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Global Shocks and Unemployment Adjustment

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Abstract

The literature on unemployment dynamics is mainly concerned with the nature and impact of shocks to unemployment. In this paper we use OECD unemployment data to infer the nature of these shocks using factor analysis. We find that two Principal Components can account for a large part of the variance of unemployment between and within countries. We then use regression analysis in which equilibrium unemployment depends on a global shock and domestic labour market institutions, and the institutions also determine the response to global shocks and the speed of convergence to equilibrium. We find that national unemployment series do converge to a moving equilibrium and that the responsiveness shocks and the speed of convergence to equilibrium also change over time as domestic labour market institutions change. The calculation of the Principal Components is suggestive of the possible economic causes of long swings in unemployment.

JEL classification: J1, E2
Keywords: Unemployment dynamics, Principal Components, labour-market institutions.

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When observing unemployment over long periods of time it becomes apparent that its long swings – or decade-to-decade changes – dominate shorter business cycles. In most countries, the 1930s were a period of high unemployment, the fifties and sixties a period of low unemployment and the seventies and eighties a period of rising unemployment, while the verdict on the nineties is more mixed – the unemployment experiences diverge. Although many macroeconomists are still primarily concerned with monetary factors, there is a growing literature on the causes of such long swings in economic activity.[1] This was initially prompted by the persistent elevation of unemployment in most OECD countries in the seventies and eighties, the US and Scandinavia being the prime exceptions from this pattern. However, while the theoretical literature has expanded rapidly, the empirical literature has been less successful at discriminating between the competing theories. This is to some extent due to an unfortunate combination of complex models and limited data.

It is the objective of this paper to take a fresh look at the data in order to narrow down the set of plausible models and hypotheses. Instead of starting out with a set of theories to be tested – which is the approach most commonly adopted in this literature – we will be looking at the unemployment data in an attempt to identify empirical regularities. Two issues are of particular interest: First, what is the relative contribution of global factors (such as changes in oil prices and world interest rates), and domestic factors (such as labour market institutions)? In particular, what are the characteristics of shocks that have affected unemployment in the OECD in the last forty years or so? Second, can the observed persistence of national unemployment series be explained by a slow response of unemployment to transitory shocks or are the shocks themselves persistent? If the shocks themselves are persistent, labour markets may function well in the sense that employment returns to a moving equilibrium following demand shocks.

1. Theoretical issues

There are theories of unemployment that emphasise flows and there are others that emphasise stocks. There are theories that explain persistence – sometimes called

[1] See, amongst other contributions, Layard, Nickell and Jackman (1991), Phelps (1994), Blanchard (2000), Pissarides (2000).

hysteresis[2] – and others that explain changes in the underlying equilibrium. The reduced-form equation (1) can help clarify the distinction between some of the competing theories. Suppose for country i the rate of unemployment is u and the natural rate of unemployment is u^*. We can then write an equation for the (expectations-augmented) Phillips curve as

$$p_{it} = p_{it}^{e} + h_i\left(u_{it}^{*} - u_{it}\right), \qquad (1)$$

where h_i denotes the (country-specific) responsiveness of inflation to cyclical unemployment and $u*$ is the time-varying natural rate of unemployment.[3] Assume $p_{it}^{e} = p_{it-1}$, which would be a rational expectation if inflation was a random walk, but could be justified on other assumptions. We now have $\Delta p_{it} = h_i\left(u_{it}^{*} - u_{it}\right)$,[4] which is the standard textbook expectations-augmented Phillips curve; when unemployment is below (above) its natural rate, the rate of inflation is rising (falling).

Rewriting gives equation (1’) where $g = 1/h$ measures the effect of surprise inflation on unemployment:

$$u_{it} = u_{it}^{*} - g_i \Delta p_{it} \qquad (1')$$

Viewed in this light, the equation tells us that surprise inflation can bring unemployment below its natural rate. Such short-run non-neutrality of inflation has been explained by appealing to information imperfections – the equation then becomes a Lucas supply function (Friedman, 1968; Lucas 1972) – time-dependent price-setting rules (Taylor, 1980) and menu costs (Mankiw, 1985; Blanchard and Kiyotaki, 1987).

Empirically, deviations of unemployment from its natural rate are serially correlated due to the costs of hiring and firing, amongst other factors. To capture this

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[2] The concept of hysteresis has been a source of considerable confusion. Some authors take it to mean a unit root in the unemployment series; others define it in terms of the coefficient of lagged unemployment in an AR(1) process; yet others follow Phelps (1972) in defining hysteresis as implying that a temporary disequilibrium affects the position of the equilibrium point or at least creates some friction on the way back to equilibrium; and finally there is the definition of the term in physics which has been applied to the theory of unemployment by Bruno Amable, Jérome Henry, Frédéric Lordon and Richard Topol (1993), and to international trade by Richard Baldwin (1988).

[3] Equation (1) describes the “cost-push” view of inflation. See Samuelson and Solow (1960).

[4] This equation can be used to estimate the natural rate of unemployment by first assuming (incorrectly) that it is a constant, and estimating the equation (by substituting a constant term for u^*) and then using the estimate of h to calculate the natural rate:

$$\hat{u}_t^{*} = u_t + \left(1/\hat{h}\right)\Delta p_t$$

For issues involving the calculation of the standard errors of the estimate see Staiger, Stock and Watson (1997).

phenomenon we can rewrite the equation as

$$u_{it} = l_i u^*_{it} + (1 - l_i) u_{it-1} - g_i \Delta p_{it} \ . \tag{2}$$

We will write this as a partial adjustment model, where we explicitly take into account the dependency of the natural rate on in its (real) domestic, *D*, and global, *G*, determinants.[5] and allow for some persistence in the change in unemployment:

$$\Delta u_{it} = l_i \left[u^*_{it} \left(D_{it},\ G_{i,t} \right) - u_{i,t-1} \right] + d_i \Delta u_{i,t-1} - g_i \Delta p_{it} \tag{3}$$

There is a long-run relationship between unemployment and its moving natural rate u^*, and if the speed of convergence $l>0$, then following demand shocks (Dp) that move it away from the natural rate, it will gradually converge back to equilibrium. The parameter l is often taken to measure the flexibility of the labour market in a given country, l close to zero then implies hysteresis – the absence of any convergence to the natural rate – and the natural rate is no longer an attractor. When λ approaches one the difference between the actual and the natural unemployment rate – that is the cyclical unemployment rate – becomes serially uncorrelated white noise.

The value of l is important because it reflects the labour market's tendency to converge to some equilibrium in the long run. It symbolises the modern analogue to the "Keynes versus the Classics debate" on the tendency of economies to revert to full employment if left on their own. The main difference between that debate and the current one is that equilibrium now entails (involuntary) unemployment. However, as before, if the tendency is absent – l is equal to 0 – active demand management is of paramount importance. If, in contrast, l is much greater than zero, the labour market can be relied upon to converge to its equilibrium; unemployment converges to the natural rate of unemployment.

Conceptually, there are two approaches to explaining the long swings – or decade-to-decade changes – in unemployment. There is the hysteresis approach according to which the coefficient l has a value close to zero. Here, transitory shocks to unemployment – caused by monetary factors Dp or transitory changes in the elements of the vectors *D* and *G* – have a persistent, even permanent, effect on the unemployment rate. These theories include the insider-outsider model of Blanchard

[5] The reduced form $u^*(D,G)$ corresponds to a structural form where the natural rate is determined by the intersection of a downward-sloping labour demand curve (sometimes called a price-setting curve) and an upward-sloping wage curve (or wage-setting curve). The microeconomic foundations for the wage curve can be found in Shapiro and Stiglitz (1984), to take one example.

and Summers (1986) and Lindbeck and Snower (1988), as well as the human-capital channels emphasised by Layard et al. (1991). Alternatively, one can postulate a moving natural rate. Here, autonomous (unobservable) changes in u^* – caused by changes in the elements of the vectors D and G – exert an effect on observed unemployment. An increase of u^* will then exert a gradual upward effect on actual unemployment. How fast this happens depends on the coefficient l – a rigid labour market is likely to see a longer, more gradual response. Contributions in this vein include Pissarides (2000) – who follows the flow approach embodied in the so-called matching function – and Phelps (1994) – who follows a stock approach. We will refer to the moving-equilibrium approach as the "structural approach". This implies that long swings in unemployment are not due to the effect of monetary factors but rooted in real variables, the structure of the economy.

There is a large literature that attempts to estimate the correct value of l. This is a difficult task because the results depend on how we measure u^*:[6] We can assume that u^* is a constant, but in this case it is almost always never possible to reject the hypothesis that $l=0$; alternatively, one can use statistical filters – such as the Hodrick-Prescott filter[7] – to deduce the path of the natural rate from the observed actual unemployment path, but different filters give different results for l; or one can let u^* be a function of some other variables taken from economic theory, e.g. price mark-ups, the rate of productivity growth, real interest rates, energy prices etc., but different choices of these variables give different results.

With every passing year of high unemployment in Europe fresh doubts are cast on the hysteresis approach. While models in that tradition can plausibly be expected to explain persistently high unemployment over a few years, it is less likely that they can explain unemployment epochs that last many decades. When generations retire from the labour market, they bring with them any impaired human capital, disillusion with job prospects and other malaise formed during long unemployment spells. Similarly, differences between "insiders" and "outsiders" must fade as both parties move into retirement homes!

