The Effects of Labour Market Institutions on The Employment Dynamics over The Cycle

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Abstract

The object of this paper is the analysis of the effects of labour market institutions on the employment dynamics over the cycle. In the first part a theoretical framework is provided with particular emphasis on working time regulations. The conclusions of the model are empirically tested in the second part, using a sample of 20 OECD countries. The empirical analysis, concentrated both on the expansive and the recessive phase of the cycle, as well as over different phase segments, confirms the claims of the theory and yields a measure of the influence of labour market institutions on the responsiveness of employment to output cyclical dynamics.

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1 Introduction

The recent debate in most of the industrialized countries with regard to the need of labour market flexibility, has moved economic analysis to go further towards understanding the impact of alternative labour market institutional configurations on the whole economic system.

In five recent contributions, Layard, Nickell and Jackman (1991), Nickell (1997, 1997b), Nickell and Layard (1997) and Nickell and Nunziata (1999) have proposed a multiple investigation of the impact of different labour market institutions on unemployment and growth using OECD data. Their empirical findings show that the effects of labour market institutions on the economic system are far from obvious. Besides the general notion of a rigid versus a flexible labour market must be analysed in its various dimensions, taking into account the different aspects of the problem. One important feature of labour market institutions remains however largely unexplored, namely their impact on the dynamics of employment over the cycle[1]. This paper proposes to fill this gap, carrying out an empirical investigation on the impact of labour market institutions on the cyclical dynamics of employment.

The theoretical literature that deals with the dynamics of employment over the cycle has largely focused on the influence of the adjustment costs induced by employment protection levels[2]. Less attention has been devoted instead to the analysis of the impact of working time regulations. Indeed most of the theoretical studies about the employment impact of working time regulations are in fact concentrated either on the long run dynamic effects or on their static properties, especially focused on exogenous worksharing policies[3]. The aspect we are interested in is instead related to the flexibility of managing working hours, focusing specifically on its impact on the cycle.

In next sections I consider first the theoretical aspects related to the introduction of working time standards legislation in a model of employment dynamics over the cycle. Then, I present an empirical analysis of the actual impact of a set of relevant labour market institutions, included working time regulations, on the cyclical dynamics of employment of 20 OECD countries. The theoretical framework is a modified version of

[1] For example, Nickell (1997b) and Nickell and Nunziata (1999), although focusing on the effects of labour market institutions on the dynamics of employment, do not analyse them in a cyclical perspective.

[2] See, among the others, Nickell (1986), Bentolila and Bertola (1990) and Hamermesh (1993). An excellent survey is contained in Bertola (1998).

[3] See for example Hart (1987), Calmfors and Hoel (1989) and Hoon (1995). An exception to this is Staffolani (1992).

Nickell's seminal model of employment dynamics over the cycle[4]. The main characteristics of this model are the simplifying assumption of a deterministic cycle, the solution's phase dynamics and the twofold characteristics of working time standards, including upward and downward working time flexibility[5]. We are going to focus on the dynamics of employment over different phases of the cycle, as well as over different segments of each phase[6].

The structure and contents of each section of the paper is the following.

Section two sets up a theoretical framework for the analysis of the effects of working time standards regulations and employment protection on employment cyclical dynamics. The section provides a solution of the model, extensively explained in the Appendix.

Section three is devoted to the empirical investigation of the effects of the labour market institutions we considered in the theoretical model on employment dynamics over the cycle, showing the results of different models estimated for the expansive phase of the cycle as well as for the recessive phase and different phase segments.

My conclusions are presented in section four.

2 The Theoretical Framework

The model assumes that the representative firm faces a known deterministic cyclical weekly demand for its products $x(t)$. The cycle, of period say 2τ, is supposed to be regular and perfectly foreseen. Other relevant assumptions are the absence of inventories, no voluntary quits and the constancy of the level of capital over the cycle. This means that the firm's decisions about the capital stock are not affected by the deviations from the trend demand growth, and labour is the only variable factor that can accommodate cyclical variations in demand. In this framework, labour supply issues are not taken into account.

