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## DISCUSSION PAPER SERIES

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### EXPLAINING DISPARITIES IN UNEMPLOYMENT DYNAMICS

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## ABSTRACT

### Explaining Disparities in Unemployment Dynamics\*

This paper attempts to explain disparities among the unemployment experiences of different OECD countries in terms of the 'fragility' of the short-run unemployment equilibrium (the impact of labour market shocks on the short-run unemployment rate) and the lag structure of the employment determination, wage setting, and labour force participation decisions. The effects of this lag structure on unemployment dynamics are captured through two general measures of 'unemployment persistence' (occurring when temporary shocks have prolonged effects on unemployment) and 'imperfect unemployment responsiveness' (occurring when permanent shocks have a delayed effect on unemployment).

JEL classification: E32, J31, J32, J64

Keywords: unemployment, labour market dynamics, employment, wage determination, labour force participation

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## NON-TECHNICAL SUMMARY

This paper aims to explain disparities among the unemployment experiences of different OECD countries in terms of two interrelated phenomena: (i) the ‘fragility’ of the short-run employment equilibrium, which we measure by the impact of labour demand shocks on the short-run equilibrium unemployment rate; and (ii) the way in which lags in the process of employment determination, wage setting, and labour force participation allow labour demand shocks to have a prolonged effect on unemployment.

The underlying hypothesis is that an important element of the differences in the unemployment experiences among OECD countries over the past two decades is attributable to differences in lag structures. Specifically, countries that differ in terms of labour turnover costs are likely to differ in terms of the way lagged employment affects current employment and current wages. Differences in union membership rules may be expected to result in differences in the way past union membership affects current wages. Differences in wage bargaining procedures may give rise to significant differences in the degree of wage staggering and thereby influence the way lagged wages affect current wage determination. Differences in unemployment benefit systems are bound to affect the search intensities of the long-term unemployed and thereby influence the way lagged unemployment affects current wages. Differences in other Welfare State provisions will influence people’s propensity to drop out of the labour force and thus affect the current participation rate. Clearly, this list could be extended considerably.

The empirical part of the paper shows that there are significant differences in these lagged effects in Germany, Spain, the United Kingdom and the United States, and that they play an important part in explaining why these countries have responded so differently to the global recessions of the past two decades. Our analysis attempts to capture important features of unemployment dynamics through two concepts: (i) *unemployment persistence*, which occurs when a temporary labour demand shock has prolonged effects on unemployment; and (ii) *imperfect unemployment responsiveness*, which occurs when a permanent labour demand shock has delayed effects on unemployment. Positive unemployment persistence arises when a temporary drop in labour demand continues to raise unemployment after the shock has disappeared. Unemployment is ‘under-responsive’ when there is inertia and ‘over-responsive’ when there is over-shooting.

The degree of unemployment fragility affects the unemployment dynamics. The greater the degree of unemployment fragility, the more a current drop in labour demand reduces current employment and increases current unemployment. But since current employment and unemployment affect future employment and real

wages via the lagged effects described above, the degree of fragility also has a clear bearing on the degree of unemployment persistence and imperfect unemployment responsiveness.

*Unemployment persistence* has received much attention in the macro literature in the past, but thus far we have had no sufficiently general measures of it to permit us to compare how labour market systems with different dynamic structures respond to temporary shocks. Although *imperfect responsiveness* of unemployment has received far less attention in the literature, we maintain that it is no less important than unemployment persistence. There is no evidence that labour market shocks are predominantly temporary, rather than permanent, and it is vital to explore the degree to which labour market systems respond differently to temporary and permanent shocks.

Being able to compare unemployment persistence and imperfect responsiveness across different dynamic systems is important because, as our empirical estimates suggest, countries differ dramatically in terms of the lag structures characterizing their labour markets. Whereas the labour market experiences of Germany, Spain, and the United Kingdom have been superficially similar in the sense that unemployment in all these countries has been slow to recover from the global recessions of the past two decades, our analysis suggests that the lags responsible for the slow recoveries differ substantially from country to country.

This implies that different countries may require quite different unemployment policies to overcome what, on the surface, looks like the same unemployment problem. Through changes in job security legislation, wage subsidies to the long-term unemployed, and so on, policy-makers are able to influence the lagged effects operative in the employment, wage setting, and labour force participation decisions. In so far as the lags underlying unemployment persistence and imperfect responsiveness differ from one country to another, different policy approaches may be needed to improve the resilience of these countries' labour markets. A first step towards identifying the required policy differences would be to measure the degree to which each of the different lagged effects contribute to unemployment persistence and imperfect responsiveness. This is the subject of another paper (see Karanassou and Snower (1993)).

Beyond that, our empirical results indicate that countries where unemployment responds relatively sluggishly to temporary shocks need not be ones where unemployment also reacts sluggishly to permanent shocks. Our empirical results indicate that whereas Spain, the United Kingdom, and the United States are characterized by positive persistence and under-responsiveness, Germany features positive persistence and over-responsiveness. Whereas Spain displays more unemployment persistence than the United Kingdom, UK unemployment is more under-responsive than Spanish unemployment. In the aftermath of a

temporary shock, it takes UK unemployment a shorter time to reach its long-run equilibrium than German unemployment, but in the aftermath of a permanent shock, the opposite holds. A glance at the German and UK unemployment rates over the past two decades reveals that both have recovered slowly from global recessions; our analysis indicates, however, that the reason why each did so may be quite different. This suggests that the relative unemployment performance of different countries depends importantly on the degree to which their labour market shocks are temporary or permanent.

# EXPLAINING DISPARITIES IN UNEMPLOYMENT DYNAMICS

by Marika Karanassou\* and Dennis J. Snower\*

## 1. Introduction

It is difficult, if not impossible, for the standard Keynesian and neoclassical macroeconomic models to explain the vastly different unemployment experiences of OECD countries over the past two decades. The dominant macro theories have failed us in this regard, and it is important to be aware of how far-reaching this failure has been.