Stephen Nickell and Olivier Blanchard have, amongst many others, made recent

[6] See, amongst many other contributions, Karanassou and Snower (1998) and Henry, Karanassou and Snower (2000).

[7] The Hodrick-Prescott filter, in essence, minimises the sum of squared deviations between trend and actual observations with a penalty for curvature.

contributions to the structural approach. Nickell (1998, 1999, 2002, 2003, 2004) puts the emphasis on the institutional elements of the vector *D* above, in particular variables measuring labour-market institutions. Nickell and his co-authors have constructed summary indices of important features of the labour market for most of the OECD countries, such as the level and duration of unemployment benefits, the density, coverage and centralisation of labour unions, employment-protection legislation, spending on active labour-market programmes, and labour taxation. It is his contention, supported by empirical evidence, that variation in these institutional variables help explain differences across countries for a given time period as well as differences over time for any given country. Nickell and Ours (2000) explain changes in equilibrium unemployment in the UK and the Netherlands by changes in labour market institutions. They argue that the main difference between the two countries is that while Dutch unions were already co-operative, British unions were made to co-operate by government actions. In both countries, financial incentives for work for unemployed workers collecting benefits were increased.

Blanchard (see Blanchard and Wolfers, 2000), in contrast, emphasises the interaction of shocks and institutions. Here he follows in the footsteps of Krugman (1994), chapter 17 in Phelps (1994) and Layard et al. (1991): Institutions are important not because of the direct impact they exert on unemployment, but because they determine how sensitive unemployment is to certain macroeconomic shocks.[8]

Numerous real macroeconomic shocks affecting u^* have been discussed in the literature. Changes in (world) real interest rates affect the hiring and training of workers – higher interest rate imply a higher level of the natural rate of unemployment (Phelps, 1994); lower expected productivity growth also reduces training investment and causes higher unemployment (Pissarides, 2000; Hoon and Phelps, 1997); alternatively, a fall in productivity growth rates only gradually affects workers' wage aspirations, hence unit labour costs and unemployment go up (Ball and Moffit, 2001; Ball and Mankiw, 2002); higher oil prices reduce labour demand causing higher unemployment (Bruno and Sachs, 1985; see also Carruth, Hooker and Oswald, 1998); higher stock prices imply expectations of increased future profits and a higher implicit shadow price of trained workers, which brings increased training and

[8] In contrast, a recent paper by Phelps (2002) has a discussion of the role of institutions in the genesis of shocks, especially productivity shocks, current and anticipated, which then can have an effect on unemployment.

employment (Phelps and Zoega, 2001); higher start-up costs reduce firm creation and employment (Pissarides, 2002); shop closing laws can suppress service employment (Burda, 2000) and, finally, higher real exchange rates (appreciated) may make mark-ups of price of marginal cost fall which raises labour demand (the real product wage) and employment (Hoon, Phelps and Zoega, 2004).[9] Meanwhile, the erstwhile proponents of hysteresis have become increasingly silent. Instead of postulating that labour-market institutions may cause hysteresis – as in Layard et al. (1991) – what is currently under debate is whether these institutions exert a direct effect on the natural rate of unemployment or whether they interact with macroeconomic shocks in its determination.

2. Preliminaries

We start by measuring unemployment persistence by testing for a unit root in unemployment. We then look for explanations for the observed persistence and begin with labour market institutions. First we consider the direct relationship between unemployment and institutions and thereafter the interdependencies between shocks and institutions.

2.1 Unemployment persistence

Let us return to equation (3). Notice if the natural rate is a country specific constant, $u^*_{it} = u^*_i$, the equation – with an error term ε added – reduces to the standard ADF equation augmented by an inflation surprise term

$$\Delta u_{it} = \alpha_i - \lambda_i u_{it-1} + \delta_i \Delta u_{it-1} - \gamma_i \Delta \pi_{it} + \varepsilon_{it} \qquad (4)$$

where $\alpha_i = \lambda_i u^*_i$ and the hypothesis of interest is that $\lambda_i = 0$ implying no adjustment. Again, if $\lambda_i = 0$ there is said to be complete hysteresis, there is no equilibrium rate of unemployment that acts as an attractor for actual unemployment. If $\lambda_i > 0$, in contrast, there is mean reversion and the coefficient can be used as a measure of the flexibility of the labour market, that is how rapidly the market returns to equilibrium. Table 1

[9] Our list is by no means exclusive: Changes in the age and educational composition of the labour force affect the natural rate of unemployment. For a discussion of the former in the US context, see Shimer (1998) while for the importance of educational composition see Francesconi, Orszag, Phelps and Zoega (2000). There is also the apparent empirical relationship between unemployment and home ownership (see Oswald, 1997; and a contrasting view by Leuvensteijn and Koning, 2004). Katz and Krueger

below shows the results of an ADF test for 21 countries, which form our core sample of countries in this paper.

Australia	-1,91	Germany	-0,77	New Zealand	-2,06
Austria	-1,04	Greece	-1,34	Norway	-1,82
Belgium	-2,00	Iceland	-1,99	Portugal	-2,96
Canada	-1,97	Ireland	-1,44	Spain	-2,11
Denmark	-1,76	Italy	-2,24	Sweden	-2,10
Finland	-2,47	Japan	1,27	U.K.	-2,24
France	-1,56	Netherlands	-2,59	U.S.	-3,20

Table 1. ADF tests on unemployment rates, 1960-2003. Rejection of unit root at 1% level if ADF < -4.20; at the 5% level if ADF < -3.52; and at the 10% level for ADF < -3.19.

We fail to reject the existence of a unit root at the 1% and the 5% confidence level for all countries. We can, however, reject at the 10% confidence level for the United States only. For the sake of comparison, the average world unemployment series has an ADF statistic of -1.581, so the unit-root effect could be coming from very persistent global shocks.

There is a large literature on why it may be difficult to reject the hypothesis $l=0$ when there is in fact adjustment to equilibrium in the data, that is the true value of l is greater than zero: these include the low power of the tests[10]; the sensitivity to the span of the data – over a century of data unemployment looks *I(0)* over half a century perhaps *I(1)*;[11] there may be mean shifts (Perron, 1989); there may be non-linear adjustment with unemployment looking like a random walk within a range of the equilibrium but adjusting back into the range fairly quickly.

It so happens that one of the stylised facts of unemployment is that shifts in its mean rate between decades and half-decades account for most of its variance. Bianchi and Zoega (1998) use a statistical analysis based on Markov switching regression

(1999) focus on the impact of increased rates of incarceration as well as temporary jobs in the US, and Autor and Duggan (2001) discuss the role of increased stringency of disability insurance.

[10] Panel unit-root tests may have more power, but they require the unit-root tests for the different countries to be independent. This is unlikely since the e are almost certainly correlated because of global shocks that influence all countries. See Papell, Murray and Ghiblawi (2000).

[11] Bianchi and Zoega (1997) look at historical unemployment data for France, the UK and the US and find that the unemployment series can be described as stationary around an infrequently changing mean. Moreover, the speed of convergence towards mean unemployment is slower when unemployment is high and differs across the three countries: the two European countries having more persistence. A more recent paper by Tim Hatton (2002) draws on a recently developed, historically-consistent, time series for the UK from 1871 to 1999 and finds that trends in labour productivity do matter but only go part of the way towards explaining wide swings in average unemployment across the decades.

models to identify the dates of infrequent changes in the mean of the unemployment rate series of fifteen OECD countries between 1970 and 1996. We find that for most countries, unemployment persistence is much reduced once the (infrequently) changing mean rate has been removed. Papell, Murray and Ghiblawi (2000) get similar results using panel data.[12] This implies that while the effect of some shocks to unemployment persists, the effect of other shocks does not. When one then extends the sample to cover much longer periods these mean shifts become visibly transient and unit root tests reject more frequently over such long periods. We next turn to the possible causes of these shifts in the mean rate of unemployment and start by reviewing some of the existing work in this area.

2.2 Institutions

One-way of simplifying equation (3) is to average the data over many years and assume that $u=u^*$. In this case the estimated equation becomes

$$u_{it} = u^*_{it}\left(D_{i,t},\ G_{i,t}\right) + e_{it}. \qquad (3')$$

Let us begin by focusing exclusively on institutions, omitting G from equation (3') and letting D only include institutional variables.[13] Following Nickell (1999, 2003) and using his data,[14] we define six periods: 1960-1964, 1965-1972, 1973-1979, 1980-1987, 1988-1995 and 1996-1999 and estimate a panel where unemployment is a function of different labour-market institutions: the unemployment benefit replacement ratio, the maximum allowed duration of benefits, union density, union coverage, the coordination of unions and employers, employment protection legislation,[15] taxes on labour and active labour market expenditures. We have six observations for each of the seven institutions for each country. This allows us to

[12] A related paper by Coakley, Fuertes and Zoega (2001) assesses the hysteresis and structuralist theories of unemployment in the light of the post-1960 experiences of the US, UK and Germany. Structural breaks are detected for the UK and Germany in 1980 and for the US in 1973, indicating a sharp one-time increase in their respective natural rates. Bootstrap symmetry tests provide evidence of dynamic asymmetries for all series with rapid mean reversion following booms and persistence in the wake of recessions.