Given a fixed stock of machines M, the firm sets $M_1(t)$ of these going for $h(t)$ hours a week, utilizing one worker on each operative machine. Assuming a single shift system, the employment of the firm at any point in time is $M_1(t)$ and the output produced is $h(t)\,M_1(t)$.

The profit maximizing firm will then solve the following problem:

[4]See Nickell (1978).

[5]See section 2.4, for an extensive description of this feature.

[6]Note that the terminology adopted in the literature about the different phases of the cycle is not exempt from generating confusion. To avoid any misunderstanding, our terminology will be the following: expansive (recessive) phase is the phase during which cyclical employment is growing (reducing), and boom (slump) is when cyclical employment is greater (lower) than average.

$$\max \int_0^\infty e^{-rt} \{phM_1 - W(h)M_1 - aA - dD\} \, dt \tag{1}$$

subject to:

$$\dot{M}_1 = A - D, \qquad A \geq 0, D \geq 0 \tag{2}$$

$$M - M_1 \geq 0 \tag{3}$$

$$x - hM_1 \geq 0 \tag{4}$$

where p is the output price (constant), $W(h)$ is the wage schedule, A is the accessions rate, D is the dismissal rate, and a and d are respectively the hiring and firing costs per employee.

Following (2) we see that the dynamics of employment are determined by the combined effect of accessions and dismissals, while (3) states that the level of machines in operation cannot exceed the stock of machines M owned by the firm . Finally, (4) states that at any moment in time the output produced by the firm is demand constrained, given that inventories are ruled out.

The wage schedule specification is the following:

$$W(h) = \begin{array}{ccc} w\bar{h}_1 + \phi_d w \left(h - \bar{h}_1\right) & \text{if} & h \leq \bar{h}_1 \\ wh & \text{if} & \bar{h}_1 < h < \bar{h}_2 \\ wh + \phi_u g \left(h - \bar{h}_2\right) & \text{if} & h \geq \bar{h}_2 \end{array} \tag{5}$$

with ϕ_d,ϕ_u $\in$ $[0, 1]$. I am assuming that standard hours are fixed by law at a level $\bar{h}_1$, and that actual hours can be adjusted by firms at a level that can be greater or lower than $\bar{h}_1$. The hours decision of firms is regulated by working time standards legislation, that affects both upward as well as downward flexibility of hours, i.e. the shape of the wage schedule, given the level of standard hours. Usually overtime premia are increasing in hours. This could depend on the increasing difficulty of convincing workers to perform overtime rates above a certain threshold[7] or, more interestingly from our point of view, on institutional constraints.

Given the hourly standard wage w, overtime is then regulated in such a way that the first $\left(\bar{h}_2 - \bar{h}_1\right)$ hours are paid at a constant rate w . Overtime hours that exceed the $\bar{h}_2$ level are paid at an increasing rate,

[7]See Santamaki (1983), (1984).

with $\phi_u g\left(h-\bar{h}_2\right)$ the overtime premium, g being an increasing convex function in hours, i.e. $g'>0$ and $g''>0$. The parameter ϕ_u measures working time standards legislation regulating *upward hours flexibility.* If legislation is strict with respect to overtime, the parameter will approach 1 and the firm will pay the maximum amount of overtime premium. If otherwise this parameter approaches 0, the firm faces complete flexibility in the adoption of overtime measures, and each overtime hour will be paid just the standard hourly wage. Any value of this parameter in the $\{0,1\}$ interval, represents a different degree of overtime flexibility.

Working time standards legislation in fact also regulates *downward hours flexibility*, i.e. the cost of reducing working hours below the standard level during the slump, by means of parameter ϕ_d. The case of a constant fall back pay equal to $w\bar{h}_1$, is a special case of the wage specification, when $\phi_d=0$, and represents the maximum degree of downward rigidity. In this case each reduction in hours below the standard level doesn't imply any reduction in the total weekly pay per employee. On the contrary if $\phi_d=1$, the firm will face a maximum degree of internal downward flexibility, and it will pay only effective hours $h\leq\bar{h}_1$. Any value of this parameter in the $\{0,1\}$ interval, represents a different degree of downward flexibility.

