# Unemployment, Labour Market Institutions and Shocks*

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**Abstract**

This paper aims to explain the cross sectional differences in, and the time series evolution of, OECD unemployment from 1960 to 1995. We want to know how much of it can be accounted for by changes in labour market institutions, and the interactions of institutions and macroeconomic shocks. Our aim is also to verify the consistency of unemployment fluctuations with the labour cost results presented in Nunziata (2001). Our findings suggest that labour market institutions have a direct significant impact on unemployment in a fashion that is broadly consistent with their impact on real labour costs. Broad movements in unemployment across the OECD can be explained by shifts in labour market institutions, although this explanation relies on high levels of endogenous persistence. We cannot rule out a significant role for institutions through their interaction with adverse shocks, although the estimates do not appear extremely robust in this case. In contrast, the direct effect of institutions still holds when we include the possibility of interactions between shocks and institutions.

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# 1 Introduction

Figure 1 illustrates the evolution of unemployment in OECD countries over our estimation period, 1960 to 1995. Figure 2 shows the cross sectional variation in average unemployment. The unemployment picture across different countries is diverse, characterized by an upward trend from the early 1970s in most cases. The time pattern of European unemployment is not distant from the OECD average. However, if we consider the five main European countries we notice a 3 percent average difference from the sample mean from the middle 1980s onward[1], mostly driven by Southern European countries. The North American countries fluctuate around the OECD mean, the Scandinavian countries display, instead, unemployment levels that are consistently lower than the OECD average, excluding the last three observations. Anglo-Saxon Europe is characterized by the highest unemployment rate, because of the figures for Ireland before 1995.

This paper aims to explain these cross sectional differences, as well as the time series evolution of OECD unemployment from 1960 to 1995[2]. We want to know how much of it can be accounted for by changes in labour market institutions, or interactions between institutions and macroeconomic shocks. Our aim is also to verify the consistency of the unemployment analysis with the labour cost findings presented in Nunziata (2001). We are effectively trying to understand the long-term shifts in both unemployment and aggregate demand (relative to potential output). We emphasise this because it is sometimes thought that the fact that unemployment is determined by aggregate demand factors is somehow inconsistent with the notion that unemployment is influenced by labour market institutions. This is wholly incorrect.

The analysis of the effects of institutions on unemployment has largely developed in recent years. Section 2 introduces a brief account of the new directions undertaken by the most recent empirical research in this field. Section 3 presents our main econometric analysis, including a set of dynamic simulations that examine the explanatory power of our model. Section 4 extends the analysis in order to test the role played by the interaction of institutions and macroeconomic shocks. Finally, section 5 contains some concluding remarks.

# 2 Institutions and Unemployment: What is Known and What is Still to Know

The multi-country empirical literature on unemployment and labour market institutions experienced a recent boost when new data on time varying institutional indicators were made available by the OECD and other researchers[3]. The first works in the field date from around the early 1990s and rely on simple cross sectional regressions. Here, we present a brief survey of the analysis produced up to now, in order to understand which questions have been answered yet, and which still need to be answered.

Following the taxonomy proposed by Blanchard and Wolfers (2000), we can classify the analysis explaining OECD unemployment into three broad categories: the ones

[1] Note that all the group means are unweighted averages.
[2] A synthesis of our findings is contained in Nickell and Nunziata (2002).
[3] See Nunziata (2001) for a detailed account of the data and relative sources.

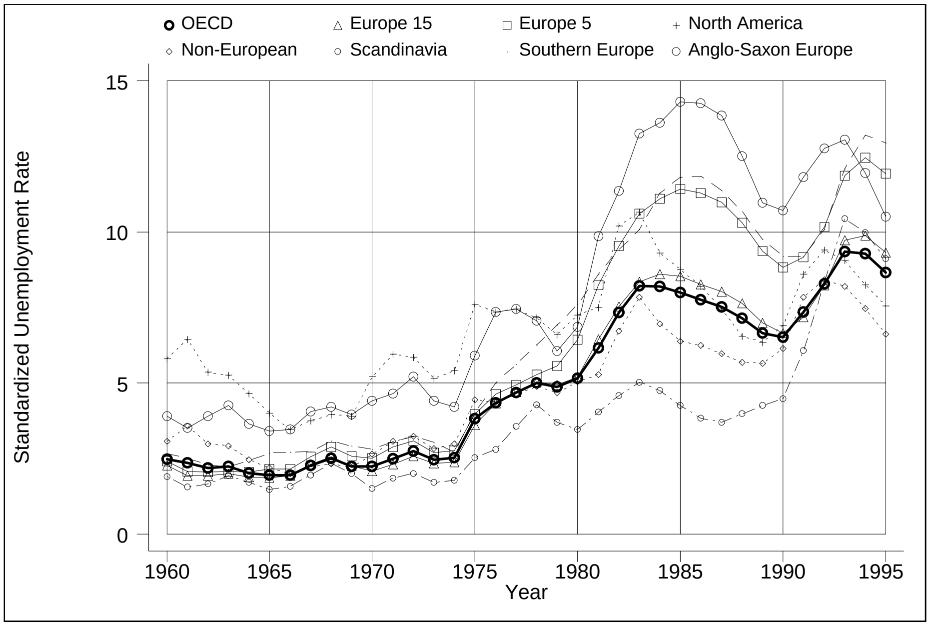


Figure 1: The evolution of unemployment in OECD countries: 1960-1995

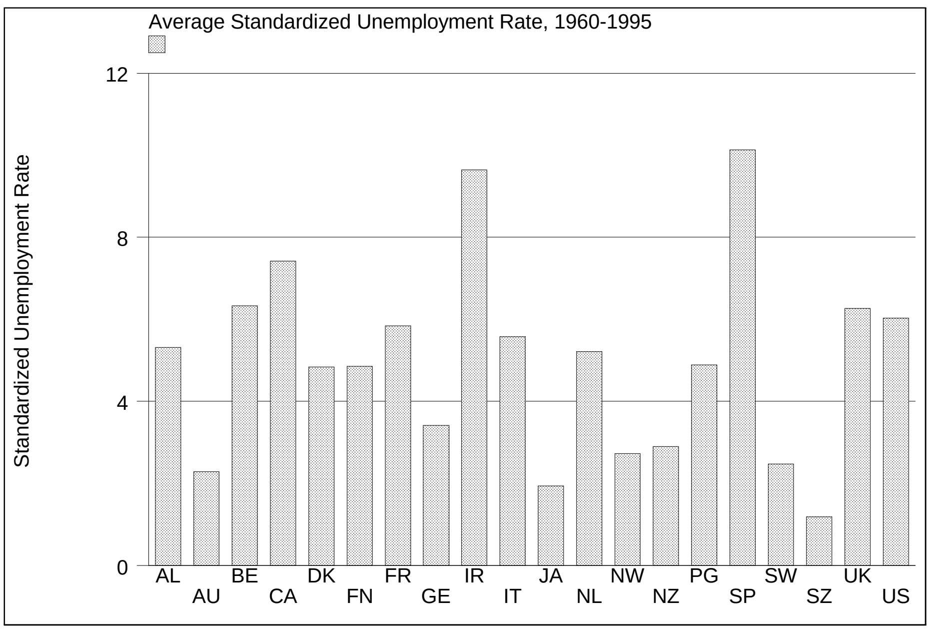


Figure 2: Cross country variation in OECD unemployment: 1960-1995 average

that focus on the role of adverse macroeconomic scenarios, the ones that focus on the role of institutions and the ones that focus on the interaction between institutions and macroeconomic conditions. In what follows we concentrate on the second and the third categories, since in our belief the third encompasses the first. Indeed, as noted before in the literature, trying to explain OECD unemployment through focusing solely on the role of adverse macroeconomic shocks is problematic. The differences in the shocks across countries are not sufficient to explain the variation in OECD unemployment.

## 2.1 The Approach Based on Institutions

Nickell (1997) proposes a refutation of the widespread picture of a flexible North American labour market versus a rigid European one, and of the explanation of the diversities in the unemployment performances of the two continents based on this assumption. The main argument of this influential paper is that European markets are characterized by an enormous variation in unemployment rates, and the countries with the highest unemployment rates are not necessarily the rigid ones. Nickell proposes an empirical analysis of the effects of labour market institutions on unemployment in 20 OECD countries, observed in the two periods 1983-1988 and 1989-1994. The model is estimated by FGLS random effects. As there are only two observations per country, it exploits the cross sectional variation in institutions.

The paper contains a range of models, analysing log unemployment (total, long-term and short-term), the employment population ratio (whole working age and prime age males) and overall labour supply. The institutional indicators are mainly provided by the OECD, and contain information on the same variables analysed in this paper, together with a measure of active labour market policies and labour standards regulations. The empirical results are consistent across different models, and suggest that high unemployment is associated with generous unemployment benefits, high unionization associated with low bargaining coordination and high taxes. On the contrary, labour market rigidities that do *not* raise unemployment significantly include strict employment protection or labour standards regulations, high benefits associated with pressure on the unemployed to take jobs[4] and high unionization levels accompanied by high levels of bargaining coordination.

Elmeskov et al. (1998) propose an empirical analysis of the effects of labour market institutions on OECD structural unemployment, extending previous work by Scarpetta[5]. They consider 19 OECD countries observed over the period 1983-1995 and adopt a FGLS random effects specification for their unemployment equation. Their results are in line with the findings of Nickell (1997), although they identify a positive significant coefficient on employment protection regulations and provide evidence in support of significant interaction effects between institutions. The claim of the paper is that some European countries[6] have been successful in reducing unemployment in recent years thanks to their labour market reforms, particularly oriented towards the insiders. Some of the change in regulations that might have reduced unemployment are stricter unemployment benefits

[4] This is enforced through reducing the duration of benefits or influencing the ability (or willingness) of the unemployed to take jobs.

[5] See Scarpetta (1996).

[6] These are Australia, Denmark, Ireland, The Netherlands, New Zealand and United-Kingdom.

provision (both through tightened eligibility conditions and reduced replacement rates) and looser fixed term contracts regulations.

Belot and Van Ours (2000, 2001) insist on the potential relevance of complementarities between institutions and propose a static fixed effect multi-country unemployment model that includes institutions and a set of interactions among institutions as explanatory variables. The results of their model suggest that in some countries institutions have a direct effect on unemployment while in others the interaction effects are more important. The tax rate and the replacement rate are found to be the most important factors in determining unemployment, and in general the impact of labour market reforms is affected by the institutional factors that determine the bargaining position of the worker.

## 2.2 The Approach Based on Institutions and Shocks

Layard et al. (1991)[7] present a dynamic model of unemployment where institutions are interacted with shocks, or factors which may influence unemployment in the longer term. These are: wage pressure (simply a dummy which takes the value 1 from 1970), the benefit replacement ratio, real import price changes and monetary shocks. They affect unemployment through their interactions with time invariant institutions, different sets of institutions affecting the degree of unemployment persistence (accounted for by the lagged dependent variable), the impact of wage pressure variables, including the replacement rate and import prices, and the effect of monetary shocks. Their model explains the data better than individual country autoregressions with trends.

Blanchard and Wolfers (2000) concentrate on the combined role played by institutions and macroeconomic conditions. They identify a set of macroeconomic variables that could have played a role in the explanation of European unemployment. These are the decline in total factor productivity growth, the real interest rate and the adverse shifts in labour demand[8].

Looking at these factors in Europe, TFP growth, was subject to a continuous secular decline from the 1960s to the 1990s. On average, TFP growth was around 5% in the 1960s and had declined to around 2% at the end of the 1970s, remaining stable at this level up to the 1990s. As regards the real interest rate, it decreased in most European countries, except Germany, from the 1960s to the second half of the 1970s, and started to rise afterwards to levels that are comparable with the 1960s. The log of the labour share[9] has been increasing in most European countries from the 1960s up to the middle of the 1970s, when it started to decrease[10].

The authors argue that although the effect of these shocks is not supposed to persist in the long run, their interaction could explain part of the European unemployment

[7] See Chapter 9, p. 430-437.

[8] It is worthwhile noting that the definition of "shock" for each of these variables is in some sense misleading since none of them is mean reverting. However, in order to avoid confusion, from now on our terminology will be the one used by the authors.

[9] The labour share considered by Blanchard and Wolfers is purged of the effects of factor prices in presence of a low elasticity of substitution.

[10] The case of the UK is different, since the labour share decreased from the 1960s, and started to increase from the early 1970s onward.

time series in recent decades. Broadly speaking, a decline in TFP, accompanied by slow wage adjustment to the new equilibrium, could have pushed up unemployment in the 1970s. Then, the real interest rate increases in the 1980s could have negatively affected capital accumulation, maintaining high levels of unemployment in that period. Finally, an adverse shift in labour demand may be responsible for the high unemployment levels of the 1990s[11].

The main idea in the paper is that these trended variables may explain the general increase in unemployment in Europe, while the cross sectional variation across countries can be imputed to their different institutions. In order to test this assumption they estimate an unemployment equation where the impact of the institutions is interacted with the vector of macroeconomic shocks.

They first treat the shocks as unobservable but common to all countries, interacting the time dummies $d_t$ with a vector of time invariant institutions[12] $\sum_j b_j X_{ij}$:

$$u_{it} = c_i + d_t \left(1 + \sum_j b_j X_{ij}\right) + e_{it} \tag{1}$$

where $i$ is a country index, $t$ a five year period index, and $j$ an index for institutions. As an alternative specification of their model, they substitute the time dummies with the country specific series of TFP growth, real interest rate and labour demand shift:

$$u_{it} = c_i + \left(\sum_k Y_{kit} a_k\right) \left(1 + \sum_j b_j X_{ij}\right) + e_{it} \tag{2}$$

where $k$ is an index for the shocks.

The estimation of equation (1) yields significant effects, with the expected signs, for all institutions excluding union coverage. Moreover, the time effects, for average levels of the institutional indicators, account for a 7.3% rise in unemployment from the 1960s to the 1990s. The impact of the shocks on unemployment is mediated by labour market institutions. This implies that, for example, a 1 percent increase in unemployment for average levels of institutions, becomes 0.58 when employment protection is at a minimum and 1.42 when employment protection is at a maximum. When substituting the time invariant employment protection and unemployment benefit variables with analogous time varying indicators, the results are similar, although the estimated effect is weaker.

Estimating equation (2) with shocks only, the authors find that TFP and the real interest rate are significant and have the expected sign. However, the heterogeneity of the shocks across countries is not able to account for the cross sectional diversities in the unemployment rate. When introducing the interactions with institutions, all three shocks are significant, with the expected sign. The coefficients on institutions are all significant with the expected sign, with the exception of union coverage. The most important institutional effects are the benefit replacement rate, benefit duration, union density and coordination.

[11]Depending on the ultimate nature of this adverse labour demand shock some conclusions about the future can be derived. If the shock originated through a reduction in labour hoarding, as the authors suggest, profits may be positively affected, with the hope for an employment increase in the near future triggered by higher capital accumulation.

[12]These are the indicators in Nickell (1997).

In general, the institutional coefficients are 1.5 to 2 times larger than the ones estimated for equation (1). However, although the fit of (2) is good, it is much lower than the fit of (1), despite the fact that the former allows for different shocks across countries. Hence, the time dummies are still better than the three shocks in explaining the evolution of OECD unemployment. In addition, substituting time invariant institutions with their analogous time varying indicators also reduces the fit.