From the traditional Keynesian perspective, the source of unemployment lies in the product market. A fall in product demand leads to a fall in labor demand via an intermarket spillover that arises when wages and prices are sticky. Alternatively, when prices are more flexible than wages, a fall in product demand leads to a fall in the price level relative to the wage level, and the resulting rise in the real wage leads to a fall in labor demand. In either case the product and labor market activities are firmly coupled to one another. This vision is starkly at variance with what happened in the 1980s. In most European countries, the recession of the early 1980s lasted much longer in labor than in product markets. Product demand grew at robust rates throughout much of Europe after 1982, but many European labor markets continued to stagnate for four to six years later. In short, Europe experienced a "decoupling" of product and labor markets, quite at variance with Keynesian thinking. This decoupling was far more pronounced in the EC countries than in the EFTA or the US. Whereas the Keynesian theory would lead us to expect that the close relation between product demand and unemployment would be most pronounced in countries with particularly sluggish wages and prices, it is

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impossible to argue that the EFTA and the US economies are characterized by far more wage-price inertia than the EC.

From the New Classical Macro perspective, variations in unemployment can be attributed to (i) variations in the natural rate of unemployment due to, say, demographic changes, changes in minimum wages, and supply-side impediments to labor market activity or (ii) deviations of unemployment from its natural rate due to errors in price expectations or intertemporal substitution. This approach looked quite plausible in the late 1960s and the 1970s, when the rising unemployment seemed closely related to the influx of women into the labor force, the rise in union militancy, the increasing stringency of job security legislation, and the surge of state involvement in product markets. The appearance of sustained, high inflation in the aftermath of the Vietnam war - an unprecedented occurrence in much of the postwar OECD - could also perhaps be identified as a source of expectational errors and intertemporal substitution.

This however ceased to be a compelling diagnosis in the 1980s. After the oil price shock of 1979 and the contractionary fiscal and monetary policies of the early 1980s, inflation declined and then stabilized over much of the rest of the decade, leaving precious little latitude for mistaken inflationary expectations or intertemporal substitution. Thus it was difficult to argue that the rising unemployment of the 1980s was due to a substantial increase in unemployment over its natural rate. Nor could it be blamed on a sustained rise in the natural rate itself. For, with the Conservative Revolution of this period came a break-up of supply-side impediments in labor and product markets; deregulation, privatization, and retrenchment in job security legislation were common in many European countries. Union density was no longer on the rise and the demographic changes of the 1960s and 70s were no longer strongly in evidence. Thus it was hard to see where the rise in the natural rate should have come from.

Out of the consequent dissatisfaction with the Keynesian and classical



explanations of unemployment has grown a renewed interest in the way lags in the process of employment determination, wage setting, and labor force participation allow labor market shocks to have a prolonged effect on unemployment. The underlying hypothesis is that an important part of the differences in the unemployment experiences among OECD countries over the past two decades is attributable to differences in lag structures. Specifically, countries that differ in terms of the labor turnover costs are likely to differ in terms of the way lagged employment affects current employment and current wages. Differences in union membership rules may be expected to result in differences in the way past union membership affects current wages. Differences in wage bargaining procedures may give rise to significant differences in the degree of wage staggering and thereby influence the way lagged wages affect current wage determination. Differences in unemployment benefit systems are bound to affect the search intensities of the long-term unemployed and thereby influence the way lagged unemployment affects current wages. Differences in other Welfare State provisions will influence people's propensity to drop out of the labor force and their eagerness to reenter and thereby influence the way in which the lagged labor force affects the current participation rate. Clearly, this list could be extended considerably.

The upshot of this line of thinking is that if there are important inter-country differences in these lagged effects and if these effects play a significant role in explaining a country's unemployment dynamics, then they may also have an important role in explaining why different countries, facing similar labor market shocks in the course of a global recession, should have such different unemployment experiences. This is the issue that motivates this paper.

(a) why temporary labor market shocks (such as the supply-side shocks of the mid-1970s and early 1980s) had such prolonged effects on unemployment and

(b) why longer-term labor market shocks (such as the disinflationary macro policies of the early 1980s and possibly also the early 1990s) have such delayed effects on unemployment.

Thus far, the prolonged effects of temporary labor market shocks have received much more attention in the macro literature than the delayed effects of permanent shocks. Many economists, following Blanchard and Summers (1986), have argued that European labor markets are characterized by hysteresis, whereby temporary shocks have *permanent* unemployment effects, so that the unemployment tends to get stuck at whatever it happens to be at the moment. This view, however, flies in the face of a widely recognized empirical phenomenon: although unemployment rates may be high (say, over 15%) for limited periods of time, they tend to return within a narrow band, lying between 2% and 8% in most OECD countries. In the presence of hysteresis and random labor market shocks there could be no such tendency. For this reason, models in which temporary shocks have *prolonged* effects appear more plausible than those in which they have permanent effects.

There is certainly no reason to believe, however, that all the significant labor market shocks experienced in the OECD over the past two decades have been temporary (lasting, say, a year). Longer-term shocks, particularly those associated with demand management and supply-side policy swings, have no doubt played an important role as well. The interesting issue regarding permanent shocks is not whether they have permanent effects on unemployment - for permanent supply-side shocks, such as deregulation or changes in union legislation, generally do have such effects - but rather why these effects take such a long time to manifest themselves. This phenomenon could take two different forms: On the one hand, unemployment may be said to display "inertia" when a permanent shock has a smaller effect on unemployment in the short run than in the long run (so that, in the aftermath of a permanent shock that raises the long-run unemployment rate, the short-run unemployment rate remains beneath the long-run one in the transition period. On the other hand, there is unemployment "over-shooting" when the short-run effect is greater than the long-run one.

In this paper we attempt to capture these various features of unemployment dynamics, through two concepts:

(1) "*unemployment persistence*" occurs when a temporary labor demand shock has prolonged effects on unemployment and

(2) "*imperfect unemployment responsiveness*" occurs when a permanent labor demand shock has delayed effects on unemployment.

Positive unemployment persistence arises when a temporary drop in labor demand continues to raise unemployment after the shock has disappeared. Unemployment is "under-responsive" when there is inertia and "over-responsive" when there is over-shooting.

