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Abstract

This paper adds to the already vast economic literature on the respective role of shocks and institutions in unemployment dynamics. Conclusions of existing studies widely diverge. Such divergences are mainly due to a weak theoretical framework underlying the models which have been estimated. We have tried to overcome such weaknesses by relying on a structural model based on a Phillips curve in order to obtain a reduced form unemployment equation. Once estimated, this reduced form accounts for the importance of macroeconomic shocks in explaining changes in unemployment. The introduction of institutional variables and the estimation of three potential effects on unemployment (level, persistence and sensitivity to shocks) lead to results, which are consistent with theoretical predictions. Nevertheless, the role of institutions in explaining changes in unemployment is limited. We use a panel data approach by pooling country data in order to disentangle fixed country effects.

Keywords: Equilibrium unemployment; Structural model; shock; labour market institutions; OECD; cross-section estimation.

JEL Classification: C13, C31, E24

Contents

1 Introduction

Since the influential work of Blanchard and Wolfers (2000), many studies have tried to explain the differences in the OECD unemployment rate as the result of interaction between shocks and labour market institutions. Modelling this interaction is viewed as a promising way for understanding the puzzle of unemployment disparities which can be explained by none of the two kinds of variables individually. Indeed, on the one hand, OECD countries have been affected by symmetric shocks and have nevertheless experienced different unemployment dynamics. On the other hand, before the 1970s, all these countries had low unemployment rates in spite of quite different labour market institutions.

Using cross section data, these studies test a direct relationship between the unemployment rate, shocks and institutions and thus have the advantage of readily allowing for international comparisons. However, testing a reduced equation of the unemployment rate constitutes also their main drawback as they do not analyze formally the link between the unemployment rate and the wage determination process. As a consequence, empirical results are quite divergent among studies since they often lay on *ad hoc* specifications that may have little theoretical foundations.

The present contribution formally deduces a reduced form of the unemployment rate equation from a wage and price setting structural model. The econometric estimation of this reduced form accounts for the importance of macroeconomic shocks in explaining changes in unemployment. We use a panel data approach by pooling country data in order to disentangle fixed country effects. The introduction of institutional variables and the estimation of three of their potential effects on unemployment (on its level, on its persistence and on its sensitivity to shocks) leads to results which are consistent with theoretical predictions. Nevertheless, the role of institutions in explaining changes in unemployment is limited and the results are fragile. Particularly, some endogeneity problems cannot be ruled out, thus reversing the original causality going from institutions to unemployment.

The present paper highlights the main drawbacks of the methodology which consists in testing a reduced form of the unemployment rate without analysing formally the link between the unemployment rate and the wage determination process (Section 2). Section 3 shows how

the reduced model can be inferred from a wage and price setting structural model where the wage equation is a Phillips curve. It also defines precisely the concept of shock and institution. Section 4 simulates a small macroeconomic model and shows how the impact of shocks may depend on labour market institutions. The next two sections display the results of the econometric estimations. In Section 5, estimations include only shocks variables. Institutions are implicitly taken into account *via* fixed effect on coefficients. Section 6 tests the additional impact of institutional variables in order (1) to find out if fixed effects variance accross country reflects differences in institutional characteristics, (2) to apprehend the eventual impact of time-varying institutions.

2 Empirical literature on shocks and institutions

The empirical literature testing the effect of shocks and institutions on unemployment generally assumes that the evolution of the unemployment rate depends on economic shocks, on institutional variables and on the past unemployment rate (U):

$$U_t = f(shocks, institutions, U_{t-1}) \tag{1}$$

One of the first estimations of such a relation is to be found in the seminal work of Layard *et al.* (1991, p. 55). Based on a panel of 20 OECD countries, their work does not take macroeconomic shocks into account. Their estimated equation is only a function of institutional variables as follows:

Average unemployment rate (%) (1983-88)	=	0.24	+ 0.92 Duration of unemployment benefit (years) + 0.17 Replacement rate (%) - 0.13 Active employment policies (%) + 2.45 Coverage of collective agreements (1-3) - 1.42 Labour unions coordination (1-3) - 4.24 Employers coordination (1-3) - 0.35 Change in the inflation rate (%)

The value of the centred R^2 shows that more than 90% of the differences in the average unemployment rate during the 1983-88 period is explained by six institutional characteristics of the labour market. All coefficients are significant and have the sign expected by theoretical wage bargaining models. Labour unions strength as well as the level and the duration of unemployment benefits have a negative impact on employment, while the degree of coordination between social partners has a positive impact (Soskice, 1990).

This result, which attributes an important role to labour market institutions as a determinant of unemployment, is nonetheless obtained on data referring to a rather limited time period. Further work on international comparisons was not able to establish an automatic and robust link between economic performance and wage bargaining systems[1]. For instance, the OECD (1997) attempts to find some econometric relationships between certain institutional variables and economic performance indicators such as the employment and unemployment rates, inflation and wage inequalities. This study constructs several indicators of the collective bargaining systems for 19 Member countries, such as the bargaining coordination, trade union density and coverage. As no relation of the " reversed-U " type[2] appears, the authors conclude to a " negative " result.

Even if results were more " positive " according to the neo-classical view as previous work were, one can still cast some doubts on their robustness since some of the main causes of the unemployment hike, *i.e.* macroeconomic shocks, are disregarded. The purely institutional

[1]For an empirical literature review see OECD (1997) or Cadiou *et al.* (1999).

[2]Some models of wage bargaining predict a "reversed-U " type relationship between the equilibrium rate of unemployment and the level of wage negotiation (Calmfors and Driffill, 1988).

approach neglects the fact that, before the 1970s shocks, all the OECD economies had a low unemployment rate, despite showing an already wide diversity in labour market institutions. By overlooking the role of shocks, the study implicitly assumes that all OECD economies have been affected by the same shock. In order to overcome this critique, various studies have estimated an unemployment equation including some shocks. Among the earliest studies, the one by Layard *et al.* (1991, table 12, p. 433) takes into account restrictive monetary policies and increases in import prices. But this methodology became popular in the economic literature mainly after the seminal paper of Blanchard and Wolfers (2000).

The main advantage of this approach is to propose a coherent empirical framework which is able to test the interaction between shocks and institutions in an international comparison. However, it presents the major shortcoming of obtaining results which are largely dependent on the specification of the model. As a matter of fact, the different studies end up to quite diverging conclusions as to the respective role of institutions and shocks in the determination of the unemployment dynamic. The conclusions of Blanchard and Wolfers (2000) are quite balanced. They explain the rise in unemployment in Europe by the interaction between labour market institutions (mainly the tax wedge on labour and the unemployment benefit replacement rate) and shocks (the slowdown in labour productivity as well as the rise in real interest rates, in oil prices and in the share of value added going to profit). According to their results, changes in institutions did not have any impact. Nickell *et al.* (2005), however, explain 55% of the rise in the European unemployment rate by shifts in labour market institutions and claim that shocks do not have a significant impact when institutions are introduced. On the contrary, Fitoussi *et al.* (2000) or Palley (2001) find a minor impact of institutions[3].

Moreover, the impact of a particular variable varies among studies. According to Belot and van Our (2004) or Baccaro and Rei (2005), the tax wedge does not explain differences in OECD employment performance, whereas it has a negative significant impact on unemployment

[3]Nickell *et al.* (2005) conclude : " [. . .] broad movements in unemployment across the OECD can be explained by shifts in labour market institutions [...] ". In Fitoussi *et al.* (2000), the conclusion is radically the opposite: " We [...] showed that the labour market reforms advocated by the OECD Secretariat, while helpful in some cases, leave us far short of explaining which countries recovered in the 1990's and by how far ". The tone is similar in Palley (2001) : " The conventional wisdom is that the cause of high European unemployment lies in a job market that is rigid and inflexible. [...] The empirical results reported in this paper directly challenge this received wisdom. [...] The evidence clearly shows that macroeconomic factors matter for unemployment [...] ".

in IMF (2003) or Bassanini and Duval (2005). While the replacement ratio is insignificant in Baccaro and Rei (2005), it has a negative impact on unemployement in Belot and van Our (2004), but a positive one in Bassanini and Duval (2005).

These differences in diagnosis do not come from different datasets on institutional variables since most studies retained those used by Nickell (1997) for the estimation of the previous equation on recent data (see Table 1, column 3). These discrepancies bear two main explanations. The first one concerns the shocks taken into consideration and the way they are modelled. The second column in Table 1 shows substantial differences in the way the impact of shocks is specified. For example, Blanchard and Wolfers (2000) use the growth rate in total factor productivity while Nickell *et al.* (2005) use the change in this growth rate or the cyclical component of productivity. Therefore, the same productivity shock will bear a permanent effect in the first study, but a mere transitory one in the second one. The second explication comes from the different specification retained in modelling the interaction between shocks and institutions. In Palley (2001) or Karanassou *et al.* (2003), shocks and institutions interact in an additive form (Equation (1.4) in Table 1), while in Blanchard and Wolfers (2000), Layard *et al.* (1991) or Fitoussi *et al.* (2000)[4], they interact in a multiplicative form (Equation (1.1) to (1.3)). Whereas the additive form states independence between the impacts of institutions and shocks on unemployment, the multiplicative form conveys interdependence. Moreover, the impact of the past unemployment rate is modelled either linearly (Equations (1.3) to (1.5)) or as a product of institutions (Equation (1.1)). Some studies, such as Layard *et al.* (1991), Nickell (1998) or Nickell *et al.* (2005), also test interactions among institutions themselfs. Algebraically, it is expressed as the product of different institutions[5] (Equations (1.1) and (1.5)). All these different specifications are special cases of the following equation for the unemployment rate:

$$U_t = (I + S + U_{t-1}) + (IS' + II' + IU'_{t-1} + SS' + SU'_{t-1} + U_{t-1}U'_{t-1}) \qquad (2)$$

[4]See also Bertola *et al.* (2001) who enrich the model of Blanchard and Wolfers (2000) with additional institutional variables: wage and population distribution, unemployment and labour force by age and gender.

[5]Belot and Van Ours (2001 and 2004) study 18 de OECD Member countries over the 1960-1995 period and use a similar specification to test interactions between shocks and institutions. According to these authors, the higher the replacement ratio, the more negative the effect of the tax wedge on unemployment. However, one can cast serious doubts on the robustness of this result since no shock is included in their model.

Where S, I and U are respectively the matrixes of shocks, institutions and unemployment rates. X' is the transposed matrix of X.

The specification of the estimated model, which strongly influences the empirical results, generally suffers from a lack of theoritical foundation[6]. It appears to be more motivated by authors' beliefs concerning the degree of persistence of shocks and the respective influence of shocks and institutions rather than by real theoretical arguments. As a consequence, this methodology is quite silent as far as the transmission channels of shocks, their degree of persistence or the endogeneity (or exogeneity) of institutions are concerned.

This may lead to serious misintepretations of economic causal relations: the rise in unemployment would explain the increase in an institutional variable rather than the opposite[7]. Typically, the rise in the unemployment benefit replacement rate or in labour taxes is likely to be the consequence for, rather than the cause of, the rise in unemployment.

Finally, the estimated model is often difficult to interpret. This is clearly not a structural unemployment rate equation since none of its determinants (employment and the labour force) are modelled. The presence of inflationary shocks such as oil prices combined with the change in inflation (Fitoussi *et al.*, 2000; Palley, 2001) or the change in the stock of money (Nickell *et al.*, 1991, 2005) suggests that we are dealing with the concept of NAIRU (*Non Accelerating Inflation Rate of Unemployement*). But this is not the case in all studies: in Blanchard and Wolfers (2000), the change in inflation is not taken into account. The analysis of the underlying structural model may help to overcome these weaknesses.

[6]Layard *et al.* (1991) is one of the rare authors providing theoretical justification by deriving the reduced unemployment equation from a wage and price structural model.

[7]In their conclusion, Blanchard and Wolfers (2000) acknowledge this weakness: " We worry about the endogeneity of labour market institutions ".

Table 1 : Some reduced approach specifications of interactions between shocks and institutions.