Fitoussi et al. (2000) propose a similar approach. They draw on the contribution of Phelps (1994) that identifies a set of five macroeconomic shocks potentially relevant to the explanation of the increase in unemployment since the 1970s, in most OECD countries. The variables suggested by Phelps are: the reduced expectations of productivity growth in the 1970s and the increase in the expected real interest rate in the 1980s, both inducing an increase in the effective cost of capital; the increase in income and services from the private assets of employees; the increase in social benefits relative to real wages net of taxes, originated by the welfare state reforms of the 1960s and 1970s, the productivity slowdown from the 1970s and the oil crisis of the 1970s.

The authors estimate an unemployment equation of the form:

$$u_{it} = \alpha_i + \mu_i u_{it-1} + \phi_i^1 r_{t-1}^* + \phi_i^2 g_{t-1} + \phi_i^3 p_{t-1}^{oil} + \\ + \phi_i^4 \left(\tilde{y}_{it-1}^W + \tilde{y}_{it-1}^S\right) \frac{1+\tau_{it-1}^p}{1-\tau_{it-1}^D} + \gamma_i \Delta\pi_{it} + \varepsilon_{it} \quad (3)$$

where $u$ is the unemployment rate, $r^*$ is the world real interest rate, $g$ is the (smoothed) rate of change in labour productivity, $p^{oil}$ is the real oil price, $\left(\tilde{y}^W + \tilde{y}^S\right)$ is the ratio of total nonwage support (per worker in the labour force) to labour productivity, $\tau^D$ is the income tax rate, $\tau^p$ is the payroll tax rate, and $\pi$ is the inflation rate. They allow the coefficients to differ across countries in equation (3) in order to check for poolability, and then they impose the restriction of common coefficients across countries, allowing for a proportionality factor $\theta_i$ :

$$u_{it} = \alpha_i + \mu_i u_{it-1} + \theta_i \left(\phi^1 r_{t-1}^* + \phi^2 g_{t-1} + \phi^3 p_{t-1}^{oil} + \phi^4 \left(\tilde{y}_{it-1}^W + \tilde{y}_{it-1}^S\right) \frac{1+\tau_{it-1}^p}{1-\tau_{it-1}^D}\right) + \\ + \gamma_i \Delta\pi_{it} + \varepsilon_{it}. \quad (4)$$

Here, the diverse impact of the macroeconomic shocks is explained by different degrees of real wage rigidity in each country, captured by the coefficient $\theta_i$.

The estimation presented by the authors shows a significant coefficient, of expected sign, on each explanatory variable. Moreover, countries such as the Netherlands, the UK and the US, characterized by decreasing unemployment rates in the 1990s, are also the ones that show low unemployment persistence (i.e. low lagged dependent variable coefficients $\mu_i$) and high sensitivity to the shocks (i.e. high $\theta_i$s).

The effect of the real interest rate is comparable with the one estimated by Blanchard and Wolfers while the effect of productivity is much larger. For example, a 1 percentage point increase in the real interest rate induces an increase in long run unemployment equal to 0.37 percent in France, 0.18 percent in Germany, 0.28 percent in Italy, 0.31 percent in the UK and 0.10 percent in the US. A 3 percent decrease in the domestic rate of productivity growth induces an increase in long run unemployment equal to 4.78 percent in France, 2.38 percent in Germany, 3.66 percent in Italy, 4.03 percent in the UK and 1.25 percent in the US.

The authors try to identify the source of the differences in the estimated $\alpha$ and $\theta$ terms, producing 2 cross sectional regressions, each with 19 observations, of each parameter on a set of labour market institutions[13]. They find that the institutions can explain around 50% of the difference in the coefficients. In addition, the sign of each institutional coefficient is as expected. The fixed effects, the $\alpha$ terms, depend positively on the benefit replacement ratio, union coverage and density, and negatively on coordination. The sensitivity to shocks parameters, the $\theta$ terms, depend positively on benefit durations, union density and negatively on coordination and active labour market programmes.

The authors extend their analysis through including the share price normalized by productivity in equation (4), inside the bracket. This variable is correlated with the entrepreneurs' expectations about the future and is found to be significant, with the expected negative sign.

Fitoussi et al.'s vision is close to the one of Blanchard and Wolfers, since their hypothesis is that the driving force behind high unemployment levels is the set of adverse macroeconomic shocks[14]. However, both analyses show that shocks are not enough to explain the variation in the evolution of unemployment across countries, and institutional information is needed to account for that.

Bertola et al. (2001) follow the procedure of Blanchard and Wolfers, analysing a sample of 20 OECD countries, observed from 1960 to 1994. They first regress unemployment on the shocks (including a change in inflation variable), country dummies and time effects. The sign and significance of the coefficients are analogous to those found by Blanchard and Wolfers. However, when they extend the Blanchard model introducing both period dummies and macroeconomic shocks, the TFP shock changes signs and the real interest rate effect becomes much smaller. The authors find that the shocks can explain only 26% of the US-other country difference in the 1970-1995 unemployment change.

In a subsequent specification the shock variables are interacted with a set of time invariant institutional indicators which have the expected sign. However, some of the shocks are not significant, and the introduction of time dummies reduces their coefficient by a half. This new specification can account for 50% of the US-other country difference in the 1970-1995 unemployment change.

According to the authors, the main reasons for the better performance of the US compared to Europe in terms of unemployment are more favourable shocks and flexible institutions. Shocks that produced a 10-12% rise in unemployment in Europe affected the US to a much smaller extent.

Overall, the approach based on both macroeconomic shocks and institutions looks appealing, since it relies on a simple mechanism that accounts for both the evolution of unemployment and its variation across countries. However, much of the success of this kind of explanation for European unemployment relies on the identification of sensible

[13] The data on institutions are provided by Nickell and Layard (1998).

[14] The restrictive monetary policies in countries aspiring to EMU membership, like France, Germany, Italy, and Spain, are an example.

and credible macroeconomic variables to be interacted with institutions. The variables proposed by these authors are typically not mean reverting, and therefore they are more than simple shocks to the equilibrium unemployment level of each country.

### 2.3 The Approach of This Paper

In what follows we first produce an empirical test of the ability of institutions to explain the time pattern of unemployment in OECD countries. Subsequently, we compare the approach based on institutions alone with the one where institutions are interacted with shocks, and investigate which one performs better.

## 3 The Explanatory Power of Labour Market Institutions

### 3.1 The Model

We follow the theoretical framework depicted in Nickell (1998) and Nunziata (2001), estimating an unemployment model where the explanatory variables are represented by all factors influencing the equilibrium level of unemployment and the shocks that cause unemployment to deviate from the equilibrium. The general unemployment equation has the form:

$$U_{it} = \beta_0 + \beta_1 U_{it-1} + \boldsymbol{\gamma}'\bar{\mathbf{z}}_{w,it} + \boldsymbol{\lambda}'\mathbf{h}_{it} + \boldsymbol{\vartheta}'\mathbf{s}_{it} + \phi_i t_i + \mu_i + \lambda_t + \varepsilon_{it} \tag{5}$$

where $U_{it}$ is the unemployment rate in percentage points, $\bar{\mathbf{z}}_{w,it}$ is a vector of labour market institutions, $\mathbf{h}_{it}$ is a vector of interactions among institutions, $\mathbf{s}_{it}$ is a vector of controls for macroeconomic shocks, $t_i$ is a country specific time trend, $\mu_i$ is a fixed country effect, $\lambda_t$ is a year dummy and $\varepsilon_{it}$ is the stochastic residual.

More specifically, the vector of labour market institutions includes the following elements:

$$\boldsymbol{\gamma}'\bar{\mathbf{z}}_{w,it} = \gamma_1 EP_{it} + \gamma_2 BRR_{it} + \gamma_3 BD_{it} + \gamma_4 \Delta UD_{it} + \gamma_5 CO_{it} + \gamma_6 TW_{it} \tag{6}$$

where $EP_{it}$ is employment protection, $BRR_{it}$ is the unemployment benefit replacement rate, $BD_{it}$ is the unemployment benefit duration, $UD_{it}$ is net union density, $CO_{it}$ is bargaining coordination, and $TW_{it}$ is the tax wedge, i.e. direct + indirect +labour tax rate.

The vector of institutional interactions in the benchmark model has the following form:

$$\boldsymbol{\lambda}'\mathbf{h}_{it} = \lambda_1 BRRBD_{it} + \lambda_2 UDCO_{it} + \lambda_3 TWCO_{it} \tag{7}$$

where the notation used is self-explanatory. Each element is expressed as an interaction between deviations from world averages. In this way the coefficient of each institution in levels can be read as the coefficient of the "average" country, i.e. the country characterized by the average level of that specific institutional indicator, since for this average country, the interaction terms are zero.

| | **RZB Test** | **RZB Test** Small sample approximation | **Interactions Test** |
|---|---|---|---|
| Statistic | $\chi^2_{(190)} = 87.67$ | $F_{(190,413)} = 87.67$ | $\chi^2_{(179)} = 4711.34$ |
| P-value | $\simeq 1$ | $\simeq 0.00$ | $\simeq 0.00$ |
| Regressors | Institutions and shocks | Institutions and shocks | Institutions and shocks |

Table 1: Poolability Tests

| | **"Strong MSE" Test** | **"First Weak" MSE Test** | **"Second Weak" MSE Test** |
|---|---|---|---|
| Statistic | $\lambda_{NT} = 0.63$ | $\lambda_{NT} = 0.63$ | $\lambda_{NT} = 0.63$ |
| $H_0$ : | $\lambda_{NT} \leq \frac{1}{2}$ | $\lambda_{NT} \leq \phi_{NT} = 3.96$ | $\lambda_{NT} \leq (N-1)\,K'/2 = 95$ |
| Pooling is better | no | yes | yes |

Table 2: MSE Poolability Tests

The vector of controls for macroeconomic shocks contains the following elements:

$$\boldsymbol{\vartheta}'\mathbf{s}_{it} = \theta_1 LDS_{it} + \theta_2 TFPS_{it} + \theta_3 D2MS_{it} + \theta_4 RIRL_{it} + \theta_5 TTS_{it} \tag{8}$$

where $LDS_{it}$ is a labour demand shock, $TFPS_{it}$ is a total factor productivity shock, $D2MS_{it}$ is a money supply shock, $RIRL_{it}$ is the long term real interest rate, and $TTS_{it}$ is a terms of trade shock[15]. These are all mean reverting, except for the real interest rate which we include simply because others have set such store by it.

The institutional indicators and the macroeconomic variables are provided by the Labour Market Institutions Database[16], assembled from the works of different researchers and institutions. All the data definitions and sources are contained in the appendix to Nunziata (2001).

In what follows we adopt the same methodology employed in the estimation of the labour cost model, i.e. we use a semi-pooled specification for (5), correcting for heteroskedasticity and serial correlation of the disturbances. We first present a set of specification and diagnostic tests that justify our choice and then we illustrate the estimation results and the dynamic simulations of the benchmark model.

## 3.2 Specification and Diagnostic Tests

### 3.2.1 A Semi-Pooled Specification

If parameter heterogeneity is ignored in a fixed effects multi-country dynamic setting like ours, the pooled estimator is inconsistent even when $T \to \infty$, as shown by Pesaran and Smith (1995).

[15]The definition of each shock is as follows: (i) $LDS$ is measured by the residuals of 20 national labour demand equations; (ii) $TFPS$ is measured by the deviations from the total factor productivity trend; (iii) $D2MS$ is equal to the acceleration of the money supply; (iv) $TTS$ is $\left(\frac{imports}{GDP}\right)\Delta\log\left(\frac{P_{import}}{P_{GDP}}\right)$ where $P_{import}$ is the imports deflator and $P_{GDP}$ is the GDP deflator at factor cost. See also Nunziata (2001) for data definitions and sources.

[16]See the description contained in Nunziata (2001b).

| | **Baseline model** |
|---|---|
| GH test | $\chi^2_{(19)} = 843.85$ |
| P-value | $\simeq 0.00$ |

Table 3: Test for groupwise heteroskedasticity

Table 1 presents a Roy-Zellner-Baltagi test of poolability under the general assumption of non spherical disturbances $\boldsymbol{\varepsilon} \backsim \mathbf{N}(\mathbf{0}, \boldsymbol{\Omega})$ and using a simplified version of the baseline model[17], without interactions among institutions. The null hypothesis of poolability is rejected if we consider the small sample approximation of the distribution of the test. The simple interaction test presented in the same table also suggests a certain degree of parameter heterogeneity, since the joint significance of the interactions between regressors and country dummies is not rejected.

However, as noted by Baltagi (1995), the pooled model can yield more efficient estimates at the expenses of bias. McElroy (1977) suggests three tests based on weaker mean square errors (MSE) criteria that do not test the falsity of the poolability hypothesis, but allow a choice between the constrained and unconstrained estimator on a pragmatic basis, i.e. on the basis of the trade-off between bias and efficiency, under the general assumption of $\boldsymbol{\varepsilon} \backsim \mathbf{N}(\mathbf{0}, \boldsymbol{\Omega})$.

Table 2 presents the test statistics calculated for the model studied in Table 1, as well as the analytical expression for the null hypothesis. According to the tests, the pooled model is preferable to the unconstrained model under the first and second Weak MSE criteria. In other words, the pooled model yields more efficient estimates than the individual country regressions.

In order to balance the efficiency gains obtained using a pooled empirical approach with the need to avoid the bias produced by an homogeneity assumption, we set up a *semi-pooled* specification for the model, introducing a set of interactions among institutions as we did for the labour cost model. In this way we allow some institutional coefficients to vary across countries and over time, and we are also able to control for the institutional complementarity effects suggested by the theory. The institutional coefficients are free to vary across countries and over time, according to the restrictions imposed by the homogeneous coefficients of each interaction.

#### 3.2.2 A Fixed Effects GLS Model Accounting for Heteroskedasticity and Serial Correlation

Our dynamic model includes fixed effects in order to control for country specific effects. This is a potential source of bias, as suggested by Nickell (1981), although the bias becomes less important as $T$ grows. However, Judson and Owen (1999) suggest that the fixed effects estimator performs as well as or better than many alternatives when $T = 30$, i.e. with a $T$ dimension similar to ours.

[17] The simplified model includes the unemployment rate (lagged), the benefit replacement ratio, union density, the tax wedge, a labour demand shock, a TFP shock, a money supply shock, the real interest rate and s terms of trade shock. We cannot include employment protection and coordination since these indicators are not time varying for some countries, making it impossible to estimate their coefficients for all countries in a set of country by country regressions.

| | **Baseline model** |
|---|---|
| $LM$ test, $AR(1)$ | |
| $v_{it} = \rho v_{i,t-1} + \varepsilon_{it}$ | $\chi^2_{(1)} = 77.37$ |
| $H_0 : \rho = 0$ | P-value$\simeq$0.000 |
| $LM_5$ test, $MA(1)$ | |
| $v_{it} = \varepsilon_{it} + \lambda \varepsilon_{i,t-1}$ | $N(0,1) = 8.80$ |
| $H_0 : \lambda = 0$ | P-value$\simeq$0.000 |

Table 4: Test for serial correlation

| | **Baseline model** |
|---|---|
| Fisher panel statistic of Dickey Fuller test (w.t.) | $\chi^2_{(40)} = 75.87$ P-value$\simeq$0.000 |
| Fisher panel statistic of Phillips Perron test | $\chi^2_{(40)} = 77.52$ P-value$\simeq$0.000 |

Table 5: Test for cointegration in panel regression

If the residuals are not homoskedastic, the estimates will still be consistent but inefficient. Table 3 presents a groupwise likelihood ratio heteroskedasticity test performed on the residuals of the baseline model estimated by OLS. The test is chi-squared distributed with $G-1$ degrees of freedom, where $G$ is the number of groups in the sample, 20 countries in our case. The null hypothesis of homoskedasticity across groups is rejected.