Clearly, however, the dynamic unemployment responses to temporary and permanent shocks leave a dramatic feature of the unemployment experience of many OECD countries over the past two decades unexplained, namely, the rapid rise in unemployment in the onset of global recessions. Many economists have observed that a moderate drop in labor demand often has a large impact on unemployment in the short run. Let us refer to this feature as the "*fragility*" of the short-run unemployment equilibrium. The greater the effect of a labor demand shock in period  $t$  on equilibrium unemployment in that period, the more fragile is equilibrium unemployment. This concept is closely related to its namesake in Blanchard and Summers (1988).<sup>1</sup>

The degree of unemployment fragility obviously affects the unemployment dynamics. The greater is the degree of unemployment fragility, the more a current drop in labor demand reduces current employment and increases current unemployment. But since current employment and unemployment affect future employment and real wages via the lagged effects mentioned above, the degree of fragility also has a clear bearing on the degree of unemployment persistence and imperfect responsiveness.

This paper takes a first step toward tracing the interrelations among the fragility, persistence, and imperfect responsiveness of unemployment and provides

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<sup>1</sup>In Blanchard and Summers (1988) the equilibrium is fragile in the sense that once the labor market has been perturbed from such an equilibrium, it has little - if any - tendency to return to it. Under various well-known specifications of labor market dynamics, the more sensitive is the equilibrium to labor demand shocks, the longer it takes the labor market to reach its equilibrium after such shocks. See, for example, the analysis in the next section.

empirical measures of these phenomena. Section 2 sets out a simple analytical framework for studying these phenomena. Section 3 presents general measures of unemployment persistence and imperfect responsiveness. Section 4 contains an empirical analysis of fragility, persistence, and imperfect responsiveness in Germany, the UK, and the US. Section 5 concludes.

## 2. Some Simple Analytics

The simplest way to represent unemployment fragility is to consider the following labor market system:

$$\text{labor demand equation: } n_t = a_0 + a_1 \cdot w_t \quad (1a)$$

$$\text{wage setting equation: } w_t = b_0 + b_1 \cdot n_t \quad (1b)$$

$$\text{labor force equation: } l_t = l \quad (1c)$$

where  $n_t$  is aggregate employment,  $w_t$  is the real wage, and  $l_t$  is the aggregate labor force (all in logs). Let equation (1a) be the short-run labor demand curve, representing the condition that the real marginal revenue product of labor is equal to the real wage. The curve is downward-sloping under full capacity and diminishing returns to labor, but it may be flat or even upward-sloping under excess capital capacity.<sup>2</sup> Equation (1b) could be interpreted as the real wage that emerges from an implicit or explicit nominal wage bargain between employers and their employees, at any given level of employment, taking employers' price responses to the negotiated wages into account. The equilibrium real wage and employment is given by the intersection of these labor demand and wage setting curves. The difference between the labor force and employment at the equilibrium real wage is the short-run equilibrium level of unemployment. Approximating

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<sup>2</sup>See Lindbeck and Snower (1993) and Karanassou and Snower (1993).

the level of unemployment by  $U_i \approx l_i - n_i$ , equilibrium unemployment is

$$U_i = l - \frac{a_0 + a_1 \cdot b_0}{1 - a_1 \cdot b_1} \quad (2)$$

We define the fragility unemployment in terms of the effect of an exogenous shift in the labor demand curve on equilibrium unemployment:

$$\rho = - \frac{\partial U_i}{\partial a_0} = \frac{l}{1 - a_1 \cdot b_1} \quad (3)$$

The larger is  $\rho$ , the more fragile is the unemployment equilibrium.

To explore the relation of unemployment fragility to the persistence and responsiveness of unemployment, we need to introduce lagged endogenous variables into the equation system (1a)-(1c). For brevity, we do not consider the microeconomic foundations for these lags; this has been done in detail elsewhere in the literature,<sup>3</sup> which has highlighted a number of particularly important lags operating on the labor demand, wage setting, and labor force participation decisions. Our next step, rather, is to examine how each of these lags - considered in isolation - interacts with the degree of labor market fragility to produce unemployment persistence and responsiveness.

For expositional simplicity, we will give names to the various sets of lags, suggesting some underlying rationales:

- (1) lagged employment terms in the labor demand equation will be called the "*employment adjustment effect*", since firms' employment adjustment costs often make current labor demand depend on past employment;<sup>4</sup>
- (2) lagged employment terms in the wage setting equation will be called the "*insider membership effect*", since the size of firms' insider workforces may influence the insiders' objectives in the wage setting process;

<sup>3</sup>References are given below.

<sup>4</sup>See, for example, Nickell (1978).

(3) lagged real wage terms in the wage setting equation will be called the "*wage staggering effect*", since staggered wage setting makes current real wages depend on their past values;<sup>5</sup>

(4) lagged unemployment terms in the wage setting equation will be called the "*long-term unemployment effect*", since the long-term unemployed may search less intensively for jobs and thus have less influence on the wage setting process than the short-term unemployed;<sup>6</sup> and

(5) lagged labor force terms in the labor force equation will be called the "*labor force adjustment effect*", since costs of entry to and exit from the labor force often make the current labor force depend on its past magnitudes.

Clearly, there is no presumption that these rationales provide a comprehensive explanation of the associated lags; to the contrary, it is not difficult to think of other, perhaps equally important, explanations for each of the lags. Our nomenclature is no more than an expositional device. Furthermore, these are not of course the only lags that occur in the labor demand, wage setting, and labor force equations, but they are particularly important both in the empirical and theoretical literature, so that it makes sense to focus our attention on them.

The simplest way of illustrating the *employment adjustment effect* is to include lagged employment in the labor demand equation (1a):

$$n_t = a_0 + a_1 \cdot w_t + a_2 \cdot n_{t-1} \quad (4)$$

Solving the system (4), (1b), and (1c), we obtain the following unemployment dynamics equation:

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<sup>5</sup>See, for example, Taylor (1979). If there is staggered price setting as well, the lag structure can no longer be explained exclusively in terms of lagged *real* wages. See Blanchard (1986).

<sup>6</sup>See, for example, Bean and Layard (1988).

$$u_t = A_0 + A_1 \cdot u_{t-1} \quad (5)$$

where

$$A_0 = \left[ (1 - a_1 \cdot b_1 - a_2) \cdot l - a_0 - a_1 \cdot b_0 \right] \text{ and } A_1 = a_2 \cdot \rho \quad (5a)$$

To ensure stability, we assume that  $0 \leq A_1 \leq 1$ .