Note that there's no specific reason why upward and downward internal flexibility should be regulated in the same way, so I prefer to keep the two labour standard parameters distinct[8].

Given this framework, labour input dynamics are characterized by two different sources of adjustment, namely the external and the internal labour market. The firm can vary its labour input requirements on the extensive margin, by a change in its stock of workers, or on the intensive margin, varying the level of working hours per each employee. Accession and dismissal costs represent adjustment costs related to the variation of labour input on the extensive margin. Roughly, the former includes hiring and training costs, while the latter are typically enforced by employment protection legislation. By definition they are proportional to the *change* in the stock of workers. Intensive margin labour costs are instead increasing in the *level* of hours. Indeed[9]while workers represent a stock, hours are an intensity flow at which the existing stock is employed[10].

[8]Note also that, given the specified wage schedule we also have that
$Z(h)=w\bar{h}_1(\phi_d-1)$ if $h\leq\bar{h}_1$
$Z(h)=0$ if $\bar{h}_1<h<\bar{h}_2$
$Z(h)=\phi_u g'h-\phi_u g$ if $h\geq\bar{h}_2$.

[9]See for example Hamermesh (1993) and Hart (1987).

[10]Actually the stock of employees is also subject to an *effort* intensity. Anyway effort is usually not completely controlled by the firm, generating the incentive prob-

To summarize, I'm going to consider two kinds of labour market institution, namely external and internal flexibility[11]. The former is related to the costs of adjusting the stock of workers, while the latter depends on the costs of varying the rate of utilization of the existing workforce.

These two institutional features will reflect differently on the cost structure faced by the firm. External flexibility will affect dismissals and accessions costs, namely the parameters a and d in the model, while internal flexibility will affect the shape of the wage schedule through the parameters ϕ_d and ϕ_u.

2.1 The Dynamics of the System

The solution of the model, as shown in Appendix A, yields a dynamic path for employment and hours that can be split into different phases, as shown in Fig. .1.

Starting from the beginning of the descending phase of the cycle, from 0 to t_0, the employment level is set at M and hours are constant at h^*, while demand is not fully satisfied, because of the constancy of the price level.

The hours level is determined by the condition

$$W'(h^*) = p \tag{6}$$

and total output is Mh^*.

From t_0 onward, demand starts to be satisfied. Being the employment level still fixed at M, the progressive reduction in demand due to the cyclical contraction is accommodated by a reduction in hours till t_1, following the dynamic relation

$$h(t) = \frac{x(t)}{M}. \tag{7}$$

The reduction in hours stops, when it is reached a certain threshold h_d which satisfies the condition

$$Z(h_d) = -rd \tag{8}$$

where $Z(h) = hW'(h) - W(h)$ with $Z'(h) > 0$ since $W''(h) > 0$.

lems widely discussed in the literature. I don't take these issues into account for sake of simplicity.

[11] Another terminology used in the literature is "numerical" and "temporal" flexibility, see for example Staffolani (1992).