Table 4 presents the two versions of the Baltagi and Li (1995) serial correlation test in fixed effects models, assuming two alternative specifications for the error autocorrelation structure, namely $AR(1)$ and $MA(1)$. The asymptotic distribution of the test statistics is calculated for large $T$. Under both assumptions, the null hypothesis of no serial correlation in the disturbances is rejected.

Given the results of the heteroskedasticity and autocorrelation tests, the feasible GLS estimator in this paper is constructed assuming country groupwise heteroskedasticity, and an AR(1) structure in the disturbances, $\varepsilon_{it}$. Since we model contemporaneous cross country correlations through the inclusion of time dummies, the variance covariance matrix $\hat{\Omega}$ is characterized by only $N \times 2$ parameters. This implies that our model is immune of the potential bias affecting feasible GLS time-series cross-sectional models, described by Beck and Katz (1995)[18].

### 3.2.3 Panel Cointegration Properties

Given the large $T$ dimension of our model, we check its cointegration properties by means of a simple Fisher-Maddala-Wu test[19] that combines the results of $N$ individual country unit roots tests of any kind, each with P-value $P_i$ , in the statistic $-2\sum \log P_i$ , shown

[18]See the argument contained in Nunziata (2001).
[19]See Maddala and Wu (1996) and Fisher (1932).

to be $\chi^2$ distributed with $2N$ degrees of freedom[20].

Table 4 presents two versions of the cointegration test, using, respectively, Dickey Fuller with trend and Phillips Perron[21] tests. The P-values are MacKinnon approximations. The null hypothesis of no cointegration is rejected in both cases.

### 3.3 The Estimation Results

Tables 6, 7 and 8 present the estimation output from a set of alternative specifications of the unemployment model of equation (5). These are:

1. the baseline model;
2. the static model;
3. the static model with no macroeconomic shocks;
4. including $\Delta TW$;
5. including Oswald's Home Ownership variable (Portugal excluded) which represents the proportion of owner occupier households and, according to Oswald, is a proxy for labour mobility;
6. including an indicator of fixed term contracts and temporary work agencies regulations (Portugal excluded);
7. excluding Portugal for a comparison with the previous model;
8. excluding Portugal and Spain in order to check for the impact of the non democratic regimes in these countries in the 1970s and the transition to democracy afterwards;
9. including coordination types dummies;
10. using an alternative measure of bargaining coordination;
11. estimation on a subsample from 1970;
12. estimation on a subsample from 1970, using unemployment in logs;
13. check 1 of the hump shaped effect of taxation on unemployment, dividing the countries into three groups according to their degree of bargaining coordination[22];
14. check 2 of the hump shaped effect of taxation on unemployment, dividing the countries into three groups according to their degree of bargaining centralization;
15. including union density in levels;
16. substituting the macroeconomic shocks with the change in inflation;

[20] The test relies on the assumption of no cross country correlation and whenever this assumption is not met Maddala and Wu suggest bootstrapping to define the critical values. In our model we control for cross country correlation by means of time dummies, and therefore we assume we are free to use the exact distribution of the test for inference.

[21] See Dickey and Fuller (1979) and Phillips and Perron (1988).

[22] See Alesina and Perotti (1997) and Daveri and Tabellini (2000) for some empirical evidence on this.

17. the baseline model estimated by OLS;
18. the baseline model using 5 years averaged data;
19. the baseline model using 5 years averaged data, including union density in levels;
20. the baseline model using 5 years averaged data, including union density in levels and Oswald's Home Ownership variable.

All models are estimated by fixed effects GLS, with the correction for heteroskedasticity and serial correlation commented on above, except for Model 17 which is estimated by OLS.

Model 1 is the benchmark specification. It is characterized by a significant effect for most labour market institutions, except employment protection. Although the cointegration tests indicate that our model can explain the long run properties of unemployment, the estimated lagged dependent variable coefficient is quite high. This could mean that unemployment is highly persistent and/or that our model is not capturing the complexity of the data generating process. Indeed, in contrast to the analysis summarized in section 2, our shock variables are mean reverting, implying that institutions have to play a major role in the explanation of the evolution of OECD unemployment.

As regards the explanatory power of the model, we can see from Tables 9 and 10 that neither the time dummies nor the country specific time trends are significant, and their contribution to the fit of our equation is marginal. The ability of the model to explain the time pattern of the unemployment rate in each OECD country is investigated by means of a set of dynamic simulations contained at the end of this section.

Looking at the impact of each institutional indicator, benefit replacement rates and benefit durations have a significant positive effect on unemployment, and their impact is reinforced by their interaction[23].

Taxation has a positive impact on unemployment, which is moderated if wage bargaining coordination is high. The overall effect of taxation is, however, not as large as the one estimated by Daveri and Tabellini, with a 10 percent increase in the tax wedge inducing only a 1 percent increase in unemployment for average levels of coordination.

The impact of union density is not significant in levels[24], but we find a significant effect for its difference, consistent with the labour cost model. The role of coordination in wage bargaining appears to be one of moderating the impact of union density and taxation, as shown by the interaction terms with these indicators. The effect is also negative in levels.

As regards the macroeconomic shocks, we find a significant negative effect for the labour demand shock and the total productivity shock. The latter effect is consistent with the labour cost model. The acceleration of the money supply is not significant, while both the real interest rate and the terms of trade shock are significant with positive sign, as expected.

Columns 2 and 3 present the static version of the baseline model, respectively with and without the macroeconomic shocks. Most of the results in column 1 can also be observed in column 2, except that there is now a significant positive effect for employment protection, but no effect from the change in union density, and coordination in levels.

[23]This result is not matched by the labour cost model, where only the replacement rate is significant.
[24]This is consistent with previous results by Elmeskov et al. (1998).

| | (1) $UR$ | (2) $UR$ | (3) $UR$ | (4) $UR$ | (5) $UR$ | (6) $UR$ | (7) $UR$ |
|---|---|---|---|---|---|---|---|
| $UR(-1)$ | **0.863** | | | **0.864** | **0.866** | **0.869** | **0.868** |
| | [48.49] | | | [49.08] | [47.61] | [47.97] | [47.69] |
| $EP$ | **0.146** | **0.679** | **0.041** | **0.151** | **0.151** | **0.167** | **0.220** |
| | [0.91] | [1.90] | [0.12] | [0.95] | [0.89] | [1.02] | [1.34] |
| $BRR$ | **2.208** | **4.339** | **4.356** | **2.212** | **2.195** | **2.619** | **2.267** |
| | [5.44] | [5.04] | [5.16] | [5.43] | [5.24] | [6.26] | [5.46] |
| $BD$ | **0.473** | **1.732** | **1.563** | **0.433** | **0.401** | **0.521** | **0.428** |
| | [2.49] | [4.01] | [3.55] | [2.22] | [2.06] | [2.67] | [2.22] |
| $BRRBD$ | **3.752** | **14.872** | **16.657** | **3.890** | **3.072** | **3.641** | **3.216** |
| | [3.97] | [8.36] | [9.43] | [4.10] | [3.16] | [3.79] | [3.34] |
| $UDCO$ | **-6.983** | **-13.325** | **-6.990** | **-6.838** | **-7.482** | **-7.679** | **-7.458** |
| | [6.12] | [6.14] | [3.33] | [5.99] | [6.48] | [6.68] | [6.46] |
| $TWCO$ | **-3.456** | **-13.562** | **-11.889** | **-3.439** | **-3.625** | **-3.044** | **-3.693** |
| | [3.29] | [6.57] | [5.83] | [3.25] | [3.38] | [2.93] | [3.47] |
| $\Delta UD$ | **6.989** | **-0.856** | **-1.677** | **6.810** | **5.973** | **7.031** | **6.173** |
| | [3.17] | [0.19] | [0.39] | [3.09] | [2.57] | [3.04] | [2.65] |
| $CO$ | **-1.007** | **0.869** | **1.947** | **-1.019** | **-0.898** | **-0.913** | **-1.004** |
| | [3.54] | [1.37] | [3.15] | [3.56] | [3.01] | [3.24] | [3.52] |
| $TW$ | **1.511** | **3.490** | **2.121** | **1.570** | **1.585** | **2.267** | **1.680** |
| | [1.72] | [1.94] | [1.19] | [1.70] | [1.77] | [2.56] | [1.89] |
| $LDS$ | **-23.580** | **-28.888** | | **-24.023** | **-24.854** | **-23.780** | **-24.138** |
| | [10.36] | [6.11] | | [10.50] | [10.58] | [10.43] | [10.41] |
| $TFPS$ | **-17.872** | **-11.553** | | **-17.739** | **-17.522** | **-16.788** | **-17.404** |
| | [14.14] | [4.24] | | [13.88] | [13.34] | [13.28] | [13.35] |
| $\Delta^2 MS$ | **0.228** | **1.875** | | **0.179** | **0.238** | **0.272** | **0.247** |
| | [0.93] | [2.82] | | [0.73] | [0.96] | [1.12] | [1.00] |
| $RIRL$ | **1.812** | **11.745** | | **1.818** | **2.544** | **2.238** | **2.562** |
| | [1.56] | [5.12] | | [1.55] | [2.14] | [1.93] | [2.17] |
| $TTS$ | **5.823** | **14.682** | | **5.824** | **5.000** | **4.637** | **4.930** |
| | [3.26] | [3.94] | | [3.21] | [2.75] | [2.58] | [2.71] |
| $\Delta TW$ | | | | **-1.568** | | | |
| | | | | [0.98] | | | |
| $HO$ | | | | | **3.017** | | |
| | | | | | [1.21] | | |
| $FTC$ | | | | | | **0.422** | |
| | | | | | | [3.79] | |
| $TWA$ | | | | | | **-0.121** | |
| | | | | | | [0.96] | |
| *Country dummies* | $\surd$ | $\surd$ | $\surd$ | $\surd$ | $\surd$ | $\surd$ | $\surd$ |
| *Time dummies* | $\surd$ | $\surd$ | $\surd$ | $\surd$ | $\surd$ | $\surd$ | $\surd$ |
| *Obs* | 600 | 600 | 646 | 598 | 579 | 579 | 579 |
| *Countries* | 20 | 20 | 20 | 20 | 19 | 19 | 19 |
| *av.T* | 30.0 | 30.0 | 32.3 | 29.9 | 30.5 | 30.5 | 30.5 |
| Pval Cf=0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Pval f.e.=0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average $\mid \rho_i \mid$ | 0.68 | 1.05 | 0.92 | 0.71 | 0.60 | 0.60 | 0.60 |
| RMSE | 0.58 | 1.21 | 1.25 | 0.58 | 0.58 | 0.58 | 0.58 |

t-ratios in brackets.

Table 6: OECD Unemployment Models: 1960-1995

| | (8) $UR$ | (9) $UR$ | (10) $UR$ | (11) $UR$ | (12) $UR$ | (13) $UR$ | (14) $UR$ |
|---|---|---|---|---|---|---|---|
| $UR(-1)$ | **0.869** | **0.863** | **0.887** | **0.850** | **0.784** | **0.881** | **0.871** |
| | [45.56] | [48.33] | [49.74] | [41.56] | [32.58] | [50.34] | [48.91] |
| $EP$ | **0.253** | **0.066** | **-0.506** | **-0.112** | **-0.153** | **-0.095** | **-0.092** |
| | [1.53] | [0.41] | [3.35] | [0.43] | [1.88] | [0.61] | [0.59] |
| $BRR$ | **2.237** | **2.553** | **1.728** | **2.231** | **0.193** | **2.175** | **2.400** |
| | [5.36] | [6.21] | [4.15] | [4.09] | [1.60] | [5.23] | [5.69] |
| $BD$ | **0.430** | **0.449** | **0.201** | **0.820** | **0.223** | **0.459** | **0.475** |
| | [2.29] | [2.29] | [1.00] | [3.84] | [3.38] | [2.35] | [2.43] |
| $BRRBD$ | **3.206** | **4.404** | **4.222** | **3.443** | **0.419** | **3.830** | **4.399** |
| | [3.35] | [4.57] | [4.22] | [2.89] | [1.38] | [3.99] | [4.51] |
| $UDCO$ | **-7.597** | **-6.254** | **0.912** | **-8.136** | **-0.169** | **-6.370** | **-6.800** |
| | [6.53] | [5.59] | [1.66] | [5.11] | [0.48] | [5.94] | [6.17] |
| $TWCO$ | **-3.619** | **-2.922** | **-2.375** | **-0.871** | **-0.391** | | |
| | [3.40] | [2.75] | [3.97] | [0.70] | [1.46] | | |
| $\Delta UD$ | **6.699** | **7.198** | **7.039** | **8.840** | **2.007** | **7.144** | **6.334** |
| | [2.88] | [3.35] | [3.24] | [3.57] | [3.42] | [3.17] | [2.83] |
| $CO$ | **-1.002** | **-1.007** | **-0.132** | **-1.178** | **-0.121** | **-1.139** | **-0.934** |
| | [3.48] | [3.43] | [1.22] | [3.22] | [1.64] | [3.85] | [2.98] |
| $TW$ | **1.773** | **1.610** | **-1.063** | **0.717** | **0.042** | | |
| | [1.97] | [1.80] | [1.29] | [0.67] | [0.18] | | |
| $LDS$ | **-22.308** | **-23.681** | **-20.800** | **-24.163** | **-3.474** | **-23.714** | **-23.658** |
| | [9.65] | [10.38] | [8.74] | [9.38] | [5.53] | [10.16] | [10.20] |
| $TFPS$ | **-16.980** | **-18.550** | **-19.524** | **-17.009** | **-3.644** | **-18.018** | **-18.956** |
| | [13.21] | [14.85] | [14.70] | [12.95] | [11.22] | [13.99] | [14.75] |
| $\Delta^2 MS$ | **0.265** | **0.280** | **0.374** | **0.172** | **0.187** | **0.193** | **0.197** |
| | [1.09] | [1.18] | [1.32] | [0.65] | [2.59] | [0.74] | [0.78] |
| $RIRL$ | **2.923** | **1.642** | **0.744** | **-0.965** | **-0.094** | **1.868** | **1.440** |
| | [2.46] | [1.42] | [0.62] | [0.76] | [0.32] | [1.59] | [1.22] |
| $TTS$ | **4.275** | **6.201** | **5.572** | **7.179** | **0.543** | **5.170** | **5.075** |
| | [2.34] | [3.42] | [2.92] | [3.68] | [1.43] | [2.86] | [2.83] |
| $TW{\cdot}Gunc$ | | | | | | **1.351** | **1.926** |
| | | | | | | [1.31] | [1.78] |
| $TW{\cdot}Gint$ | | | | | | **1.449** | **1.328** |
| | | | | | | [1.63] | [1.50] |
| $TW{\cdot}Gcoo$ | | | | | | **1.064** | **0.174** |
| | | | | | | [1.27] | [0.20] |
| $CO1$ | | **-0.483** | | | | | |
| | | [3.10] | | | | | |
| $CO2$ | | **-0.453** | | | | | |
| | | [3.25] | | | | | |
| $CO3$ | | **0.159** | | | | | |
| | | [0.593] | | | | | |
| $CO4$ | | **-0.276** | | | | | |
| | | [2.54] | | | | | |
| $CO6$ | | **-0.174** | | | | | |
| | | [1.54] | | | | | |
| *Country dummies* | $\surd$ | $\surd$ | $\surd$ | $\surd$ | $\surd$ | $\surd$ | $\surd$ |
| *Time dummies* | $\surd$ | $\surd$ | $\surd$ | $\surd$ | $\surd$ | $\surd$ | $\surd$ |
| *Obs* | 549 | 600 | 600 | 491 | 485 | 600 | 600 |
| *Countries* | 18 | 20 | 20 | 20 | 20 | 20 | 20 |
| *av.T* | 30.5 | 30.0 | 30.0 | 24.5 | 24.2 | 30.0 | 30.0 |
| Pval Cf=0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Pval f.e.=0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average $\mid \rho_i \mid$ | 0.55 | 0.69 | 0.75 | 0.60 | 0.70 | 0.69 | 0.69 |
| RMSE | 0.55 | 0.56 | 0.58 | 0.53 | 0.61 | 0.58 | 0.58 |

t-ratios in brackets.