In this first-order difference equation, the coefficient  $A_1$  determines the degree of unemployment persistence as well as the degree of imperfect responsiveness. Consider a temporary negative labor demand shock occurring only in period  $t=0$ ,  $da_0 < 0$ , which corresponds to a temporary positive shock to the unemployment dynamics equation:  $dA_0 > 0$  in  $t=0$ . Clearly, in the initial period,  $du_0 = dA_0$ , and since the shock disappears thereafter,  $du_1 = A_1 \cdot du_0 = A_1 \cdot dA_0$ ,  $du_2 = A_1^2 \cdot dA_0$ , and so on. In general, the effect of the temporary shock on unemployment is  $du_t = A_1^t \cdot dA_0$ . Thus, the greater the coefficient  $A_1$ , the greater is the degree to which the temporary shock persists.

Now consider a permanent shock:  $dA_0 > 0$  for  $t \geq 0$ . The long-run unemployment level before the shock is  $\bar{u}_t = \bar{u} = A_0 / (1 - A_1)$ . In the first period after the shock,  $du_1 = dA_0$ , and since the shock is permanent,  $du_2 = dA_0 + A_1 \cdot du_1 = (1 + A_1) \cdot dA_0$ ,  $du_3 = dA_0 + A_1 \cdot du_2 = (1 + A_1 + A_1^2) \cdot dA_0$ , and so on. In general, the effect of the permanent shock on unemployment is  $du_t = \frac{1 - A_1^{t+1}}{1 - A_1} \cdot dA_0$ . The effect on the long-run unemployment level is  $\bar{du} = \frac{1}{1 - A_1} \cdot dA_0$ . If unemployment were perfectly responsive, the full effects of the permanent shock would manifest themselves immediately so that  $du_t$  would be equal to  $\bar{du}$ .

When  $A_1 > 0$ , however, the full effects are delayed, so that  $du_t - \bar{du} = -\frac{A_1^t}{1 - A_1} \cdot dA_0 < 0$ .

Here unemployment is "under-responsive" in the sense that unemployment displays inertia in response to the permanent shock. The greater the coefficient  $A_1$ , the greater is the degree of under-responsiveness.

*Proposition 1: For the first-order unemployment dynamics equation (5), unemployment persistence and imperfect responsiveness are firmly related: the more persistent are the unemployment effects of a temporary shock, the more under-responsive is unemployment to a permanent shock.*

Equation (5a) shows that when the employment adjustment effect above is responsible for the unemployment dynamics, then the fragility of the unemployment equilibrium gives leverage to the degree of unemployment persistence and under-responsiveness. The reason is straightforward. The greater the fragility coefficient  $\rho$ , the greater is the effect of a current positive labor demand shock on current employment. Due to the employment adjustment effect, the greater is the rise in current employment, the greater will be the resulting rise in future employment. Thus, if the shock is temporary, the more persistent will be its effect on employment and (since the labor force is constant) also on unemployment. If the shock is permanent, the longer it will take for the entire long-term effect to appear.

Along the same lines, it is easy to examine the effect of fragility on persistence and imperfect responsiveness with respect to the other major sources of unemployment dynamics. Turning to the *insider membership effect*, this may be positive or negative, depending on the relative strength of two countervailing influences: (i) For any given distribution of labor demand shocks, the smaller is the insider workforce of a firm, the greater will be the insiders' job security at any given real wage, and consequently the higher the negotiated wage will be.<sup>7</sup> (ii) The smaller is the insider workforce, the smaller will be the bargaining power of the insiders (because, for example, the weaker are the threats that the insiders make to the firms in case of bargaining disagreement), and therefore the lower the negotiated wage will be.<sup>8</sup> If the

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<sup>7</sup>See, for example, Blanchard and Summers (1986) and Lindbeck and Snower (1987a).

<sup>8</sup>See, for example, Lindbeck and Snower (1987b).



size of the current insider workforce depends on past employment, the negotiated wage will depend on past employment as well.<sup>9</sup> The simplest way of illustrating the insider membership effect is to include lagged employment in the wage setting equation (1b):

$$w_t = b_0 + b_1 \cdot n_t + b_2 \cdot n_{t-1} \quad (6)$$

Solving the system (1a), (6), and (1c) again yields an unemployment dynamics equation of the form (5) with slope

$$A_1 = a_1 \cdot b_2 \cdot \rho \quad (6a)$$

where both  $a_1$  and  $b_2$  could be either positive or negative. If the job security effect dominates ( $b_2 < 0$ ) and the labor demand curve is downward-sloping ( $a < 0$ ), or if the bargaining power effect dominates ( $b_2 > 0$ ) and the labor demand curve is upward-sloping, then current unemployment depends positively on lagged unemployment. Here, as in the previous case, unemployment displays positive persistence and under-responsiveness. On the other hand, if the bargaining power effect dominates ( $b_2 < 0$ ) and the labor demand curve is downward-sloping ( $a < 0$ ), or if the job security effect dominates ( $b_2 < 0$ ) and the labor demand curve is upward-sloping ( $a < 0$ ), then there is negative unemployment persistence and over-responsiveness. In either case, however, the more fragile is the unemployment equilibrium, the more leverage the insider membership effect has on the degree of unemployment persistence and imperfect responsiveness.

To illustrate the isolated influence of the *wage staggering effect* on unemployment persistence and imperfect unemployment responsiveness, we include a lagged wage term in the wage setting equation (1b):

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<sup>9</sup>This is of course not the only reason why the negotiated wage may depend on past employment. Employment adjustment costs may be responsible as well, since firms' objectives in wage negotiations will then depend on their past employment levels.

$$w_t = b_0 + b_1 \cdot n_t + b_3 \cdot w_{t-1} \quad (7)$$

By (1a), (8), and (1c), we then obtain an unemployment dynamics equation with slope

$$A_1 = b_3 \cdot \rho \quad (7a)$$

Here, once again, the fragility of the unemployment equilibrium gives leverage to the persistence and under-responsiveness of unemployment arising from this wage staggering effect.