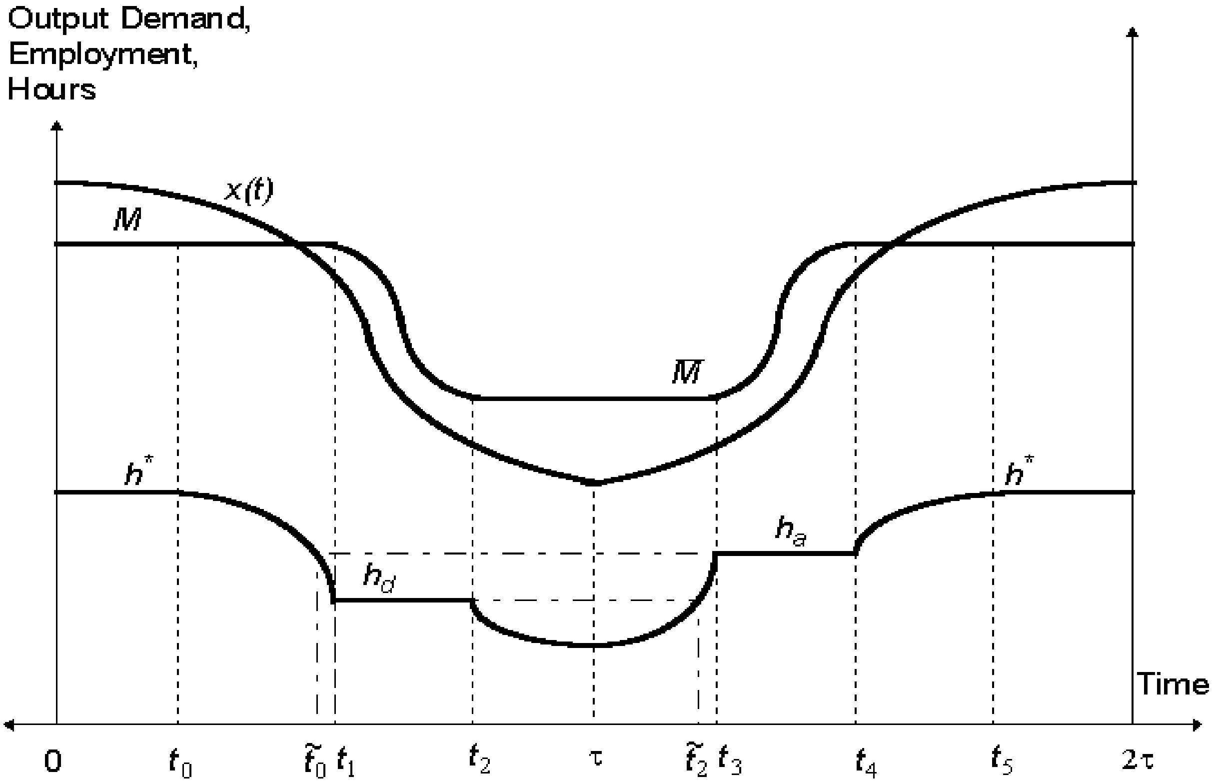

Figure 1: The dynamics of the system

During this period, from $t_1$to t_2, the contraction in demand is then accompanied by a reduction in the employment level, following

$$M_1(t) = \frac{x(t)}{h_d}. \tag{9}$$

During the slump, from t_2 to t_3, the dismissals of employees ends when M_1 reaches its minimum value over the cycle $\bar{M}$, where the latter is determined by the equation

$$-\left(ae^{-rt_3} + de^{-rt_2}\right) = \int_{t_2}^{\tilde{t}_2} w\bar{h}_1 (\phi_d - 1) e^{-rt} dt \tag{10}$$

together with the conditions

$$\bar{M} = \frac{x(t_2)}{\bar{h}_1} = \frac{x(t_3)}{\bar{h}_2}, \tag{11}$$

where $\tilde{t}_2$, with $t_2 < \tilde{t}_2 < t_3$, is the time instant in which hours are equal to the standard level $\bar{h}_1$. The cyclical variation in demand is then accompanied by a variation in hours, following the dynamic constraint

$$h(t) = \frac{x(t)}{\bar{M}}. \tag{12}$$

Hours will then decrease from t_2 to τ, and increase at the beginning of the expansion phase, from τ to t_3.

When increasing hours reach a certain level h_a identified by

$$Z(h_a) = ra, \tag{13}$$

the firm starts hiring, following the rule

$$M_1(t) = \frac{x(t)}{h_a}. \tag{14}$$

till t_4, when employment reaches its maximum level over the cycle, M. Hours start then to increase to accommodate the rise in demand due to the ascending phase of the cycle, following the relation in (7), until they reach their maximum level h^* in t_5.