Table 7: OECD Unemployment Models: 1960-1995 (continued)

| | (15) $UR$ | (16) $UR$ | (17) $UR$ | (18) $UR$ | (19) $UR$ | (20) $UR$ |
|---|---|---|---|---|---|---|
| $UR(-1)$ | **0.859** | **0.876** | **0.867** | | | |
| | [47.16] | [41.81] | [42.27] | | | |
| $EP$ | **0.257** | **-0.053** | **-0.254** | **0.935** | **0.966** | **0.955** |
| | [1.47] | [0.34] | [0.95] | [2.45] | [2.54] | [2.08] |
| $BRR$ | **2.457** | **1.977** | **2.783** | **3.123** | **3.068** | **3.846** |
| | [6.05] | [4.87] | [5.17] | [2.59] | [2.85] | [3.40] |
| $BD$ | **0.560** | **0.006** | **0.335** | **2.496** | **2.794** | **3.228** |
| | [2.84] | [0.04] | [1.07] | [3.65] | [3.99] | [4.42] |
| $BRRBD$ | **4.067** | **3.952** | **4.316** | **5.731** | **5.841** | **7.607** |
| | [4.31] | [4.16] | [3.36] | [2.57] | [2.72] | [3.35] |
| $UDCO$ | **-7.224** | **-3.679** | **-4.472** | **-15.655** | **-14.925** | **-14.527** |
| | [6.01] | [3.15] | [2.87] | [5.57] | [5.22] | [4.79] |
| $TWCO$ | **-3.620** | **-1.748** | **-1.836** | **-15.788** | **-16.132** | **-17.160** |
| | [3.40] | [1.61] | [1.27] | [4.92] | [5.53] | [5.79] |
| $\Delta UD$ | | **7.138** | **4.247** | **1.028** | | |
| | | [3.16] | [1.64] | [0.10] | | |
| $CO$ | **-0.947** | **-0.492** | **-0.958** | **0.212** | **0.210** | **0.126** |
| | [3.38] | [1.60] | [2.98] | [0.29] | [0.31] | [0.18] |
| $TW$ | **1.488** | **1.839** | **2.224** | **1.491** | **1.839** | **1.272** |
| | [1.70] | [2.00] | [1.93] | [0.66] | [0.85] | [0.57] |
| $LDS$ | **-25.903** | | **-22.847** | **-86.342** | **-85.754** | **-84.199** |
| | [11.18] | | [8.80] | [8.37] | [8.51] | [7.45] |
| $TFPS$ | **-18.257** | | **-20.422** | **-26.515** | **-32.340** | **-33.949** |
| | [14.24] | | [12.41] | [3.05] | [3.27] | [2.77] |
| $\Delta^2 MS$ | **0.385** | | **0.456** | **12.731** | **12.762** | **14.586** |
| | [1.48] | | [1.72] | [2.38] | [2.62] | [2.48] |
| $RIRL$ | **1.505** | | **0.713** | **27.528** | **29.244** | **31.334** |
| | [1.28] | | [0.52] | [4.82] | [5.62] | [5.22] |
| $TTS$ | **5.927** | | **5.782** | **79.703** | **78.062** | **73.510** |
| | [3.32] | | [2.87] | [10.75] | [10.59] | [9.23] |
| $UD$ | **-0.224** | | | | **2.581** | **2.049** |
| | [0.24] | | | | [1.38] | [1.04] |
| $HO$ | | | | | | **-1.517** |
| | | | | | | [0.29] |
| $\Delta^2 p$ | | **-0.170** | | | | |
| | | [4.10] | | | | |
| *Country dummies* | $\surd$ | $\surd$ | $\surd$ | $\surd$ | $\surd$ | $\surd$ |
| *Time dummies* | $\surd$ | $\surd$ | $\surd$ | $\surd$ | $\surd$ | $\surd$ |
| *Obs* | 600 | 636 | 600 | 127 | 127 | 123 |
| *Countries* | 20 | 20 | 20 | 20 | 20 | 19 |
| *av.T* | 30.0 | 31.8 | 30.0 | 30.0 | 30.0 | 30.0 |
| Pval Cf=0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Pval f.e.=0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Average $\mid \rho_i \mid$ | 0.70 | 0.68 | 0.57 | | | |
| RMSE | 0.58 | 0.58 | 0.69 | 0.56 | 0.62 | 0.62 |

t-ratios in brackets.

Table 8: OECD Unemployment Models: 1960-1995 (continued)

| Time dummies | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **1966** | 0.07 | (0.3) | **1976** | 0.69 | (0.6) | **1986** | 0.62 | (0.3) |
| **1967** | 0.02 | (0.1) | **1977** | 0.61 | (0.5) | **1987** | 0.79 | (0.4) |
| **1968** | 0.11 | (0.3) | **1978** | 0.72 | (0.5) | **1988** | 0.56 | (0.3) |
| **1969** | -0.06 | (0.1) | **1979** | 0.59 | (0.4) | **1989** | 0.53 | (0.2) |
| **1970** | 0.11 | (0.2) | **1980** | 0.55 | (0.4) | **1990** | 0.98 | (0.4) |
| **1971** | 0.37 | (0.6) | **1981** | 1.14 | (0.7) | **1991** | 1.33 | (0.5) |
| **1972** | 0.5 | (0.7) | **1982** | 1.41 | (0.8) | **1992** | 1.62 | (0.6) |
| **1973** | 0.28 | (0.3) | **1983** | 1.21 | (0.7) | **1993** | 1.55 | (0.6) |
| **1974** | 0.08 | (0.1) | **1984** | 0.69 | (0.4) | **1994** | 1.14 | (0.4) |
| **1975** | 0.92 | (0.9) | **1985** | 0.52 | (0.3) | **1995** | 0.58 | (0.2) |

t-ratios in brackets.

Table 9: Time dummies from model (1)

| Time Trends | | | | | |
|---|---|---|---|---|---|
| **Australia** | -0.054 | (0.5) | **Japan** | -0.059 | (0.6) |
| **Austria** | -0.059 | (0.6) | **Netherlands** | -0.045 | (0.5) |
| **Belgium** | -0.022 | (0.2) | **Norway** | -0.067 | (0.7) |
| **Canada** | -0.072 | (0.8) | **New Zealand** | 0.003 | (0.0) |
| **Denmark** | -0.078 | (0.8) | **Portugal** | -0.107 | (1.1) |
| **Finland** | 0.017 | (0.2) | **Spain** | 0.042 | (0.4) |
| **France** | -0.019 | (0.2) | **Sweden** | -0.078 | (0.8) |
| **Germany** | -0.006 | (0.1) | **Switzerland** | -0.041 | (0.4) |
| **Ireland** | 0.022 | (0.2) | **UK** | -0.007 | (0.1) |
| **Italy** | -0.015 | (0.2) | **US** | -0.026 | (0.3) |

t-ratios in brackets.

Table 10: Time trends from model (1)

Column 3 indicates, instead, that once we omit the controls for macro shocks, the model produces inconsistent results, especially regarding the tax wedge and the coordination indicators. This result suggests that the macro controls are needed in order to obtain a clean estimate of the long run relationship between unemployment and institutions.

In column 4 we check for a rate of change effect in the tax wedge, which is not found to be significant. Column 5 indicates a positive impact of home ownership, although it is weak, as in the labour cost model[25]. Column 6 shows that strict fixed term contract regulations have a positive impact on unemployment, while temporary agency regulations are not significant. This result is consistent with the empirical findings of Nunziata and Staffolani (2001) on a sample of nine European countries.

The last two models are estimated excluding Portugal because no data are available on these indicators for that country. We check, therefore, the effect of omitting Portugal in column 7, and of omitting both Portugal and Spain in column 8. This is also to ensure that the inclusion of two countries characterized by non democratic regimes up to the mid 1970s does not affect our estimates. The main results are very stable, and all our findings are confirmed if not reinforced.

Model 9 includes the Traxler and Kittel coordination dummies[26] incorporated in the labour cost model. These are:

$CO1$=inter-associational coordination, i.e. coordination by the major confederations of employers and labour;

$CO2$=intra-associational coordination, i.e. within the major confederations of employers and labour;

$CO3$=pattern setting coordination, i.e. actions by a dominant sector establishing a pattern for other sectors;

$CO4$=state imposed coordination;

$CO6$=state sponsored coordination, i.e. with the state joining the bargaining process as an additional party.

The coordination types that have a significant and negative effect on unemployment are inter-associational, intra-associational and state imposed coordination.

In model 10 we check the robustness of the coordination effect using an alternative indicator provided by Nickell et al. (2001) that accounts for short term variation in coordination. The effect, in levels, of coordination, as well as the effect of the interaction with union density, disappear. However, the interaction with the tax wedge is robust to the change in the indicator, remaining negative and significant.

Model 11 is the baseline equation estimated from 1970 onwards. After dropping almost 20 percent of the observations, most of the institutional effects are confirmed, although the tax wedge effect is not significant both in levels and interacted with coordination. If we estimate the model over the same period but using unemployment in logs[27], as in column 12, the effect of institutions appears to be moderately weaker.

[25] As we will see below, the interpolation to measure this institutional indicator does not seem to be enough to account for this explanatory weakness.

[26] See Traxler (1996) and Traxler and Kittel (2000). We include five of the six categorical variables originally set by these authors, excluding CO5, non-coordination, in order to avoid multicollinearity.

[27] Using logs of unemployment from 1970 onwards is not problematic (as it is in the full sample case) since some countries are characterized by unemployment rates close to zero in the early 1960s only.

Columns 13 and 14 present a test of the Alesina and Perotti and Daveri and Tabellini hypothesis[28] of a hump shaped effect of taxation on unemployment. In the first case we divide the observations into three groups according to the degree of wage bargaining coordination. Each group is defined, respectively, as uncoordinated, intermediate and highly coordinated. We then construct a dummy for each group and interact it with the tax wedge indicator. The numerical criteria defining each group are the same as in the wage equation[29]. The tax wedge effect is only vaguely hump shaped in model 13, with a 10% level significant positive effect on intermediate countries only. If we substitute our coordination measure with a centralization indicator, as in column 14, we find instead a positive significant impact in uncentralized countries only. In addition, the tax effect is weaker the higher is centralization.

Model 15 contains the union density indicator in levels, which is found to be insignificant. Model 16 substitutes the macroeconomic shock controls with an inflation change variable in order to replicate the results of previous models, such as Nickell (1997). The variable's coefficient is negative and significant and the institutional coefficients are robust to this change, apart from that on the benefit durations indicator, which becomes insignificant.

The OLS estimation of the baseline model, i.e. without taking into account the problems of heteroskedasticity and serial correlation, is presented in column 17. The estimates of columns 1 and 17 are very similar, apart from the lack of significance of the benefit duration indicator.

Another robustness check is presented in the last three columns of Table 8. These models are estimated using five years averaged data, reducing the number of observations from 600 to 127. The 5 years averaged version of the baseline model, presented in column 18, confirms most of our previous results, apart from the lack of significance of the tax wedge in levels and the rate of change in union density. Model 19 includes union density in levels which has a weak positive effect. The home ownership variable effect is estimated in model 20. Although the 5 years averaging reduces the degree of interpolation in the home ownership indicator, we still obtain an insignificant coefficient.

Summarizing the results above, our models are able to produce a quite satisfactory explanation of the unemployment patterns in OECD countries, which is largely consistent with the findings of our labour cost model. It is possible that with better institutional indicators on unions and with information on the enforcement of the unemployment benefits we would be able to produce better results that do not have to rely on such a high level of endogenous persistence to fit the data.

The next section contains a set of dynamic simulations of the baseline model in order to assess how much of the unemployment evolution in each country can be explained by institutions.

## 3.4 Dynamic Simulations

The model simulations generate an unemployment series for each country through a recursive procedure that substitutes the lagged dependent variable with the previous year's

[28] See Alesina and Perotti (1997) and Daveri and Tabellini (2000).

[29] *Gunc* is the dummy for the group of uncoordinated countries, characterized by a coordination level $CO < 1.5$. *Gint* is the indicator for the intermediate countries, with $1.5 \leq CO \leq 2$, and *Gcoo* is the indicator for highly coordinated countries with $CO > 2$.

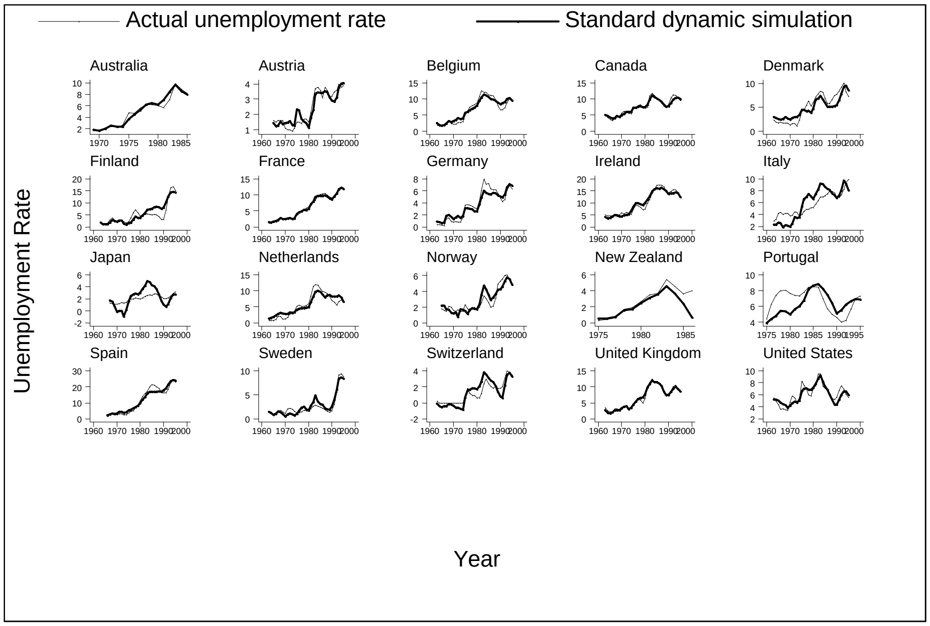


Figure 3: The unemployment model fit: actual and simulated unemployment

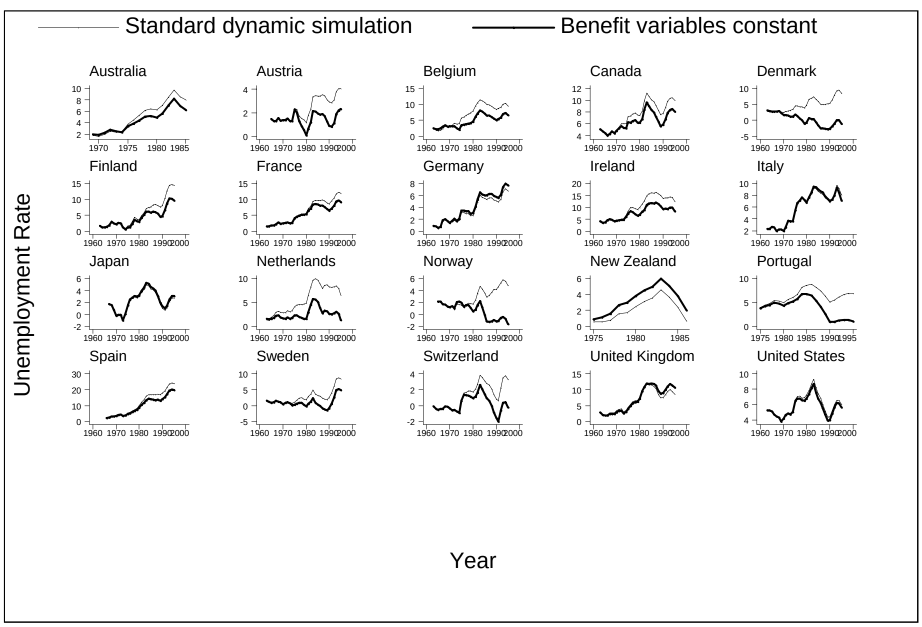


Figure 4: Dynamic simulations keeping the benefit indicators constant at average 1960s values

