks get absorbed in lower employment as well as in reductions in the real wage. Most of the econometric studies have examined short-run wage behavior in response to various supply shocks; a few, particularly Newell and Symon (1985), address the difficult econometric issue of whether the failure of downward real wage adjustment is a short-run phenomenon or a long-run phenomenon. This question is important, for it determines whether a one-time shift in labor demand (say a rise in oil prices) is likely to cause a transitory rise in unemployment, or a permanent increase in the NAIRU.

Supply shocks may be defined broadly as anything which shifts the demand for labor in equation (2). Here we must be particularly careful about the definitions of W and P. Presumably worker utility in (1) depends upon net-of-tax nominal wages, deflated by a consumer price index, or $W(1-t)/P_c$ Labor demand in (2) depends on the nominal wage inclusive of labor taxes (e.g. payroll taxes for social security), deflated by the value added deflator, or $W(1+\tau)/P_v$. Anything which alters the ratio of the real consumption wage to the real employer costs is like a supply shock, in that it shifts a properly specified labor demand schedule in (2). Many authors have christened the ratio of these two measures as "the wedge", the log of which can be approximated as:

$$(8)\ \log(\text{wedge}) = \tau + t + (p_c - p_v)$$

In sum, the relevant supply shocks to examine are: increases in payroll taxes (τ), increases in employee labor taxes t, relative price shocks (such as the OPEC shocks) which affect p_c-p_v, shifts in technical change (the parameter a in (2)), and shifts in the capital stock. In principal, any adverse change in these measures must be balanced, at full employment, by a reduction in the real take-home consumption wage. A rise in the wedge, for example, requires an equiproportional drop in real take-home pay.

Almost all studies confirm that downward real wage adjustments in most economies are not rapid enough to prevent a rise in the wage gap following an adverse supply disturbance. What is less clear from the evidence is whether the increase in the wage gap is a permanent response to a supply shock, or is rather a transient blip in real labor costs that is reduced over time. In the former case, the NAIRU can be expected to rise in the "long run" (i.e. until the next shock occurs) while in the latter case, the increase in the measured NAIRU will be reversed over time, even in the absence of new disturbances. In any case, it appears that the relevant adjustments are very slow. Note that the union wage model predicts a permanent rise in the NAIRU.

Empirically, the major supply shocks appear to be tax and productivity changes, rather than the oil shocks on which I and many others have focussed.

Knoester (1983) and Knoester and Van der Windt (1985) provide powerful evidence that tax increases do not lead to the necessary reductions in $W(1-t)/P_c$, as they must in order to stay at full employment, but rather get shifted forward onto capital (and thus unto employment). Knoester and Van der Windt examine real consumption wage growth in ten OECD economies, and in every case, a rise in labor taxes leads to an increase in pre-tax real wage growth. The implication is that a rise in either t or τ causes an increase in the employer's real labor costs $W(1+\tau)/Pv$, as predicted in the union-wage model. In their study of wage setting in the U.K., Layard and Nickell similarly find that labor tax increases are absorbed largely by the firm, rather than by reductions in the workers net-of-tax take home pay. Indeed, their equations allow them to measure the unemployment effects of tax increases in various periods. They find (Table 9, p.74) that increases in taxes (including employer and employee labor taxes, income taxes, and indirect taxes) contributed 1.2 percentage points to the rise in unemployment in 1967-74 relative to 1956-66; 1.3 percentage points to a further rise during 1975-79; and 0.9 percentage points more during 1980-83. Over the sixteen years 1967-83, therefore, the total increase in unemployment due to tax increases is estimated to be 3.4 percentage points.

Interestingly, many authors have found that the rapid wage increases in the early 1970's are hard to explain even after accounting for increased taxes, productivity growth, etc. Perry (1975), Gordon (1977), Sachs (1979), and more recently Layard and Nickell (1984), Bruno and Sachs (1985), and Newell and Symons (1985) have all stressed the empirical importance and essential puzzle of the wage explosion during 1968-73. Layard and Nickell allow for a change in union "strength", measured by a change in the union to non-union markup, to enter the aggregate wage equation. This variable helps to account for the real wage boom of the early 1970's. The union effect is calculated to account for about 1.2 percentage points in the overall rise in unemployment. Newell and Symons find an even more important role for a militancy dummy variable in their equations for 16 OECD economies. Indeed, for the E.C. as a whole, they attribute approximately one half of the 3.7 percent increase in unemployment during 1977-81 relative to 1963-67 to their wage-explosion variable, and relatively little to the tax and other wedge variables.

(c) Reduced-form Estimates of the Phillips Curve

We have already discussed in the Introduction several studies which have shown a significant rise in the estimated NAIRU in the European economies. Some studies, such as Grubb, Jackman, and Layard (1983) and Bruno and Sachs (1985), have combined the labor demand and wage equations to come up with reduced form Phillips curve equations in which the supply variables are allowed to enter freely. In one set of estimates in Bruno and Sachs (Tables 10.2 and 10.3), the wage gap w^g is entered as a shift variable in the Phillips curve equation, as a proxy for shifts in U*. The estimated equation is of the form:

$$(9) \quad \pi_t = a_0 + a_1\pi_{t-1} + a_2 w_t^g + a_3\pi_t^m + a_4\psi_t + a_5 U_t$$

where π_t is consumer price inflation, ψ_t is annual productivity change, and π_t^m is import price inflation. The results for the European economies in the sample are shown in Table 3, below. The first column shows the estimated coefficient on w^g, the second shows the measured wage gap as of 1981, and the

Table 3. The Wage Gap and the Phillips Curve

Country	Estimated Value of a_2	w^g in 1981	Increase in U Needed to Counteract w^g
Belgium	10.4[a] (3.5)	29.3	5.3
Denmark	19.0 (1.6)	7.0	3.7
France	10.9 (0.9)	1.9	-0.3
Germany	42.1 (7.9)	12.2	4.3
United Kingdom	71.3 (3.9)	19.3	9.6

[a]Numbers in parentheses are t-statistics

Source: Column 3 is calculated as $- a_2 w^g / a_5$, using the estimates from Bruno and Sachs (1985), Table 10.2. All other data are from Tables 10.2 and 10.3.

third column shows how much the unemployment rate would have to rise in order to eliminate the inflationary effects of the wage gap, using the coefficients estimated in (9). Note that all of the countries except France demonstrate a marked shift in the Phillips curve associated with the rise in the wage gap. For France, we suspect, measurement problems plagued our estimates of the wage gap.