[13] For a critical assessment of the cross-country evidence see Baker, Glyn, Howell and Schmitt (2004).

[14] The data on labour market institutions is taken from his 2003 paper in the DICE Report, *Journal for Institutional Comparisons*.

[15] There is limited consensus on the effect of employment protection legislation on unemployment. While Layard and Nickell (1999) find no such effect, Lazear (1990) found a significant positive effect, as did Elmeskov, Martin and Scarpetta (1998) using the OECD summary index of formal employment protection. However, Addison and Grosso (1996) find no significant evidence when using data similar to those used by Lazear. Moreover, in an earlier paper, Blanchard and Jimeno (1995) point out that the degree of enforcement of employment protection differs significantly between Spain and Portugal despite similar summary indicators of the strictness of the legislation.

explain differences in unemployment over both time and space. Equation (3’) now takes the form of equation (5) below:

$$u_{it} = u^*_{it}(D_{it}) + t_t d_t + e_{it} \qquad (5)$$

where D is a vector of the seven institutional variables for 20 OECD countries.[16] In addition to the six institutional variables, we add d_t, which is a time dummy for year t. The product $t*d$ then measures global shocks where t_t is a coefficient that is restricted to take the same value for all countries for period t. The results are reported in the table below.

Explanatory variables	1960-1999	1980-1999
Replacement ratio	8.18* (1.70)	11.11* (3.03)
Duration of benefits	-1.46 (0.99)	-0.84 (2.07)
Density	-0.02 (0.02)	0.02 (0.03)
Coverage	0.01 (0.02)	0 .07* (0.03)
Coordination	-2.18* (0.57)	-5.47* (1.37)
Employment protection	0.50 (0.66)	3.95* (1.77)
Taxes on labour	0.03 (0.04)	-0.08 (0.06)
Labour market expenditures		-10.19* (3.05)

Table 2. Unemployment and labour market institutions. Standard errors in parentheses. Weighted –least-squares estimation. The star denotes statistically significant coefficients at the 5% level. The replacement ratio is measured in the first year of an unemployment spell and averaged over three family types. Duration is a function of the replacement ratio in the first five years of an unemployment spell. Density is the percentage employed workers that belong to a union. Coverage measures the percentage of employees affected by collective bargaining. Coordination is an index that measures the extent to which unions and employers take the national employment implications into account when bargaining over wages. Employment protection is also an index, the higher the number the greater is the protection. Taxes (%) include payroll taxes, income taxes and consumption taxes. Labour market expenditures measure active labour market policies. See Nickell (2003).

In the first set of results the labour market expenditures variable is omitted but all periods included. In this case, unemployment is a statistically significant and positive function of the unemployment benefit replacement ratio and a negative and significant function of coordination. Other coefficients are insignificantly different from zero.

[16] Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, UK and the U.S.

The only surprise here is the duration of benefits, which unexpectedly has a negative sign. This is presumably caused by the inclusion of the Scandinavian countries (low unemployment, fairly long duration). In the second set of results we add a variable measuring (active) labour market expenditures for the period 1980-1999, which was not included before because of lack of data for the period 1960-1979. In addition to the significant effect of the unemployment benefit replacement ratio and union and employer coordination, we now find that higher union coverage raises unemployment and labour market expenditures lower it.

Figure 1 has the time effects $t*d$ for the whole period. This variable rises from a rate around 3% in the late sixties to over 4% in the late seventies to 7% in the eighties and then falls to between 5% and 6% in the nineties. These very significant differences between periods suggest that changes in institutions do not adequately account for national developments. Clearly, the steep rise in unemployment in the seventies and at the beginning of the eighties is not captured by the institutional variables in the equation.

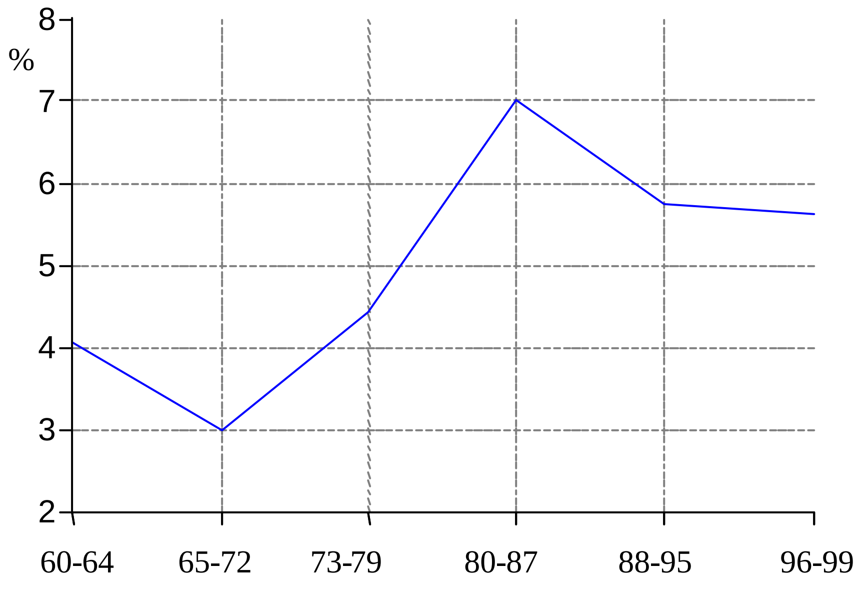

Figure 1. Global shocks not explained by institutional changes (*t*d*).

In contrast, a significant fraction of the variation across countries for each time period is captured by differences in labour-market institutions as seen in the table below.

Period	R-squared (60-99)	R-squared (80-99)	Mean unemployment
1960-64	0.11	–	3.4
1965-72	0.45	–	2.8
1973-79	0.81	–	4.2
1980-87	0.47	0.71	7.8
1988-95	0.17	0.58	7.5
1996-99	0.11	0.32	7.6

Table 3. Institutions and differences in unemployment across countries. The second column corresponds to column (2) in Table 2 and the third one to column (3). In each case the panel was estimated as a system of equations – one equation for each time period – and this gave one R^2 for each period.

Interestingly, the equation appears to explain the cross-country differences better in the seventies and eighties than in the sixties and nineties. The seventies and the eighties were the decades when supply shocks rocked the OECD economies. It seems that the effects of the institutional differences only kicked in during these large shocks but were of little importance during periods of less turmoil. This leads us to believe that it is not the institutions themselves that are of importance but their interaction with economic shocks. It is this interaction to which we turn.

2.3 Shocks and institutions

Following Zoega (1993), Phelps (1994) and Blanchard and Wolfers (2000) we next estimate an equation where $u^*_{it} = a_i + b_i(t_t d_t)$, d_t is again a time dummy for period t – so the product $t*d$ measures global shocks where t_t is again a coefficient that is restricted to take the same value for all countries for period t – a_i is a country-specific fixed effect and b_i measures the sensitivity of national unemployment to global shocks:

$$u_{it} = a_i + b_i(t_t d_t) + e_{it} \qquad (6)$$

Once we have the estimates of b_i, we can relate these to the institutions of the labour market; $\hat{b}_i = B(D_i)$.

Using the same periods as above we find that the equation does a good job at explaining the variation in unemployment over time, as well as between countries. The figure below shows the evolution of the global shocks $t*d$ over the period.

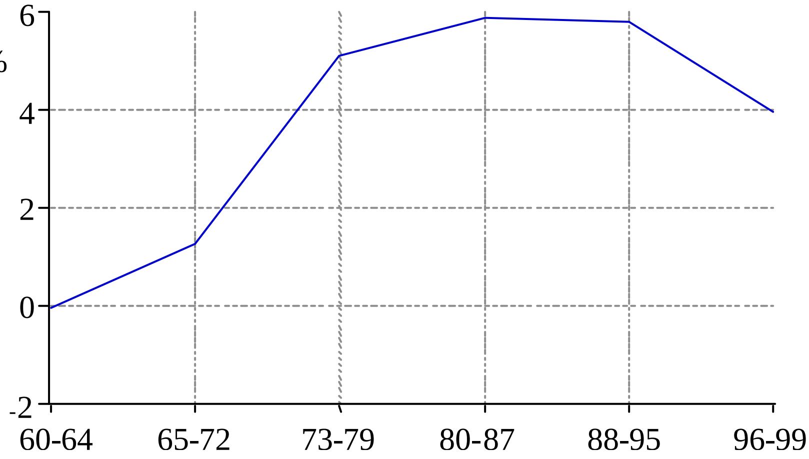

Figure 2. Global shocks to unemployment ($t*d$)

Note the steep rise in the late seventies, early eighties and the partial recovery in recent years. The variable is currently 4% higher than in the late 1960 and the only around 2% below its maximum in the eighties. The estimated coefficients follow in the table below. Note the large variation in the sensitivity to global shocks ranging from b=0.12 in the US to b=2.95 for Spain.