From t_5 onward demand is again not fully satisfied and the cyclical dynamics of the system starts again.

The level of M is set to maximize the discounted level of profits over the cycle, i.e. it is given by the equation

$$\int_0^{t_0} \phi_u \Psi(h^*) e^{-rt} dt + \int_{t_0}^{\tilde{t}_0} \phi_u \Psi(h) e^{-rt} dt + \int_{t_4}^{t_5} \phi_u \Psi(h) e^{-rt} dt + \tag{15}$$
$$+ \int_{t_5}^{2\tau} \phi_u \Psi(h^*) e^{-rt} dt = q \int_0^{2\tau} e^{-rt} dt + a e^{-rt_4} + d e^{-rt_1}$$

where $\tilde{t}_0$, with $t_0 < \tilde{t}_0 < t_1$, is the time instant when hours equal the $\bar{h}_2$ level, q is the retail price of capital, and $\Psi(h) = \left[g'\left(h - \bar{h}_2\right) h - g\left(h - \bar{h}_2\right)\right]$.

Assuming that hiring and firing costs are such that $h_d \equiv \bar{h}_1$ and $h_a \equiv \bar{h}_2$, the firm will start to fire as soon as decreasing hours reach the standard level $\bar{h}_1$, and will start to hire when increasing hours reach the increasing overtime premium level $\bar{h}_2$.

Next step is the analysis of how the employment dynamics over the cycle are affected by labour market institutions, where the latter are represented in the model by the parameters d for employment protection,ϕ_u for overtime standards legislation and ϕ_d for working time reduction flexibility.

2.2 The Effects of Employment Protection on Employment Dynamics

2.2.1 Employment Levels

Following the results in the Appendix we obtain that a tougher employment protection legislation succeeds in increasing the minimum level of employment over the cycle, i.e.

$$\frac{\partial \bar{M}}{\partial d} > 0$$

However, from differentiation of the equation (15) we obtain also that

$$\frac{\partial M}{\partial d} < 0$$

i.e. the perverse effect of employment protection is that the firm reduces the level of employment during the peak of the cycle.

Combining these results we see that the variance of employment over the cycle is reduced while we cannot say anything about its average without making further assumptions.

2.2.2 The Timing of the System's Dynamics

An increase in labour protection causes a modification in the temporal structure of the phases in which the dynamics of the system are structured.

Higher employment protection induces an increase in the length of period $\{t_5, t_0\}$, when total demand is not fully satisfied and hours are equal to the maximum level h^*. Besides it causes an increase in the duration of the period $\{t_4, t_1\}$ in which the firm employes the maximum number of workers M, and a reduction of the hiring period $\{t_3, t_4\}$.

This means that an increase in the costs of adjusting the labour input on the extensive margin leads to a rise in the rate of utilization of the existing workforce on the internal margin, confirmed by the fact that the firm will adopt the maximum amount of hours for a longer fraction of the cycle.

Nothing can be said about the duration of the dismissals period $\{t_1, t_2\}$ and the minimum employment interval $\{t_2, t_3\}$ since the effects of higher employment protection on t_2 are ambiguous.

2.3 The Effects of Overtime Standards Legislation on Employment Dynamics

2.3.1 Employment Levels

Overtime standard legislation has no effects on the lowest level of employment over the cycle $\bar{M}$, i.e.

$$\frac{\partial \bar{M}}{\partial \phi_u} = 0$$

Instead, the effects on M are such that

$$\frac{\partial M}{\partial \phi_u} > 0.$$

This means that looser overtime standard legislation decreases the maximum level of employment over the cycle without affecting the employment level during the slump.

2.3.2 The Timing of the System's Dynamics

A decrease in overtime premia causes an increase in the duration of period $\{t_5, t_0\}$ in which demand is not completely satisfied and hours are equal to the maximum level h^*. The length of period $\{t_2, t_3\}$, in which $M_1 = \bar{M}$, is unaffected, while period $\{t_4, t_1\}$ in which $M_1 = M$ is longer.