A different approach is attempted in Sachs and Wyplosz (1985), where shifts in the French NAIRU are studied. The "wedge" and productivity shift variables are put directly in the Phillips curve, as determinants of shifts in U*. A provisional estimate of a modified Phillips curve for France is as follows (the numbers in parentheses are t-statistics):

$$(10)\quad \pi_t = \pi_{t-1} - \underset{(4.5)}{4.66}\, U_t - \underset{(0.78)}{0.93}\,(U_t - U_{t-1}) + \underset{(1.70)}{0.09}\,(\pi^m_{t-1} - \pi_{t-1})$$

$$- \underset{(3.80)}{49.79}\,[\log(\text{productivity}) - \log(\text{wedge})]$$

$$+ \underset{(4.25)}{3.18}\,\text{time} \qquad \bar{R}^2 = 0.69 \qquad \hat{\rho} = \underset{(5.01)}{-0.78}$$

The regression is a standard Phillips curve, except for the inclusion of a NAIRU shift variable, which is given as the log of trend labor productivity minus the log of the wedge (I explain this variable in a moment). Otherwise, current inflation π_t is written as a function of lagged inflation, π_{t-1}, the level and change in U_t, import price inflation π^m_{t-1} relative to domestic price inflation π_{t-1} (i.e. relative import price shocks), and a time trend. The (log) productivity variable is measured as a + $(k-\ell^f)/\beta$, which we saw from equation (2) gives the "warranted" product wage (i.e., the product wage consistent with full employment) based on underlying labor productivity. When we calculate $a + (k-\ell^f)/\beta$ - log(wedge), we have a measure of the warranted real take-home pay as a function of technology, taxes and shifts in relative input prices.

The estimated NAIRU is found by solving for U_t in (10) assuming $\pi_t = \pi_{t-1} = \pi^m_{t-1}$, and $U_t = U_{t-1}$. Thus,

$$(10') \quad U^{NAIRU} = \left(\frac{3.18}{4.66}\right) \text{time} - \left(\frac{49.79}{4.66}\right)[\log(\text{productivity}) - \log(\text{wedge})]$$

Since the time trend increases by 1 each year, the equation suggests that productivity <u>net</u> of the wedge (i.e. the warranted take-home pay) must grow by (3.18/49.79) = 0.064, or 6.4 percent per year, in order for the NAIRU to remain constant. The post-'73 rise of the wedge in France and an accompanying slowdown in productivity growth have both reduced the growth of the warranted wage well below 6.4 percent per year. Accordingly, the NAIRU has risen sharply since 1973, by about 5 percentage points, to a rate of about 8 percent (alternative regression estimates put the range at 7.5 to 9 percent). The increase during the period 1963-72 was only about 1 percentage point, both because underlying productivity growth was faster and the wedge increased at a much slower pace. For further details, see Sachs and Wyplosz (1985).

II. Demand Management Policies and the Shifting NAIRU

Supply shocks that deliver increases in the NAIRU are naturally best handled by supply-side measures. Incomes policies, social contracts between governments and unions, supply-side tax cuts, etc. are possible devices for handling such disturbances. Having noted that, however, it is still important to focus attention on the appropriate role for demand management policies, particularly in the case that supply-side measures are politically or institutionally difficult to implement (see Calmfors (1984) for a very innovative and largely successful attempt to show how political organization and union organization in the Northern European economies can shape the scope for supply-side measures). The question of demand management becomes even trickier in the case that actual demand management policies can affect the evolution of the NAIRU, according to the "hysteresis" hypothesis, to which I now turn. The decade-long bout with high and rising unemployment in Europe has provoked enormous frustration, and urgings from some analysts for a significant reflation (see, for example, Layard, Basevi _et al_. (1984), and Blanchard _et al_. (1985); see also the discussion by Gordon (1985) in his paper for this conference). One argument for expansion is that the current levels of unemployment clearly exceed the current NAIRU, and that on the margin, employment gains are more important than further gains against inflation. A second and increasingly popular argument is that even if the NAIRU is high, demand expansion is justified on the grounds that continued slack would itself contribute to yet further increases in the NAIRU. The argument, as broached in the Introduction, holds that the NAIRU depends not just on supply factors such as the "wedge", but also on the actual levels of unemployment in the economy.

Blanchard _et al_. (1985) offer two interesting empirical arguments in support of this proposition. Hargraves Heap (1980) offers several more theoretical arguments. The simplest argument is that the NAIRU depends on the capital stock (remember from Section I that a decline in K is like a supply shock), and that the evolution of the capital stock depends not just on factor prices but also on the state of demand in the economy. Hence, by running the economy at unemployment rates below the NAIRU, new investment is spurred, which will eventually reduce the NAIRU. The empirical basis of this case is outlined in Blanchard et al. The second empirical argument is that the NAIRU drifts up over time when $U > U^*$ because the long-term unemployed eventually become unemployable. Once this occurs, they stop contributing to the downward pressure on inflation. An extremely interesting regression analysis shows that only the unemployment rate for the short-term unemployed (those unemployed less than six months) contributes significantly to the Phillips curve equation. As the authors put it: "Many of the long-term unemployed in total unemployment have in effect ceased looking for work and, as a result, may be inefficient draftees in the fight against high real wages and inflation." (p.30) This same effect has led Newell and Symons (1985) to enter U in their Phillips curve equation as $U_t - 0.5U_{t-2}$ under the assumption that the current NAIRU is raised by $0.5U_{t-2}$.

Given the plausibility and popularity of the hysteresis argument, it is unfortunate that the policy implications of hysteresis have not yet been worked out. Does the existence of hysteresis mean that the economy should be run at very low unemployment rates, so that the NAIRU is reduced to very low levels? Does it mean that supply shocks should not be fought with unemployment, because that merely contributes to longer-term structural problems? The answers are not yet known.