Country	Constant term α	Sensitivity β	Country	Constant term α	Sensitivity β
Australia	2.53 (0.28)	1	Japan	1.57 (0.59)	0.33 (0.15)
Austria	1.38 (0.29)	0.43 (0.08)	Netherl.	1.81 (1.22)	0.87 (0.31)
Belgium	2.91 (0.72)	1.17 (0.19)	Norway	1.75 (0.46)	0.39 (0.12)
Canada	5.30 (0.38)	0.68 (0.10)	New Z.	-0.02 (0.63)	1.16 (0.15)
Denmark	2.20 (0.55)	0.79 (0.14)	Portugal	3.04 (0.70)	0.56 (0,18)
Finland	2.11 (1.23)	1.35 (0.32)	Spain	2.17 (0.52)	2.95 (0.21)
France	2.11 (1.29)	1.53 (0.16)	Sweden	1.19 (1.06)	0.81 (0.27)
Germany	3.92 (1.29)	0.43 (0.32)	Switzerl.	0.15 (0.32)	0.49 (0.09)
Ireland	4.91 (1.67)	1.13 (0.42)	UK	3.01 (0.78)	0.95 (0.20)
Italy	3.83 (0.62)	0.84 (0.16)	US	5.21 (0.65)	0.12 (0.17)

Table 4. Parameter estimates from equation (3). Standard errors in parentheses. Weighted-least-squares estimation. Unemployment measured in percentages. The β for Australia is given a value 1.

The cross-country differences in the sensitivity to global shocks $\hat{b}$ can be explained by the average value of the national labour-market institutions. The results are in Table 4 below.[17]

Constant term	0.07 (0.40)	Union coverage	0.01* (0.004)
Replacement ratio	2.31* (1.04)	Coordination	-0.66 (0.37)
Duration of benefits	0.43 (0.36)	Employment protection	0.77* (0.34)
Union density	0.00 (0.02)	Labour market expenditures	-0.27 (0.43)
Observations	19	R-squared	0.54

Table 5. Sensitivity to global shocks and institutions. Standard errors in parentheses. A star indicates statistical significance at the 5% level. Ireland is not included because of missing data on union coverage.

As expected, the sensitivity of global shocks is a positive function of the replacement ratio, the duration of unemployment benefits, union coverage and employment protection. It is a negative function of the degree of coordination. Both union density and labour market expenditures have a statistically insignificant coefficient.

The interaction of shocks and institutions can explain both the variation across countries for a given year as well as changes over time. However, this treatment has several limitations.

3. Shocks identified

The preliminary investigation in Section 2 has two important weaknesses. First, the time-varying effects mask a mixture of national and global effects. The statistical significance of the parameter t does not establish the finding that there are important global developments affecting each country's natural rate of unemployment. Equally likely, it might only reflect the average value of a set of idiosyncratic factors. So the question about the nature of the shocks to unemployment remains. This was the first question posed at the beginning of this paper.

Second, we have ignored the distinction between structural – that is a moving natural rate – and hysteresis approaches to unemployment. We did not attempt to distinguish between transitory shocks having a persistent effect on unemployment, on the one hand, and persistent shocks to the natural rate of unemployment. This was the other important issue discussed in Section 1, i.e. whether labour markets have a tendency to converge to some equilibrium over time.

3.1 Shocks

Clearly there are some underlying unobserved variables that are influencing the pattern of unemployment. Instead of using time dummies as a proxy or taking these from theory as described in Section I above, we will calculate the underlying shocks from the 42*21 matrix (T*N) U of unemployment data for twenty-one countries (our core sample listed in Table 1 above) and forty-two years using the method of *Principal Components*. This method offers an ideal way of extracting a measure of the unobserved natural rate of unemployment – or its determinants – from the data. In other words, Principal-Components analysis offers an ideal way of deriving a set of (independent) shocks that may account for a large fraction of the variation in the data.

Consider the partial adjustment model, which is a simplified version of equation (3):

$$\Delta u_{it} = l_i\left(u_{it}^* - u_{it-1}\right) + d_i \Delta u_{it-1} + e_{it} \qquad (7)$$

where the natural rate depends on vectors of domestic D and global G factors:

$$u_{it}^* = u_i^* + q_i ' D_{it} + f_i ' G_t \qquad (8)$$

The equation can be written in terms of the current values of the global and domestic factors:

$$u_{it} = g_i ' G_t + e_{it} \qquad (9)$$

$$g_i ' = l_i f_i ' \qquad (10)$$

$$e_{it} = l_i\left(u_i^* + q_i ' D_{it}\right) + \left(1 - l_i\right)u_{it-1} + d_i \Delta u_{it-1} + e_{it} \qquad (11)$$

and the current values of the global factors G can be estimated as the Principal Components of the u_{it}.[18]

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[17] We omit labour taxation this time since there is no a-priori reason for this variable to affect the sensitivity of unemp loyment to shocks.

[18] These may also capture some of the effect of past values of the global factors, which influence u_{it-1} and Δu_{it-1}.

We calculate the Principal Components of the contemporaneous covariance matrix.[19] We first take the standardised *U* matrix and construct its variance-covariance (correlation) matrix *U'U* and diagonalise the matrix in the following way:

$$A'U'UA = \Phi \qquad (12)$$

where *A* is the matrix of orthogonal eigenvectors and F is the (21*21) diagonal matrix of eigenvalues. We can then define $Z = UA$ to be the 42*21 matrix of Principal Components (PCs) where each column of matrix Z is a 42*1 vector of observations for one principal component. Each eigenvalue gives the proportion of the total variance of matrix *U* explained by the relevant PC. Table 5 gives the four largest eigenvalues, together with the percentage of the variance and the cumulative percentage of the variance of matrix *U* explained by the first four Principal Components.

Shocks	Eigenvalues	Percentage of variance explained	Cumulative percentage explained
Z_1: Continental shocks	14.16	69%	69%
Z_2: American shocks	3.15	15%	84%
Z_3: Late-eighties shocks	0.98	5%	89%
Z_4: Scandinavian shocks	0.74	4%	93%

Table 5. Principal Components for OECD unemployment

The first principal component Z_1 is shown in Figure 3 below and the corresponding eigenvector can be found in Table 6. The factor loadings are similar for all the countries except for the United States, which gets a much lower value. The following countries have somewhat higher loadings than the rest: Australia, Belgium, France, Germany, Italy and Spain. Since five of these six countries are on the

[19] Of course the factors and the errors may have a dynamic structure. A dynamic factor analysis takes the Principal Components of the spectral density matrix. Dynamic factor analysis is appropriate if the variables include leading, coincident and lagged indicators of the unobserved factor, e.g. the business cycle, as in Kose et al. (2003); or if one is primarily interested in forecasting. We are interested in the adjustment of the various unemployment rates to the unobserved world factors, therefore extracting the static factors and measuring the adjustment to them is more relevant than having the dynamics absorbed in the factors. We are interested in estimating

$$A(L)y_t = f_t^s + e_t^s$$

while the dynamic factor model has the time-series representation

$$y_t = B(L)f_t^d + e_t^d,$$

where *A(L)* and *B(L)* are polynomials in the lag operator.

European Continent we label this first PC the “Continental shocks”. The shock explains a very high percentage of the total variation in the unemployment matrix *U* (69%). This variable has very low values until 1975, then an increase in mean value and again an increase after 1980. The late eighties have a partial recovery and then a rapid but transient elevation in the early nineties.

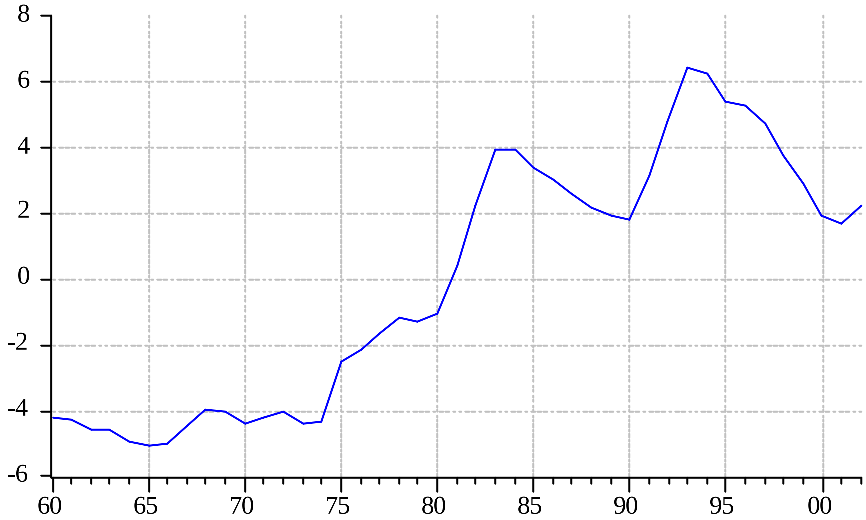

Figure 3. The Continental shocks

The Continental shock variable captures the economic turmoil following the two oil price hikes in the seventies (1973 and 1979); the recession that hit much of Europe in the early eighties; and the recession that followed German unification and the accompanying high interest rates and exchange rate problems in the early nineties. In contrast to the elevation of unemployment in the seventies and the eighties, the elevation in the nineties turned out to be only transient since the Continental shocks variable had the same value in year 2000 as it had in year 1990.[20]

[20] Interestingly, the elements of this first eigenvector are well explained by the institutional variables in Section 2. If we estimate an equation with the eigenvector as a dependent variable and the institutions of Table 4 above (average values) as regressors, we find that the unemployment benefit replacement ratio has a positive coefficient (0.1 (t=0.9)), the same applies to duration (0.1 (t=2.8), labour taxes (0.002 (2.5)) and employment protection (0.06 (t=1.8)) while coordination and labour market expenditure have negative coefficients (-0.03 (t=1.0) and –0.03 (t=1.2) respectively). Union density and coverage have statistically insignificant coefficients.