It is worthwhile noting that, given the condition determining the maximum amount of hours

$$w + \phi_u g' \left(h^* - \bar{h}_2\right) = p \tag{16}$$

from simple differentiation we obtain the expected result

$$\frac{\partial h^*}{\partial \phi_u} = -\frac{g'(h^*)}{\phi_u g''(h^*)} < 0. \tag{17}$$

This means that looser overtime standard legislation will increase both the level of maximum hours as well as the length of the fraction of the cycle in which they are adopted by the representative firm.

It is also true that the firm will reduce the time in which existing employees work for a constant level of $\bar{h}_1$ and $\bar{h}_2$ hours, with a reduction in hiring as well as firing levels.

2.4 Hours Flexibility During the Slump

Given the wage schedule specification of equation (5) the firm faces the possibility of reducing the internal cost of labour during the slump, when $h \leq \bar{h}_1$. Simple comparative statics shows that the level of M is unaffected, while we have

$$\frac{\partial \bar{M}}{\partial \phi_d} > 0$$

i.e. an increase in internal downward flexibility during the slump induces an increase in the minimum employment level $\bar{M}$.

Increasing downward working time flexibility is then reducing the dismissal rate during recessions, increasing the number of employees who can retain their jobs in that phase of the cycle. Given that $\bar{M}$ is higher, the dismissal period will be shorter, as well as the hiring phase, with an overall increase in the length of period $\{t_2, t_3\}$,when $M_1 = \bar{M}$. This is because the firm does not need to hire as the cycle recovers since the number of employees is already higher than in the alternative case of rigid working time regulations during the slump. The labour input adjustments will be made through the adjustment of hours.

Notice that if $\phi_d = 0$ we are in the case of a constant fall back pay equal to $w\bar{h}_1$, with the firm simply hoarding labour as hours fall below the standard level.

2.5 Overall Working Time Regulation

The effects of an increase in overall working time flexibility, through a decrease in overtime standards parameter ϕ_u and an increase in downward flexibility ϕ_d, are similar to the ones caused by higher employment protection. However, while in both cases the variance of employment over the cycle is reduced, the dynamics of hours are different. In fact in this case we have an increase of working hours in correspondence to the peak of the cycle and a reduction during the slump, while in the case of higher employment protection the buffer function of hours is achieved through a change in the timing of the system. In other words higher working time flexibility increases the variance of hours over the cycle, while higher employment protection modifies the timing of the dynamics of the system, possibly reducing the variance of hours. However, if working time regulations are set up in an asymmetric way over the cyclical phases, total employment can be increased through a reduction in flexibility during booms, and an increase during slumps.

3 Empirical analysis

3.1 The Dependent Variable: Employment Responsiveness To Output Dynamics

We now want to know if the empirical evidence is consistent with the conclusions we reached in section two. In order to achieve this objective we first need an unambiguous notion of *cycle*, and secondly a measure of the responsiveness of employment to cyclical variations in output.

The first point is approached by applying the Hodrick - Prescott[12] filtering technique to output data. Although the choice of this filtering technique is not exempt from criticism[13] we prefer to follow the standard practice adopted in the business cycles literature, in order to allow for comparisons. In what follows, an expansive phase is defined as the phase of the cycle during which an increase in output is translated into an increase in employment. Viceversa a recessive phase is defined as the interval in which the decrease in cyclical output forces a reduction in employment.

Regarding the second point, the variable I use is the elasticity of employment with respect to output, measured over each phase of the cycle. In a detrended world as the one depicted by the theoretical model, this is simply

$$\varepsilon_{M_1 x} = \frac{\gamma_{M_1}}{\gamma_x} = \frac{x}{M_1}\frac{dM_1}{dx}. \tag{18}$$

Dealing with trended data, we need to adopt a different technique for the expansive and for the recessive phase analysis. In fact, in the

[12]See Hodrick and Prescott [1997].