I now offer a brief, and simple, analysis of this issue, to see whether hysteresis provides a strong case for a European expansion in the absence of independent improvements in the NAIRU (everybody is for expansion if demand-expanding measures can be combined with wage restraint, or other supply expanding policies!) To model this case, I assume that changes in the NAIRU are determined by deviations of actual unemployment from the contemporaneous NAIRU:

$$(11)\quad \dot{U}^*_t = f(U_t - U^*_t) \qquad f > 0$$

A similar formulation of the hysteresis hypothesis is found in Hargraves Heap (1981). The standard case, without hysteresis is given by f = 0. We will study that special case along with the case in which f > 0.

The rest of the model will rely on a standard Phillips curve approach, stated in continuous time. Letting π_t be the instantaneous inflation rate, I assume that changes in the inflation rate are induced by deviations of U_t and U^*_t

$$(12)\quad \dot{\pi}_t = -\phi(U_t - U^*_t)$$

It is assumed that the Phillips curve in (12) represents the partial adjustment mechanism outlined earlier. Also because of the implied lags in nominal wage change in responding to price changes, it is assumed that policy-makers can influence the level of unemployment at each instant, through standard demand management tools.

Policymakers are assumed to minimize an intertemporal social loss function, of the form:

$$(13)\quad V_0 = \int_0^\infty e^{-\delta t} v(\pi_t, U_t)dt$$

$v(\pi_t, U_t)$ is the instantanous level of social loss (negative welfare). Of course the loss v is increasing in both arguments. Moreover, I assume that the function is convex, so that the marginal costs of inflation or unemployment rise as the levels of inflation or unemployment increase. δ is the pure rate of social time discount, and intertemporal social loss is the disounted integral of the instantaneous loss levels. As a specific, and easily tractable example, I assume now that instantaneous social loss is quadratic in its arguments, so that (13) is re-written as:

$$(13') \quad V_0 = \int_0^\infty e^{-\delta t}[U_t^2/2 + \alpha\pi_t^2/2]dt$$

Importantly, bliss is defined as a zero level of inflation and unemployment. In reality, the bliss point should allow for a positive frictional level of unemployment. In our context however, all that is important is that the bliss level of unemployment is below the initial level of the NAIRU; introduction of non-zero target level for U would not change any results as long as that target level is below U_0^*.

The policy problem is given as:

(14) max V_0 with respect to the time path of U, subject to
(11) and (12)

Technically, the problem requires a straightforward application of optimal control techniques. There is no issue of time inconsistency of the optimal plan in this case because the agents in the private sector are not modelled as forward looking. To solve the problem, we simply set up the Hamiltonian H, and take first-order conditions (hereafter, time subscripts will be dropped when not necessary). λ and γ are the costate variables associated with the Phillips curve equation and hysteresis equation, respectively.

(15) $H = e^{-\delta t}[U^2/2 + \alpha\pi^2/2 - \lambda\phi(U - U^*) + \gamma f(U - U^*)]$

(a) $\partial H/\partial U = 0 \Rightarrow U = \lambda\phi - \gamma f$

(b) $\partial H/\partial \pi = -d/dt[e^{-\delta t}\lambda] \Rightarrow \alpha\pi = \delta\lambda - \dot{\lambda}$

(c) $\partial H/\partial U^* = -d/dt[e^{-\delta t}\gamma] \Rightarrow \lambda\phi - \gamma f = \delta\gamma - \dot{\gamma}$

(d) $\dot{\pi} = - \phi(U - U^*)$

(e) $\dot{U}^* = f(U - U^*)$

In order to best understand the implications of these first-order conditions, it is useful to begin with the standard policy case in which f = 0.

A. Optimal policy in the absence of hysteresis

Once f is set equal to zero, we can ignore γ (γ is the costate variable associated with U*, which is now considered fixed). The first order conditions then simplify to:

(15')

(a) $U = \lambda\phi$

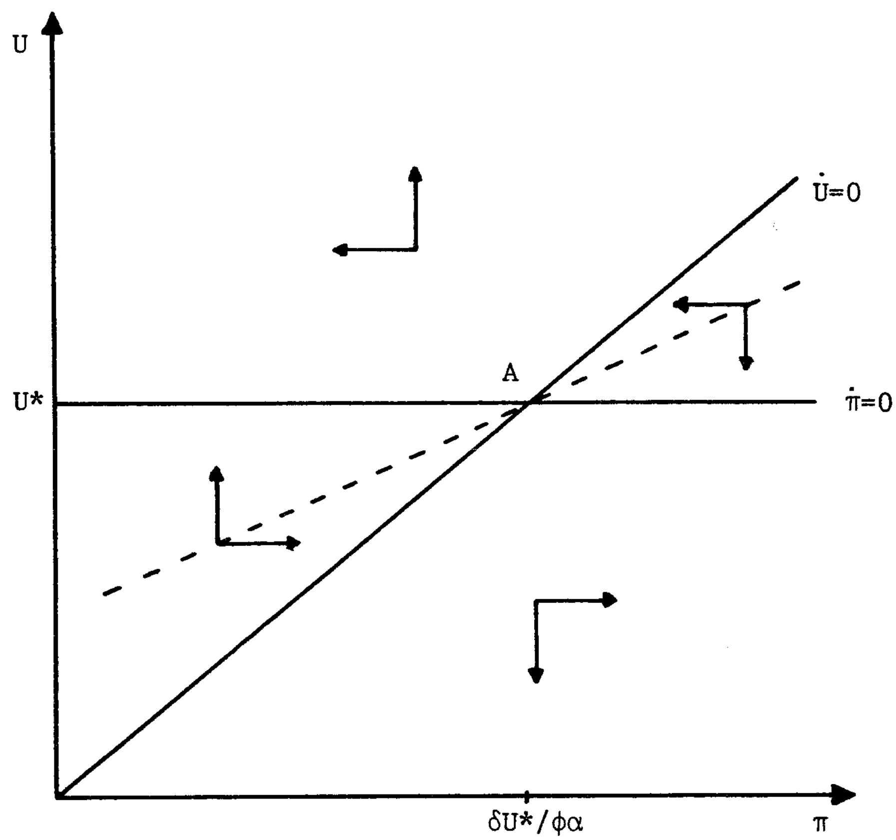
(b) $\dot{\lambda} = \delta\lambda - \alpha\pi$