Articles/specification	**Shocks**	**Institutions**
Layard *et al.* (1991) (1.1) $U_{it} = I_1 U_{it-1} + (1 - I_1) I_2 (I_{3t} + C_{1t} + I_4 C_{2t})$ • Replacement ratio is the only institution varying with time. • Period : $1956 - 1988$ / 19 OECD countries.	Variations of imported prices (1+), and of the stock of money (2-).	Unemployment benefit duration (1+, 2+), Coordination ok wage negotiation (1-, 2-), Labour force turnover rate (1-), Replacement ratio (3+), Dummy for wage pressure since 1970 (3+), Duration of labour contracts (4-), Degree of indexation and synchronisation of labour contracts (4-).
Blanchard and wolfers (2000) (1.2) $U_{it} = C_t(1 + I)$ • The introduction of institution variations gives unsatisfactory results. • Period : $1960 - 1995$ / 20 OECD countries.	Trend growth rate of total factor productivity (-), Real interest rate (+), Share of value added going to labour (+).	Replacement ratio (3+), Unemployment protection (+), Labour market active policies (-), Unemployment protection (+), Tax rate (+), Union coverage (+), Union density (+), Coordination index (-).
Fitoussi *et al.* (2000) (1.3) $U_{it} = \lambda_i U_{it-1} + I_1 + I_2 C_{1t} + C_{2t}$ • Stable institution (mean for the period 1983-88). • Period : $1960 - 1998$.	Trend growth rate of labour productivity (1-), World real interest rate (+), Variation of inflation (-), Social transfers (1+), Inflation (2-).	Replacement ratio (1+), Duration of unemployment benefit (2+), Union coverage (1+,2+), Union density (1+,2+), Coordination index (1-,2-).
Paley(2001) (1.4) $U_{it} = \lambda_i U_{it-1} + I_t + C_t$ • Variation of institutions : 2 means (1983-88 and 1989-94). • Period : $1979 - 1998$ / 20 OECD countries.	Variation of inflation (-), Real interest rate (+), GDP growth rate (-).	Idem Blanchard and Wolfers (2000), Trade openess ratio (-).
Nickell *et al.* (2005) (1.5) $U_{it} = \lambda_i U_{it-1} + I_t + I_t I'_t + C_t$ • Time-varying institutions. • Period : $1962 - 1995$ / 20 OECD countries.	Labour demand (-), Second difference of money stock (-) and of the logarithm of total factor productivity (-), Gap between this productivity and its trend (-), Variation of real import prices (+).	Replacement ratio (+), Unemployment benefit duration (+), Unemployment protection (+), Tax rate (+), Union density (+), Union coverage (-).

Key : C and I are respectively matrix of shock and institution, U_{it} the unemployment rate of country i; $(i+)$: the shock (respectively the institution) has a positive impact on C_i (respectively I_i).

3 A structural model of wage-price setting

Since the formalisation of Wage Setting / Price Setting (WS/PS) models by Layard *et al.* (1991), the Equilibrium Rate of Unemployment (ERU) has been defined as the unemployment rate that equalises the real wage asked by workers (WS curve) with the one employers are able to pay considering their price setting behaviour (PS curve). The ERU is equivalent to the concept of the NAIRU formalised by Phelps (1967, 1968) since inflation stability implies adequacy between the WS and the PS curve. Several specifications of the structural model are possible. In particular, the advocates of the Phillips curve and the supporters of the WS curve in level (Layard *et al.*, 1991; Blanchard and Katz, 1999; Chagny *et al.*, 2002) disagree. We chose a Phillips curve based on previous findings (Heyer, Reynès and Sterdyniak, 2007 ; Reynès, 2006). Firstly, the Phillips curve is a more general model since traditional WS curves in level correspond to the limit case of a Phillips curve with full hysteresis. Secondly, the Phillips curve appears to have more realistic foundations since it does not entail arbitrary hypotheses concerning the reservation wage of workers. A general specification of the Phillips curve is:

$$\dot{W}_t = \Psi + \alpha \dot{P}^C_{t-1} + \beta * U_t - \beta' \Delta U_t + \delta \dot{P}^{ROD}_t - \gamma(\dot{P}^C_t - \dot{P}^V_t) - \theta \dot{T}^C_t + \zeta \dot{T}^I_t \qquad (3)$$

Where W is wage, P^C the consumer price index, U the unemployment rate, P^{ROD} labour productivity, P^V the price of value-added, T^C the employer social contribution rate, T^I the direct and indirect tax rate[8].

This relation embodies a large set of wage setting mecanisms such as collective bargaining between employers and trade unions or individual bargaining between the employer and each worker. Equation (3) implies nonetheless that employees and employers agree on indexing wages to some key variables which may be object for negotiation. These variables are mainly inflation, productivity gains, terms of trade $(\dot{P}^C_t - \dot{P}^V_t)$ and the tax wedge. The level and delay of indexation may vary accross country.

Compared to the traditional WS curve *à la* Layard *et al.* (1991), this general specification

[8]The lower-case variables are in logarithm. *t* is the time operator. Variables in first difference and in growth rate are respectively referred to as $\Delta X_t = X_t - X_{t-1}$ and $\dot{X}_t = X_t/X_{t-1} - 1 \approx \Delta x_t$. All coefficients are positive and long-run, ignoring adjustment lags for algebraic simplicity.

of the Phillips curve presents the advantage that it does not require a unit indexation of wages on prices and labour productivity to be postulated *a priori*. Hence, it represents the result of wage bargaining, where employees are not always able to obtain the automatic indexation of their wages on prices and where the reference to labour productivity growth is not necessarily made.

Whereas the unit indexation of wages on prices is generally motivated by the absence of nominal illusion of workers and firms, several theoretical arguments go against this proposition of full indexation. As wages are not continuously negotiated, the real wage may decrease with inflation. When inflation is low, workers may not perceive the decrease of their purchasing power (Akerlof *et al.*, 2000). But they may not be able to maintain their purchasing power in periods of sustained inflation either, since their bargaining power may be weakened especially if the labour market situation is not favourable (*e.g.* Tobin, 1972). In some countries, trade unions may contribute to the reduction in inflation if they are concerned by macroeconomic performances (Calmfors and Driffill, 1988; Soskice, 1990) or if they fear the reaction of the Central bank. Then, unions may also agree to take into account the evolution of labour productivity in order to limit the negative impact of a productivity slowdown ($\delta > 0$). However, this is not always the case since labour productivity growth is a macroeconomic concept which has no meaning at the firm level. If trade unions are concerned by the competitiveness of their firm, they may accept wage losses in case of a deterioration of the terms of trade due for instance to an oil shock ($\gamma > 0$) or of a rise in the employer's social contribution ($\theta > 0$). On the contrary, they may want to maintain their purchasing power and ask for wage hikes after an increase in their social contribution rate($\zeta > 0$).

Ψ is a coefficient representative of wage-push factors that may vary with the bargaining power of workers and may then depend positively on the trade union membership or the unemployment benefit replacement rate. Finally, changes in the unemployment rate may influence the Phillips curve because wages can be affected not only by the level but also by the change in employment (Phillips, 1958; Lipsey, 1960) or by hysteresis phenomena[9]. It is generally regarded as full hysteresis when only changes in the unemployment rate influence the wage setting (*e.g.*

[9]Hysteresis occurs when the long-term unemployed exert no influence on wage-setting (Blanchard and Summers, 1986; Lindbeck, 1993). However, some authors contest the use of the term hysteresis to describe this phenomenon (Cross, 1995).

Blanchard and Summers, 1986). Full hysteresis is often detected in the United Kingdom (*e.g.* Chagny *et al.*, 2002).

Consumer prices are a function of the import price (P^M) and the price of value-added :

$$\dot{P}_t^C = \eta \dot{P}_t^M + (1-\eta)\dot{P}_t^V \tag{4}$$

The price-of-value-added-setting results from profit maximisation in an imperfect competitive market. Firms set their price as a mark-up (M) over unit labour costs. Assuming no adjustment lag for algebraic simplicity, the growth rate of the price of value-added is:

$$\dot{P}_t^V = \dot{W}_t + \dot{T}_t^C - \dot{P}_t^{ROD} + \dot{M}_t \tag{5}$$

$$m_t = \xi + \xi' T_t^{CU} + \xi'' I_t^R \tag{6}$$

The mark-up may depend on the tensions in the labour market, *i.e.* on the production capacity-utilisation ratio (T^{CU}): it may also depend on real interest rates (I^R) if firms take their capital cost into account in their price setting process. Combining Equations (3), (4), (5), (6) leads to the following reduced Phillips curve, where a rise in inflation depends on permanent and transitory shocks ($Z^{LT} et Z^{MT}$):

$$\Delta \dot{P}_t^C = Z_t^{LT} + Z_t^{MT} - \beta U_t - \beta' \Delta U_t \tag{7}$$

$$Z_t^{LT} = \Psi - (1-\alpha)\dot{P}_{t-1}^C - (1-\delta)\dot{P}_t^{ROD} \tag{8}$$

$$Z_t^{MT} = \dot{M}_t + (1-\theta)\dot{T}_t^C + [\eta/((1-\eta)(1-\gamma))](\dot{P}_t^M - \dot{P}_t^C) + \zeta \dot{T}_t^I \tag{9}$$

From Equation (7), it is possible to infer the ERU, defined as the unemployment rate stabilising inflation ($\Delta \dot{P}_t^C = 0$). The long-term ERU (ERU_{LT}, U^{LT}) is the unemployment rate that

stabilises inflation in the long run and depends only on permanent shocks:

$$U_t^{LT} = [\Psi - (1-\alpha)\dot{P}_{t-1}^{C} - (1-\delta)\dot{P}_t^{ROD}]/\beta \tag{10}$$

It depends on inflation and labour productivity if there is a non-unit indexation of wages on prices and labour productivity. In the case of inflation, an inflation-unemployment dilemma remains in the long run. The medium-term ERU (ERU^{MT}, U^{MT}) stabilises inflation in the medium run and thus takes also into account temporary shocks:

$$U_t^{MT} = [\beta'/(\beta+\beta')]U_{t-1} + (Z_t^{LT} + Z_t^{MT})/(\beta+\beta') \tag{11}$$

Integrating Equation (11) into (7) allows to express changes in inflation as a function of the gap between the unemployment rate and the ERU_{MT}:

$$\Delta\dot{P}_t^{C} = -(\beta+\beta')(U_t - U_t^{MT}) \tag{12}$$

Inverting this equation allows for expressing the unemployment rate as a function of its past level and of inflationary shocks:

$$\begin{aligned} U_t \;=\; & \phi_0 U_{t-1} + \phi_1 + \phi_2\dot{P}_{t-1}^{C} + \phi_3\dot{P}_t^{ROD} + \phi_4\Delta T_t^{CU} + \phi_5\Delta I_t^{R} \\ & + \phi_6\dot{T}_t^{C} + \phi_7(\dot{P}_t^{M} - \dot{P}_t^{C}) + \phi_8\dot{T}_t^{I} + \phi_9\Delta\dot{P}_t^{C} \end{aligned} \tag{13}$$

With $\phi_0 = \beta'/(\beta+\beta')$, $\phi_1 = (1-\phi_0)\psi/\beta$, $\phi_2 = -(1-\phi_0)(1-\alpha)/\beta$, $\phi_3 = -(1-\phi_0)(1-\delta)/\beta$, $\phi_4 = \xi'/(\beta+\beta')$, $\phi_5 = \xi''/(\beta+\beta')$, $\phi_6 = (1-\theta)/(\beta+\beta')$, $\phi_7 = \eta/(1-\eta)(1-\gamma)/(\beta+\beta')$, $\phi_8 = \zeta/(\beta+\beta')$, $\phi_9 = -1/(\beta+\beta')$.

According to this structural model, the unemployment rate depends not only on shocks but also on institutional characteristics of the wage-price setting embodied in the value of the parameter ϕ_i. The higher ϕ_0, *i.e.* the higher is the hysteresis (β'), the more persistent the unemployment rate. The higher ϕ_1, *i.e.* the higher is the wage push factor (ψ), the higher the unemployment rate. The response to shock may also depend on the characteristics of the

wage setting process. The lower ϕ_3, *i.e.* the closer to unity the indexation of wage on labour productivity (δ), the lower the increase in the unemployment rate after a productivity slowdown. A similar reasoning holds for other shocks: deterioration of the term of trade, increase in the employer's social contribution, etc.

As a consequence, the parameters of the model express nothing else but labour market institutions. Their value may vary across countries because of differences in wage-price setting mecanisms. This statement can be evaluated by testing fixed effect on these coefficients with cross-section econometrics techniques (Section 5). It is also possible to test if differences accross countries can be explained by differences in institutional variables such as the trade union membership, the unemployment benefit replacement rate, the minimum wage level, the degree of mismatch, the tax wedge, the degree of competitiveness, etc (Section 6). In addition, testing the impact of these institutional variables allows us to evaluate the effect of time-varying institutions on the unemployment dynamics.