The simplest way of viewing the *long-term unemployment effect* is to suppose that the greater is last period's unemployment, *ceteris paribus*, the larger is the pool of the long-term unemployed, and the smaller is the number of workers competing for the vacant jobs, and consequently the higher will be the negotiated real wage. The isolated influence of this effect on unemployment persistence and imperfect responsiveness may be illustrated by transforming the wage setting equation (1b) as follows:<sup>10</sup>

$$w_t = b_0 + b_1 \cdot n_t + b_4 \cdot (u_{t-1} - l) \quad (8)$$

and, by (1a), (8), and (1c), deriving the slope of the corresponding unemployment dynamics equation:

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<sup>10</sup>To motivate this wage setting equation, suppose that  $\theta \cdot (U_t/L)$  is the probability of finding a job in the current period, where  $U_t$  is the level of unemployment (not in logs),  $L$  is the labor force (also not in logs), and  $\theta$  is a constant ( $0 < \theta \leq 1$ ). Then the number of long-term unemployed is  $U_t^{\text{LT}} = \hat{\theta} \cdot (U_t/L) \cdot U_{t-1}$ , and in logs  $u_t^{\text{LT}} = \theta + u_t - l + u_{t-1}$ . If the wage setting function takes the form  $w_t = \hat{b} + b_1 \cdot n_t - b_4 \cdot (u_{t-1} - u_t)$ , it may be rewritten in the form  $w_t = b_0 + b_1 \cdot n_t - b_4 \cdot (u_{t-1} - l)$ , with  $b_0 = \hat{b} + b_4 \cdot \theta$ .

$$A_1 = -a_1 \cdot b_4 \cdot \rho \quad (8a)$$

How the long-term unemployment effect influences unemployment persistence and imperfect responsiveness depends on the slope of the labor demand curve and the degree of fragility of the unemployment equilibrium. When the labor demand curve is downward-sloping, there is positive persistence and under-responsiveness; when it is upward-sloping, there is negative persistence and over-responsiveness. The degree of fragility amplifies this effect, whichever direction it goes.

Finally, the simplest form of the *labor force adjustment effect* is described by the following modification of the labor force equation (1c):

$$l_t = c_0 + c_1 \cdot l_{t-1} \quad (9)$$

By (1a), (1b), and (9), the slope of the resulting unemployment dynamics equation is

$$A_1 = c_1 \quad (9a)$$

which is clearly independent of the degree of labor market fragility.

In short, the way in which the degree of fragility affects the strength of each source of unemployment persistence and imperfect responsiveness may be summarized as follows:

*Proposition 2: The greater the degree of labor market fragility ( $\rho$ ), ceteris paribus, the greater is the leverage of*

- the employment adjustment cost effect ( $a_2$ ),
- the insider membership effect ( $b_2$ ),
- the staggered wage setting effect ( $b_3$ ), and
- the long-term unemployment effect ( $b_4$ ),

*each considered in isolation, on unemployment persistence and responsiveness.*

### 3. Measuring Persistence and Imperfect Responsiveness of Unemployment

In the previous section we have seen that, when the dynamics of unemployment can be represented by a first-order difference equation, such as equation (5), the coefficient  $A_1 = (\partial U_t / \partial U_{t-1})$  can serve as measure of both unemployment persistence and imperfect responsiveness. But this is a special case. When more than one of the lags in the determination of employment, wages, and labor force participation are operative at the same time, the resulting unemployment dynamics will be of higher order and will require more general measures of unemployment persistence and imperfect responsiveness. We now proceed to present such measures.

If we extend our system of labor market equations to include all the lags discussed in the previous section, we obtain

$$n_t = a_0 + a_1 \cdot w_t + a_2 \cdot n_{t-1} \quad (10a)$$

$$w_t = b_0 + b_1 \cdot n_t + b_2 \cdot n_{t-1} + b_3 \cdot w_{t-1} + b_4 \cdot (u_{t-1} - D) \quad (10b)$$

$$l_t = c_0 + c_1 \cdot l_{t-1} \quad (10c)$$

Approximating the unemployment rate by  $U_t \cong l_t - n_t$ , equations (10a) - (10c) may be used to derive a higher-order unemployment dynamics equation. While it is not difficult to think of other lags and variables to include in this system, the ones above are ample to illustrate the general problem of measuring unemployment persistence and imperfect responsiveness. As we will see, the associated unemployment dynamics equation may display complex cyclical patterns for which the degree of unemployment persistence and imperfect responsiveness need not invariably be inversely related.

### 3a. Measures of Unemployment Persistence

Since unemployment persistence arises only when a temporary labor demand shock continues to affect unemployment after the shock has disappeared, it appears natural to measure it in terms of either (i) the discounted sum of the differences through time ( $t \geq 1$ ) between unemployment in the presence and absence of the shock (occurring at  $t = 0$ ), normalized by the size of the shock or (ii) the number of periods after the shock has occurred that it takes unemployment to return to an  $\epsilon$ -neighborhood of the time path it would have followed in the absence of the shock. We denote these two measures by  $\pi_1$  and  $\pi_2$ , respectively.

Specifically, consider a temporary drop in labor demand whereby the coefficient  $a_0$  in equation (1a) falls in period  $t = 0$  ( $\Delta a_0 < 0$ ) and then returns to its original value. Now, for all the periods after the shock ( $t > 0$ ), compute the comparative dynamic term  $\Delta u_t$ , representing the difference between unemployment in the presence and the absence of the shock. Then the first measure of unemployment persistence may be expressed as

$$\pi_1 = \sum_{t=1}^{\infty} \delta^t \cdot \frac{\Delta u_t}{\Delta a_0} \quad (11a)$$

where  $\delta$  ( $0 \leq \delta \leq 1$ ) is the time discount factor. When  $\pi_1 = 0$ , there is no persistence; when  $\pi_1 > 0$  (so that a temporary drop in labor demand causes the discounted stream of subsequent unemployment levels to be positive) there is "positive persistence"; and when  $\pi_1 < 0$ , there is "negative persistence". For  $\delta = 1$ , an infinite  $\pi_1$  characterizes the special case of "hysteresis".