By differentiating the equation linking U to λ, and substituting in the equation for $\dot{\lambda}$, and combining the results with the Phillips curve equation in (12), we can write the system in U and π, in the following way:

$$(16)\quad \begin{bmatrix} \dot{U} \\ \dot{\pi} \end{bmatrix} = \begin{bmatrix} \delta & \alpha\phi \\ -\phi & 0 \end{bmatrix} \begin{bmatrix} U \\ \pi \end{bmatrix} + \begin{bmatrix} 0 \\ \phi\, U^* \end{bmatrix}$$

A graphical analysis of this system is shown in Figure 2. Note that the phase arrows indicate the saddlepoint stability of the system, a standard feature of dynamic optmization problems. The optimal dynamic path for the system must

Figure 2. Unemployment and Inflation Dynamics with Optimal Demand Management

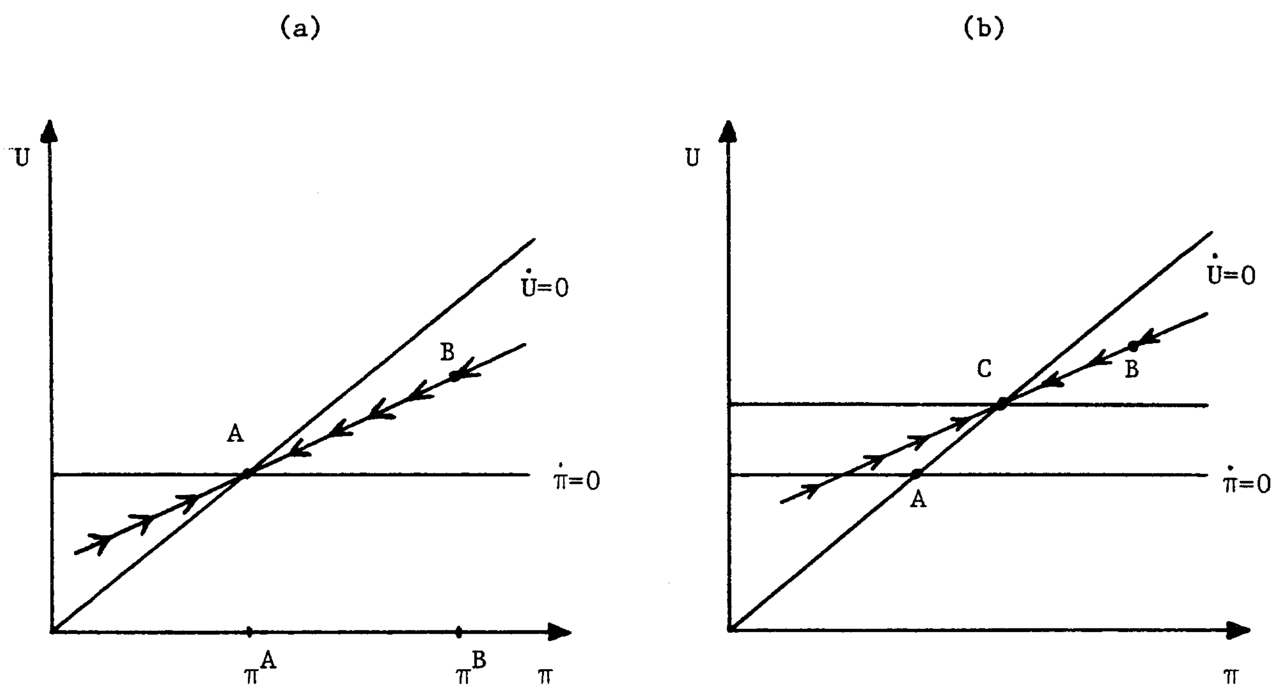


lie on the saddlepoint stable manifold shown by the dotted line.

In the steady-state, at point A, the actual unemployment rate equals the NAIRU, U* (assumed constant), and inflation is positive, at the rate $\pi = \delta U^*/\phi\alpha$. It is interesting that the optimizing policymaker should choose to remain fixed at U* and <u>positive</u> inflation in the long run, even though a better steady state point (U* and zero inflation) is clearly available. The reason that the economy converges to a positive inflation rate is that were the economy to be at $U = U^*$ and $\pi = 0$ it would be advantageous to have a temporary expansion at the cost of a higher permanent inflation! Why? Because at $U=U^*$ and $\pi = 0$, the instantaneous marginal costs of higher inflation are zero and the instantaneous marginal benefits of reduced inflation are positive (this is because inflation is at the bliss point, while unemployment is not). As long as the time discount rate is positive, it always pays to undertake at least some expansion relative to the zero-inflation equilibrium. The result is positive steady-state inflation. Note that the steady state inflation rate is higher the lower is the weight on inflation in the welfare function (α), and the higher is the rate of social time discount (δ).

Using the system in Figure 2 we can investigate the consequences of two types of disturbances. First, in Figure 3a consider the implications of a blip in the inflation rate at $t = 0$, due to some factor (e.g. a temporary oil price shock) that does not raise the long-run NAIRU. In that case, the initial inflation rate moves from the level at point A to the level at point B. The system must adjust along the saddlepoint path, so that unemployment (which is the policy variable), also jumps up at time 0, to the level shown at point B. Over time, both inflation and unemployment return (along the

Figure 3. Dynamics following (a) Transitory and (b) Permanent Supply Shocks



saddlepoint path) to the long-run equilibrium at A. Thus, a one-time price shock that does not raise U* leads to a stagflationary period in which inflation temporarily exceeds its long-run level and unemployment is temporarily greater than U*.

Perhaps more interesting is the case in Figure 3b. Assume now that the inflation shock also raises the NAIRU, along the lines of the union-wage model. Then, the new long-term equilibrium shifts to a point like C. Importantly, the rise in the NAIRU leads to a higher <u>long-run</u> inflation rate as well as a higher long-run unemployment rate, even with optimal policymaking. When U* rises, the gap between the optimum and the equilibrium unemployment rate increases. Policymakers are no longer willing to stop expanding at the previous steady-state inflation rate, since at that point, the marginal discounted benefits of a temporary expansion exceed the marginal costs. This model therefore provides a positive analysis as to why the rise in the NAIRU in Europe was also associated with a significant rise in inflation over the past decade. The answer is not simply bad demand management. Rather, with the NAIRU so high, it has paid for policy makers to try to eke out even a temporary demand expansion for the purposes of keeping U temporarily below U*.