In case of full hysteresis ($\beta = 0$), the unemployment rate data has a unit root: $\phi_0 = 1$ and the model does not provide a consistent equilibrium growth path anymore: a permanent increase or decrease in the unemployment rate is necessary for inflation stability (Equation (13)). As in the WS curve à la Layard *et al.* (1991), only a unit indexation of wages on prices and productivity ($\alpha = \delta = 1$) and a coefficient $\psi = 0$ are consistent with a stable equilibrium growth path. Because of the full hysteresis hypothesis, an increase in the social contribution rate or any shock increasing the desired mark-up of workers and firms (such as increases in the real interest rate or in the capacity-utilisation ratio) would permanently raise the unemployement rate. With a Phillips curve (without full hysteresis), a slowdown in labour productivity or a fall in inflation would raise permanently the ERU_{LT} but increases in the social contribution rate or in the desired mark-up of firms (following an increase in the interests rate or in the capacity-utilisation ratio) would only have a transitory effect on the medium-term ERU. For more details see Reynès (2006, chap. 3).

4 Simulating shock under different institutions

Using a simple macroeconomic model, this section simulates the impact of an inflationary shock on the unemployment dynamic under different labour market institutions. The cases of partial and full hysteresis are successively treated. The previous wage and price structural model (Equations (3) to (6)) is completed with four additional equations. As population is assumed stable, the unemployment rate can be expressed as a linear function of the logarithm of employment (N) (Equation (14)). Assuming a constant returns to scale production function with complementary factors (Leontief's function), employment behaves as the gap between demand (Y) and productivity trend (Equation (15)). Aggregate demand, which includes private demand and public outlays, depends positively on the expected production level (past production augmented by productivity gains) and on the public budget deficit (D) and negatively on the real interest rate (Equation (16)). Monetary policy is described by a reaction function *à la* Taylor (1993). The Central bank fixes the nominal interest rate (I^N) as a function of the gap between the effective and the target inflation and of the output gap (Equation (17)).

$$U_t = -n_t \tag{14}$$

$$n_t = y_t - \dot{P}_t^{ROD} t \tag{15}$$

$$y_t = y_{t-1} + \dot{P}_t^{ROD} - \sigma(I_t^N - \dot{P}_t^C) + D_t \tag{16}$$

$$I_t^N = I_t^{N*} + \epsilon(\dot{P}_t^C - \dot{P}_t^{C*}) + \lambda(y_t - \dot{P}_t^{ROD} t) \tag{17}$$

Where I_t^{N*} and $\dot{P}_t^{C*}$ are respectively the nominal interest rate and the inflation targets.

The reference scenario is one where all variables, including productivity gains, and all constant terms are set equal to 0. The values of the parameters are set as follows:

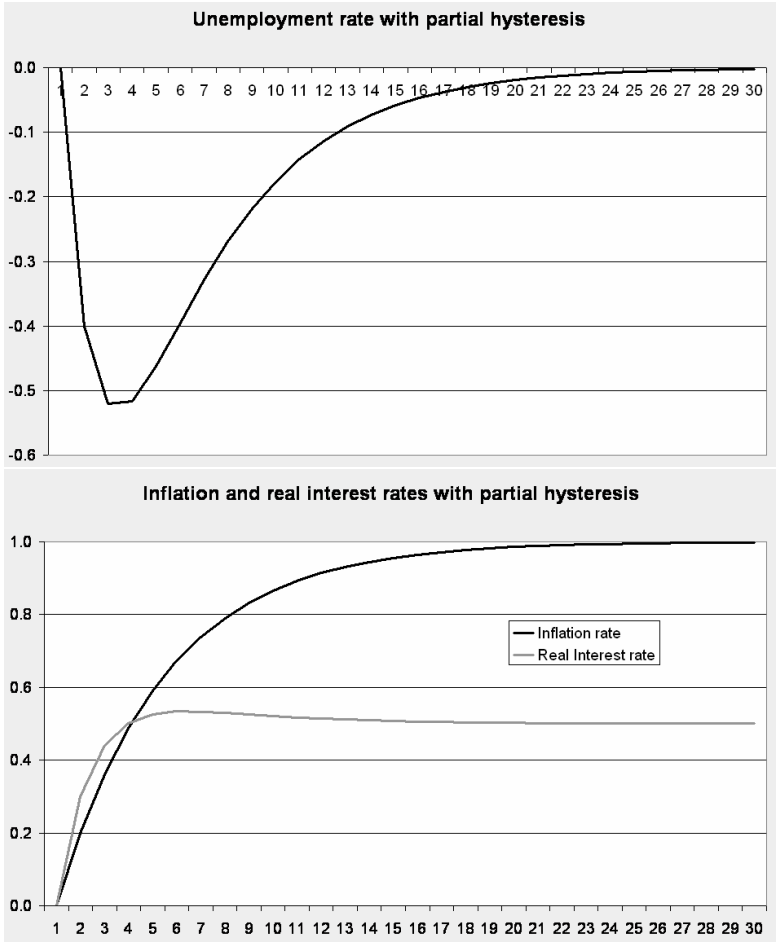
- for partial hysteresis : $\beta = 0.25$ and $\beta' = 0.25$
- for full hysteresis : $\beta = 0$ and $\beta' = 0.25$
- $\sigma = 2$
- unit-indexation of wages on prices : $\alpha = 1$

- no indexation of wages on the terms of trade ($\gamma = 0$), on the employer's social contribution rate ($\theta = 0$) and on productivity ($\delta = 0$)
- the import share in consumption is : $\eta = 0.25$
- the monetary authority attributes the same importance to the objectives of price and of output stability and : $\epsilon = 0.5$ and $\lambda = 0.5$

4.1 The case of partial hysteresis

4.1.1 Impact of a permanent demand shock (a budget deficit increase)

With a unit indexation of wages on consumer prices an expansionary fiscal policy entailing a permanent increase in the budget deficit leads to a temporary fall in unemployment. The monetary authority reacts to the fall in unemployment and to the subsequent increase in inflation by raising the nominal interest rate. The higher interest rate, by its depressing effect on investment reduces aggregate demand and boosts unemployment. In the long term, the unemployment rate reaches its initial level and the fiscal multiplier is equal to 0. Only with a partial indexation of wages on prices ($\alpha < 1$), the fiscal multiplier is positive as implied by the inflation-unemployment dilemma.



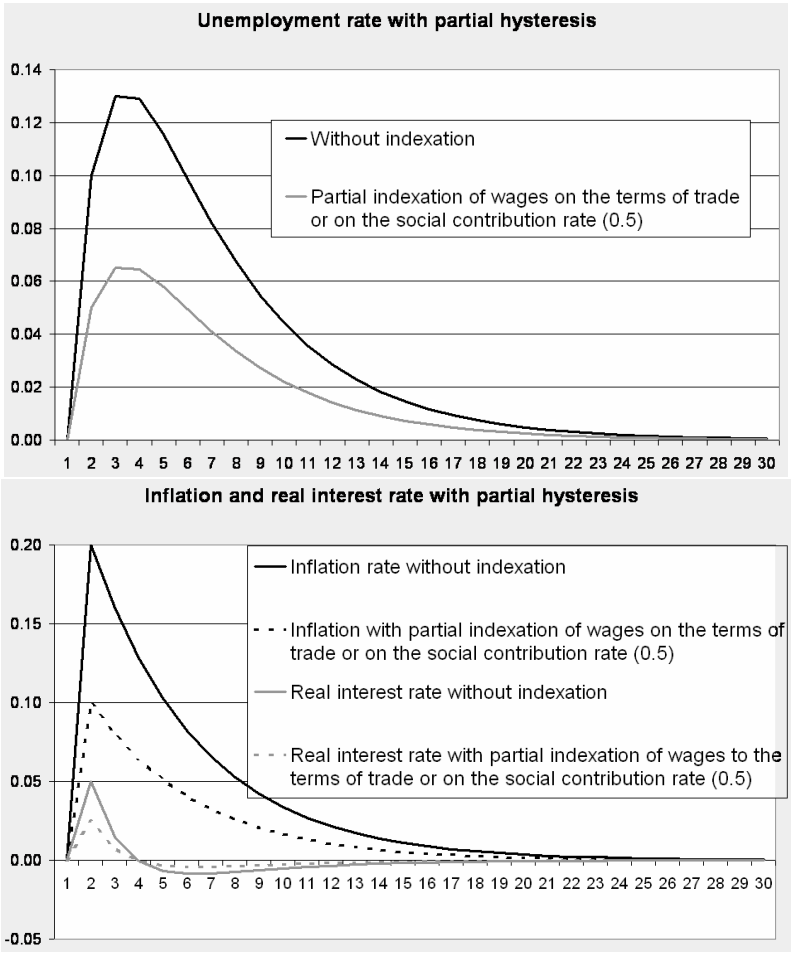
Key: in pourcentage; $D_t = 1$

4.1.2 Impact of a temporary supply shock (increase in import prices or in the employer's social contribution rate)

An inflationary shock, such as an increase in import prices leads to a temporary increase in the unemployment rate, as the immediate reaction of the monetary authority to higher inflation crowds out investment with a negative impact on aggregate demand and employment. In presence of a high degree of coordination between workers, unions and the Central bank the desired level of inflation can be attained by the common action of the monetary authority and of negotiation among social partners. If workers are willing to accept wage losses by a total or partial indexation of wages on the terms of trade ($\gamma = 0.5$), the higher imported inflation will not be entirely transferred onto wages and onto the prices of value-added, thus reducing the inflationary impact of the initial shock. In this less inflationary environment, the response of

the monetary authority will be less restrictive and the rise in the unemployment rate of a lower extent.

In the case of an increase in the employer's social contribution rate, the results are qualitatively the same as in the case of an increase in input prices or in the mark-up, whether in a non-cooperative environment ($\theta = 0$) or in a cooperative one ($\theta = 0.5$).

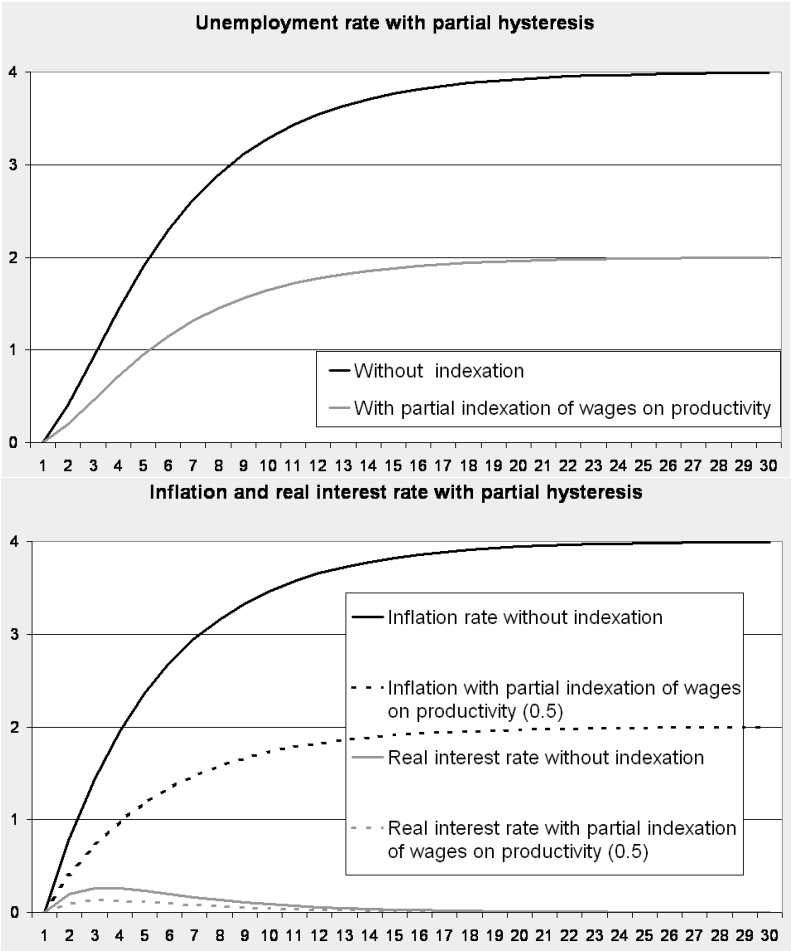


Key: in pourcentage; $\dot{P}_t^M = 1$

4.1.3 Impact of a permanent supply shock (slowdown in the productivity trend)

A permanent supply shock such as a slowdown in the trend of technical progress provokes a permanent drift of inflation which is counteracted by a rise in the nominal interest rate. By curbing activity and increasing the unemployment rate to its new non-inflationary level, the Central bank stabilises the inflation rate to a higher level. In a cooperative environment, where

wages adjust to lower productivity ($\delta = 0.5$), the new equilibrium unemployment rate will be lower as the hike in inflation is offset by wage losses and by a lower interest rate increase. This new equilibrium is compatible with a lower inflation than in a non-cooperative setting ($\delta = 0$).