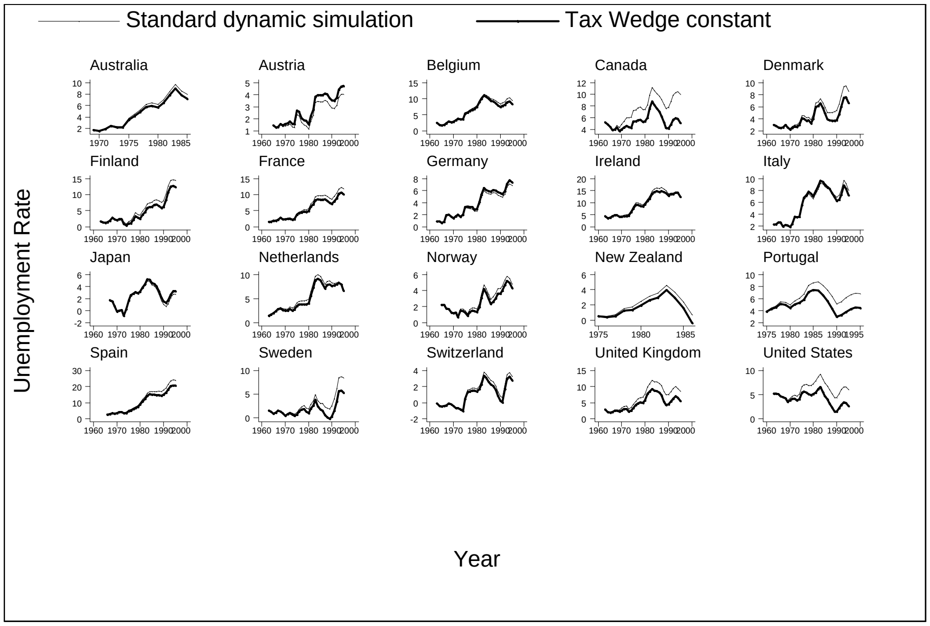


Figure 5: Dynamic simulations keeping the tax wedge constant at average 1960s values

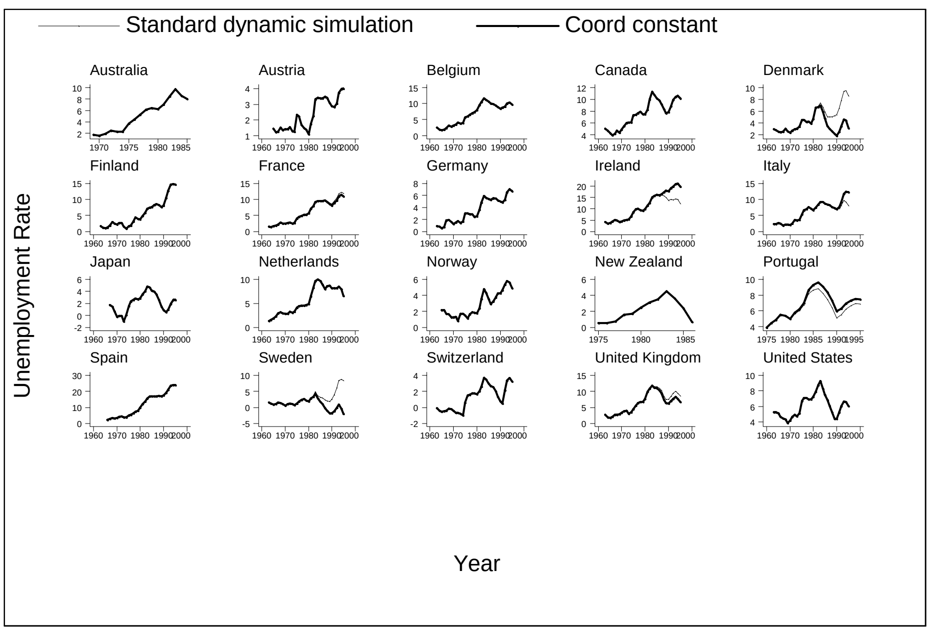


Figure 6: Dynamic simulations keeping coordination constant at average 1960s values

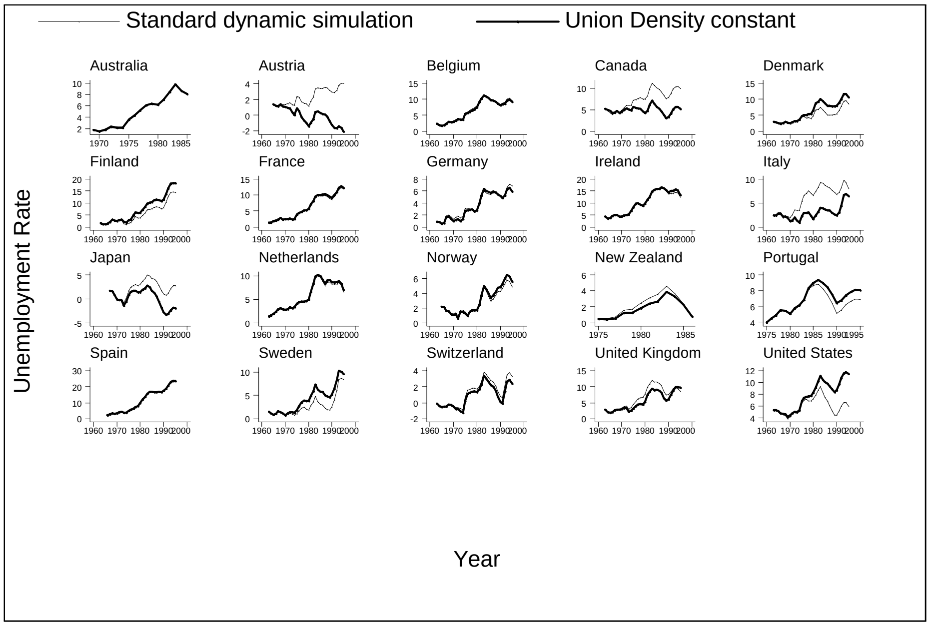


Figure 7: Dynamic simulations keeping union density constant at average 1960s values

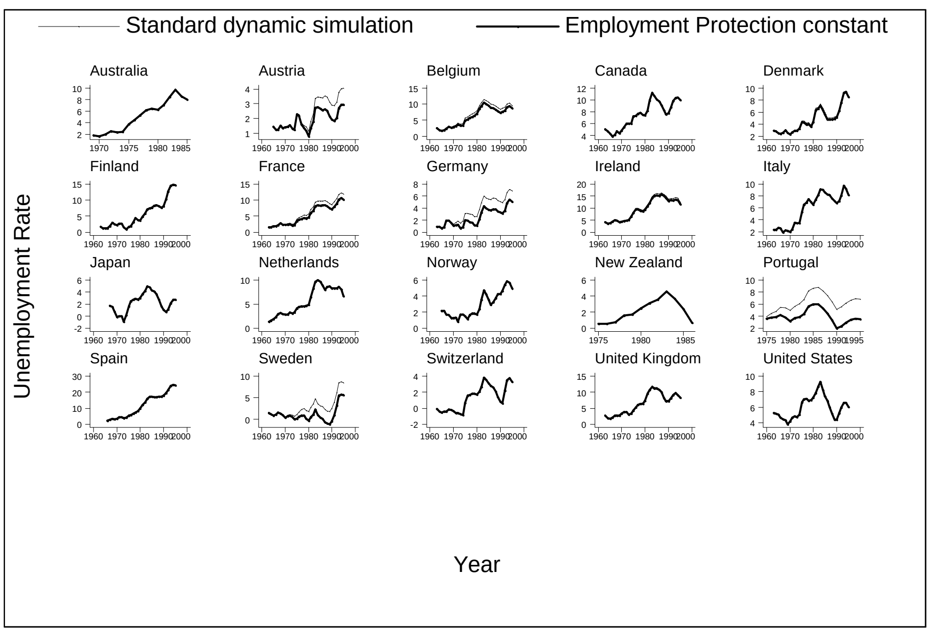


Figure 8: Dynamic simulations keeping employment protection constant at average 1960s values

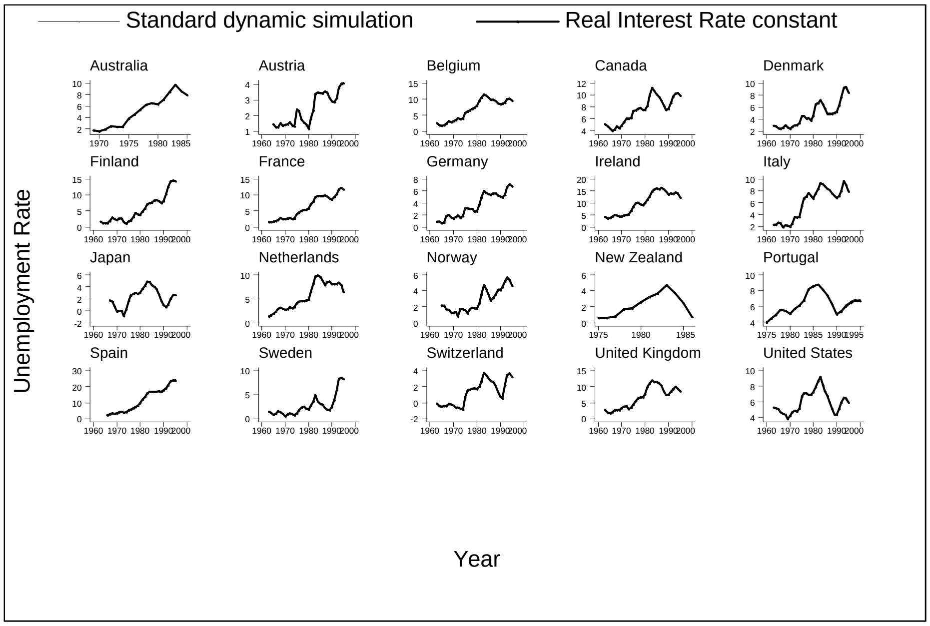


Figure 9: Dynamic simulations keeping the real interest rate constant at average 1960s values

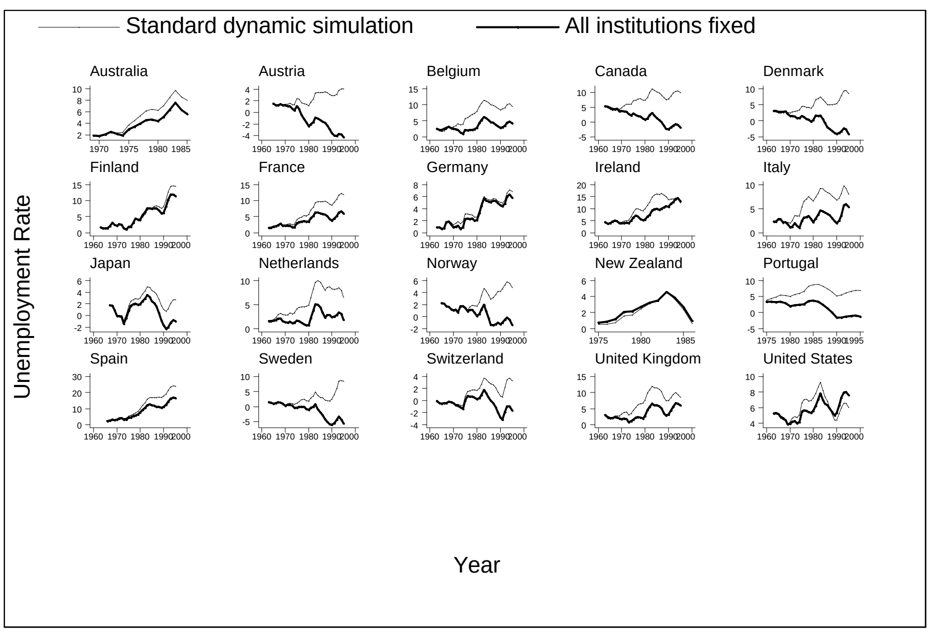


Figure 10: Dynamic simulations keeping all isntitutions fixed at average 1960s values