In summary, in the absence of hysteresis, a temporary price shock leads to a temporary stagflationary episode, with prices and unemployment eventually returning to their initial level. A price shock that also raises the NAIRU leads to a stagflationary episode in which both unemployment and inflation remain higher in the steady state.

B. Optimal Policy in the Presence of Hysteresis

Now we return to the major theme of this section: the effects of hysteresis on the optimal policy path of U. Returning to the first-order conditions in (15), differentiate (15)(a), and substitute (15)(b) and (15)(c), and then use (15)(d) and (15)(e), to get the following three dimensional autonomous system (note that U* is now a state variable, by assumption):

$$(17) \quad \begin{bmatrix} \dot{U} \\ \dot{\pi} \\ \dot{U}^* \end{bmatrix} = \begin{bmatrix} \delta+f & -\phi\alpha & 0 \\ -\phi & 0 & \phi \\ f & 0 & -f \end{bmatrix} \begin{bmatrix} U \\ \pi \\ U^* \end{bmatrix}$$

Once again this system is saddlepoint stable, as may be checked by the fact that there is exactly one positive eigenvalue in the transition matrix in (17).[2] There is also one negative eigenvalue and one eigenvalue equal to zero. The zero root means technically that the system will display hysteresis, so that U, U*, and π will not have the tendency to return to an initial steady state even after a transitory perturbation.

To analyze this system I adopt a method suggested first by Dixit (1980). Let the vector $(1, c_{12}, c_{13})$ be the normalized left eigenvalue associated with the positive (unstable) real root in (17). Let r_1 denote that positive real root ($r_1 > 0$ by assumption). Then, it is easy to prove that the actual unemployment rate along the optimal path must equal:

$$(18) \quad U = -c_{12}\pi - c_{13}U^*$$

To find the specific values for c_{12} and c_{13}, note that the left eigenvector must satisfy the following equation:

$$(19)\quad (1 \;\; c_{12} \;\; c_{13}) \begin{bmatrix} \delta+f & -\phi\alpha & 0 \\ -\phi & 0 & \phi \\ f & 0 & -f \end{bmatrix} = (r_1 \;\; r_1c_{12} \;\; r_1c_{13})$$

Therefore, we can easily find that c12 = $-(\phi\alpha/r_1)$, and that $c_{13} = \phi c_{12}/(f+r_1)$. Substituting into (18), we come up with the equation for optimal unemployment policy along the adjustment path. Note that c_{12}, $c_{13} < 0$.

To see the implications of this optimal policy, substitute (18) back into (17), to find a two-dimensional system in U* and π. This system is as follows:

$$(20)\quad \begin{bmatrix} \dot{\pi} \\ \dot{U}^* \end{bmatrix} = \begin{bmatrix} \phi c_{12} & \phi(1+c_{13}) \\ -fc_{12} & -f(1+c_{13}) \end{bmatrix} \begin{bmatrix} \pi \\ U^* \end{bmatrix}$$

Note that given the equation for r_1, it is possible to prove that $c_{13} > -1$.[3] Also, $c_{12} < 0$ and $c_{13} < 0$.

The system in (20) is shown graphically in Figure 4. The loci for $\dot{U}^* = 0$ and $\dot{\pi} = 0$ are the same, as can be verified by direct inspection of (20). The fact that the loci are identical is the implication of having a zero eigenvalue in the original autonomous system. With only one locus defining the equilibrium for both U* and π, it is easy to see that any point on the locus is a stationary point! In this sense, unemployment and inflation will be path dependent. The stationary positions of U* and π, and in fact of U since U=U* in the steady state, are determined by the specific path along which the economy arrives on the stable locus.

Consider, for example, the one-time inflation shock that we analyzed in Figure 3a. Starting from an equilibrium point A in Figure 5a, the economy jumps to point B. In view of the optimal unemployment policy rule given by