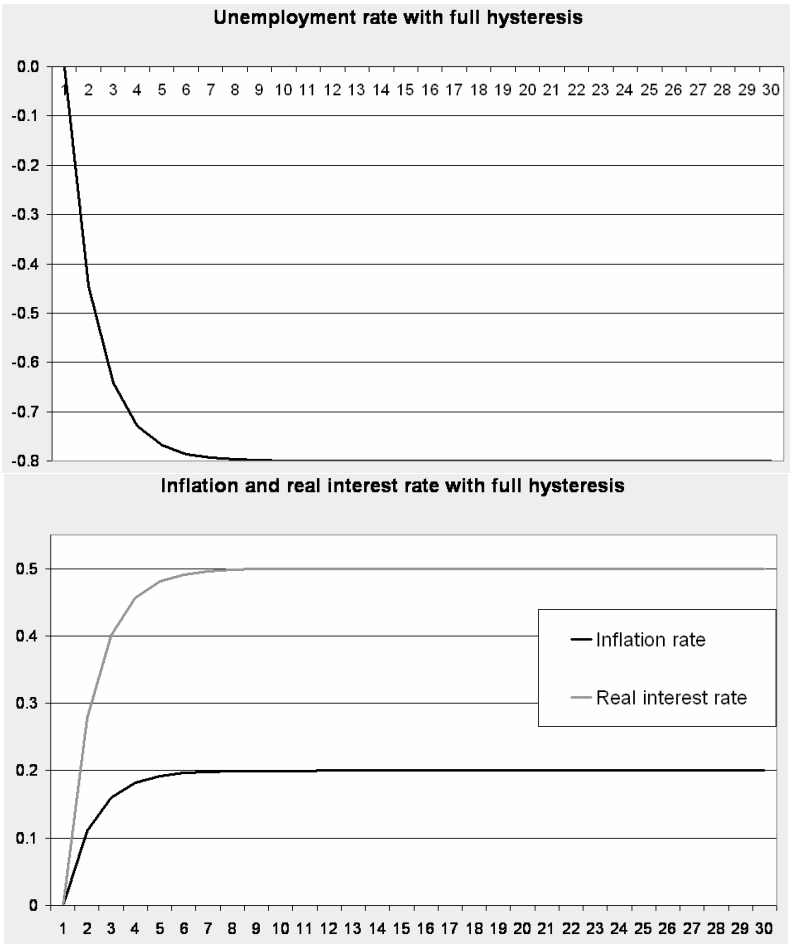
Key: in pourcentage; $\dot{P}_t^{ROD} = -1$

4.2 The case of full hysteresis ($\beta = 0$)

A permanent supply shock in the presence of full hysteresis leads to premanent drifts of inflation and of the equilibrium rate of unemployment. Curbing activity and raising unemployment by a restrictive monetary policy does not lead to a new non-inflationary equilibrium. As previuosly discussed, only full indexation of wages on productivity ($\delta = 1$) allows for a consistent equilibrium path. Thus, in the following we focus only on shocks allowing for the existence of a non-explosive long term growth path.

4.2.1 Impact of a permanent demand shock (a budget deficit increase)

The case of an expansionary fiscal policy entailing a permanent increase in the budget deficit leads to a permanently lower unemployment rate in the case of full hysteresis. The initial fall in unemployment is higher since it is counteracted by a less restrictive monetary response than in the case of partial hysteresis. As inflation depends only on the change in the unemployment rate, and not on its level, the rise in inflation is lower.

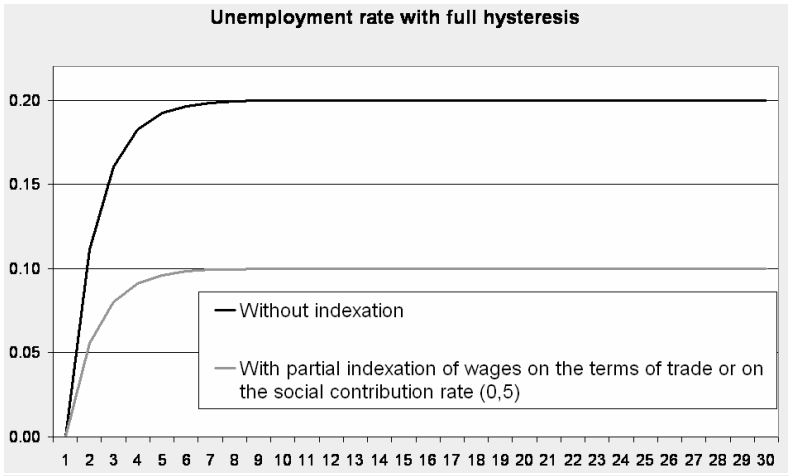


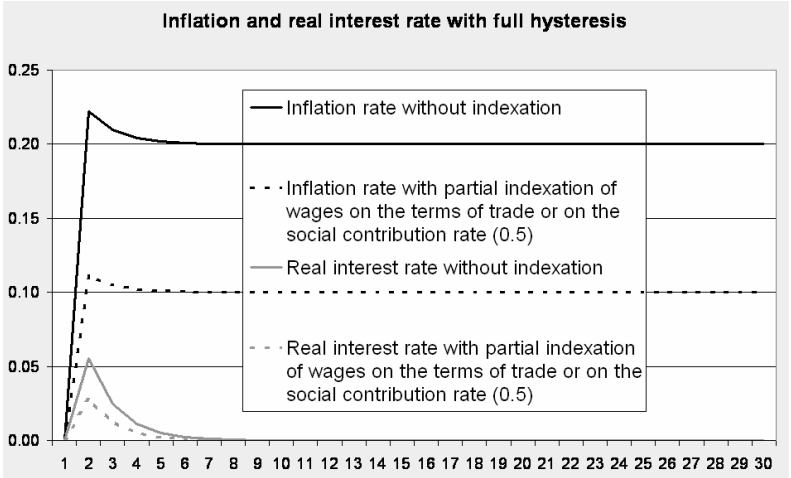
Key: in pourcentage; $D_t = 1$

4.2.2 Impact of a temporary supply shock (increase in import prices or in the employer's social contribution rate)

With full hysteresis, the effect of a temporary supply shock is the same as that of a permanent one with partial hysteresis. The initial shock on the cost of inputs leads to an increase

in inflation causing an immediate response of the monetary authority and thus to a rise in unemployment. However, once the unemployment rate has reached its peak, the adjustment of the unemployment rate to its equilibrium level is indefinitely slow, thus transforming the initial temporary shock into a permanent one. The higher unemployment rate is combined to a more inflationary environment. If workers accept to lower their wages in order to counteract the imported inflation shock, then the response of the monetary authority will be less restrictive. The new equilibrium will be one with lower unemployment and inflation rates than in the case of absence of cooperation between workers and monetary authorities.





Key: in pourcentage; $\dot{P}_t^M = 1$

5 Estimating the theoretical model

5.1 The benchmark model

We use OECD data over the 1960-2006 period (see the data Appendix A). Missing values actually reduce our estimation sample to the 1962-2005 period. Using panel data, we have first estimated the following benchmark model (Table 2), where unemployment depends on its past level, on changes in inflation, on the terms of trade $\dot{P}^M_{i,t-1} - \dot{P}^C_{i,t-1}$, on productivity growth and on the real interest rate[10]:

$$U_{i,t} = \alpha_i + \lambda U_{i,t-1} + \varphi_0(\dot{P}^C_{i,t} - \dot{P}^C_{i,t-1}) + \varphi_1(\dot{P}^M_{i,t-1} - \dot{P}^C_{i,t-1}) + \varphi_2 \dot{P}^{ROD}_{i,t-1} + \varphi_3 I^R_{i,t-1} + \epsilon_{i,t} \quad (18)$$

Specific characteristics of each country are taken into account with fixed effects on the intercept α_i. All independent variables are lagged for two reasons. Firstly, the negative impact of a shock on unemployment is likely to be delayed. Secondly, from an econometric point of view, a lagged specification avoids the endogeneity bias. Besides differences in lags, our estimated specification is quite similar to the unemployment equation (13) derived from our theoretical model. Few differences must however be mentioned. Some of the variables of the theoretical model are not reported in our estimation because they did not have a significant impact: the capacity utilisation ratio, the employer social contribution rate or the tax rate. The fact that only the first difference of inflation is significant suggests the absence of a long run unemployment inflation dilemma.

The interest rate in first difference (as suggested in the theoretical model) is not significant either. But its level is (Table 2), as it is often the case in the literature (see Table 1: Blanchard and Wolfer, 2000; Fitoussi *et al.*, 2000; Palley, 2001). This discrepancy with our simple theoretical model may have several sources. Firstly, the way firms take into account their capital costs in their price setting process may be quite different from the way usually assumed in standard theoretical models. The mark-up Equation (6) implicitly assume that the cost of capital equals the real interest rate. Alternatively, the cost of capital may be seen as a stream of inter-

[10] All the econometric estimations were performed with the E-views 5.1 program. Programs and data are available upon requests.

ests corrected from output growth: $\sum_{i=0}^{t}(I_i^R - \dot{Y}_i)$. This specification states the intertemporal constraint of firms. In the long run, the stream of interests paid by firms has to be lower than their sales. In order to be profitable, firms must increase their price as long as the real interest rate is above their output growth. With this capital cost specification, the interest rate intervenes in level, rather than in first difference, in the price equation (5) and hence in the unemployment equation (13).

Secondly, interest rates affect the economy not only *via* the price setting. Amongst other possible channels of transmission are labour capital substitution, output growth *via* the effect on investment and consumption. With a more complex theoretical model, we could find a reduced equation where the unemployment rate is a fonction of the level of the interest rate. But this analysis goes beyond the scope of this paper.

Table 2 : Estimation of $U_{i,t}$

Number of observations : 784				R^2 : 0.961	
Variable		Coefficient	Standard Error	T-Stat	P-Value
Intercept	$\bar{\alpha}$	0.088	0.108	0.8	0.417
$U_{i,t-1}$	λ	0.910	0.009	93.87	0.000
$\dot{P}_{i,t}^C - \dot{P}_{i,t-1}^C$	φ_0	-0.048	0.014	-3.53	0.000
$\dot{P}_{i,t-1}^M - \dot{P}_{i,t-1}^C$	φ_1	0.007	0.004	1.66	0.098
$\dot{P}_{i,t-1}^{ROD}$	φ_2	-0.101	0.016	-6.38	0.000
$I_{i,t-1}^R$	φ_3	0.088	0.009	9.41	0.000

With an adjusted R^2 equal to 0.961, the estimation of the benchmark model (18) is quite satisfactory since inflationary shocks give a good explanation of OECD unemployment. Results are consistent with economic theory. Policies aimed at curbing inflation (φ_0) increase unemployement as predicted by the absence of a long run unemployment/inflation dilemma. Oil price shocks, accounted for *via* the import prices (φ_1), explain part of the increase in OECD unemployment. Labour productivity growth is significant with a negative sign (φ_2). This reflect the increase in OECD unemployment caused by the productivity slowdown shock which occured mainly in the 1980s. The increase in interest rates, by discouraging investment has a recessive effect on activity and thus on employment (φ_3). Other shocks, often mentionned in

the literature (the rise in public finance deficit, in stock market prices and in the share of value added going to profit) were also tested but they were not significant. Finally, the coefficient of the lagged unemployment variable is high ($\lambda = 0.91$) suggesting the presence of hysteresis. Nevertheless, the hypothesis of full hysteresis ($\lambda = 1$) is rejected by the Wald test. This result is at odds with most of the unit root tests which generally conclude to the non-stationarity of the unemployment series[11]. Nevertheless, we chose to keep the unemployment rate in level because we want to test heterogeneity in its persistence.

5.2 Fixed effects as institutional discrepancies

The estimation of the benchmark model presents the advantage of showing a clear link between shocks and unemployment dynamics. However, heterogeneity between countries is only taken into account with a fixed effect on the intercept. The sensitivity of unemployment to shocks and its persistence are implicitly assumed homogenious accross OECD countries. This hypothesis may not be verified, since estimated parameters reflect institutional characteristics (Section 2) which differ accross OECD countries.