[13]For example see Harvey and Jaeger (1993), King and Rebelo (1993) and Cogley and Nason (1995).

former case, once the expansive interval is determined we calculate ε_{M_1x} using actual instead of detrended data for employment and output. The reason for this choice is that we prefer to use original instead of filtered data, in order to avoid any possible distortion determined by the filter. This is possible in the analysis of expansions since the cyclical and the trend component have the same sign.

The situation is different for contractions, since in this case the cyclical and the trend component have opposite signs. Using actual data is not the best strategy here, since the cyclical and the trend component could cancel out, distorting the information contained in the dependent variable. For example we could end up with a positive rate of growth of output during a contraction, if the productivity growth incorporated in the trend component is greater than the negative cyclical component and the information contained in ε_{M_1x} calculated as in the previous case could be totally misleading. Thus, in the contractive phase case, we prefer to use filtered data for both output and employment, since we repute the distortion caused by the filter to be inferior to the distortion caused by the effect described above. Anyway in this case care must be taken in the interpretation of the results, since the information contained in the data could be altered by the filter. In both cases the elasticity values have to be positive by definition.

Given the conclusions of the theoretical model, we expect labour market institutions to have a non negligible effect on the translation of output into employment dynamics.

3.2 Expansive Phase Analysis

3.2.1 Comparative Dynamics for expansions

Before showing the results of the estimated model in the next paragraph, I present here the comparative dynamics results that describe the effects of labour market institutions on the dependent variable, using the theoretical framework of section two.

The output elasticity of employment over the expansive phase is equal to

$$\varepsilon_{M_1x} = \frac{\gamma_M}{\gamma_x} \tag{19}$$

where γ_x is the rate of growth of output during the expansion phase, with $\gamma_x > 0$ by definition, and γ_{M_1} is the employment rate of growth during the same expansion. Using the notation of section two we have

$$\gamma_{M_1} = \frac{M - \bar{M}}{\bar{M}} \tag{20}$$

where M is the maximum level of employment over the cycle and $\bar{M}$ is the minimum level.

We are interested in the effects of employment protection d and working time standards legislation ϕ_u and ϕ_d on the dependent variable. As shown in Appendix A we have the following results:

$$\frac{\partial \bar{M}}{\partial d} > 0 \tag{21}$$

$$\frac{\partial M}{\partial d} < 0 \tag{22}$$

$$\frac{\partial \bar{M}}{\partial \phi_u} = 0 \tag{23}$$

$$\frac{\partial M}{\partial \phi_u} > 0 \tag{24}$$

$$\frac{\partial \bar{M}}{\partial \phi_d} > 0 \tag{25}$$

$$\frac{\partial M}{\partial \phi_d} = 0. \tag{26}$$

The empirical Employment Protection variable EP corresponds to the theoretical value of d. Differently, Working Time Standards indicates the combined effect of the two variables measuring upward and downward flexibility, respectively ϕ_u and ϕ_d. Hence, higher working time rigidity measured by higher values of WT, corresponds to higher levels of ϕ_u and lower levels of ϕ_d, i.e. greater costs of increasing the level of working hours during booms and reducing them during slumps

Combining the above equations we obtain the two following important results

$$\frac{\partial \varepsilon_{M_1 x}}{\partial EP} = \left\{ \frac{1}{\bar{M}} \underset{(-)}{\frac{\partial M}{\partial d}} - \frac{M}{\bar{M}^2} \underset{(+)}{\frac{\partial \bar{M}}{\partial d}} \right\} \gamma_x^{-1} < 0 \tag{27}$$

and

$$\frac{\partial \varepsilon_{M_1 x}}{\partial WT} = \frac{1}{\gamma_x} \left\{ \frac{1}{\bar{M}} \underset{(+)}{\frac{\partial M}{\partial \phi_u}} - \frac{1}{\bar{M}^2} \left[-M \underset{(+)}{\frac{\partial \bar{M}}{\partial \phi_d}} \right] \right\} > 0. \tag{28}$$

Equation (27) states that an increase in the employment protection level reduces the output elasticity of employment during the expansive phase, while equation (28) states that an increase in the strictness of working time regulations increases it.