The second measure of unemployment persistence may be specified as

$$\pi_2 = \underset{t}{argmax} \left[ \frac{\Delta u_t}{\Delta a_0} > \varepsilon \right] \quad (11b)$$

for some small positive constant  $\varepsilon$ . In other words, this measure represents the maximum number of time periods over which the effect of the temporary shock on unemployment exceeds some small positive value. Here we are not able to distinguish between positive and negative persistence. In a dynamically stable system, where the unemployment effects of a temporary labor demand shock eventually decline toward zero, this measure is positive and finite. When there is no persistence,  $\pi_2 = 1$ ; at the opposite extreme of hysteresis,  $\pi_2$  is infinite.

Although these measures can clearly be applied to *any* stable system of labor market equations determining the unemployment rate, we can get a better intuitive grasp of what these measures mean by applying them to the first-order equation (5). As shown in Section 2, when a temporary shock  $da_0$  occurs in time period  $t = 0$ , the difference between unemployment in the presence and absence of the shock in all subsequent time periods  $t > 0$  is  $du_t = A_1^t \cdot da_0$ . The discounted sum of these differences yields our first measure of unemployment persistence:

$$\pi_1 = \frac{\delta \cdot A_1}{1 - \delta \cdot A_1} \quad (12a)$$

and second measure is

$$\pi_2 = \underset{t}{argmax} \left[ A_1^t > \varepsilon \right] \quad (12b)$$

Observe that, in line with our discussion in the previous section, both measures do indeed depend positively on the slope  $A_1$  of the unemployment dynamics equation.

### 3b. Measures of Unemployment Responsiveness

Since unemployment is imperfectly responsive when the long-term effects of a permanent shock are delayed, it appears natural to measure it in terms of either (i) the discounted sum of the differences through time between the actual unemployment effect of the permanent shock and the long-run effect, or (ii) the number of periods after the shock has occurred that it takes unemployment to reach an  $\varepsilon$ -neighborhood of its long-run level in the presence of the shock. We denote these two measures by  $\sigma_1$  and  $\sigma_2$ , respectively.

In particular, let  $\Delta u_t$  be the difference between unemployment level in the presence and absence of a permanent shock,  $\Delta a_0$ , occurring in time period  $t = 0$ . Let  $\bar{\Delta u}_t$  be the difference between the corresponding long-run levels in the presence and absence of the shock. If unemployment were perfectly responsive in a stable dynamic system,  $\Delta u_t$  would be equal to  $\bar{\Delta u}_t$  in every time period  $t$ . The difference  $(\Delta u_t - \bar{\Delta u}_t)$  may then be attributed to imperfect unemployment responsiveness. Thus our first measure of unemployment responsiveness may be expressed as

$$\sigma_1 = \sum_{t=1}^{\infty} \delta^{t-1} \cdot \frac{\Delta u_t - \bar{\Delta u}_t}{\Delta a_0} \quad (13a)$$

When  $\sigma_1 < 0$ , there is "under-responsiveness" of unemployment, in the sense that the permanent shock leads to a smaller discounted stream of actual unemployment increments than long-run unemployment increments, i.e. unemployment displays "inertia". When  $\sigma_1 > 0$ , there is "over-responsiveness" of unemployment, in that the discounted stream of actual unemployment increments exceeds that of long-run unemployment increments; this can happen when unemployment "overshoots" its long-run equilibrium.

Our second measure of unemployment responsiveness is

$$\sigma_2 = \underset{t}{argmax} \left[ \left| \frac{\Delta u_t - \Delta \bar{u}_t}{\Delta a_0} \right| > \varepsilon \right] \quad (13b)$$

This measure, in other words, represents the maximum number of time periods over which the absolute value of the difference between the actual and the long-run effect of the permanent shock on unemployment exceeds some small, positive value. Once again, this measure does not permit us to distinguish between under- and over-responsiveness of unemployment. When unemployment is perfectly responsive,  $\pi_2 = 1$ ; at the opposite extreme of hysteresis,  $\pi_2$  is infinite.

For the first-order unemployment dynamics equation (5), stability implies that  $0 \leq A_1 \leq 1$ , and then the long-run unemployment level is  $\bar{u}_t = \bar{u} = A_0/(1 - A_1) > 0$ . The actual unemployment effect of a permanent shock  $da_0$  is  $du_t = [(1 - A_1^t)/(1 - A_1)] \cdot da_0$ ; the long-run effect is  $d\bar{u} = da_0/(1 - A_1)$ . The discounted sum of the difference between these two effects over all periods yields our first measure of imperfect responsiveness:

$$\sigma_1 = - \frac{A_1}{(1 - A_1) \cdot (1 - \delta \cdot A_1)} \quad (14a)$$

and our second measure becomes:

$$\sigma_2 = \underset{t}{argmax} \left[ \frac{A_1^t}{1 - A_1} > \varepsilon \right] \quad (14b)$$

Once again, note that both measures depend positively on the slope  $A_1$  of the unemployment dynamics equation.

It is easy to show that our measures of unemployment persistence and imperfect responsiveness do not depend on whether unemployment in the initial time period ( $t = 0$ )



is at its long-run equilibrium value.

#### **4. Empirical Analysis of Unemployment Persistence and Imperfect Responsiveness**

We now construct an empirical framework for assessing the degree of labor market fragility and measuring the persistence and imperfect responsiveness of unemployment. We focus attention on four countries - Germany, Spain, the UK, and the US - over the postwar period. The empirical analysis should be seen as illustrating our methodology for analyzing fragility, persistence and imperfect responsiveness, rather than providing definitive measures of these magnitudes. With this in mind, our primary concern in constructing the empirical model has been to keep it sufficiently simple to identify the sources of persistence and unemployment responsiveness with ease. This explains why we have chosen not to disaggregate the model by sector (it is a one-sector model) or by time period (the model is annual).

In estimating a system of labor market equations for each of the three countries, we followed a three-step procedure: First, we estimated an employment equation, a wage setting equation, and a labor force equation independently by OLS, conducting a full range of misspecification tests. Second, we estimated the preferred specifications of these equations as a system, using 3SLS. And finally, we performed the simulation exercises necessary to yield our measures of the persistence and imperfect responsiveness of unemployment. Details of the estimation procedure and results of the econometric tests are described in detail in Karanassou and Snower (1993). For our purposes here it is sufficient to summarize the system of equations that we ultimately settled on for each of the countries:<sup>11</sup>

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<sup>11</sup>The estimations are based on OECD data for the period 1952-1988. The equations pass the tests for misspecification and structural stability.