| Country | Decade | BRR | BD | TW | CO | ΔUD | EP | RIRL |
|---|---|---|---|---|---|---|---|---|
| AL | 1980s | 1.59 | 0.08 | 0.67 | 0.01 | -0.03 | 0 | 0.01 |
| AL | 1990s | | | | | | | |
| AU | 1980s | 3.76 | 0.53 | -0.52 | 0.05 | 3.13 | 0.7 | -0.01 |
| AU | 1990s | 4.72 | 0.85 | -0.65 | 0.06 | 5.05 | 1.07 | 0.01 |
| BE | 1980s | 3.82 | -1.04 | 0.59 | -0.03 | 0.33 | 1.07 | 0.04 |
| BE | 1990s | 3.62 | -1.08 | 1.04 | -0.04 | 0.39 | 1.02 | 0.07 |
| CA | 1980s | 1.89 | -0.74 | 2.6 | -0.08 | 4.09 | 0 | 0.03 |
| CA | 1990s | 2.2 | -0.79 | 4.29 | -0.1 | 4.71 | 0 | 0.11 |
| DK | 1980s | 7.04 | 0.15 | 1.01 | 1.16 | -2.53 | 0.31 | 0.17 |
| DK | 1990s | 9.01 | 0.91 | 1.8 | 4.52 | -2.24 | 0.18 | 0.16 |
| FN | 1980s | 4.13 | 0.52 | 1.38 | -0.07 | -2.75 | 0 | -0.03 |
| FN | 1990s | 6.55 | 2.29 | 1.94 | -0.11 | -3.49 | -0.06 | 0.1 |
| FR | 1980s | 1.11 | 0.24 | 1.14 | 0.16 | -0.29 | 1.32 | 0.03 |
| FR | 1990s | 1.53 | 1.29 | 1.55 | 0.76 | -0.46 | 1.62 | 0.1 |
| GE | 1980s | -0.62 | 0.14 | -0.4 | 0.12 | -0.25 | 1.71 | 0.02 |
| GE | 1990s | -0.88 | 0.13 | -0.53 | 0.13 | 0.34 | 1.79 | 0.04 |
| IR | 1980s | 3.37 | -1.49 | 1.09 | -0.47 | -0.03 | 0.67 | 0.01 |
| IR | 1990s | 3.88 | -1.1 | 0.27 | -6.03 | -1.05 | 0.79 | 0.12 |
| IT | 1980s | -0.42 | -0.17 | -0.24 | -0.08 | 4.95 | 0.08 | -0.04 |
| IT | 1990s | 0.49 | -0.07 | 0.78 | -1.84 | 3.19 | 0 | 0.1 |
| JA | 1980s | -0.39 | -0.1 | -0.33 | 0.16 | 2.54 | 0 | 0.02 |
| JA | 1990s | -0.43 | -0.11 | -0.55 | 0.18 | 4.3 | 0 | 0.06 |
| NL | 1980s | 3.14 | 3.49 | 0.86 | 0.01 | -0.27 | 0 | 0.11 |
| NL | 1990s | 3.94 | 4.17 | 0.27 | 0.03 | -0.41 | -0.06 | 0.17 |
| NW | 1980s | 5.24 | 1.67 | 0.54 | -0.02 | -0.3 | 0 | 0.05 |
| NW | 1990s | 8.36 | 3.59 | 0.59 | -0.03 | -0.66 | -0.07 | 0.18 |
| NZ | 1980s | -1.3 | 0.08 | 0.71 | 0.04 | 0.47 | 0 | -0.1 |
| NZ | 1990s | | | | | | | |
| PG | 1980s | 2.14 | 0.36 | 1.2 | -0.52 | -0.42 | 2.54 | 0.03 |
| PG | 1990s | 6.85 | 2.21 | 2.35 | -0.71 | -1.22 | 3.26 | 0.18 |
| SP | 1980s | 2.3 | 1.34 | 1.8 | 0.12 | 0.17 | -0.1 | -0.01 |
| SP | 1990s | 3.25 | 2.43 | 3.08 | 0.1 | 0.4 | -0.29 | 0.12 |
| SW | 1980s | 2.77 | 0.37 | 1.35 | 1.4 | -2.54 | 2.62 | 0.02 |
| SW | 1990s | 3.55 | 0.5 | 2.7 | 7.17 | -1.96 | 2.93 | 0.09 |
| SZ | 1980s | 1.36 | -0.1 | 0.45 | 0.08 | 0.5 | 0 | 0.03 |
| SZ | 1990s | 3.08 | 0.29 | 0.53 | 0.09 | 0.82 | 0 | 0.06 |
| UK | 1980s | -0.49 | -0.08 | 2.67 | 0.45 | 2.3 | 0.28 | -0.04 |
| UK | 1990s | -1.77 | 0.05 | 3.05 | 1.66 | 0.27 | 0.32 | 0.03 |
| US | 1980s | 0.55 | -0.11 | 2.67 | -0.04 | -2.45 | 0 | 0.04 |
| US | 1990s | 0.38 | -0.15 | 3.17 | -0.03 | -4.87 | 0 | 0.08 |

All unemployment rate changes are calculated as the difference between the standard dynamic simulation and the simulation keeping the specific institutional dimension constant at average 1960s values.

Table 11: Dynamic simulated changes in unemployment keeping each institutional regressor fixed

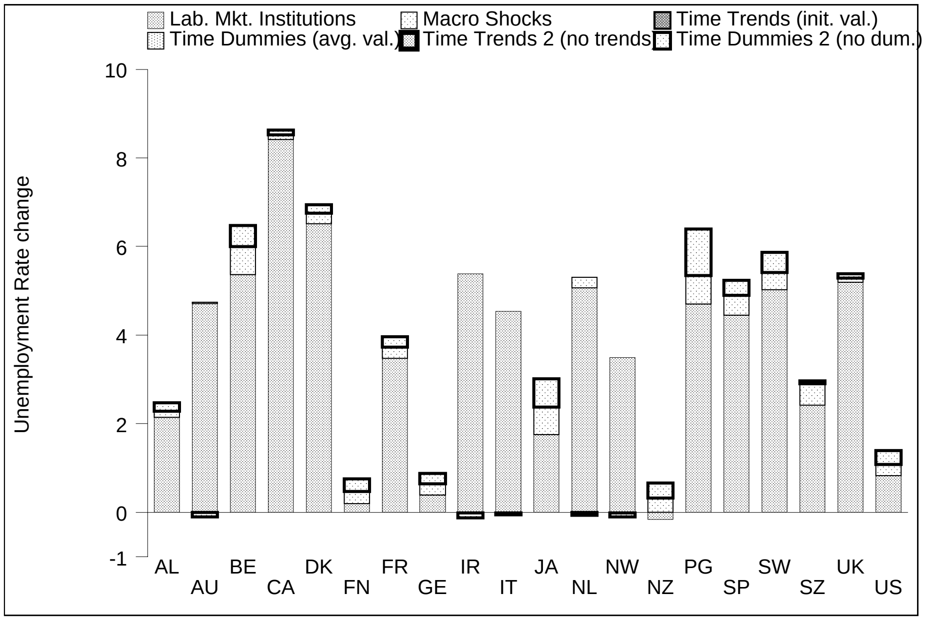


Figure 11: Dynamic simulations with fixed regressors: changes in unemployment in the 1980s imputed to specific variables

predicted value obtained from the baseline model[30]. Figure 3 displays actual unemployment and the simulated series for each country, showing a good overall fit for each country, apart from Portugal and, to a lesser extent, Japan.

In figures 4 to 9 we present a set of simulations obtained constraining one or more regressors to be at their average 1960s value. In this way we calculate the variation in unemployment that can be attributed to the evolution of specific regressors over the estimation period. The numerical values of the changes in unemployment triggered by the evolution of each institutional dimension are summarized in Table 11. The changes are calculated for the 1980s and the 1990s. As an example, the rise in taxation from the 1960s to the 1990s has induced an increase in unemployment in Canada of more than 4 percentage points, around 3 percentage points in Spain, the UK and the US and only 1.5 in France. The effect of benefits is large in most countries, while unions have a large positive effect in Austria, Canada and Italy[31]. The overall impact of the real interest rate is negligible.

Another summary account of the dynamic simulations is contained in Figures 11 and 12, where the impact of each regressor is assessed in a comparative way. From these figures it emerges quite clearly that the effect of institutions dominates the impact of the macroeconomic shocks, the time trends and the time dummies[32]. Figures 13 and 14 are

[30]This is the same procedure employed in Nunziata (2001).

[31]Differently from Austria and Canada, the positive impact of unions in Italy is mainly concentrated in the 1970s and the 1980s.

[32]This is verified through excluding the time trends and the time dummies from the simulated model,

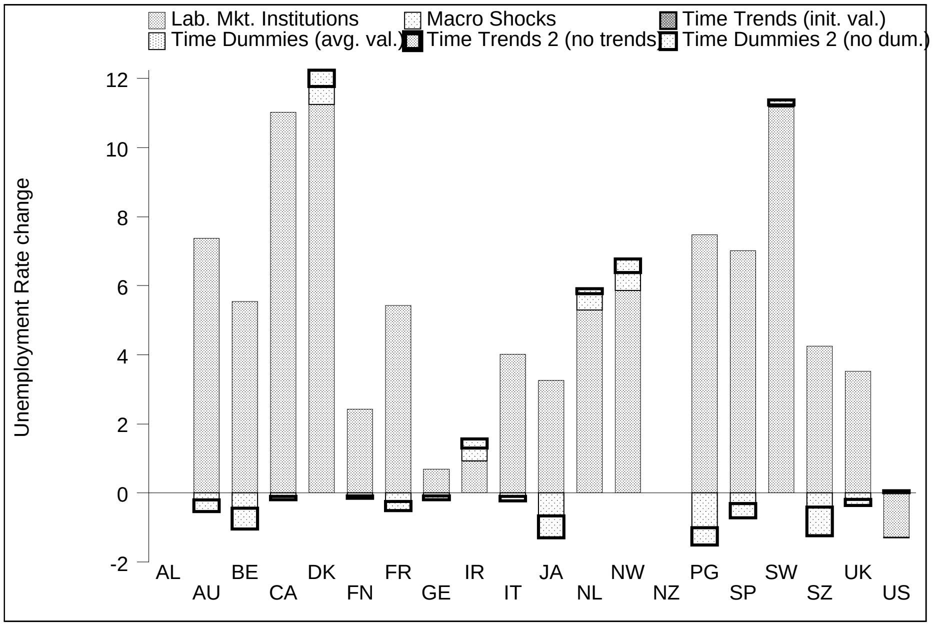


Figure 12: Dynamic simulations with fixed regressors: changes in unemployment in the 1990s imputed to specific variables

analogous to the figures presented for the labour cost model, where the impact of each institutional dimension is stacked on each country bar.

Overall, the institutions seem to explain a significant part of the change in unemployment since the 1960s in Australia, Belgium, Denmark, Finland, France, Italy, Netherlands, Norway, Spain, Switzerland and the UK. They probably explain too much in Austria, Portugal and Sweden, while they are unsuccessful in explaining unemployment in Germany, New Zealand and the US. The last case is not a surprise given the mainly cyclical nature of US unemployment.

Looking at the simulation figures we notice that the labour market institutions can explain around 55 percent of the 6.8 percent increase in the average European unemployment rate from the 1960s to the 1990s[33]. The model's explanatory power is therefore very good, especially considering the fact that the early 1990s were characterized by a deep recession in most European countries. If we exclude Germany from this calculation, a country for which our model is not able to say much, we explain 63 percent of the rise in unemployment in the rest of Europe.

Regarding the contribution of each institutional dimension, the change in the benefit system is the most relevant, contributing 39 per cent. Increases in the tax wedge generate 26 per cent, shifts in union variables are responsible for 19 per cent and changes in em-

and through fixing them to their average value (over the whole sample).

[33]Note that we consider European OECD countries only, therefore excluding Greece and Eastern Europe.

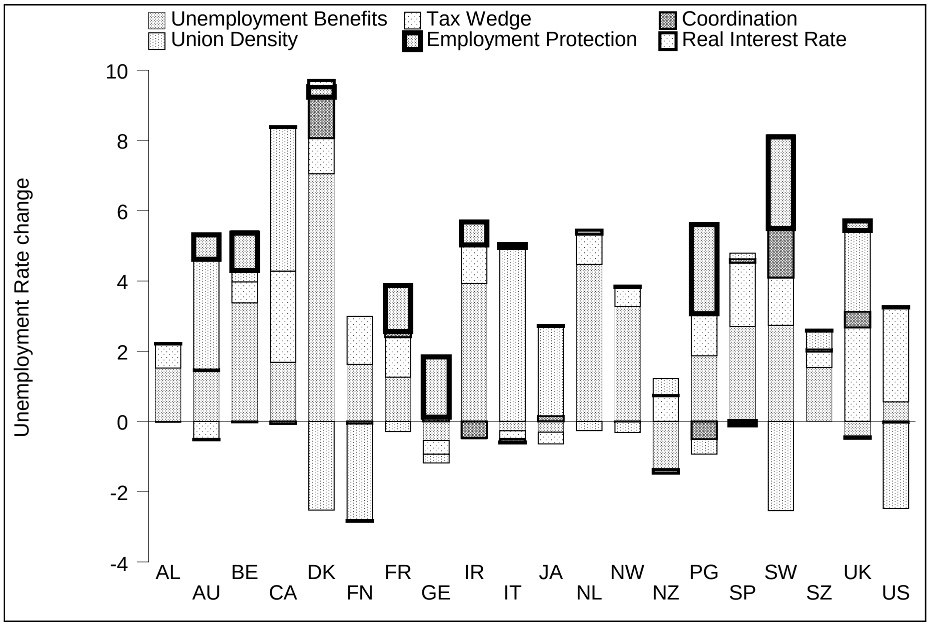


Figure 13: Dynamic simulations with regressors fixed at 1960s average values: changes in unemployment in the 1980s imputed to specific institutional dimensions

ployment protection regulations contribute 16 per cent. In other words, the combination of benefits and taxes are responsible for two-thirds of that part of the long-term rise in European unemployment that our institutions explain.

# 4 Institutions and Shocks: a General Framework

In the previous section we proposed a model whose explanation of the evolution of unemployment in OECD countries is based on the direct effect of institutions, controlling for a set of mean reverting macroeconomic shocks. What we have not examined is the hypothesis that the role of institutions is mainly one affecting the impact of the shocks, as suggested by the works discussed above[34]. In this section we aim to discriminate between these two hypotheses, i.e. we want to understand if institutions affect unemployment directly or through their interaction with the shocks.

The first question we need to answer is how best to describe the macroeconomic shocks. The easiest way is to rely on time effects, i.e. to treat the shocks as unobservable but common across countries[35]. This approach has the advantage of its generality but the disadvantage of relying on the hypothesis of identical shocks in all countries in each year. The latter assumption is far from ideal, especially when we want to disentangle how

[34] See page 5.

[35] This is what Blanchard and Wolfers propose in the first part of their paper.

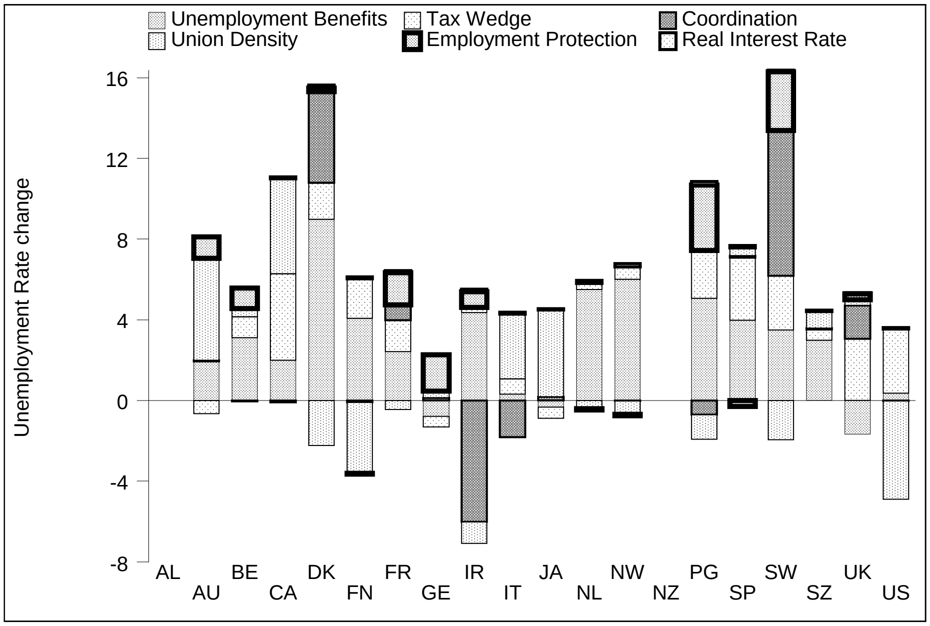


Figure 14: Dynamic simulations with regressors fixed at 1960s average values: changes in unemployment in the 1990s imputed to specific institutional dimensions

much of the effect of a shock to a country is actually shaped by its specific institutional framework.

A first best solution would be to include a vector of relevant observable macroeconomic shocks. Blanchard and Wolfers suggest using the decline in total factor productivity growth, the real interest rate and the adverse shifts in labour demand. However, as noted above, none of these variables is mean reverting. In fact all the variables are characterized by marked trends. Therefore they do not seem the best choice if we are interested in modelling the degree of turbulence which each country is subject to, and seeing how labour market institutions interact with it.