We now check this hypothesis of homogeneity by testing fixed effect for the sensitivity (θ_i) and persistence coefficients (λ_i). In order to simplify the analysis and the description of results, the model has been constrained by constructing a shock variable:

$$U_{i,t} = \alpha_i + \lambda_i U_{i,t-1} + \theta_i S^{hocks}_{i,t-1} + \varepsilon_{i,t} \tag{19}$$

Where $S^{hocks}_{i,t-1} = \frac{\hat{\varphi_0}}{\hat{\varphi_3}}(\dot{P}^C_{i,t} - \dot{P}^C_{i,t-1}) + \frac{\hat{\varphi_1}}{\hat{\varphi_3}}(\dot{P}^M_{i,t-1} - \dot{P}^C_{i,t-1}) + \frac{\hat{\varphi_2}}{\hat{\varphi_3}}\dot{P}^{ROD}_{i,t-1} + I^R_{i,t-1}$.

The shock variable is constructed by using empirical estimators of the benchmark model: $\hat{\varphi_0}$, $\hat{\varphi_1}$, $\hat{\varphi_2}$ and $\hat{\varphi_3}$ from Table 1. The arbitrary normalisation through $\hat{\varphi_3}$ does not change econometric results but makes their interpretation easier.

We then estimate the three parameters of equation (19). This two-stages procedure of estimation has the advantage of simplicity, but it may lead to biased value for coefficients and

[11] Only the test of Levin, Lin and Chu rejects the unit root hypothesis.

standard errors. We control this bias by comparing the results with the one-stage procedure estimation of simultaneous equations . The bias is generally small either for the coefficients and the standard errors (see Appendix B).

We first estimated individual coefficients without constraints. This is equivalent to an OLS estimation country by country. As this test gave disappointing result, we imposed some constraints: the three models test fixed individual effects on the intercept α_i; the second model tests, in addition, fixed effet on the unemployment persistence λ_i, but the sensibility to shocks θ_i is common accross countries, whereas the third model retains the opposite specification.

Table 3 : Individual coefficients

	Model 1	Model 2	Model 3
Pays	α_i	λ_i^{***}	θ_i
Australia	0.038	0.82	0.121^{***}
Austria	-0.027	0.97	0.051
Belgium	0.306^{**}	0.89	0.129^{***}
Canada	0.140	0.84	0.155^{***}
Denmark	-0.210	0.88	0.060^{***}
Finland	0.273^{**}	0.94	0.210^{***}
France	0.343^{**}	0.94	0.085^{**}
Germany	0.285^{*}	0.95	0.170^{***}
Ireland	0.350^{**}	0.94	0.187^{***}
Italy	0.045	0.87	0.040^{**}
Japan	0.151	0.80	0.022
Netherland	0.136	0.89	0.120^{***}
New-Zealand	-0.180	0.91	0.089^{***}
Norway	-0.107	0.92	0.058^{**}
Portugal	0.538^{***}	0.60	0.015
Spain	0.709^{***}	0.92	0.226^{***}
Sweden	-0.113	0.98	0.040
Switzerland	-0.005	0.94	0.123^{***}
United Kingdom	0.067	0.88	0.165^{***}
United States	-0.030	0.69	0.127^{***}
Mean	**0.085**	**0.89**	**0.109**
Std err.	**0.17**	**0.06**	**0.03**
α_i **std err.**	**0.17**	**0.34**	**0.21**

(***) : significant at 1%, (**) 5%, (*) 10%

Unemployment persistence varies signicantly accross countries (Table 3). Most of the countries are close to full hysteresis ($\lambda_i > 0.9$): Austria, Finland, France, Germany, Ireland, New-

Zealand, Norway, Spain, Sweden and Switzerland. A second group of countries presents an intermediate level of hysteresis ($0.8 < \lambda_i < 0.9$): Australia, Belgium, Canada, Denmark, Italy, Japan, the Netherlands and the United-Kingdom. Only Portugal (0.60) and the United States (0.69) show a low level of hysteresis.

There is also some heterogeneity in the sensibility of unemployment to shocks. The group of countries displaying high sensitivity ($\theta_i \approx 0.2$) is composed by Finland, Germany, Ireland, Spain and the United-Kingdom. On the contrary, sensitity is low and/or not significantly different from 0 in Austria, Denmark, Italy, Japan, Norway, Portugal and Sweden. The remaining countries are in an intermediate position ($\theta_i \approx 0.1$): Australia, Belgium, Canada, France, the Netherlands, New-Zealand, Switzerland and the United States.

The introduction of fixed effect for the persistence and the sensitivity of unemployment to shocks increases the α_i standard error from 0.17 to 0.34 and 0.21 respectively(see last line of Table 3) and hence improve the explanation of the unemployment level. The unexplained part (α_i) tends to be more specific to each country.

This heterogeneity accross countries is confirmed by the Fisher test, sometimes called Hsiao (1986) test as we used panel data. The test rejects the null hypothesis of equality between coefficients (Table 4).

Table 4 : Fisher tests

	Model 1	Model 2	Model 3
Fisher Statistic	2.87	1.42	6.13
Pvalue	0.000	0.069	0.000

6 Introducing institutional variables

As suggested by our theoretical model (Section 2), this heterogeneity in coefficients is likely to reflect institutional heterogeneity amongs OECD members. The next step is to test if these differences can be explained by labour instutitutions data such as trade union membership, unemployment replacement ratio, tax wedge, etc. In other words, we found out that there were less hysteresis in certains countries or less sensitivity to shocks in others, but we would like to know why and if institutions provide a satisfactory explanation to such results. Moreover, the previous

fixed effect approach implicitly assumes stable institutions over time in a given country. Important labour market reforms in certain countries may challenge this hypothesis. Incorporating institutional variables may thus help us take into account time variation in institutions.

In order to do so, Equation (19) is amended as to incorporate institutional variables ($Inst$):

$$U_{i,t} = (\alpha_0 + \alpha_1 Inst) + (\lambda_0 + \lambda_1 Inst)\, U_{i,t-1} + (\theta_0 + \theta_1 Inst)\, S_{i,t-1}^{hocks} + \varepsilon_{i,t} \tag{20}$$

As suggested by our theoritical model, institutional variables may explain differences in the intercept (which reflect wage push factors), in persistence and in the sensitivity to shocks. The model remains linear and the least square estimator can easily be applied since the estimation consists in incorporating in Equation (19) a few extra independent variables: $Inst$, $Inst * U_{i,t-1}$ and $Inst * S_{i,t-1}^{hocks}$. Constraints on shocks are abandoned when shocks are not coupled with institutions :

$$\begin{aligned} U_{i,t} &= (\alpha_{0,i} + \alpha_1 Inst) + (\lambda_0 + \lambda_1 Inst) U_{i,t-1} + \varphi_0 (\dot{P}_{i,t}^{C} - \dot{P}_{i,t-1}^{C}) \\ &+ \varphi_1 (\dot{P}_{i,t-1}^{M} - \dot{P}_{i,t-1}^{C}) + \varphi_2 \dot{P}_{i,t-1}^{ROD} + \varphi_3 I_{i,t-1}^{R} + \varepsilon_{i,t} \end{aligned} \tag{21}$$

The introduction of institutional variables as a determinant of OECD unemployment generally leads to fragile econometric results. The significance of institutions and the sign of their impact is highly sensitive to changes in specification. Whereas the results are often significant when institutions are tested separately, the impact of institutions generally disappear if extra instutional varibles are incorporated. This is partly due to collinearty between some of these variables. Moreover, the R^2 does not improve much, compared to the benchmark model based exclusively on shocks. Testing simultaneously several institutions and several of their potential impacts (on the intercept, on the persistence and on the sensitivity to shock) provides poor results whose the interpretation is difficult.

As a consequence, we followed a two-stage estimation procedure. Firstly, we tested each institution separately in (20) in order to select the significant variables and to assess if their impact is consistent with economic theory (Section 6.1). Secondly, we tested the institutional variables which turned out to be significant simultaneously in order to evaluate their robustness

to changes in specification (Section 6.2). Comparing the statistical properties of alternative specifications allows us to select the best model including the greatest number of institutional variables. Finally, Section 6.3 tests if this model reduces significatively fixed-effect heterogeneity.

6.1 Testing institutions separately

Results obtained when each institutional variable is separately tested are summarised in the next three tables. Every time, the three potential impacts of a given institution are tested on the level of unemployement (*i.e.* on the intercept), on its persistence and on its sensitivity to shocks. But only significant regressors are displayed in the following tables.

Table 5 presents the estimation of the effects of active labour market policy (ALMP) spendings as a percentage of GDP ($almp$) or as a percentage of GDP normalized by the unemployment rate ($almp\_unem$), as well as the effects of employment protection (epl).

Table 5 : Introduction of institutional variables

U_t	$almp$		$almp\_unem$	epl	
Cst	$-0,931^{***}$	0.368^{*}	1.562^{***}	-0.008^{***}	$\bar{\alpha}$
U_{t-1}	0.895^{***}	0.811^{***}	0.921^{***}	0.829^{***}	λ_0
S^{hocks}			0.055^{***}	0.17^{***}	θ_0
$\dot{P}^C_t - \dot{P}^C_{t-1}$	-0.094^{***}	-0.103^{***}			φ_0
$\dot{P}^M_{t-1} - \dot{P}^C_{t-1}$	0.005	0.005			φ_1
$\dot{P}^{ROD}_{t-1}$	-0.170^{***}	-0.152^{***}			φ_2
I^R_{t-1}	0.081^{***}	0.077^{***}			φ_3
$Inst.$	1.370^{***}				α_1
$Inst. * U_{t-1}$		0.079^{***}	-0.132^{***}	0.104^{***}	λ_1
$Inst. * S^{hocks}$			-0.001^{*}	-0.095^{***}	θ_1
R^2	0.957		0.952	0.962	
Obs.	372	372	352	766	

When the three potential effects of $almp$ are tested simultaneously, the coefficient related to the variable $Inst. * S^{hocks}$ is not significant. Besides, positive impact of $almp$ on unemployment persistence is not robust, since $almp$ would decrease persistence when tested simultaneously with the effect on the unemployment rate. The latter is the only robust effect to changes in specification, with a positive signe. This surprising result, which is not in accordance with standard economic theory, may come from the strong endogeneity of ALMP spendings to unemployment. Indeed, the higher the uneployment rate, the higher the ALMP spendings, rather than the opposite.

This counterintuitive result comes all the more from an endogeneity bias as the conclusions are radically modified when the ALMP spendings are normalized by the unemployment rate ($almp\_unem$). The coefficient of the latter variable has a significant and negative signe on unemployment persistence and on its sensitivity to shocks. This specification, whose the results are more coherent with standard wisdom, seems to rule out the endogeneity problem.

The impact of employment protection (epl) is positive on unemployment persistence and negative on the sensitivity to shocks whereas the effect on the unemployment level is not significant. The results are consistent with standard economic theory. Employment protection has a cycle-smoothing effect which make the unemployment rate less sensitive to shocks. At the same time, it leads to higher inertia that may increase structural unemployment.

The impact of the unemployment benefit duration (bd) is not significant on the unemployment level, but it is negative on its persistence and positive on the sensitivity to shocks (Table 6). The fact that an increase in the benefit duration lowerpersistence of the unemployment rate is at odds with standard labour supply theoretical models. However, one possible beneficial effect of long benefit duration for unemployment persistence is that it prevents from skills deterioration by leaving the time to find the appropriate job. But by providing more time for job search, the impact of a given shock is more harmful for contemporary unemployement.

Table 6 : Introduction of institutional variables

U_t	bd	$brr1$	$udnet\_vis$	
Cst	0.092	0.13	0.06	$\bar{\alpha}$
U_{t-1}	0.981^{***}	0.839^{***}	0.870^{***}	λ_0
S^{hocks}	0.052^{***}			θ_0
$\dot{P}_t^C - \dot{P}_{t-1}^C$		-0.047^{***}	-0.058^{*}	φ_0
$\dot{P}_{t-1}^M - \dot{P}_{t-1}^C$		0.007	0.008^{*}	φ_1
$\dot{P}_{t-1}^{ROD}$		-0.096^{***}	-0.093^{***}	φ_2
I_{t-1}^R		0.091^{***}	0.096^{***}	φ_3
$Inst.$				α_1
$Inst. * U_{t-1}$	-0.149^{***}	0.001^{***}	0.00007^{*}	λ_1
$Inst. * S^{hocks}$	0.080^{***}			θ_1
R^2	0.961	0.960	0.960	
Obs.	764	764	720	

The impacts of the unemployement replacement rate ($brr1$) and of the trade union membership density ($udnet\_vis$) on the unemployment persistence are significant and positive. This result is consistent with some theoretical predictions. A high replacement rate may disincentivate return to employment whereas in a non-cooperative trade union context, a strong bargaining power may enhance insider wages to the detriment of hiring outsiders. Besides, these two variables have no significant impact neither on the unemployment level nor on its sensitivity to shocks.