The German system:<sup>12</sup>

$$n = 1.58 + 1.24 \cdot n_{-1} - 0.40 \cdot n_{-2} - 0.06 \cdot w - 0.05 \cdot r + 0.001 \cdot t$$

(2.49)      (8.84)      (-2.93)      (-1.79)      (-2.94)      (1.55)

$$w = -0.05 + 0.73 \cdot w_{-1} - 1.05 \cdot u + 0.008 \cdot t + 0.10 \cdot \tau_2$$

(-0.71)      (12.38)      (-5.21)      (3.57)      (2.51)

$$l = 0.99 + 1.59 \cdot l_{-1} - 0.70 \cdot l_{-2} + 0.08 \cdot u + 0.0003 \cdot t$$

(1.25)      (8.14)      (-3.80)      (0.96)      (0.90)

The Spanish system:<sup>13</sup>

$$n = 1.91 + 1.33 \cdot n_{-1} - 0.53 \cdot n_{-2} - 0.02 \cdot w - 0.07 \cdot r$$

(4.92)      (9.86)      (-4.37)      (-3.10)      (-3.93)

$$w = 8.40 + 0.73 \cdot w_{-1} - 1.75 \cdot u_{-1} + 0.03 \cdot t - 0.96 \cdot n_{-1}$$

(1.91)      (7.38)      (-3.02)      (3.13)      (-2.00)

$$l = 2.64 + 1.29 \cdot l_{-1} - 0.50 \cdot u + 0.54 \cdot u_{-1} - 0.56 \cdot l_{-2} + 0.03 \cdot w$$

(3.56)      (9.91)      (-3.42)      (3.77)      (-4.00)      (3.44)

The UK system:<sup>14</sup>

$$n = 3.72 + 1.07 \cdot n_{-1} - 0.33 \cdot n_{-2} + 0.10 \cdot w - 0.08 \cdot k$$

(4.04)      (9.83)      (-3.30)      (2.77)      (-2.77)

<sup>12</sup>The following are the definitions of the variables used:  $r$  = competitiveness ( $P_M - P$ ),  $P_M$  = deflator for imported goods and services,  $P$  = GNP deflator,  $t$  = time,  $\tau_2$  = average income tax rate. (All variables are in logs.) The  $t$ -ratios are in parentheses. The instruments are  $n_{-1}$ ,  $n_{-2}$ ,  $r$ ,  $t$ ,  $w_{-1}$ ,  $\tau_2$ ,  $l_{-1}$ ,  $l_{-2}$ , and GNP.

<sup>13</sup>The instruments are  $n_{-1}$ ,  $n_{-2}$ ,  $r$ ,  $w_{-1}$ ,  $t$ ,  $l_{-1}$ , and  $l_{-2}$ .

<sup>14</sup> $k$  = capital stock (from IQ, 3% annual depreciation),  $\tau_1$  = employment tax rate, and  $z$  = population. The instruments are  $n_{-1}$ ,  $n_{-2}$ ,  $r$ ,  $t$ ,  $w_{-1}$ ,  $\tau_1$ ,  $l_{-1}$ ,  $l_{-2}$ ,  $z$ , and  $k$ . We have not felt it necessary to exclude ex ante the possibility that labor demand may be positively associated with the real wage. A number of recent theories, such as increasing returns to job matching (as in Howitt and McAfee (1987)) and increasing returns under excess capital capacity (as in Karanassou and Snower (1993b)), explain how this may arise. See also Blanchard and Summers (1988).

$$w = 8.06 + 0.51 \cdot w_{-1} - 1.51 \cdot u + 0.02 \cdot t - 0.11 \cdot \tau_1 - 0.87 \cdot n_{-1}$$

(4.03)      (5.47)      (-5.92)      (7.10)      (3.37)      (-4.36)

$$l = -0.96 + 1.16 \cdot l_{-1} - 0.45 \cdot l_{-2} + 0.37 \cdot z$$

(-2.61)      (9.70)      -3.78      (4.20)

The US system:<sup>15</sup>

$$n = 0.09 + 0.60 \cdot n_{-1} - 0.27 \cdot w + 0.28 \cdot k$$

(0.28)      (4.66)      (-2.49)      (3.09)

$$w = 0.61 + 0.90 \cdot w_{-1} - 0.48 \cdot \Delta u + 0.07 \cdot \tau_2 - 0.04 \cdot n_{-1}$$

(1.82)      (27.70)      (-2.96)      (1.98)      (-1.70)

$$l = -1.83 + 0.86 \cdot l_{-1} + 0.29 \cdot z - 0.11 \cdot u - 0.001 \cdot t$$

((-3.16))      (24.57)      (4.59)      (1.34)      (1.94)

To derive our measures of unemployment persistence, we conduct simulation exercises on each of the systems above, together with an identity defining the unemployment rate. To preserve the linearity of the system, we use the approximation  $u_t \cong l_t - n_t$ , with  $l_t$  and  $n_t$  in logs. To generate the base runs, each system is solved from 1988 up to the period in which the system reaches its long-run equilibrium, using the 1988 values of all exogenous variables. The associated unemployment time series we call  $u_t$ , "base unemployment". Next, a temporary labor demand shock is imposed: the constant term in the employment equation was reduced by 0.01005 in year 1988 only; this is equivalent to a 1% reduction in the constant term of the corresponding equation expressed in absolute terms, rather than logs. Let the resulting unemployment time series be  $u'_t$ , "post-shock unemployment". The difference between base unemployment and

<sup>15</sup>The instruments are  $n_{-1}$ ,  $r$ ,  $t$ ,  $w_{-1}$ ,  $\tau_1$ ,  $\tau_2$ ,  $r$ ,  $l_{-1}$ ,  $z$ , and  $(P_c - P)$ , where  $P_c$  is the consumption deflator.

post-shock unemployment is the time series of unemployment increments  $\Delta u_t = u'_t - u_t$ .