Figure 4. Dynamics of the NAIRU and Inflation in the Case of Hysteresis

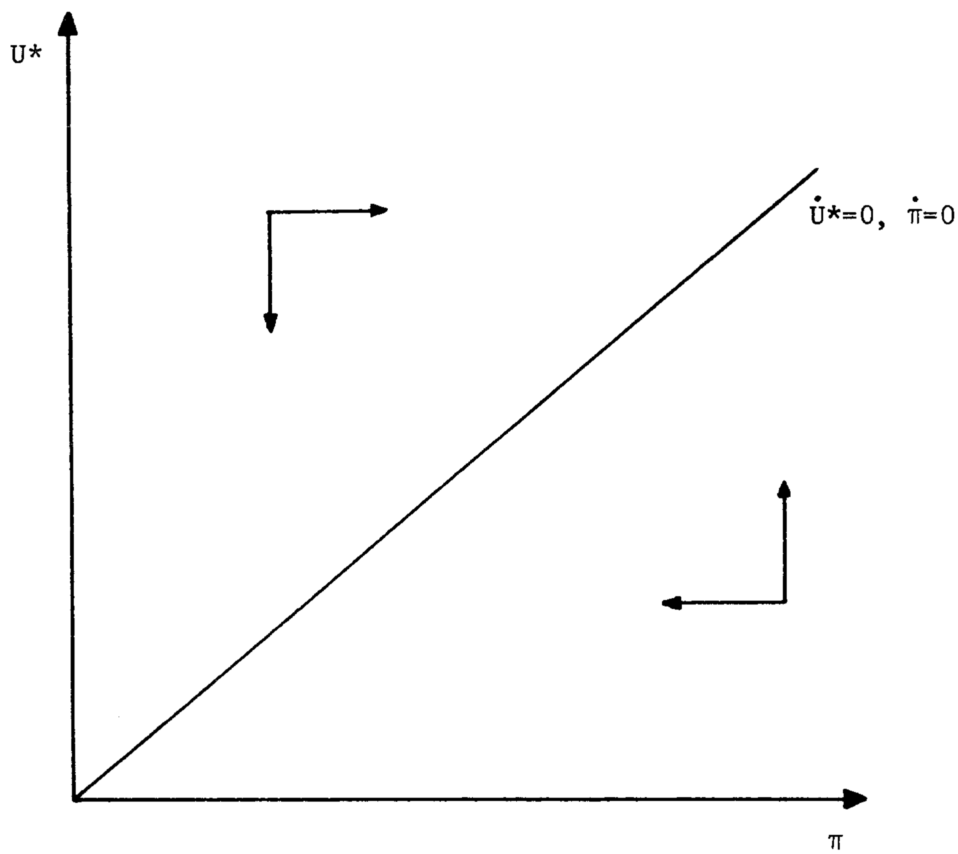
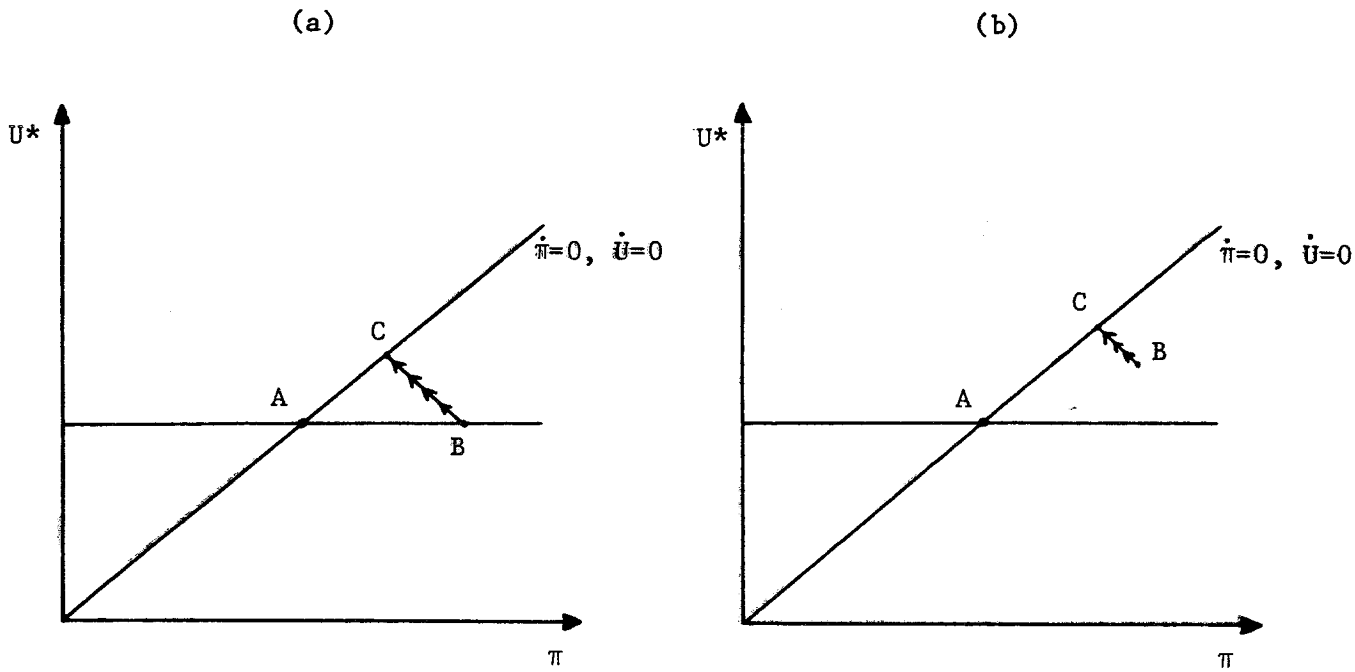


Figure 5. Supply shocks in the Case of Hysteresis

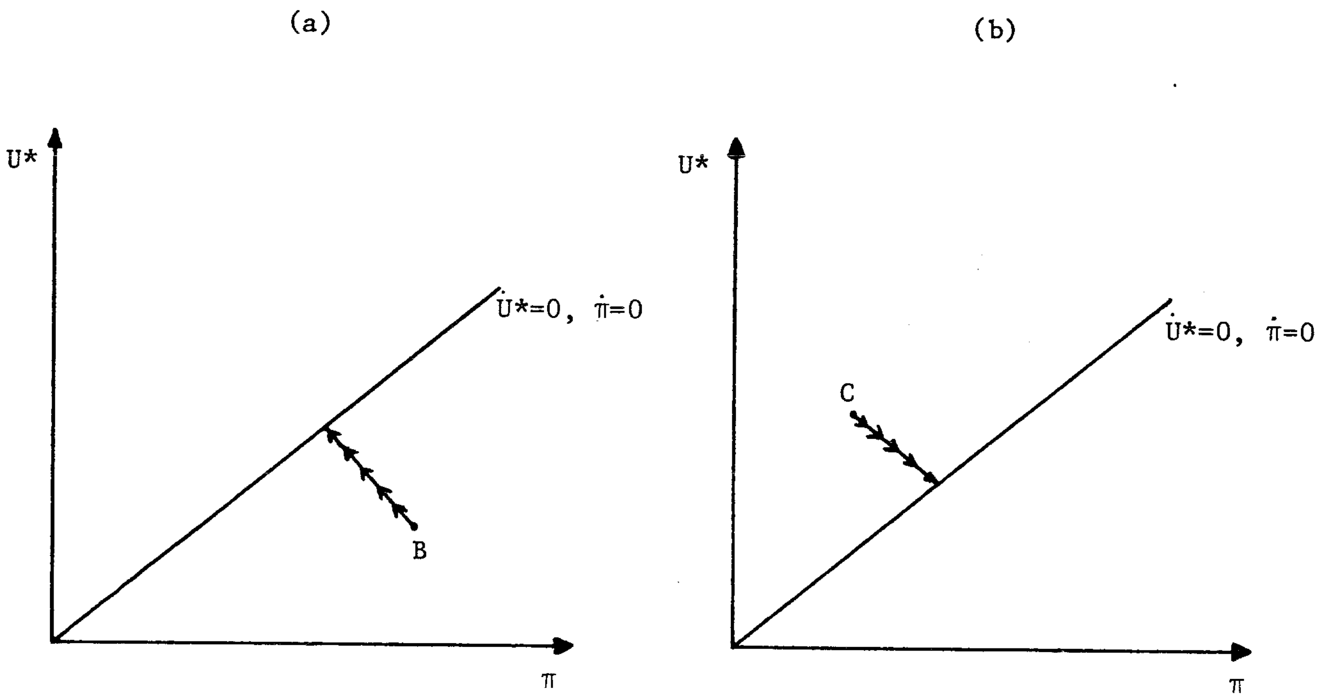


(20), the inflation shock prompts a jump in the unemployment rate. According to the hysteresis assumption, U* begins to rise. The system follows the phase arrows from point B, and arrives at the stable locus at point C. The result is striking: in the present of hysteresis and optimal demand management, a one-time jump in the inflation rate leads to a permanent rise in U*, U and π. Even with optimal policy, the result is a long-run increase in both inflation and unemployment!