Finally, the impacts of coordination (cow) and of the centralisation level (cew_int) of wage negotiation, of the education level ($educ\_int$) and of the labour tax rate ($t1$) have been tested in the Table 7.

Table 7 : Introduction of institutional variables

U_t	$(cew\_int-2)^2$	$(cow-2)^2$		$t1$	$educ\_int(-5)$		
Cte	0.033	0.098	0.181	0.130	0.151	0.032	$\bar{\alpha}$
U_{t-1}	0.911^{***}	0.918^{***}	0.908^{***}	0.844^{***}	0.971^{***}	0.904^{***}	λ_0
S^{hocks}	0.084^{***}					0.019	θ_0
$\dot{P}^C_t - \dot{P}^C_{t-1}$		-0.048^{***}	-0.048^{***}	-0.048^{***}	-0.052^{***}		φ_0
$\dot{P}^M_{t-1} - \dot{P}^C_{t-1}$		0.008^{*}	0.008	0.009^{*}	0.008		φ_1
$\dot{P}^{ROD}_{t-1}$		-0.099^{***}	-0.100^{***}	-0.092^{***}	-0.106^{***}		φ_2
I^R_{t-1}		0.088^{***}	0.088^{***}	0.093^{***}	0.082^{***}		φ_3
$Inst.$			-0.204^{**}				α_1
$Inst. * U_{t-1}$		-0.031^{**}		0.003^{**}	-0.007^{**}		λ_1
$Inst. * S^{hocks}$	0.023^{*}					0.010^{***}	θ_1
R^2	0.960	0.960	0.960	0.962	0.959	0.959	
Obs.	779	779	779	697	754	754	

The first two variables correspond to a wage negotiation index of coordination and centralisation: cow and cew_int. These variables take five possible values: 1, 1.5, 2, 2.5, and 3, a high value corresponding to high centralisation, and a low value corresponding to negotiation at the company scale. According to the theory, extreme values of centralisation induce more efficiency in terms of employment, for several reasons. A strongly decentralised negotiation allows automatic adjustments to the cyclical situation of firms. On the contrary, highly centralised negotiations provide higher incentives to employers and trade unions to take into account macroeconomic equilibrium matters. The intermediate situation provides unions with negotiation power, excluding quick adjustments to the cycle, and does not encourage firms and employees to take into account the macroeconomic context during the negotiations. The two variables cow and cew_int have been added in the regression, either directly, or as a function of the distance to the central value (2). Tested linearly, the two variables have no significant effect on unemployment through neither of the three potential effects. On the contrary, $(cew\_int-2)^2$

and $(cow-2)^2$ have a significative impact respectively on sensitivity to shocks and persistence of unemployment. The effect of $(cow-2)^2$ is consistent with the theory whereas the one of $(cew\_int-2)^2$, whose effect on sensitivity to shocks is negative, is not. However, the latter effect is only significant at the 10 $\%$ level.

Besides, education has no immediate effect on unemployment. However, the education variable introduced with a five years lag has an effect on the unemployment persistence and on the sensitivity to shocks. A better educated labour force reduces unemployment persistence by improving its opportunity in job search. The positive effect on the sensitivity to shocks is more difficult to interpret from a theoretical point of view. Moreover, as the introduction of this variable strongly modifies the other coefficients of the model, we fear the existence of collinearity problem.

Finally, the level of the labour tax rate is positively correlated to unemployment persistence, whereas no effect on the intercept and on the sensitivity to shock is found. This result is often interpreted as a validation of the standard neoclassical view, where any increase in labour costs discourages firms from hiring. However, one should be cautious in judging the beneficial effect for employment of tax cuts based on this econometric results. Indeed, it should not be forgotten that econometric techniques indentify correlation but do not say anything on the direction of causality. Hence, another quite plausible interpretation is that persistent unemployment in OECD obliged economic authorites to increase taxes in order to equilibrate public accounts.

6.2 Testing institutions simultaneously

In this section, the robustness of the significant variables is tested by regressing them simultaneously in the unemployment equation. The variables $almp$ and $almp\_unem$ are not tested because the lack of observations prevents the correct comparison of the different models. Variables producing an impact on unemployment persistence and on the sensitivity to shocks are successively tested.

On the unemployment persistence: The seven variables impacting the unemployment persistence ($brr1$, $(cow-2)^2$, bd, $educ\_int(-5)$, $t1$, $udnet\_vis$ and epl) are tested simultaneously two by two. Each effect is compared against the 6 others, leading to the following results :

- bd : 3 times negative, 3 times insignificant
- $brr1$: 5 times positive, once insignificant
- $(cow-2)^2$: 3 times negative, 3 times insignificant
- $educ\_int(-5)$: 6 times insignificant
- $t1$: 6 times positive
- $udnet\_vis$: 6 times positive
- epl : 6 times insignificant

Therefore the three most robust variables are $brr1$, $t1$ and $udnet\_vis$. Tested together, all coefficients associated to these variables remain significant, except for $brr1$. Hence, we finally select two variables: $t1$ and $udnet\_vis$.

On the unemployment sensitivity to shocks: Testing two by two the four variable having an effect on the sensitivity to shocks (bd, $(cew\_int-2)^2$, epl, $educ\_int$) leads to the following results:

- bd : once positive, 2 times insignificant
- $(cow-2)^2$: once positive, 2 times insignificant
- epl : 3 times negative

The only robust variable is employment protection, which decreases unemployment sensitivity to shocks.

Simultaneous evaluation of robustness: When tested simultaneously, the three previously selected variables remain significant, with the same sign for the estimated coefficient. Hence, the equation including the greatest number of institutional variables is:

$$U_{i,t} = \alpha_i + (\lambda_0 + \lambda_1 t1_{i,t} + \lambda_2 udnet\_vis_{i,t})U_{i,t-1} + (\theta_0 + \theta_1 epl_{i,t})S^{hocks}_{i,t-1} + \varepsilon_{i,t} \quad (22)$$

The associated coefficients are :

Table 11: Results of the regressions

		$t1$
U_t		$udnet\_vis$
		epl
$Intercept$	$\bar{\alpha}$	0.012
U_{t-1}	λ_0	0.789^{***}
$U_{t-1} * t1$	λ_1	0.0041^{***}
$U_{t-1} * udnet - vis$	λ_2	0.0006^{*}
S^{hocks}	θ_0	0.177^{***}
$S^{hocks} * epl$	θ_1	-0.102^{***}
R^2		**0.962**
Number of obs.		653

This result is econometrically robust and consistent with the standard neoclassical view, since the tax rate and union density would increase unemployment persistence, whereas employment protection would reduce its sensitivity to shocks. It also allows a decomposition of changes in unemployment into a shock effect and into an institutional effect (see Appendix C). However, the R^2, which equals to 0.962, is hardly greater than the one in the regression including only shock variables (0.961, Table 2). The introduction of institutional variables is thus quite desappointing since it carries little additional information (from a statistical point of view) compared to the previous explanation of OECD unemployment based exclusively on shocks. Moreover, we fear the existence of endogeneity of institutions in particular in the case of the tax rate effect.

6.3 Institutions and heterogeneity

The introduction of fixed effects in Section 5.2 showed institutional heterogeneity in the unemployment level, in its persistence and in its sensitivity to shocks. We want to test whether the introduction of institutional variables reduces this heterogeneity. In other words, we test if insti-

tutional variables provide a proper explanation of heterogeneity in unemployement persistence and in the sensitivity to shocks.

In the final model retained, no institution has a significative influence on the unemployment level. Therefore, after taking into account of institutions, we test remaining heterogeneity in Equation (22) only on unemployment persistence and on the sensitivity to shocks:

Test 1 : Persistence, $H_0 : \lambda_0 = \lambda_{0,i}$

$$\hat{U}_{i,t} = \hat{\alpha}_i + \left(\hat{\lambda}_{0,i} + \hat{\lambda}_1 t1_{i,t} + \hat{\lambda}_2 udnet\_vis_{i,t}\right) U_{i,t-1} + \left(\hat{\theta}_0 + \hat{\theta}_1 epl_{i,t}\right) S_{i,t-1}^{hocks}$$

Test 2 : Sensitivity to shocks, $H_0 : \theta_0 = \theta_{0,i}$

$$\hat{U}_{i,t} = \hat{\alpha}_i + \left(\hat{\lambda}_0 + \hat{\lambda}_1 t1_{i,t} + \hat{\lambda}_2 udnet\_vis_{i,t}\right) U_{i,t-1} + \left(\hat{\theta}_{0,i} + \hat{\theta}_1 epl_{i,t}\right) S_{i,t-1}^{hocks}$$

Table 9 : Tests

	Test 1 : Persistence	Test 2 : Sensitivity
	$\hat{\lambda}_{0,i=1} = ... = \hat{\lambda}_{0,i=20} = \hat{\lambda}_0$	$\hat{\theta}_{0,i=1} = ... = \hat{\theta}_{0,i=20} = \hat{\theta}_0$
F-stat	1.00	4.19
Pvalue	0.46	0.00

The Fisher test accepts the null hypothesis of homogeneity on the persistence coefficient but it rejects it for the coefficient of the sensitivity to shocks. Hence, the selected institutions explain adequately the statistical heterogeneity in unemployment persistence accross OECD countries but not heterogeneity in the sensitivity to shocks.

7 Conclusions

This paper provides a theoritical and empirical appraisal of the shocks-institutions controverse as an explanation of unemployment heterogeneity in OECD countries. Based on this work, our answer to the question asked in the title of this paper is negative: the interaction between shocks and institutions does not explain exhaustively the OECD unemployment puzzle. Whereas shocks provide a satisfactory explanation to fluctuations in unemployment, the usual institutional variables present a rather desappointing empirical result. Their statistical influence on unemployment is not robust to change in specifications. Some collinearity problems hamper the construction of a robust model including a wide range of institutions. The statistical

improvement realised upon introduction of institutions is rather modest and endogeneity issues make the interpretation of the correlation between institutions and unemployment quite tricky. In terms of economic policy implications, our results suggests that the mainstream economic view puts too much emphasis on the beneficial effect of structural reforms which deal with the microeconomic determinants of unemployment to the detriment of the role of macroeconomic governance.

Finally, this paper tried to propos a rigorous theoretical framework allowing for a better identification of the interaction between shocks and labour market institutions. It showed that a shocks-institution interpretation is possible without including institutional variables, since coefficients estimates express nothing else but institutions. The fact that they summarise a wide range of heterogeneous institutional characteristics may explain why the inclusion of institutional variables gives disappointing empirical results. The available institutional variables may be a poor proxy for the reality. Some of these variables are not always available over a long period. Some are not directly observable at a macroeconomic level or are at least very difficult to ascertain reliably (*e.g.* the reservation wage, the bargaining strength of workers, the value of leisure). Some others are even impossible to measure (*e.g.* the flexibility of the labour market). A further investigation could consist in appraising the impact of these "unobservable variables" by testing on panel data stochastic variations in coefficients with a random coefficient (or unobservable component) econometric method such as the Kalman filter approach, as initiated by the Time-Varying NAIRU literature (*e.g.* Heyer *et al.*, 2007).

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Appendix

A Glossary

We used OECD data. Institutional data have been compiled by William Nickell [12], whereas economic series come directly from the OECD *Economic Outlook* database. Most of the institutional data have been interpolated from their last known value until 2006 in order to increase the number of observations. This is a fairly good approximation since institutionnal series are general quite stable over time.

A.1 Labour market institutions data

- $almp$: Expenditure on Active Labour Market Policies as a percentage of the GDP.
- $almp\_unem$: Expenditure on Active Labour Market Policies as a percentage of the GDP divided by the Unemployment Rate.
- bd : Benefit duration index, constructed from replacement rates from first to fifth year of benefit.
- $brr1$: Gross unemployment benefit replacement rate.
- cew_int : Index of bargaining centralization, between 1 (plant level) and 3 (Central level).
- cow : Index of bargaining coordination between 1 (Uncoordinated) and 3 (strong coordination).
- $educ\_int$: Educational attainment of the total population aged 15 and over expressed as average years of schooling
- epl : Employment protection measured as the strictness of employment protection legislation.
- hpy : Average actual annual hours worked per person in employment.