Country	Z_1	Country	Z_1	Country	Z_1
Australia	0.2520	Germany	0.2471	Norway	0.2385
Austria	0.2351	Greece	0.1928	New Zeal.	0.2180
Belgium	0.2462	Iceland	0.1906	Portugal	0.1541
Canada	0.2279	Ireland	0.1830	Spain	0.2557
Denmark	0.2340	Italy	0.2440	Sweden	0.1989
Finland	0.2191	Japan	0.1802	UK	0.2340
France	0.2575	Netherlands	0.2112	US	0.0846

Table 6. Eigenvector for first principal component; the "Continental shocks".

We now turn to the second principal component Z_2, shown in Figure 4. This second PC explains around 15% of the total variation in the unemployment matrix and together the first two PCs explain 84% of the variation in the data. Since PCs are orthogonal, if Z_1 has all positive weights, the second PC, the Z_2, must have a mixture of negative and positive weights. It turns out that Z_2 has a large weight for the US and a strong resemblance to the US unemployment plot. Other countries with large positive weights are: Ireland, the Netherlands, Portugal and the United Kingdom. All five countries experienced falling unemployment in the 1990s.

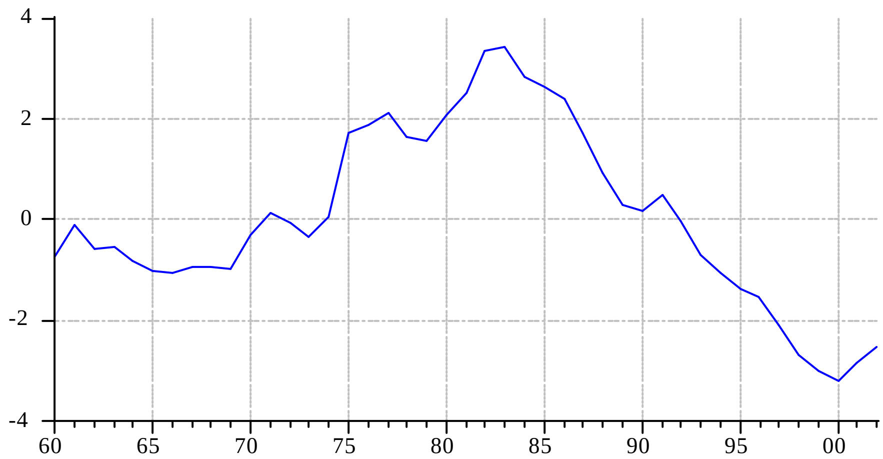

Figure 4. The American shocks

Note the expansion in the late sixties, the recession of the early seventies, the mid-seventies and the very steep recession of the early eighties. There follows a complete recovery in the latter part of the eighties – which contrasts starkly with the behaviour of the Continental shocks – then the very shallow recession at the beginning of the nineties and, finally, the extraordinary performance in the late nineties.

Country	Z_2	Country	Z_2	Country	Z_2
Australia	0.0999	Germany	-0.1296	Norway	-0.0996
Austria	-0.2088	Greece	-0.2851	New Zeal.	-0.1376
Belgium	0.1231	Iceland	-0.2312	Portugal	0.2901
Canada	0.2096	Ireland	0.3113	Spain	0.0256
Denmark	0.1851	Italy	-0.1303	Sweden	-0.2545
Finland	-0.1939	Japan	-0.2255	UK	0.2212
France	-0.0223	Netherlands	0.295	US	0.4292

Table 7. Eigenvector for second principal component; the "American shocks".

Countries with large negative weights are Greece, Iceland, Japan and Sweden. These countries shared negative experiences in the nineties; unemployment was on the rise. On the whole, this factor appears to capture the diverse experiences in the past ten to fifteen years, while some countries succeeded in reducing their structural unemployment rate, others were much less successful.

The third Principal Component Z_3 has large positive weights for Iceland, New Zealand and Norway and large negative weights for Belgium, Japan and Portugal. The first three countries had unemployment rise in the late eighties and only fall back toward the middle of the nineties. The latter three countries had exactly the opposite experience; unemployment fell in the late eighties and then rose again towards the mid-nineties. We call this the "Late-eighties shocks." It is shown in Figure 5.

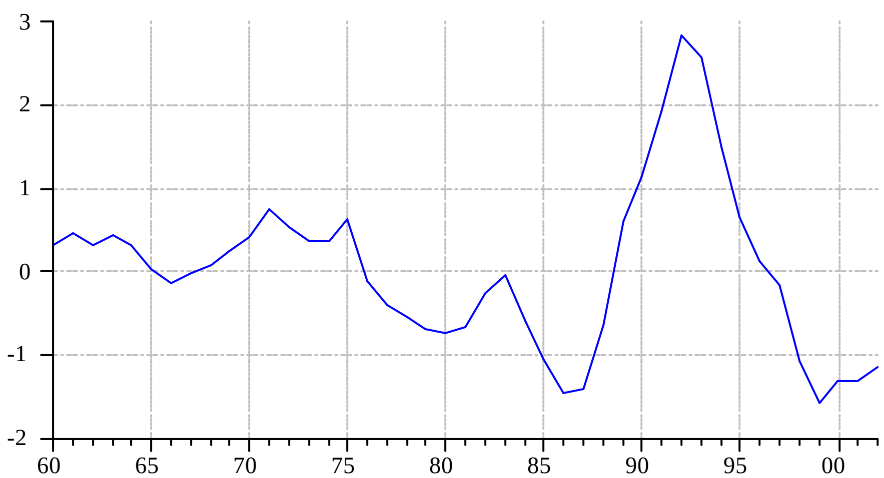

Figure 5. The Late-eighties shocks

The final principal component Z_4 shows a dramatic shock in the early nineties and then a full recovery during the nineties to the low levels experienced in the mid-eighties. This Principal Component explains 4% of the variation in matrix *U*, which brings the cumulative explanatory power of the first three Principal Components up to 93%.

Country	Z_3	Country	Z_3	Country	Z_3
Australia	0.0397	Germany	-0.1833	Norway	0.2100
Austria	-0.0194	Greece	-0.1030	New Zeal.	0.4100
Belgium	-0.2525	Iceland	0.3824	Portugal	-0.3451
Canada	0.1350	Ireland	0.2161	Spain	-0.1065
Denmark	0.1329	Italy	-0.1527	Sweden	0.1299
Finland	0.0974	Japan	-0.4818	UK	-0.0445
France	-0.1038	Netherlands	-0.0468	US	0.1473

Table 8. Eigenvector for the third principal component; the “Late-eighties shock”.

This PC has very large positive weights for Finland, Iceland, Portugal and Sweden. Since three out of four countries are Scandinavian, we label the PC the “Scandinavian shocks.”

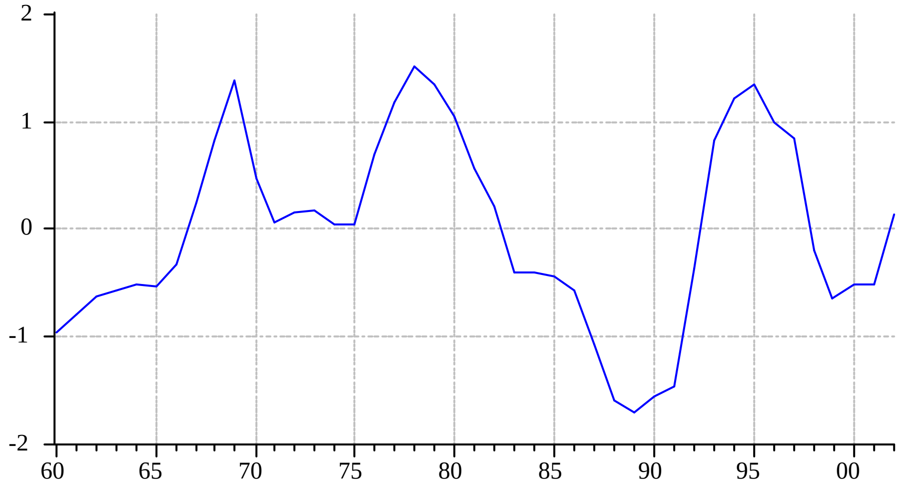

Figure 6. The Scandinavian shocks

This pattern corresponds well not just with measured unemployment in Iceland, Sweden and Finland, but also to the economic turbulence that hit those countries.

There is the recession in the late sixties and the early nineties recession. The spike after 1975, in contrast, appears to coincide with a rise in Portuguese unemployment.

Country	Z_4	Country	Z_4	Country	Z_4
Australia	0.0191	Germany	-0.0517	Norway	-0.2153
Austria	-0.2049	Greece	-0.3673	New Zealand	-0.1351
Belgium	0.0199	Iceland	0.3418	Portugal	0.4741
Canada	0.0016	Ireland	-0.2197	Spain	-0.0569
Denmark	0.0339	Italy	-0.1217	Sweden	0.3969
Finland	0.4247	Japan	-0.0072	UK	-0.0259
France	-0.0262	Netherlands	-0.0821	US	0.0033

Table 9. Eigenvector for the fourth principal component; the "Scandinavian shocks".