In Figure 5b we analyze the case in which the supply shock raises both π and U* on impact. The conclusion is the same, only more so. Again, the shock leads to a permanent increase in unemployment and inflation.

We are now in a position to answer the questions at the beginning of this section. The existence of hysteresis does not necessarily mean that an economy with high inflation and unemployment should necessarily expand. If at the initial condition the inflation rate is high and the unemployment rate is moderate, as in point B in Figure 6, then the optimal path involves rising unemployment and falling inflation. If, on the other hand the initial position is one of low inflation and high U*, as in point C, then an expansion is warranted. Given the inflationary costs of expansion when the initial NAIRU is high, there is no general case for an expansion in the presence of hysteresis. With respect to policy responses to supply shocks, it is clear from the analysis of Figure 5 that unemployment indeed should be used in response to an inflationary shock (of course, if supply-side measures are available they should be used instead), even though the result of the temporary rise in U is a permanent rise in U*.

Figure 6. Conditions for Demand Expansion or Contraction in the Case of Hysteresis



III. Conclusions

High unemployment is the major policy problem confronting the macroeconomic authorities in Europe. The major reason that policymakers in Europe eschew demand expansion in the face of such high unemployment rates is not the belief that a policy expansion would be ineffective in reducing the unemployment rate, but rather the fear that an expansion would rekindle inflation. In the context of standard demand-side models, such fears look foolish. On the other hand, a great deal of recent theoretical and empirical work has shown that the non-inflationary threshold unemployment rate (i.e. the NAIRU) has been rising steadily since the early 1970's. The policymakers are right about demand management: even at today's high unemployment rates, a demand expansion could well re-ignite inflation in many countries. A country-by-country analysis of aggregate supply conditions is necessary in order to determine the scope for a demand expansion.

The theoretical work described in this paper helps us to understand the some of the reasons that the NAIRU has increased. The major theoretical puzzle has always centered on the fact that on the household level, labor supply seems to be fairly inelastic. Household labor market behavior suggests that adverse supply shocks should be willingly absorbed by labor through the mechanism of real wage reductions. However, on the aggregate level, real wage reductions seem to be anything but smooth. The model of union wage determination in the paper emphasizes the point that when individuals (with inelastic labor supplies) bargain for wages through a monopoly union, it is possible, if not likely, that adverse supply shocks will be absorbed in the form of reductions in employment, rather than reductions in the real wage. The union-wage models do not, of course, account for the failure of the non-union sector to absorb smoothly the workers laid off from the union sector. Various regulations may well block the adjustment of the non-union sector. The failure of the non-union sector to grow strongly in most European countries, in contrast to its rapid growth in the United States, should be a prime area of future empirical research.

The empirical work reviewed here has demonstrated several important points in addition to the major finding of a sharp increase in the NAIRU in most European countries. First, the level of unemployment has been importantly affected by movements of the real wage, as is stressed in the union-wage model. This finding is established both in econometric labor demand equations and in estimates of the wage gap. Second, wage setters adjust the real wage only partially, if at all, in response to various supply disturbances, with the implication that the real product wage facing firms is likely to increase when labor taxes or oil prices increase. In this sense, the econometric wage equations confirm that adverse supply shocks tend to open up wage gaps. Third, econometric Phillips curve equations tend to confirm the fact that supply shock variables are in part or in whole responsible for the shifts in the NAIRU in the past decade.

The second section of the paper discusses the implications for demand management of different forms of supply shocks. The major novelty in this section is the study of the hypothesis of hysteresis, in which the NAIRU itself rises endogenously in response to continued slack in the economy. Some have argued that the presence of hysteresis would argue in favor of a demand expansion, because of the secondary benefits of reducing the NAIRU over time. In fact, the existence of hysteresis has subtle implications for demand management. The formal model shows a case in which the optimal demand response to a price shock is to absorb some of the price increase in the form of a recession, even if that results in a permanent increase in the NAIRU.

Footnotes

1. Specifically, from (2), $\pi_t = \pi_t^w + [(a_t+k_t/\beta) - (a_{t-1} + k_{t-1}/\beta)] + (\ell_t-\ell_{t-1})/\beta$. Now, let the change in $a + k/\beta$ be denoted by ψ, and approximate $(\ell_t-\ell_{t-1})/\beta$ by $-\theta(U_t-U_{t-1})$ for an appropriate θ.

2. The characteristic equation of (17) reduces to $r(r^2-\delta r-\phi^2\alpha-f^2-\delta f) = 0$. The three roots of this equation are

$$r_1 = [\delta + (\delta^2+4\phi^2\alpha+rf^2+4\delta f)^{1/2}]/2 > 0$$

$$r_2 = [\delta - (\delta^2+4\phi^2\alpha+4f^2+4\delta f)^{1/2}]/2 < 0$$

$$r_3 = 0$$

3. We want to show that $1 + c_{13} > 0$ or $c_{13} > -1$. To do this, note that $c_{13} = \phi c_{12}/(f+r_1)$ and $c_{12} = -\phi\alpha/r_1$. Combining these expressions, we have $c_{13} = -\phi^2\alpha/[r_1(f+r_1)]$. Thus, $1 + c_{13} = [r_1(f+r_1) - \phi^2\alpha]/[r_1(f+r_1)]$. Since r_1, $f > 0$, we see that $\text{sign}(1+c_{13}) = \text{sign}[r_1(f+r_1) - \phi^2\alpha]$. To show that $[r_1(f+r_1) - \phi^2\alpha] < 0$, we show first that $r_1^2 > \phi^2\alpha$. This in turn implies $[r_1(f+r_1) - \phi^2\alpha] > 0$ and therefore $1 + c_{13} > 0$. To prove $r_1^2 > \phi^2\alpha$, consider again the characteristic equation of (17), in footnote 3. We see that r_1 satisfies the equation $r_1^2 - \delta r_1 - \phi^2\alpha - f^2 - \delta f = 0$, so that $r_1^2 - \phi^2\alpha = \delta r_1 + f^2 + \delta f > 0$ (the inequality follows from the fact that r_1, δ, $f > 0$). This is what we needed to demonstrate.