In what follows we model the shocks as unobservable in order to avoid making specific assumptions about the variables relevant to each country. Keeping in mind the limitations of this approach, we also try a different specification using the observable mean reverting shocks included as controls in the previous section's model.

The framework we propose is a generalization of equation (5), i.e. of the benchmark model of Table 6. In its most general form it allows an additional term that includes the interaction between the unobservable shocks represented by the time effects and the vector of labour market institutions. In addition, we allow the lagged dependent variable coefficient, which captures the degree of unemployment persistence, to depend on a set of relevant institutions. In other words, we also check if the labour market institutional framework affects the speed at which unemployment converges towards its equilibrium level.

In analytical terms, the model in equation (5) is generalized as follows:

$$U_{it} = \beta_0 + \boldsymbol{\beta}_{1t} U_{it-1} + \boldsymbol{\gamma}_1' \overline{\mathbf{z}}_{1w,it} + \boldsymbol{\lambda}' \mathbf{h}_{it} + \boldsymbol{\vartheta}' \mathbf{s}_{it} + \phi_i t_i + \mu_i + \lambda_t \left(1 + \boldsymbol{\gamma}_2' \overline{\mathbf{z}}^d_{2w,it}\right) + \varepsilon_{it} \quad (9)$$

where $\boldsymbol{\beta}_{1t} = \left(\alpha_0 + \boldsymbol{\gamma}_3' \overline{\mathbf{z}}^d_{3w,it}\right)$, and the superscript $d$ stands for deviation from the world average.

Equation (9) suggests that institutions may have three distinct roles in explaining OECD unemployment:

1. they may directly affect unemployment as in model (5) through the vectors $\boldsymbol{\gamma}_1' \overline{\mathbf{z}}_{1w,it}$ and $\boldsymbol{\lambda}' \mathbf{h}_{it}$;

2. they may shape the impact of the shocks through the interaction with the time effects $\lambda_t \left(1 + \boldsymbol{\gamma}_2' \overline{\mathbf{z}}^d_{2w,it}\right)$;

3. they may affect unemployment persistence through the lagged dependent variable coefficient $\boldsymbol{\beta}_{1t} = \left(\alpha_0 + \boldsymbol{\gamma}_3' \overline{\mathbf{z}}^d_{3w,it}\right)$.

Note that the two vectors of interacted institutions $\overline{\mathbf{z}}^d_{2w,it}$ and $\overline{\mathbf{z}}^d_{3w,it}$ are expressed as deviations from the world average so that we may interpret the coefficients on the institutions in levels as the coefficients of the average country.

The results of our estimations are presented in Tables 12, 13 and 14. They include, in addition to the general model of equation (9), a range of alternative specifications in order to check the robustness of our findings[36].

We first try to replicate Blanchard and Wolfers' results estimating a model analogous to the one in equation (1), i.e. regressing unemployment on a constant, the country dummies and the time effects interacted with institutions:

$$U_{it} = \beta_0 + \mu_i + \lambda_t \left(1 + \boldsymbol{\gamma}_2' \overline{\mathbf{z}}_{2w,it}\right) + \varepsilon_{it} \quad . \quad (10)$$

Their sample of countries and the time period is the same as ours, although they use 5 years averaged data instead of annual data. Model $a$ is the replica of their model on our (averaged) data. Our specification differ from theirs because we end up having 127 observations instead of 159[37], and because our institutional indicators are all time varying[38]. In column $b$ we estimate the same model on annual data. Both models include union density in delta form since we do not find a significant effect for the level.

Our results in column $a$ are broadly in line with the findings of Blanchard and Wolfers. Each institution enters significantly with the expected sign with the exception of union density, which is not significant, and the tax wedge which has a negative coefficient. The fit of the equation is also comparable, with an $\bar{R}^2$ equal to 0.811 instead of 0.863. These results are confirmed in column $b$, with the addition of a significant effect of union density in delta form and a slightly worse fit. The time effects are significant in each model and

[36] In order to avoid confusion with the previous section, we denote each model in this section with a letter instead of a number.

[37] The reason for the limited sample is twofold: we have 7 observations per country while Blanchard and Wolfers have 8, and our panel is unbalanced. Some of the regressors are not available for some years, in some of the countries.

[38] Blanchard and Wolfers present a version of their model including time varying indicators for the benefit replacement rates and employment protection only.

they account, respectively, for a 4.35% and a 6.86% rise in unemployment for average values of all institutional indicators[39]. This is less than the 7.3% estimated by Blanchard and Wolfers.

This simple specification offers a good description of the data. The task now is to assess whether what matters more in explaining OECD unemployment is the direct role of institutional changes, or the role of the interactions between institutions and shocks. Columns $c$ to $n$ in the tables present a set of alternative specifications of equation (9) in order to discriminate between these two hypotheses. Following Blanchard and Wolfers we first present a simpler version of the model interacting both the LDV and the time effects with a set of time invariant institutional indicators[40]. We then proceed to use the time varying indicators.

Model $c$ is estimated using time invariant indicators in the interactions. Among the interacted institutions only, the benefit indicators are significant with expected sign, and most of the results of section 3 are confirmed. In addition, the time effects are not significant. If we reduce the model, and interact the lagged dependent variable with employment protection only, as in column $d$, we also find that the latter is significant with the expected positive sign. In other words, stricter employment protection increases unemployment persistence.

The characterization of the interactions between institutions and shocks adopted in columns $c$ and $d$ is the same as Blanchard and Wolfers', i.e. $\lambda_t \left(1 + \boldsymbol{\gamma}_2' \overline{\mathbf{z}}_{2w,it}^d\right)$. This specification implicitly assumes that each shock is shaped by institutions in the same fashion at any time. Models $e$ and $f$ relax this assumption, allowing the effect of each time dummy to depend differently on the interacted institutions in each year. In analytical terms, we use a more general specification such as $\left(\lambda_{1t} + \lambda_{2t} \boldsymbol{\gamma}_2' \overline{\mathbf{z}}_{2w,it}^d\right)$ that accounts for a partition of the effect of each shock into two bits, one interacted with institutions and one not. Every year, a different fraction of the shock will impact unemployment through its interaction with institutions. In this way we control for the possibility that the interactions may have a different degree of importance when a country faces shocks of different nature.

The estimation results of columns $e$ and $f$ provide a further, even more impressive, confirmation of the direct effect of institutions analysed in section 3. As regards the interactions, most institutions are not significant, with the exception of employment protection which has a negative coefficient[41]. Again, however, the time effects are not significant, and in model $f$ stricter employment protection reduces the adjustment speed of unemployment.

Blanchard and Wolfers typically obtain weaker results when interacting the shocks with time varying institutions. This is not necessarily true in our case. Models $g$ and $h$ use time varying institutional indicators in the interactions. They include, respectively, the simple and the more general characterization of the interactions depicted above.

Model $g$ is the only specification where the interacted institutions seem to play a more important role than the institutions in levels. The tax wedge and the interaction between coordination and union density are the only variables that show up in levels

[39] The impact of the time effects is calculated as estimated time effect in 1995 minus estimated time effect in the first available year.

[40] These are calculated as country averages of each indicator over the sample.

[41] These results are confirmed when we drop the controls for the mean reverting macro shocks $\boldsymbol{\vartheta}' \mathbf{s}_{it}$.

rather than as interactions. The time effects are significant, and they account for a 6.53% rise in unemployment at average values of all institutions. The significant impact of employment protection on unemployment persistence is confirmed.

When we adopt the more general specification for the interactions, as in column $h$, these results are partially reversed. The institutions in levels are now significant with expected sign, with the only exception being a weak effect from coordination[42]. In addition, we find several significant interacted effects and again a significant impact of employment protection on unemployment persistence. The time effects account for a 4.81% rise in unemployment at average institutional levels. In contrast to the previous results, the coefficient on interacted union density is negative.

The specifications in columns $i$ and $l$ are the same as the ones in columns $g$ and $h$, but without including the lagged dependent variable. In these columns, both institutions in levels and interacted are significant with expected sign, except for coordination in levels and the interacted tax wedge in column $i$. In addition, the time effects can explain a rise in unemployment equal, respectively, to 2.17% and 8.23%. Employment protection is now significant in levels in column $l$.

Finally, models $m$ and $n$ provide an attempt to substitute the interactions with time effects with a set of observable shocks. The variables we use are the ones contained in the vector $\mathbf{s}_{it}$, i.e. a labour demand shock, a total factor productivity shock, a money supply shock, the long term interest rate, and a terms of trade shock[43]. Each variable in the new vector $\overline{\mathbf{s}}_{it}$ is constructed in order to be an adverse shock[44]. The main difference compared to variables used by Blanchard and Wolfers is the fact that our shocks are mean reverting.

As with the time effects, we provide two alternative specifications for the interactions between institutions and shocks. Model $m$ contains a simple interaction of the form $\boldsymbol{\vartheta}'\mathbf{s}_{it}\boldsymbol{\gamma}_2'\overline{\mathbf{z}}_{2w,it}$ as in Blanchard and Wolfers, while model $n$ contains a more general specification of the form $\left(\boldsymbol{\vartheta}_1'\mathbf{s}_{it} + \boldsymbol{\vartheta}_2'\mathbf{s}_{it}\boldsymbol{\gamma}_2'\overline{\mathbf{z}}_{2w,it}\right)$. Both models contain non-interacted time dummies as controls. These do not yield significant coefficients.

The estimation results show a significant effect of expected sign for interacted coordination and benefit replacement rates, and this is common to both models. As regards the institutions in levels, the tax wedge and the benefit replacement rates are significant in both specifications, while employment protection is significant in column $m$ only, with a negative sign. Looking at the institutions interacted with the lagged dependent variable, our previous findings about employment protection are confirmed in both models, together with a similar effect for union density. The dynamic simulations of model $m$ in Figure 15 show that the interacted shocks explain part of the dynamics in unemployment in New Zealand and Portugal in the 1980s, and to a lesser extent in the late 1970s and early 1980s in Austria, Canada and the Netherlands, and in the early 1990s in Norway. The other countries are only marginally affected.

On the basis of the results above we cannot rule out a significant role for institutions through their interactions with adverse shocks, although the estimates do not appear very

[42]Note that employment protection was also insignificant in Table 6.

[43]See the definition of each shock on page 10.

[44]This means that $\boldsymbol{\vartheta}'\overline{\mathbf{s}}_{it} = \theta_1 LDS^*_{it} + \theta_2 TFPSH^*_{it} + \theta_3 D2MS_{it} + \theta_4 RIRL_{it} + \theta_5 TTS_{it}$, with $LDS^*_{it}{=}{-}LDS_{it}$ and $TFPSH^*_{it}{=}{-}TFPSH_{it}$ .

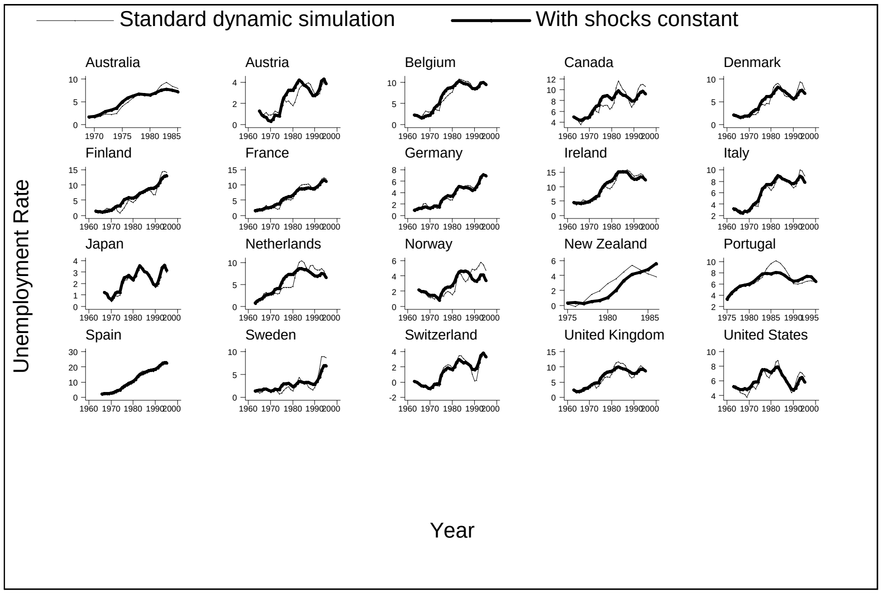


Figure 15: Dynamic simulations of model $(m)$ keeping the shocks constant at average values

robust. On the other hand, it seems that most of the implications of the previous section still hold when we include the possibility of interactions between shocks and institutions.

# 5 Concluding Remarks

The analysis contained in Nunziata (2001) introduced a general framework for analyzing the role played by labour market institutions in the determination of the economic performance of OECD countries, at the empirical level. We started with the analysis of the determinants of wages, testing the existence of a labour market adjustment mechanism that makes it possible to conceptualize the idea of an equilibrium level of unemployment that depends on a set of wage pressure institutions. The empirical analysis contained in this paper represents the following step of our research agenda, as we present an estimate of the relationship between the set of labour market institutions and equilibrium unemployment.

As in the labour cost paper, our unemployment model is estimated on a sample of 20 OECD countries observed for the period 1960-1995. Our specification is analogous to the one estimated for OECD wages, with unemployment regressed on a set of institutional indicators, macroeconomic shocks and interactions. Our estimation method is semi-pooled fixed effect GLS, accounting for heteroskedasticity and serial correlation. We include time dummies in order to control for contemporaneous correlations, and we present a set of specification tests in order to justify the choice of estimator.