We conclude that most of the OECD unemployment experience can, to a very large extent, be summarised by two constructed variables, one representing the Continental European experience and the other representing the US experience. There is also the rather unique Scandinavian pattern where the early nineties plaid a large role, this is our third constructed variable. These results provide an answer to the first of two key questions posed at the beginning of this paper; whether national unemployment rates only differ in their sensitivity to global shocks and if not, which national shocks are of importance. Our results point to the US experience as an example of an idiosyncratic development; speedy recoveries following the oil recessions and the booming nineties.

What remains is to address the second key question posed in Section I, whether unemployment dynamics can be better described as persistent effects of transitory shocks – hysteresis – or, alternatively, whether the shocks themselves happen to be persistent; national labour markets efficient but affected by persistent shocks.

3.2 Persistence or hysteresis?

We have seen that the first Principal Component Z_1 – the Continental shocks – exhibits persistence of a particular kind. Figure 3 revealed two mean shifts; one occurred in the mid seventies and one at the beginning of the eighties. Apart from these two shifts, the series looked stationary. We will now use these Continental shocks as a measure of the global shocks, $G = Z_1$, and consider to what extent this can account for the persistence of individual unemployment series.

To show the effect of different specifications of the model on the speed of adjustment we will report average equations, using the Swamy Random Coefficient Model. This estimates the model separately for each country and then forms weighted averages of the coefficients, the weights depending on the coefficient variances. For the simplest model where the natural rate is assumed to be a constant, the estimated equation is

$$\Delta u_{it} = \ l_i(u_i^* - u_{it-1}) + d_i \Delta u_{it-1} + e_{it} \ . \qquad (7')$$

The averages for the 19 countries where we have data on domestic institutions (Greece and Iceland excluded from our sample of 21 countries listed in Table 1) are

	Random coefficients model		
Variable	Coefficient (1)	Standard error (2)	(1)/(2)
Constant	0.39	0.10	3.93
u_{it-1}	0.06	0.02	3.61
Δu_{it-1}	0.49	0.05	10.61

Table 10. Weighted average estimates assuming a constant natural rate

The average speed of adjustment is 6% a year. The test for equality of coefficients is not rejected at the 5% level and the fixed effect estimates which impose slope homogeneity are very similar, with a speed of adjustment of 6.9% a year.

We then add the first PC – the Continental shock – as our measure of global shocks and the average speed of adjustment rises to 22% a year.

	Random coefficients model		
Variable	Coefficient (1)	Standard error (2)	(1)/(2)
Constant	1.29	0.03	5.18
u_{it-1}	0.22	0.04	6.30
Δu_{it-1}	0.45	0.05	10.04
G_t	0.15	0.04	4.41

Table 11. Weighted average estimates assuming a variable natural rate

When slope homogeneity is imposed, which is rejected in this case, the speed of adjustment is lower at 15%. Coefficient heterogeneity can bias the adjustment coefficient towards zero for reasons discussed in Pesaran and Smith (1995). But even so, allowing for the global shocks increases the measured speed of adjustment substantially.

Least squares with group dummy variables			
Variable	Coefficient (1)	Standard error (2)	(1)/(2)
u_{it-1}	0.15	0.01	10.79
Δu_{it-1}	0.49	0.03	16.14
G_t	0.09	0.01	7.54
R-squared = 0.32			

Table 12. Estimation of speed of adjustment with a variable natural rate and homogeneity

We cannot estimate all the individual equations with domestic measures influencing the natural rate because some of the domestic measures do not vary over time for some countries. However, we can estimate the model imposing slope homogeneity.

Least squares with group dummy variables			
Variable	Coefficient (1)	Standard error (2)	(1)/(2)
u_{it-1}	0.17	0.02	11.55
Δu_{it-1}	0.48	0.03	15.56
G_t	0.10	0.01	7.50
Replacement ratio	0.12	0.29	0.42
Duration	-0.38	0.23	1.68
Coordination	-0.18	0.09	1.98
Density	0.02	0.00(4)	3.47
Employment protection	-0.04	0.12	0.37
R-squared = 0.34			

Table 13. Estimation of speed of adjustment with a variable natural rate with institutions included

With these the speed of adjustment rises slightly from 15% to 17%. Many of the institutional variables are not significant, but this may be because they influence the impact of global shocks or the speed of adjustment. To allow for this we allow both of these to be influenced by the institutional variables. We do this by working with deviations from country means; $\tilde{u}_{it} = u_{it} - \overline{u}_i$, so that we just use the within country variation and use the model:

$$\Delta\tilde{u}_{it} = l_{it}(q' D_{it} + f_{it} G_t - \tilde{u}_{it-1}) + d\Delta\tilde{u}_{it-1} + e_{it}$$
$$l_{it} = l' D_{it}$$
$$f_{it} = f' D_{it}$$

The vector D_{it} includes a constant, coordination, employment protection, union density, duration of benefits and the replacement ratio. The variables are measured over the six periods specified above. Starting from a general model where all five institutional variables could influence responsiveness to global shocks, f, speed of convergence l, and the natural rate q, and dropping insignificant terms gave the final model. In this the speed of adjustment is a function of the coordination of wage bargains as well as employment protection,

$$l_{it} = l_0 + l_1 coor_{it} + l_2 emp_{it}. \qquad (13)$$

The natural rate $u*$ is a function of the domestic variables coordination, employment protection and union density and the global influences captured by the first Principal Component:

$$u^*_{it} = \overline{u}_i + q_0 + q_1 coor_{it} + q_2 emp_{it} + q_3 den_{it} + f_{it} G_t \qquad (14)$$

Finally, the sensitivity of the national natural rate to global shocks is a function of employment protection and the duration of benefits:

$$f_{it} = f_0 + f_1 emp + f_2 dur \qquad (15)$$

Nonlinear least squares with group dummy variables			
Variable	Coefficient (1)	Standard error (2)	(1)/(2)
d	0.50	0.03	16.79
l_0	0.33	0.06	5.38
l_1	-0.04	0.03	1.41
l_2	-0.08	0.03	2.98
q_0	0.06	0.48	0.12
q_1	-0.64	0.31	2.04
q_2	0.81	0.36	2.27
q_3	0.02	0.01	1.77
f_0	0.25	0.09	2.75
f_1	0.22	0.08	2.94
f_2	0.25	0.11	2.22
R-squared = 0.34			

Table 14. The interaction of shocks and institutions

The speed of adjustment l is a negative function of employment protection and the coordination of bargaining. The implied adjustment coefficients look sensible. They range from 7% to 29% with an average of 17%, larger than the usual estimates. In the US the adjustment rate is constant at 29%, the fastest, the coordination and employment measures do not change. France and Germany both start off the period with speeds of adjustment over 20%, these fall to 11.5% in Germany and 15% in France and then start to rise in the late 1980s in Germany, mid 1990s in France, ending at 14% for Germany, 17% for France. The natural rate u^* is a negative function of coordination and a positive function of both union density and employment protection. Finally, the sensitivity f of the domestic natural rate to global shocks – as measured by the first Principal Component – is a positive function of employment protection and the duration of unemployment benefits. We also tried adding the change in inflation, which had a negative though insignificant effect, t=-1.86, so traditional demand shocks may not be as important as real global shocks.

In sum: Employment protection causes greater unemployment persistence, high natural rates of unemployment and greater sensitivity to global shocks. Coordination, although increasing persistence, lowers the (natural) level of unemployment. Union density raises the natural rate of unemployment. Finally, the duration of benefits has a positive impact on the sensitivity of the natural rate to global shocks.

4. Conclusions

We have used unemployment data for twenty-one countries over the period 1960 to 2003 to identify unobservable global shocks to unemployment using factor analysis. We find that the first two principal components can explain 84% of the variation in unemployment across countries and over time, while the first four can explain 93% of the variation. The first variable appears to capture the first- and the second oil price shocks, as well as the recession that hit many countries in the early nineties. In contrast, the second describes transient elevations of unemployment in the mid- and late seventies as well as the phenomenal performance of the US economy in the late nineties. The remaining two shocks appear to represent the monetary shocks affecting unemployment in other countries in the late eighties and the early nineties and the banking crises that hit Scandinavia in the early nineties.

We find that the first Principal Component accounts for much of the observed persistence in the national unemployment series; there is much less inherent persistence in these series once account is taken of this underlying variable. We also find that domestic labour market institutions influence the sensitivity to global shocks, the speed of convergence to equilibrium and the natural rate itself. Allowing for global shocks and time-varying parameters produces estimates of speeds of convergence that are much faster than those common in the literature.

It follows that the key to resolving the unemployment puzzle lies in explaining the Continental shocks in the mid seventies and early eighties. A theory that explains why these shocks raised mean unemployment, while most other shocks left only a transient residue in the unemployment pool, is a candidate explanation. In contrast, theories that predict that all changes in unemployment are equally persistent – independent of the cause, size or duration of shocks – do not fit the data. We leave it to the reader to do the judging!