To derive our measure of unemployment fragility, we convert the first element ( $\Delta u_{1965}$ ) of this time series of incremental unemployment rates into an incremental unemployment level ( $\Delta U_{1965}$ ) and divide it by the temporary employment shock, to yield the effect of the shock on the short-run unemployment level. The results are given in Table 1. By our calculations, the UK unemployment equilibrium is more fragile than that of Germany (i.e. a given labor demand shock has a larger effect on the short-run equilibrium unemployment rate in the UK than in Germany); and the German unemployment equilibrium, in turn, is more fragile than that of the US, which is followed by Spain.

Normalizing the time series  $\Delta u_t$  by the size temporary shock (in logs) yields the series ( $\Delta u_t / \Delta a_0$ ), and the discounted sum of the elements of this series, from 1988 until the system reaches its long-run equilibrium, yields our first measure of unemployment persistence,  $\pi_1$  in Table 1. Our second measure is the number of periods it takes for the post-shock unemployment rate to return to a neighborhood of  $\varepsilon = 0.001$  of the base unemployment rate, given by  $\pi_2$  in Table 1.

Observe that all of the systems exhibit positive persistence, i.e. the discounted sum of the unemployment increments in the aftermath of a temporary shock is positive. By our calculations, Spanish unemployment displays more persistence than that in Germany (i.e. a temporary shock has a more long-lasting effect on unemployment in Spain than in Germany); and Germany, in turn, exhibits more unemployment persistence than the UK, which is followed by the US.

Table 6: *Fragility, Persistence, and Imperfect Responsiveness of Unemployment*

	$\rho$	$\pi_1$	$\pi_2$	$\sigma_1$	$\sigma_2$
Germany	0.103	2.598	25	5.489	37
Spain	0.059	3.198	15	-3.881	21
UK	0.117	1.465	13	-20.567	13
US	0.080	1.192	3	-13.541	36

To derive measures of imperfect unemployment responsiveness, we impose a permanent shock whereby the constant term in the employment equation is reduced by 0.01005 (the equivalent of a 1% exogenous reduction in employment) for all years from 1988 until the system achieves its long-run equilibrium, holding all exogenous variables constant at their 1988 values. Let the resulting unemployment time series be  $u_t''$ . The effect of the permanent shock on the actual unemployment rate in each time period  $t$  may be represented by  $(u_t'' - u_t)/\Delta a_0$ , where  $u_t$  is base unemployment. Next, we compute the long-run unemployment rates in the presence and the absence of the shock:  $\bar{u}''$  and  $\bar{u}$ , respectively. The effect of the shock on the long-run employment rate is  $(\bar{u}'' - \bar{u})/\Delta a_0$ . The discounted sum of the differences between these actual and long-run effects yields our first measures of unemployment responsiveness,  $\sigma_1$  in Table 1.

Note that whereas Germany exhibits *over-responsiveness* (unemployment overshooting), the other three countries all display *under-responsiveness* (unemployment inertia). Moreover, UK unemployment is more under-responsive than US unemployment, followed by that of Germany. The number of periods after the shock that it takes for the unemployment rate to reach a neighborhood of  $\varepsilon = 0.001$  of its new long-run rate (or, equivalently, the number of periods it takes for the delayed unemployment increments to reach an  $\varepsilon$ -neighborhood of zero) is given by  $\sigma_2$  in Table 1. Observe that the full effects of a permanent shock take longest to manifest themselves in Germany, followed by

the US, Spain, and the UK.

## 5. Concluding Remarks

The analysis above attempts to shed light on the disparities in unemployment dynamics among different OECD countries by examining the fragility, persistence and imperfect responsiveness of unemployment. The *fragility* of the unemployment equilibrium is significant because it indicates how sensitive unemployment is to labor demand shocks in the short run and because, as we have shown, it provides leverage for unemployment persistence and imperfect responsiveness. *Unemployment persistence* has received much attention in the macro literature over the past years, but thus far we have had no sufficiently general measures of it to permit us to compare how labor market systems with different dynamic structures respond to temporary shocks. The analysis above offers two such measures. Although *imperfect responsiveness* of unemployment has received far less attention in the literature, we maintain that it is no less important than unemployment persistence. There is no evidence that labor market shocks are predominantly temporary, rather than permanent, and it is vital to explore the degree to which labor market systems respond differently to temporary and permanent shocks. Once again, our analysis yields two general measures that permit us to compare systems with different dynamic structures.

Being able to compare unemployment persistence and imperfect responsiveness across different dynamic systems is important because, as our empirical estimates suggest, countries differ dramatically in terms of the lag structures characterizing their labor markets. Whereas the labor market experiences of Germany, Spain, and the UK have been superficially similar in the sense that unemployment in all these countries has been slow to recover from the global recessions of the past two decades, our analysis suggests that the lags responsible for the slow recoveries differ substantially from country to country.

This implies that different countries may require quite different unemployment policies to overcome what, on the surface, looks like the same unemployment problem. Through changes in job security legislation, wage subsidies to the long-term unemployed, and so on, policy makers are able to influence the lagged effects operative in the employment, wage setting, and labor force participation decisions. Insofar as the lags underlying unemployment persistence and imperfect responsiveness differ from country to another, different policy approaches may be needed to improve the resilience of these countries' labor markets. A first step toward identifying the required policy differences would be to measure the degree to which each of the different lagged effects contribute to unemployment persistence and imperfect responsiveness. This is the subject of another paper (see Karanassou and Snower (1993)).

Beyond that, our empirical results indicate that a countries where unemployment responds relatively sluggishly to temporary shocks need not be ones where unemployment also reacts sluggishly to permanent shocks. Our empirical results indicate that whereas Spain, the UK, and the US are characterized by positive persistence and under-responsiveness, Germany features positive persistence and over-responsiveness. Whereas Spain displays more unemployment persistence than the UK, UK unemployment is more under-responsive than Spanish unemployment. In the aftermath of a temporary shock, it takes UK unemployment a shorter time to reach its long-run equilibrium than German unemployment; but in the aftermath of a permanent shock, it is the other way around. A glance at the German and UK unemployment rates over the past two decades reveals that both have recovered slowly from global recessions; our analysis indicates, however, that the reason why each did so may be quite different. This suggests that the relative unemployment performance of different countries depends importantly on the degree to which their labor market shocks are temporary or permanent.

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