The main findings of the paper are the following:

| | $(a)$ | | $(b)$ | | $(c)$ | | $(d)$ | |
|---|---|---|---|---|---|---|---|---|
| shock int. | $\lambda_t\left(1+\boldsymbol{\gamma}_2'\bar{\mathbf{z}}_{2w,it}^d\right)$ | | $\lambda_t\left(1+\boldsymbol{\gamma}_2'\bar{\mathbf{z}}_{2w,it}^d\right)$ | | $\lambda_t\left(1+\boldsymbol{\gamma}_2'\bar{\mathbf{z}}_{2w,i}^d\right)$ | | $\lambda_t\left(1+\boldsymbol{\gamma}_2'\bar{\mathbf{z}}_{2w,i}^d\right)$ | |
| $\alpha_0$ | | | | | **0.844** | [35.18] | **0.846** | [38.07] |
| $\boxed{\boldsymbol{\gamma}_1'\bar{\mathbf{z}}_{1w}}$ | | | | | | | | |
| $EP$ | | | | | **-0.330** | [1.27] | **-0.363** | [1.42] |
| $\Delta UD$ | | | | | **3.994** | [1.55] | **4.155** | [1.61] |
| $BRR$ | | | | | **1.890** | [3.34] | **1.875** | [3.35] |
| $BD$ | | | | | **0.452** | [1.41] | **0.341** | [1.09] |
| $CO$ | | | | | **-0.647** | [2.08] | **-0.701** | [2.27] |
| $TW$ | | | | | **1.494** | [1.31] | **1.490** | [1.33] |
| $BRRBD$ | | | | | **2.663** | [1.90] | **2.565** | [1.91] |
| $UDCO$ | | | | | **-5.800** | [3.52] | **-5.499** | [3.42] |
| $TWCO$ | | | | | **-1.354** | [0.94] | **-1.485** | [1.04] |
| $\boxed{\boldsymbol{\gamma}_2'\bar{\mathbf{z}}_{2w}^d}$ | | | | | | | | |
| $EP$ | **0.358** | [2.12] | **0.430** | [5.92] | **0.066** | [0.42] | **0.223** | [1.45] |
| $UD$ | | | | | **0.071** | [0.14] | **0.123** | [0.24] |
| $\Delta UD$ | **-0.331** | [0.78] | **6.032** | [2.79] | | | | |
| $BRR$ | **1.668** | [3.52] | **1.308** | [6.82] | **2.260** | [3.92] | **2.375** | [4.03] |
| $BD$ | **0.951** | [3.47] | **0.984** | [8.61] | **1.139** | [4.21] | **1.171** | [4.27] |
| $CO$ | **-0.354** | [2.41] | **-0.381** | [6.43] | **-0.217** | [1.52] | **-0.255** | [1.80] |
| $TW$ | **-1.254** | [1.71] | **-1.688** | [5.96] | **-1.061** | [1.40] | **-0.991** | [1.31] |
| $\boxed{\boldsymbol{\gamma}_3'\bar{\mathbf{z}}_{3w}^d}$ | | | | | | | | |
| $EP$ | | | | | **0.047** | [1.19] | **0.0676** | [2.33] |
| $UD$ | | | | | **0.049** | [0.36] | | |
| $CO$ | | | | | **0.079** | [1.51] | | |
| $TW$ | | | | | **-0.075** | [0.35] | | |
| $\Delta^2 MS$ | | | | | **0.426** | [1.66] | **0.449** | [1.75] |
| $RIRL$ | | | | | **2.616** | [2.08] | **2.582** | [2.07] |
| $TTS$ | | | | | **3.911** | [2.10] | **3.224** | [1.72] |
| $LDS$ | | | | | **-21.668** | [8.43] | **-22.080** | [8.60] |
| $TFPS$ | | | | | **-21.007** | [13.01] | **-21.546** | [13.56] |
| time effects | 4.35% | | 6.86% | | | | | |
| significant? | yes | | yes | | no | | no | |
| time trends | | | | | $\surd$ | | $\surd$ | |
| significant? | | | | | no | | no | |
| $\mu_i$ | $\surd$ | | $\surd$ | | $\surd$ | | $\surd$ | |
| Obs | 127 | | 646 | | 600 | | 600 | |
| $RMSE$ | 1.46 | | 1.81 | | 0.53 | | 0.53 | |
| $\bar{R}^2$ | 0.811 | | 0.784 | | 0.980 | | 0.980 | |

Time Effects: estimated effect in 1995 - estimated effect in 1966, for average levels of institutional indicators. t-ratios in brackets.

Table 12: OECD Unemployment: the role of institutions and shocks

| | $(e)$ | | $(f)$ | | $(g)$ | | $(h)$ | |
|---|---|---|---|---|---|---|---|---|
| shock int. | $\left(\lambda_{1t}+\lambda_{2t}\gamma_2'\bar{\mathbf{z}}_{2w,i}^d\right)$ | | $\left(\lambda_{1t}+\lambda_{2t}\gamma_2'\bar{\mathbf{z}}_{2w,i}^d\right)$ | | $\lambda_t\left(1+\gamma_2'\bar{\mathbf{z}}_{2w,it}^d\right)$ | | $\left(\lambda_{1t}+\lambda_{2t}\gamma_2'\bar{\mathbf{z}}_{2w,it}^d\right)$ | |
| $\alpha_0$ | **0.874** | [5.52] | **0.869** | [41.24] | **0.827** | [32.88] | **0.842** | [34.19] |
| $\boxed{\gamma_1'\bar{\mathbf{z}}_{1w}}$ | | | | | | | | |
| $EP$ | **-0.125** | [0.48] | **-0.230** | [0.89] | **-0.452** | [1.61] | **-0.377** | [1.13] |
| $UD$ | **4.446** | [1.73] | **4.344** | [1.70] | **-3.221** | [0.66] | **4.456** | [1.76] |
| $BRR$ | **3.051** | [5.85] | **3.114** | [6.02] | **-0.085** | [0.09] | **2.577** | [3.53] |
| $BD$ | **0.534** | [1.67] | **0.506** | [1.63] | **-0.083** | [0.19] | **0.660** | [1.86] |
| $CO$ | **-1.200** | [3.68] | **-1.145** | [3.54] | **-0.911** | [1.23] | **-0.956** | [1.36] |
| $TW$ | **3.508** | [2.96] | **3.282** | [2.81] | **3.599** | [2.30] | **2.578** | [1.73] |
| $BRRBD$ | **4.065** | [3.02] | **4.616** | [3.64] | **2.313** | [1.61] | **3.755** | [2.77] |
| $UDCO$ | **-6.489** | [4.13] | **-6.141** | [3.97] | **-3.702** | [2.05] | **-5.899** | [3.59] |
| $TWCO$ | **-2.402** | [1.60] | **-2.684** | [1.81] | **-0.609** | [0.40] | **-1.483** | [0.96] |
| $\boxed{\gamma_2'\bar{\mathbf{z}}_{2w}^d}$ | | | | | | | | |
| $EP$ | **-0.685** | [1.72] | **-0.732** | [1.74] | **-0.096** | [0.66] | **0.538** | [1.95] |
| $UD$ | **0.463** | [1.10] | **0.303** | [0.78] | | | **-0.750** | [1.79] |
| $\Delta UD$ | | | | | **8.054** | [1.65] | | |
| $BRR$ | **-1.401** | [1.61] | **-1.637** | [1.65] | **1.952** | [4.05] | **0.840** | [1.82] |
| $BD$ | **-0.213** | [1.03] | **-0.206** | [0.96] | **0.836** | [3.21] | **0.320** | [1.63] |
| $CO$ | **0.186** | [1.35] | **0.192** | [1.33] | **-0.233** | [1.62] | **-0.194** | [1.68] |
| $TW$ | **-0.174** | [0.38] | -0.207 | [0.42] | **-0.590** | [0.92] | **-0.441** | [1.06] |
| $\boxed{\gamma_3'\bar{\mathbf{z}}_{3w}^d}$ | | | | | | | | |
| $EP$ | **0.064** | [1.40] | **0.076** | [2.06] | **0.070** | [2.11] | **0.074** | [1.87] |
| $UD$ | **-0.022** | [0.16] | | | **0.121** | [1.44] | **0.125** | [1.36] |
| $CO$ | **0.033** | [0.66] | | | **0.018** | [0.38] | **-0.015** | [0.31] |
| $TW$ | **0.306** | [1.43] | | | **-0.061** | [0.39] | **0.205** | [1.21] |
| $\Delta^2 MS$ | **0.425** | [1.67] | **0.432** | [1.70] | **0.427** | [1.66] | **0.517** | [2.03] |
| $RIRL$ | **3.148** | [2.24] | **2.719** | [1.96] | **1.941** | [1.50] | **3.236** | [2.28] |
| $TTS$ | **2.987** | [1.48] | **3.143** | [1.56] | **3.563** | [1.96] | **2.363** | [1.17] |
| $LDS$ | **-20.367** | [7.98] | **-20.307** | [7.98] | **-21.066** | [8.23] | **-20.716** | [8.05] |
| $TFPS$ | **-20.718** | [12.68] | **-20.976** | [13.11] | **-20.258** | [12.40] | **-19.695** | [11.88] |
| time effects | 0.79% | | 0.61% | | 6.53% | | 4.81% | |
| significant? | only $\lambda_{2t}'$s | | only $\lambda_{2t}'$s | | yes | | few $\lambda_{2t}'$s | |
| time trends | $\surd$ | | $\surd$ | | $\surd$ | | $\surd$ | |
| significant? | no | | no | | DK,JA<br>NW,PG | | no | |
| $\mu_i$ | $\surd$ | | $\surd$ | | $\surd$ | | $\surd$ | |
| Obs | 600 | | 600 | | 600 | | 600 | |
| $RMSE$ | 0.50 | | 0.50 | | 0.53 | | 0.50 | |
| $\bar{R}^2$ | 0.981 | | 0.981 | | 0.980 | | 0.981 | |

Time Effects: estimated effect in 1995 - estimated effect in 1966, for average levels of institutional indicators. t-ratios in brackets.

Table 13: OECD Unemployment: the role of institutions and shocks (continued)

| shock int. | $(i)$ $\lambda_t\left(1+\gamma_2'\bar{\mathbf{z}}_{2w,it}^d\right)$ | | $(l)$ $\left(\lambda_{1t}+\lambda_{2t}\gamma_2'\bar{\mathbf{z}}_{2w,it}^d\right)$ | | $(m)$ $\boldsymbol{\vartheta}'\mathbf{s}_{it}\gamma_2'\bar{\mathbf{z}}_{2w,it}^d$ | | $(n)$ $\left(\boldsymbol{\vartheta}_1'\mathbf{s}_{it}+\boldsymbol{\vartheta}_2'\mathbf{s}_{it}\gamma_2'\bar{\mathbf{z}}_{2w,it}^d\right)$ | |
|---|---|---|---|---|---|---|---|---|
| $\alpha_0$ | | | | | **0.835** | [35.49] | **0.839** | [35.66] |
| $\boxed{\gamma_1'\bar{\mathbf{z}}_{1w}}$ | | | | | | | | |
| $EP$ | **0.131** | [0.25] | **2.054** | [3.77] | **-0.487** | [1.81] | **-0.415** | [1.53] |
| $UD$ | **4.832** | [0.82] | **0.566** | [0.11] | **3.396** | [1.35] | **3.403** | [1.35] |
| $BR$ | **3.073** | [1.91] | **3.968** | [3.52] | **2.587** | [4.73] | **2.387** | [4.27] |
| $BD$ | **1.681** | [2.12] | **3.794** | [4.32] | **0.292** | [0.89] | **0.334** | [1.02] |
| $CO$ | **1.602** | [2.15] | **-1.671** | [2.27] | **-0.795** | [1.18] | **-0.927** | [1.37] |
| $TW$ | **5.259** | [1.69] | **0.286** | [0.10] | **2.397** | [1.68] | **3.041** | [2.13] |
| $BRRBD$ | **14.586** | [5.39] | **15.446** | [6.14] | **4.178** | [3.09] | **4.033** | [2.95] |
| $UDCO$ | **-7.696** | [2.37] | **0.227** | [0.07] | **-3.327** | [2.03] | **-3.936** | [2.39] |
| $TWCO$ | **-14.696** | [5.10] | **-9.302** | [3.07] | **-2.424** | [1.67] | **-2.532** | [1.75] |
| $\boxed{\gamma_2'\bar{\mathbf{z}}_{2w}^d}$ | | | | | | | | |
| $EP$ | **0.363** | [2.82] | **0.294** | [1.86] | **-0.283** | [2.37] | **-0.198** | [1.92] |
| $UD$ | | | **-2.689** | [3.84] | **0.172** | [0.49] | **0.194** | [0.66] |
| $\Delta UD$ | **2.936** | [0.78] | | | | | | |
| $BRR$ | **1.888** | [4.88] | **0.767** | [1.72] | **1.145** | [3.23] | **0.948** | [3.14] |
| $BD$ | **1.415** | [5.74] | **2.755** | [6.43] | **0.137** | [0.67] | **-0.051** | [0.30] |
| $CO$ | **-0.668** | [5.01] | **-0.656** | [4.32] | **-0.447** | [3.73] | **-0.335** | [3.22] |
| $TW$ | **-3.636** | [6.28] | # | # | **1.516** | [3.05] | **1.834** | [4.01] |
| $\boxed{\gamma_3'\bar{\mathbf{z}}_{3w}^d}$ | | | | | | | | |
| $EP$ | | | | | **0.069** | [2.20] | **0.074** | [2.31] |
| $UD$ | | | | | **0.173** | [2.15] | **0.179** | [2.22] |
| $CO$ | | | | | **0.016** | [0.34] | **0.028** | [0.59] |
| $TW$ | | | | | **-0.096** | [0.62] | **-0.146** | [0.91] |
| $\boxed{\boldsymbol{\vartheta}_1'\mathbf{s}_{it}}$ | | | | | | | | |
| $\Delta^2 MS$ | **0.663** | [1.31] | **0.772** | [1.56] | | | **0.666** | [2.31] |
| $RIRL$ | **6.683** | [2.59] | **4.411** | [1.69] | | | **1.948** | [1.38] |
| $TTS$ | **10.307** | [2.92] | **8.490** | [2.25] | | | **3.988** | [1.97] |
| $LDS$ | **-14.702** | [2.78] | **-13.903** | [2.76] | | | **-21.2668** | [8.39] |
| $TFPS$ | **-14.709** | [4.55] | **-15.346** | [5.00] | | | **-20.873** | [12.16] |
| $\boxed{\boldsymbol{\vartheta}_2'\mathbf{s}_{it}}$ | | | | | | | | |
| $\Delta^2 MS$ | | | | | **0.276** | [1.32] | **-1.231** | [1.78] |
| $RIRL$ | | | | | **2.365** | [1.81] | **6.761** | [2.19] |
| $TTS$ | | | | | **4.151** | [2.53] | **9.150** | [2.05] |
| $(-LDS)$ | | | | | **21.228** | [8.89] | **17.254** | [2.20] |
| $(-TFPS)$ | | | | | **21.637** | [12.71] | # | # |
| time effects | 2.17% | | 8.23% | | | | | |
| significant? | yes | | only $\lambda_{2t}'$s | | | | | |
| time trends | $\surd$ | | $\surd$ | | $\surd$ | | $\surd$ | |
| significant? | yes | | SP,SW | | no | | no | |
| $RMSE$ | 1.09 | | 0.96 | | 0.53 | | 0.52 | |
| $\bar{R}^2$ | 0.921 | | 0.932 | | 0.981 | | 0.981 | |

All models have 600 obs and include country dummies. Time Effects: estimated effect in 1995 - estimated effect in 1966,
for average levels of institutional indicators. t-ratios in brackets. #: the coefficient could not be properly estimated due to lack of convergence.

Table 14: OECD Unemployment: the role of institutions and shocks (continued)

1. Labour market institutions have a direct significant impact on unemployment in a fashion that is broadly consistent with their impact on real labour costs.

2. The benefit variables have a significant positive effect, reinforced by their interactions.

3. The tax wedge has a positive effect which is lowered by high levels of coordination. The hump shaped hypothesis, however, is not confirmed.

4. The increase in union density has a positive effect that is offset by high levels of coordination.

5. Coordination in wage bargaining has a direct negative effect, and a negative effect through the interactions with taxation and union density.

6. Stricter employment protection does not seem to have a significant impact on the unemployment level, although it increases unemployment persistence.

7. Stricter fixed term contract regulations have a significant positive impact on unemployment. The regulations of temporary work agencies are not significant.

8. Oswald's home ownership variable does not appear significant.

9. The effects of controls for the labour demand shock, the terms of trade shock and the TFP shock are consistently significant, and have the expected sign.

10. The significant effects of institutions are robust to different specifications, including the static version of the model, the one estimated from the 1970s and the one using 5 years averaged data.

11. Broad movements in unemployment across the OECD can be explained by shifts in labour market institutions. To be more precise, changes in labour market institutions explain around 55 per cent of the rise in European unemployment from the 1960s to the first half of the 1990s, much of the remainder being due to the deep recession observed during the latter period.

12. We cannot rule out a significant role for institutions through their interactions with adverse shocks, although the estimated effects do not appear extremely robust. On the other hand, the direct effect of institutions still holds when we include the possibility of interactions between shocks and institutions.

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