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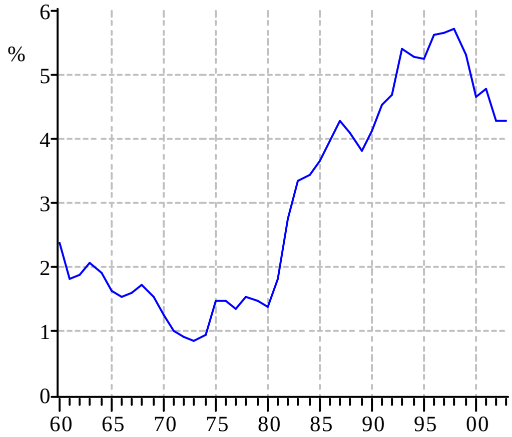
Appendix – Unemployment rates

Austria



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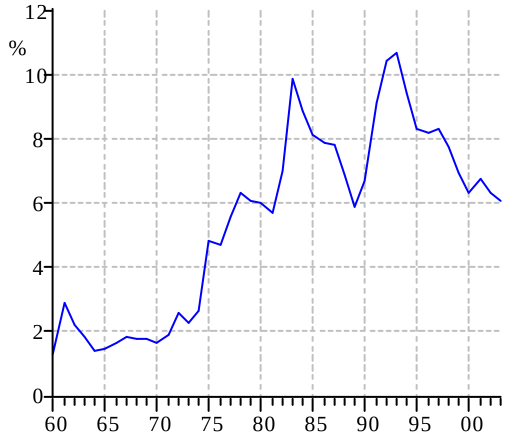

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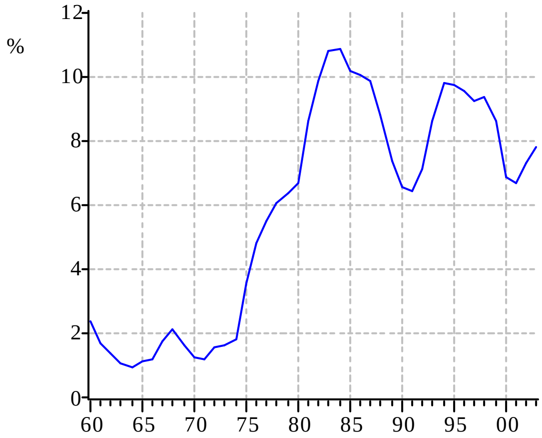

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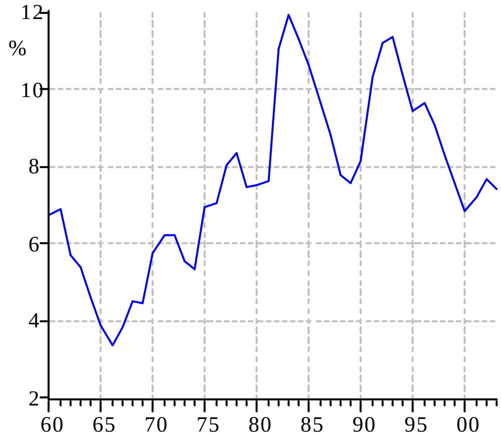

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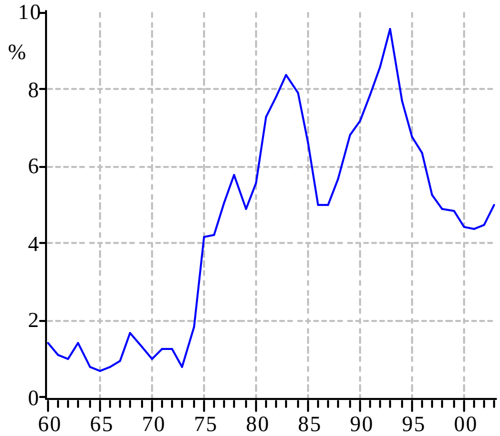

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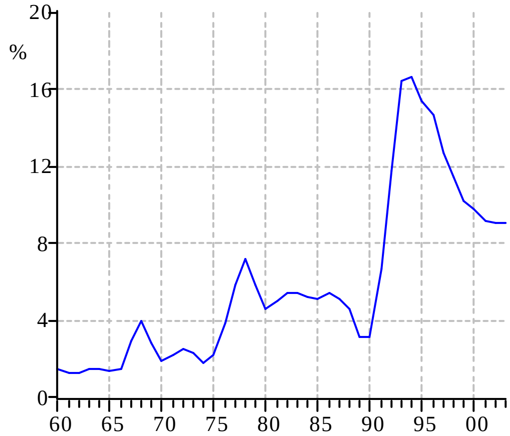

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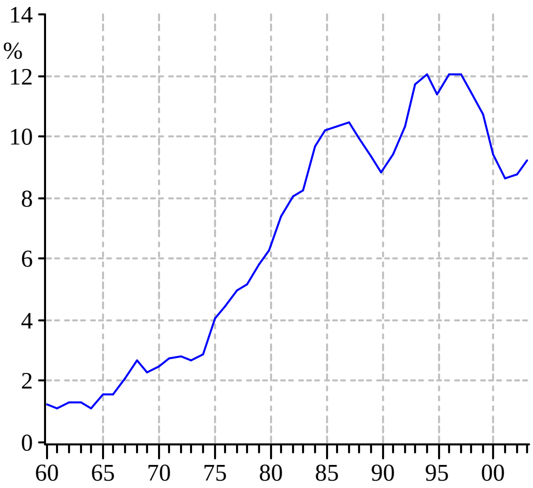

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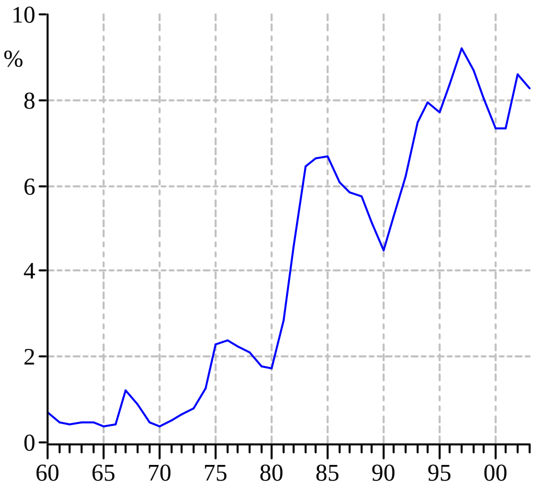

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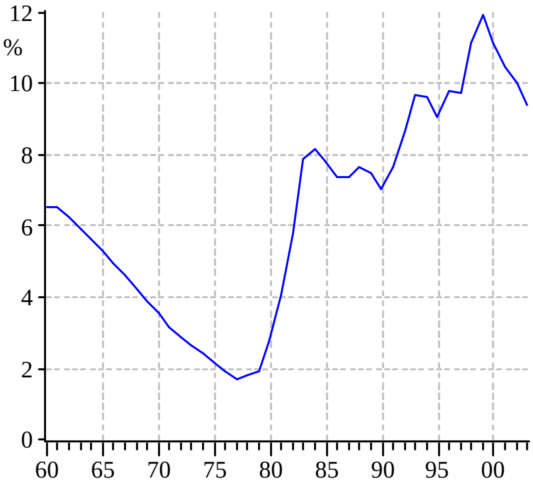

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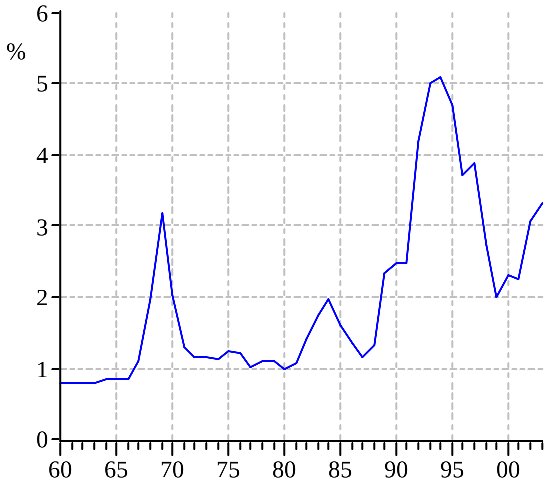

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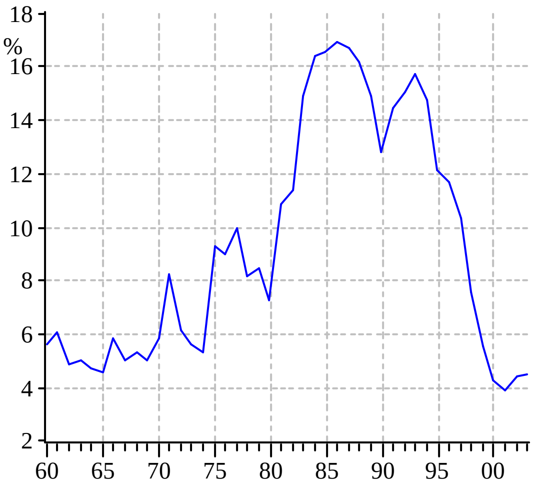