[12] Nickell W. (2006), " The CEP-OECD Institutions Data Set (1960-2004) ", *CEP Discussion Papers* 759, http://cep.lse.ac.uk/pubs/download/data0730.zip.

- $t1$: Labour tax rate, defined as the ratio between the employer's sociale security contribution and gross employees' wages.
- uc : Union coverage refers to the number of workers covered by collective agreements normalised on employment.
- $udnet\_vis$: Trade union density.

A.2 Other data

- I^N : Long-term interest rate (10-years)
- $I^R = I^N - \dot{P}^C$: Real interest rate
- N : Total (dependent and self) employment
- P^C : Consumer price deflator
- P^M : Import price (imports of goods and services deflator)
- $P^{ROD} = Y/N$: labour productivity
- P^V : Price of value-added (GDP price deflator)
- T^C : Employer social contribution rate
- T^{CU}: Capacity-utilisation ratio
- T^I : Direct and indirect tax rate
- U : Standardised unemployment rate (ILO guidelines)
- W : Wage
- Y : Gross Domestic Product (GDP) at constant prices

B : Comparing methodologies used for estimating the impact of shocks

Method 1 : The shock variable is constructed as :

$$S^{hocks}_{i,t-1} = \frac{\hat{\varphi_0}}{\hat{\varphi_3}}(\dot{P}^C_{i,t} - \dot{P}^C_{i,t-1}) + \frac{\hat{\varphi_1}}{\hat{\varphi_3}}(\dot{P}^M_{i,t-1} - \dot{P}^C_{i,t-1}) + \frac{\hat{\varphi_2}}{\hat{\varphi_3}}\dot{P}^{ROD}_{i,t-1} + I^R_{i,t-1}$$

With $\hat{\varphi_0}$ = -0.048 $\hat{\varphi_2}$ = -0.101

$\hat{\varphi_1}$ = 0.007 $\hat{\varphi_3}$ = 0.088

Method 2 : The variable S^{hocks} is an estimated variable $\hat{S}^{hocks}$. In order to obtain the good standard errors of the coefficient of the shocks variable, we made simultaneous estimation of a system with 40 equations :

$$U_{i,t} = \alpha' 1_i + \lambda U_{i,t-1} + \varphi_0(\dot{P}^C_{i,t} - \dot{P}^C_{i,t-1}) + \varphi_1(\dot{P}^M_{i,t-1} - \dot{P}^C_{i,t-1}) + \varphi_2 \dot{P}^{ROD}_{i,t-1} + \varphi_3 I^R_{i,t-1} + \epsilon_{i,t}$$

and

$$U_{i,t} = \alpha''_i + \lambda U_{i,t-1} + \theta_i \left[\frac{\varphi_0}{\varphi_3}(\dot{P}^C_{i,t} - \dot{P}^C_{i,t-1}) + \frac{\varphi_1}{\varphi_3}(\dot{P}^M_{i,t-1} - \dot{P}^C_{i,t-1}) + \frac{\varphi_2}{\varphi_3}\dot{P}^{ROD}_{i,t-1} + I^R_{i,t-1}\right] + \varepsilon_{i,t}$$

Results are given in the following table :

Table 10: Comparaison

	Method 1		Method 2	
Pays	θ_i	std err	θ_i	std err
Australia	0.121	0.031	0.094	0.031
Austria	0.051	0.043	0.009	0.031
Belgium	0.13	0.033	0.092	0.031
Canada	0.155	0.033	0.092	0.031
Denmark	0.061	0.020	0.074	0.031
Finland	0.211	0.031	0.036	0.031
France	0.086	0.031	0.051	0.031
Germany	0.17	0.059	0.039	0.031
Ireland	0.188	0.027	0.202	0.032
Italy	0.041	0.018	0.042	0.022
Japan	0.022	0.027	0.021	0.033
Netherland	0.111	0.033	0.133	0.043
New-Zealand	0.059	0.029	0.102	0.031
Norway	0.09	0.025	0.063	0.035
Portugal	0.016	0.016	0.012	0.018
Spain	0.227	0.028	0.189	0.032
Sweden	0.04	0.027	0.045	0.032
Suisse	0.124	0.043	0.003	0.031
United Kingdom	0.165	0.027	0.134	0.031
United States	0.128	0.030	0.132	0.036
$Mean$		*0.030*		*0.031*

Standard errors obtained using the second methodology vary less than those obtained using the first one. Their mean values, however, are similar. The construction of the shock variable used in the first methodology implies a higher volatility of standard errors but no higher volatility of coefficients. Even if some coefficients differ between the two methodologies, the same countries turn out to be significant with only three exceptions. Therefore, we chose to present the simplest methodology (the first one). The above mentioned check of the two methodologies has been carried out for each result presented in this paper.

C : Variance analysis, contribution of shocks and institutions to model relevance

C.1 Concept and models

It is possible to carry out this analysis further in order to quantify the impact of the introduction of institutional variables and of their interactions with shocks, for each regression, on the theoretical model proposed.

The idea is to construct, for each regression, two "synthetic" variables $\hat{U}$ and $\hat{U}^I$, and to compare them with the observed series U. $\hat{U}^I$ represents the estimated unemployment, in which some significant institutions are added. $\hat{U}$ corresponds to the unemployment variable built using variables of shocks, with estimated β_h coefficients for the same equation:

$$\hat{U}^I_{i,t} = \sum_h \hat{\beta}_h x_{h,i,t} + \sum_j \left[\hat{\lambda}_j Inst_{j,t} * U_{i,t-1}\right] + \sum_k \left[\hat{\theta}_k Inst_{k,t} * S^{hocks}_{i,t}\right] \tag{23}$$

where x_h represents the shocks, $\hat{\lambda}_j$ represents the estimated effects of institutional variables j on unemployment persistence, $\hat{\theta}_k$ the estimated effects of institutional variables k on the sensitivity of unemployment to shocks and β_h the estimated effects of shocks. According to this, one can write $\hat{U}_{i,t}$ as:

$$\hat{U}_{i,t} = \sum_h x_{h,i,t}\hat{\beta}_h \tag{24}$$

C.2 The regressions and their results

Basing upon our results on the robustness of institutional variables, we consider on the one hand the epl variable, which has a significant effect on unemployment persistence and on its reaction to shocks, and on the other hand, in a simultaneous regression, the $t1$ and $udnet\_vis$ variables, which have a significant impact on unemployment persistence, and the epl variable used in interaction with shocks.

The following table gives the results obtained for the estimations of $\hat{U}_{i,t}$ and $\hat{U}^I_{i,t}$.

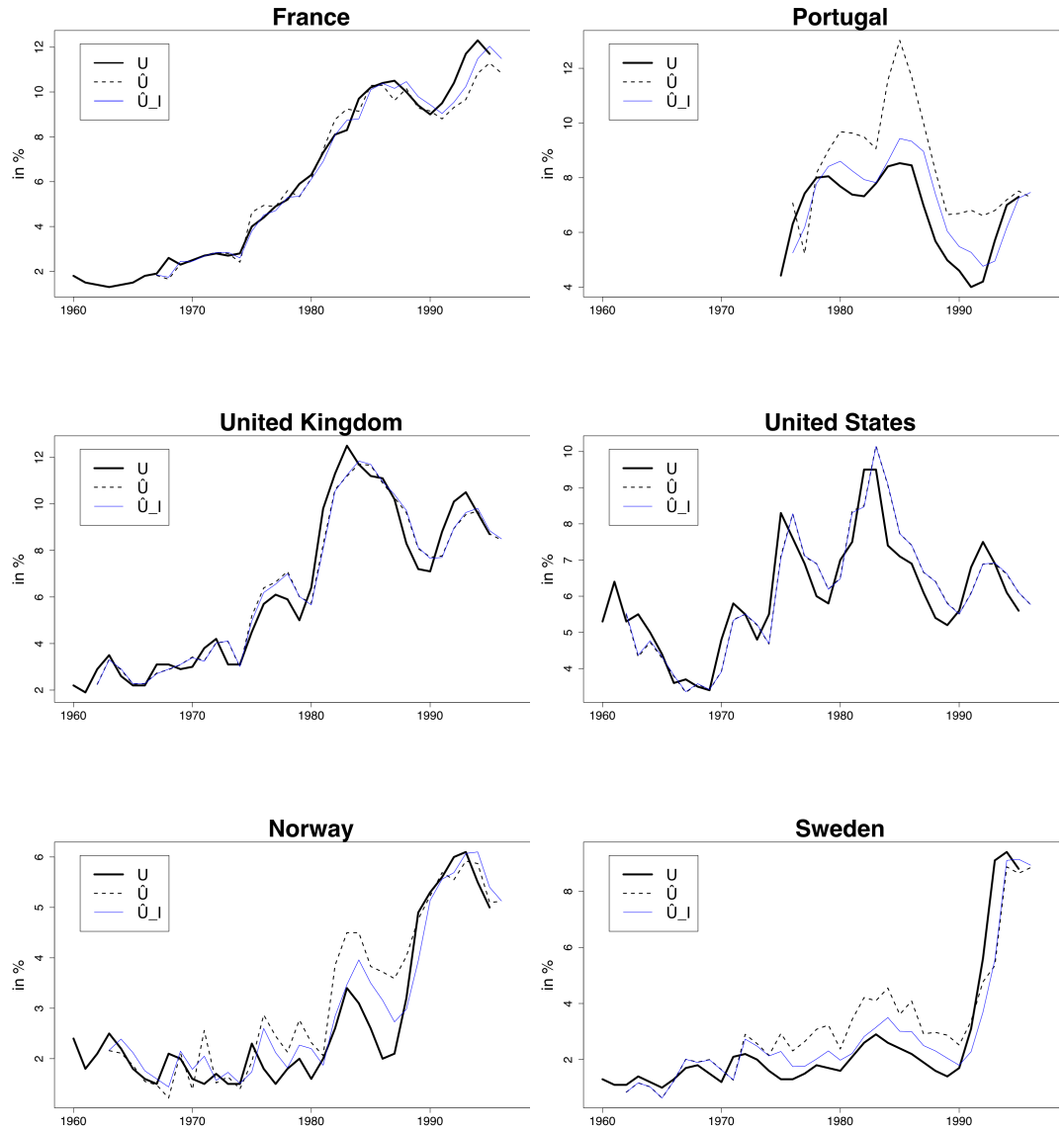
Table 11: Results of the regressions

U_t	epl	$t1$ $udnet\_vis$ epl
$Intercept$	-0.008^{***}	0.012
U_{t-1}	0.829^{***}	0.789^{***}
S^{hocks}	0.171^{***}	0.177^{***}
$U_{t-1} * epl$	0.104^{***}	
$shocks * epl$	-0.095^{***}	
$U_{t-1} * t1$		0.0041^{***}
$shocks * epl$		-0.102^{***}
$U_{t-1} * udnet - vis$		0.0006^{*}
R^2	**0.962**	**0.962**
Number of obs.	766	653

We can now compare the estimations obtained with and without the introduction of institutional variables, and have an idea of the information provided by the inclusion of these variables.