References

Artus, J.R. (1984), "The Disequilibrium Real Wage Hypothesis - An Empirical Evaluation", IMF Staff Papers 31, 249.

Beenstock, M., P. Warburton, P. Lewington, T. Macromatis (1983), "A Medium Term Macroeconometric Model of the U.K. Economy 1950-82", City University, mimeo.

Blanchard, O. et al. (1985), "Employment and Growth in Europe: A Two-Handed Approach", Centre for European Policy Studies Paper.

Black, S.W. (1984), "Learning from Adversity - Policy responses to two Shock in Oil Prices", Lurcy Inaugural Lecture.

Bruno, M. and J.D. Sachs (1981), "Supply Vs. Demand Approaches to the Problem of Stagflation," in Macroeconomic Policies for Growth and Stability, ed. H. Giersch, Mohr, Tübingen.

Bruno, M. (1985), "Aggregate Supply and Demand Factors in OECD Unemployment: An Update," Paper presented at the Conference on the Rise in Unemployment, Sussex (revised August '85).

Bruno, M. and J.D. Sachs (1985), Economics of Worldwide Stagflation, Harvard University Press.

Calmfors, L. (1984), "The Roles of Stabilization Policy and Wage Setting for the Achievement of Macroeconomic Targets", Paper presented at the Second Colloquium of the EEA, Frankfurt.

Coe, D., F. Gagliardi (1985), "Nominal Wage Determination in Ten OECD Economies", OECD Working Paper no. 19.

Dixit, A. (1980), "A Solution Technique for Rational Expectations Models with

Applications to Exchange Rate and Interest Rate Determination," unpublished, Princeton University.

Friedman, M. (1968), "The Roles of Monetary Policy," American Economic Review 58(1), 1-17.

Gordon, R. (1977), "World Inflation and the Sources of Monetary Accommodation: A Study of Eight Countries," Brookings Papers on Economic Activity 8(2), 409-468.

Gordon, R.J. (1985), "Wage Price Dynamics and the Manufacturing Output Gap in Europe, Japan and North America", Paper for presentation at the Conference on Unemployment, Yxtaholm, Sweden.

Grossman, G. (1984), "International Competition and the Unionized Sector," Canadian Journal of Economics 17(3), August.

Grubb, D., R. Jackman, R. Layard (1982), "Causes of Current Stagflation", Review of Economic Studies, 49, 707.

Grubb, D., R. Jackman, R. Layard (1983), "Wage Rigidity and Unemployment in OECD Countries", European Economic Review, 21, 11.

Grubb, D., R. Layard, J. Symons (1984), "Wages, Unemployment and Incomes Policy", in M. Emerson, ed., Europe's Stagflation, Oxford University Press.

Hargraves Heap, S.P. (1980), "Choosing the Wrong 'Natural' Rate: Accelerating Inflation or Decelerating Employment and Growth?" The Economic Journal 90.

Knoester, A. (1983), "Stagnation and the Inverted Haavelmo Effect: Some International Evidence", De Economist, 131, 548.

Knoester, A., N. van der Windt (1985), "Real Wages and Taxation in Ten OECD Countries", Erasmus University Discussion Paper 8501/GM.

Lawrence, C. and R. Lawrence (1985), "Manufacturing Wage Dispersion: An End Game Interpretation," Brookings Papers on Economic Activity 1, 47-116.

Layard, R., G. Basevi, et al. (1984), "Europe: The Case for Unsustainable Growth," Centre for European Policy Studies Paper No. 8/9.

Layard, R., S. Nickell (1984), "The Causes of British Unemployment", LSE Working Paper no.642.

McDonald, I.M. and R. Solow (1981), "Wage Bargaining and Employment," American Economic Review, December.

Minford, P. (1983), Unemployment: Cause and Cure, Martin Robertson, Oxford.

Newell, A., J. Symons (1985), "Wages and Unemployment in the OECD Countries", LSE Discussion Paper no.215.

Nickell, S. (1984), "A Review of 'Unemployment: Cause asnd Cure, by P. Minford," Economic Journal, December.

Nickell, S., M. Andrews (1983), "Unions, Real Wages and Employment in Britain 1951 - 79", Oxford Economic Papers, Nov.

Perry, G. (1975), "Determinants of Wage Inflation Around the World," Brookings Papers on Economic Activity 6(2), 403-435.

Sachs, J.D. (1979), "Wages, Profits, and Macroeconomic Adjustment: A Comparative Study," Brookings Papers on Economic Activity, 1979:2, 269.

Sachs, J.D. (1983a), "Real Wages and Unemployment in the OECD Countries," Brookings Papers on Economic Activity, 1983:1.

Sachs, J.D. (1983b), "Comment: The Economic Consequences of Mrs. Thatcher (Buiter and Miller)," Brookings Papers on Economic Activity, 1983:2.

Sachs, J. and C. Wyplosz (1985), "Mitterand's Economic Policies," presented at the Economic Policy Conference, November 1985, and forthcoming in

Economic Policy, 1986.

Symons, J. (1985), "Relative Prices and the Demand for Labour in British Manufacturing," Economica, February.

Symons, J. and R. Layard (1984), "Neo-Classical Demand for Labour Functions for Six Major Economies," Economic Journal, December.

Tobin, J. (1984), "Unemployment in the 1980s: Macroeconomic Diagnosis and Prescription," in Andrew J. Pierre, ed., Unemployment and Growth in the Western Economies, Council on Foreign Relations, New York.