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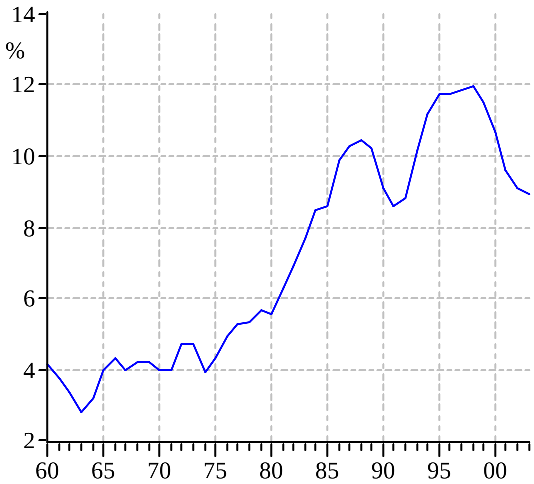

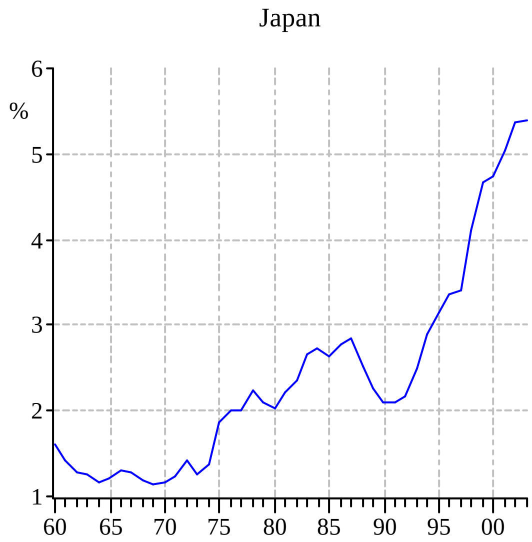
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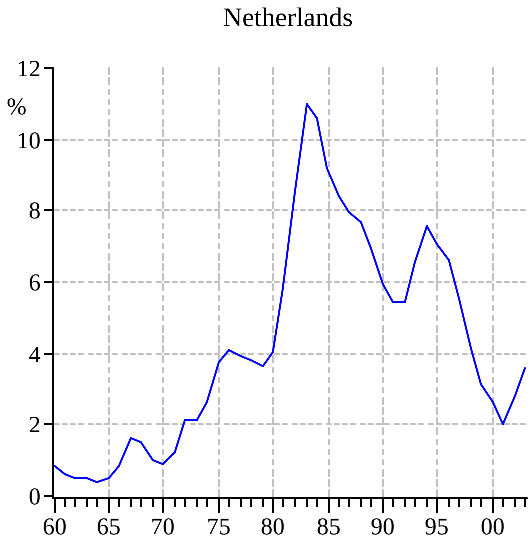
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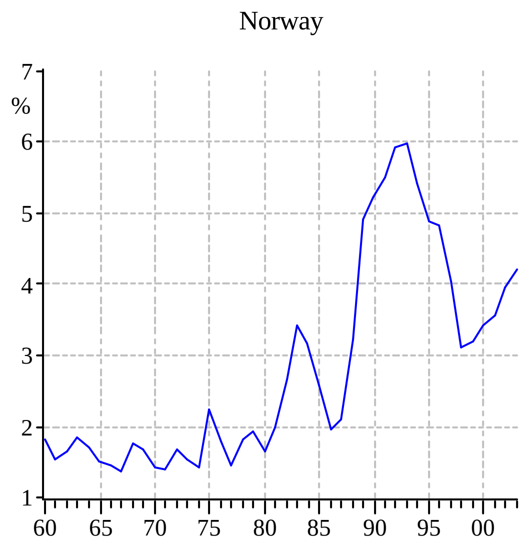
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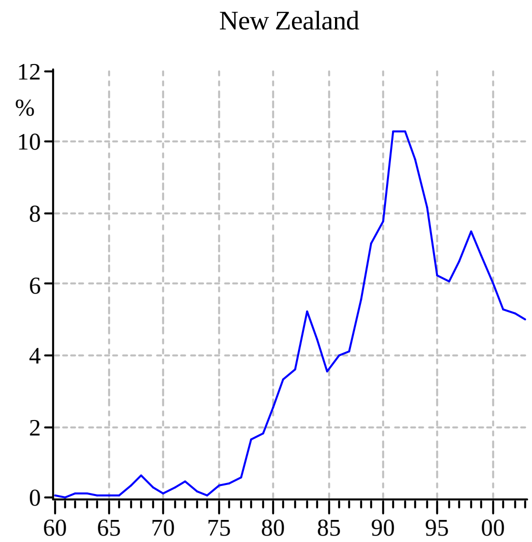
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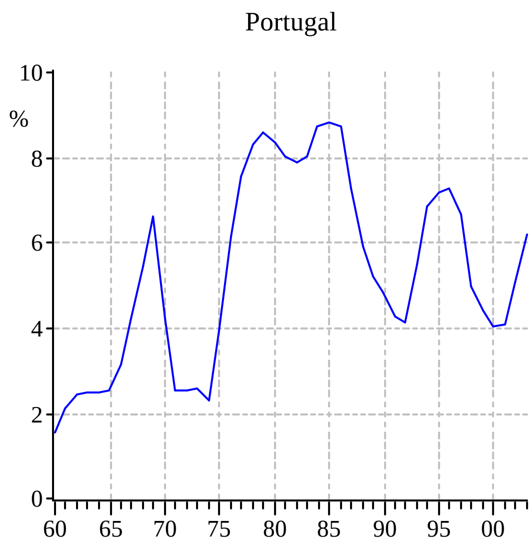
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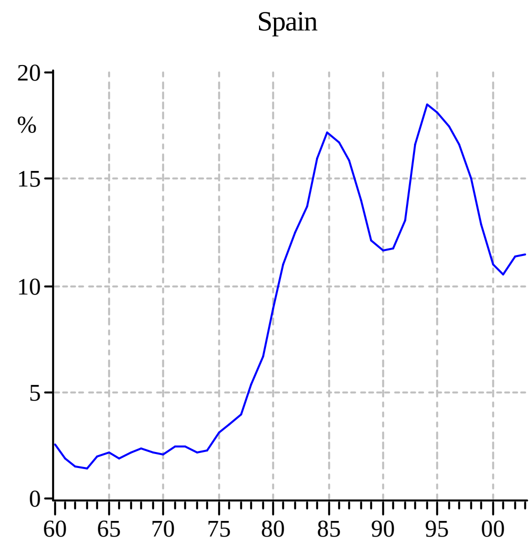
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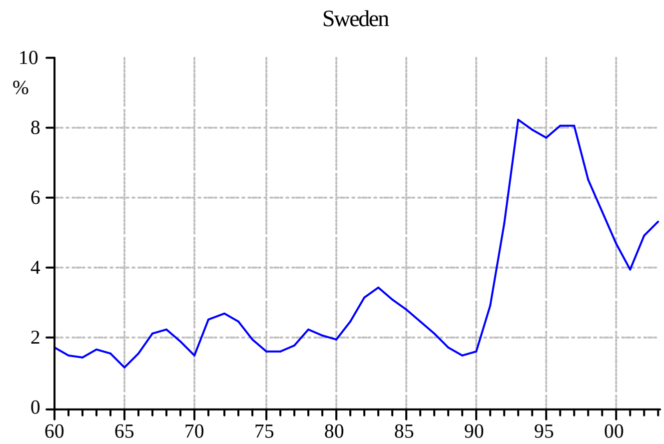
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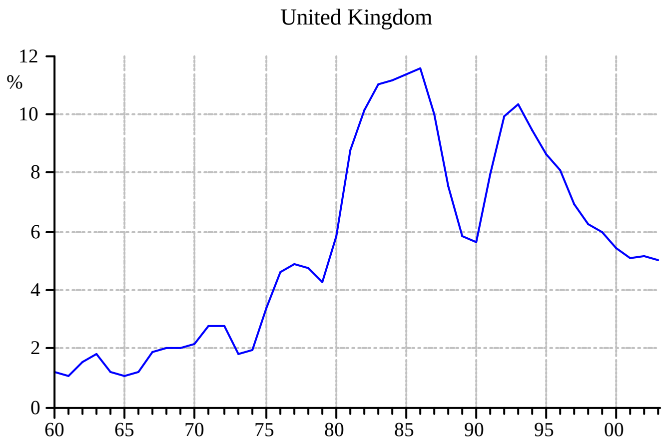
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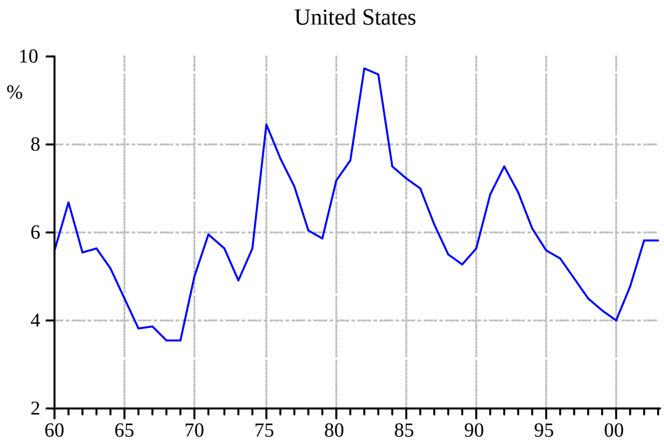
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