C.2.1 Contribution of employment protection in explaining unemployment

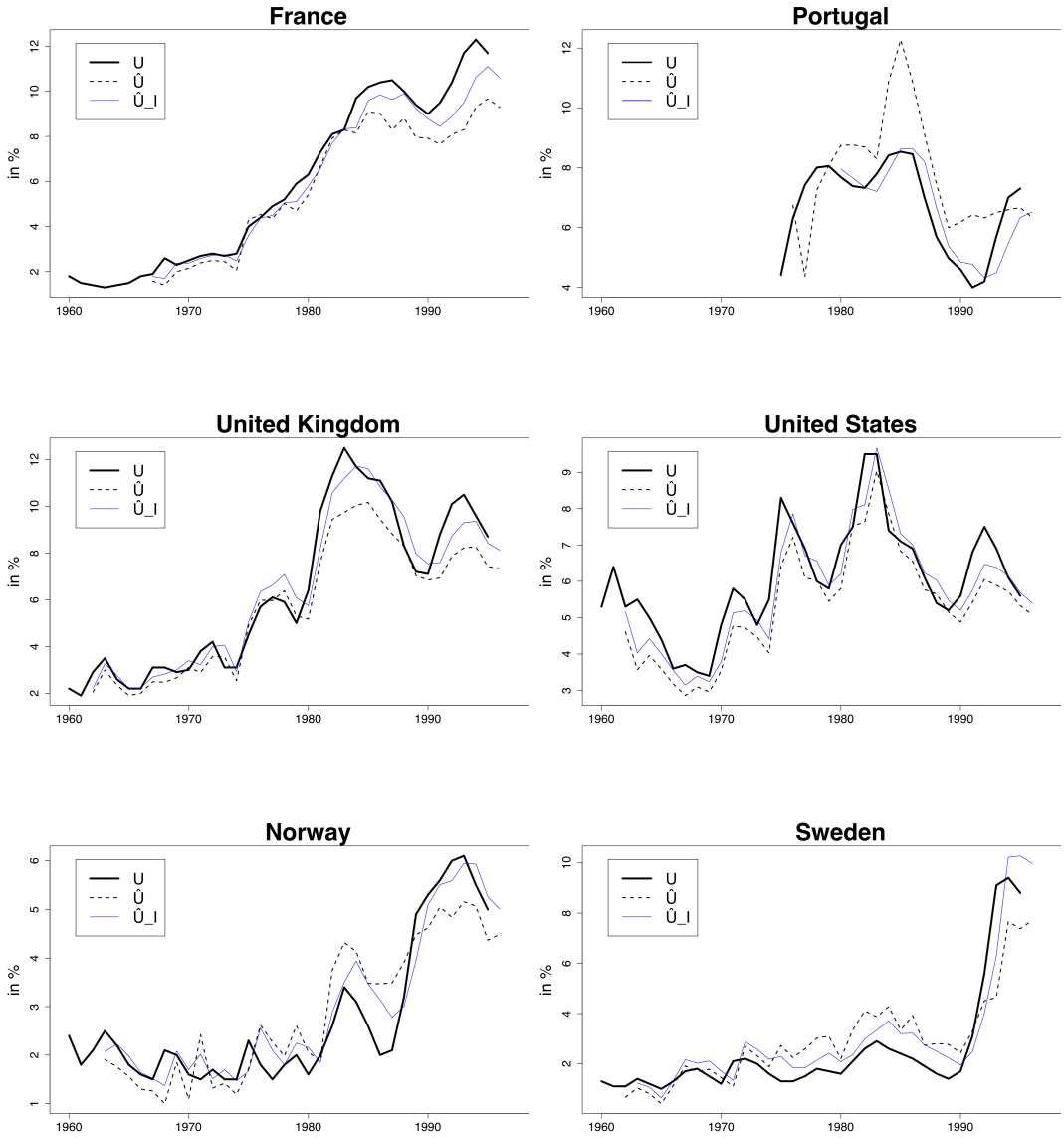
Below, we present the results of both regressions for six countries (France, Portugal, United Kingdom, United States, Norway and Sweden). We draw the three unemployment curves corresponding to the three definitions of unemployment, $\hat{U}$, $\hat{U}^I$ and U. The bold curves correspond to the observed series. In dotted lines, we have represented the $\hat{U}$ series, and in fine lines, the $\hat{U}^I$ series.



Results of the first regression (epl)

According to this graph, employment protection and its interaction with shocks provide a marginal contribution in explaining unemployment in France and Portugal; this contribution is almost nil in the United States and the United Kingdom, but it is substantial in Sweden and Norway.

C.2.2 Joint contribution of employment protection, tax rates and union density in explaining unemployment



Results of the second regression ($t1$, $udnet\_vis$, epl)

Institutions play a more important role than in the first regression, since the $\hat{U}^I$ curve is much closer of U than in the first estimation. It is the case for France (which has one of the highest tax and social contribution rates within the OECD), and Portugal, but also and above all, it is the case for the United Kingdom and the United States, where the two curves $\hat{U}^I$ and $\hat{U}$ do not

match any longer.

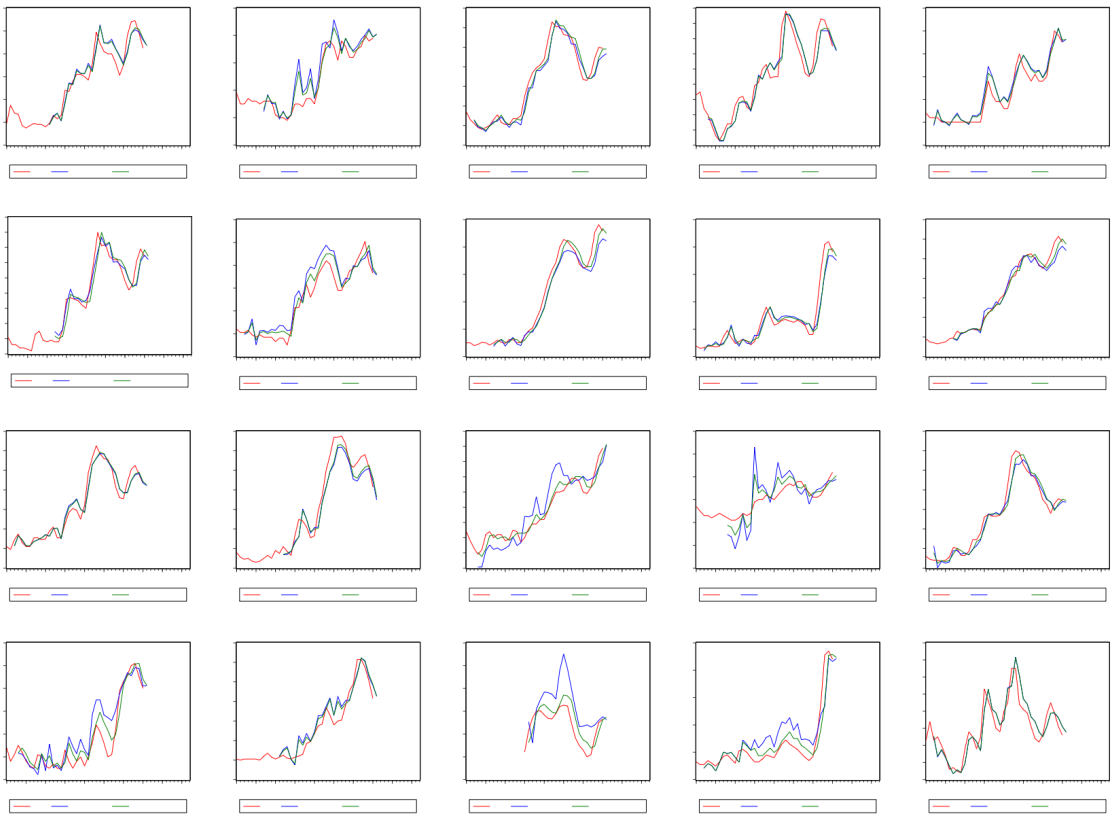
The situation is almost identical to that of the first regression for Norway, but it is not totally the case for Sweden; the latter has the highest union density[13] in the OECD during the 1960-1998 period (this figure is between 50% and 55% or Norway) and extremely high tax and social contribution rates: it is therefore logical that these institutions allow a better explanation of unemployment rates in this country.

However, this variance analysis reinforces the intuitions we can have when we observe the irregularity of our results. Unemployment dynamics are mainly explained by economic shocks while the role of institutions in this evolution turns out to be minor.

[13]This rate is about 64% for the 1960-1964 period, 83% for the 1980-1997 period, and 87% for the 1996-1998 period.

C.3 : The analysis of variance: overall outlook

Contribution of employment protection in explaining unemployment



Results of the first regression (epl)

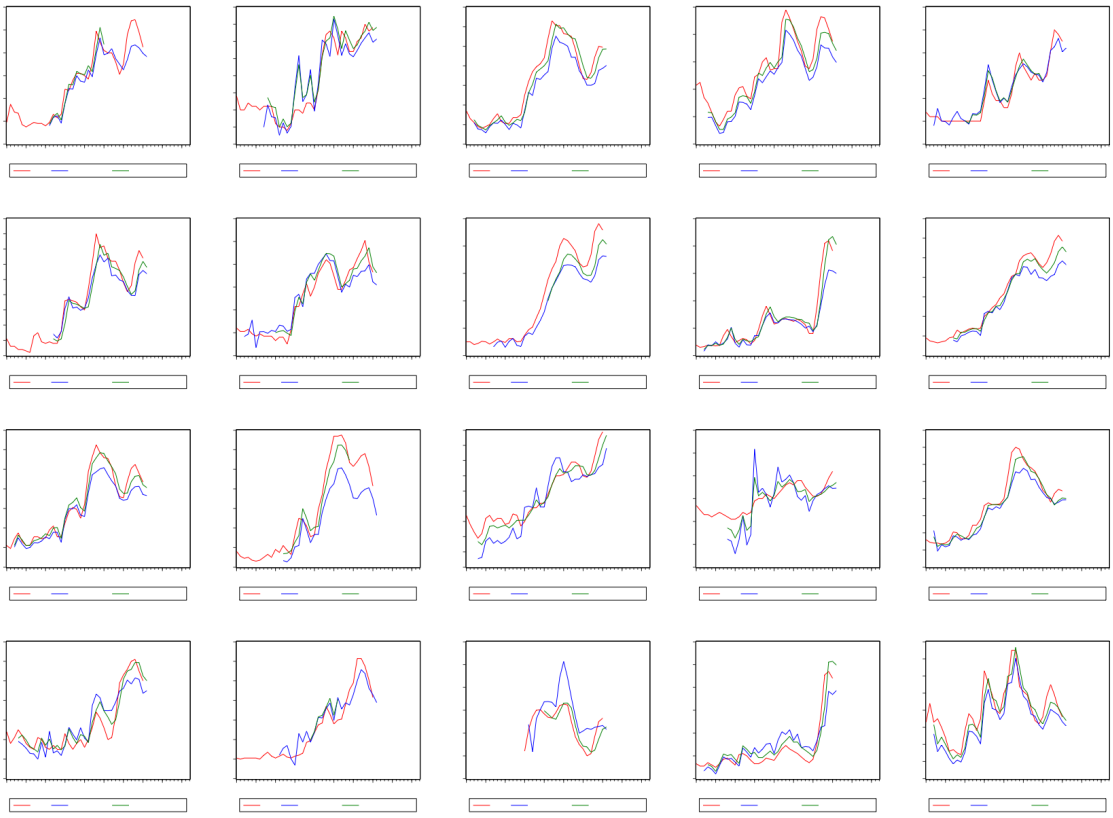
The graphs suggest two main conclusions.

Firstly, they show the increasing trend in unemployment in OECD countries during the 1960-1997 period, with a continuous and progressive rise in Canada, France, Italy and New-Zealand, a strong growth during the second half of 1970s in Australia, Austria, Belgium, Switzerland, Spain, Portugal, Germany, Denmark, Great-Britain, Ireland, the Netherlands, Finland and Japan. Some countries have experienced a second increase in the unemployment rate during the first half of 1980s (Germany, Denmark, Great-Britain, the Netherlands), whereas scandinavian countries (Finland, Norway, Sweden) really experienced unemployment only from the beginning of 1990s (with a slight increase at the beginning of 1980s for Norway and Sweden).

Ireland experienced a progressive rise of unemployment during the 1980s, with a peak in 1987, whereas in the USA, strong fluctuations appear, with a peak during the first half of 1980s.

The only countries whose institutions seem to partly explain unemployment are Portugal, Denmark, Norway and Sweden (until the 1990s for the last three), Spain (from the middle of 1980s), Italy, Japan and France. This is not the case neither in Anglo-Saxon countries (Australia, New-Zealand, Ireland, Canada, the United States and the United Kingdom) nor in Belgium, Germany, Austria, Switzerland, the Netherlands and, more surprising, Finland.

Joint contribution of employment protection, the tax rate and union density in explaining unemployment



Results of the second regression ($t1$, $udnet - vis$, epl)

The role of institutions seems to vary, not only across countries, but also and specially with time.

- The inclusion of institutions in the regression provides a significant additional explanation, for countries like Belgium, Finland, Ireland, the Netherlands and Portugal. Institutions do not improve the quality of the estimation in the case of Australia, Austria, Germany, Switzerland, Japan and New-Zealand. For the rest of the countries, (Canada, Denmark, Spain, France, the United Kingdom, Italy, Norway, Sweden and the USA), the situation est intermediate : the additional explanation of institutions is present, but limited.

- The first strong increase in unemployment discussed above takes place, for most countries, in the second half of the 1970s ; it may explain why institutions begin to play a role as explicative variables on differences among countries at the beginning of the following decade : indeed, the synthetic variable $\hat{U}^I$ is particularly close to the effective unemployment rate during the second half of the estimated period (1960-1997).