Intuitively what the first equation is saying is that high levels of employment protection reduce the employment growth induced during an expansive phase. The firm is anticipating the higher costs of dismissals during the recessive phase and reduces the level of accessions during the expansion. Besides the minimum level of employment over the cycle will also be higher because of the higher protection of employed workers. The summation of these two effects reduces the rate of growth of employment.

The second equation shows instead that more strict regulations of working time , i.e. more internal rigidity, push the firm to vary its labour input requirements during the expansive phase on the extensive margin, increasing the rate of growth of employment as the output levels raise over the expansion.

We can now compare these results with the outcome of the empirical estimates in next subsection.

3.2.2 The Model

We focus on the cyclical behaviour of 20 OECD countries over the period 1975 - 1997, identifying the expansive phases shown in Table 1 for each country in the sample.

Given the timing and duration in quarters of each expansive phase, the output elasticity of employment is calculated as follows:

$$\varepsilon_{M_1 x}^{it} = \frac{\left\{\frac{M_1(t_{\text{start}})-M_1(t_{\text{end}})}{M_1(t_{\text{start}})}\right\}}{\left\{\frac{x(t_{\text{start}})-x(t_{\text{end}})}{x(t_{\text{start}})}\right\}} \qquad \text{for } \; i = 1, \dots, 20 \qquad t = 1, \dots, 3. \tag{29}$$

where M_1 is actual employment and x is actual output each observed for the i-th country, at the start or the end of the t-th phase.

The resulting values for the dependent variable are shown in Table 2.

The estimation technique employed in the analysis is Variance Components Random Effects, allowing for a composite structure of the stochastic term in order to take into account that subsequent observations from a single country cannot be treated as independent random draws. In practice, the analysis focus on the cross country variation in cyclical employment dynamics.

	Expansive Phase 1			Expansive Phase 2			Expansive Phase 3		
Country	start	end	du	start	end	du	start	end	du
Austria	1978-3	1980-2	7	1987-3	1991-3	16	1993-2	1994-4	6
Belgium	1979-1	1980-3	6	1987-2	1990-3	13			
Denmark	1978-1	1979-3	6	1983-2	1986-1	11	1993-1	1995-2	9
Finland	1978-3	1980-2	7	1986-3	1989-4	13	1993-1	1996-1	12
France	1977-3	1979-3	8	1987-2	1989-4	10	1993-3	1995-1	6
Germany	1977-2	1979-4	10				1989-2	1991-3	9
Ireland	1976-3	1978-2	7				1988-2	1990-3	9
Italy	1978-1	1980-1	8	1986-3	1990-1	14			
Netherlands	1978-3	1979-4	5	1988-2	1990-2	8	1993-3	1994-4	5
Norway	1978-3	1980-1	6	1982-3	1987-1	18	1993-1	1994-3	6
Portugal	1975-3	1977-2	7	1978-3	1980-3	8	1984-3	1991-3	28
Spain							1986-2	1990-3	17
Sweden	1978-1	1980-1	8	1982-4	1985-1	9	1986-4	1990-2	14
Switzerland	1978-2	1981-1	11	1987-3	1990-2	11	1993-3	1995-1	6
United Kingdom	1975-4	1979-3	15	1985-1	1989-1	16	1992-3	1995-1	10
Australia	1977-4	1979-2	6	1986-4	1989-4	12	1991-4	1994-3	11
Canada	1977-2	1979-3	9	1986-4	1989-3	11	1992-3	1995-1	10
Japan	1977-2	1979-3	9	1983-3	1985-2	9	1987-1	1991-3	18
New Zealand	1975-3	1976-4	5				1992-3	1994-4	9
United States	1975-2	1978-4	14	1987-1	1989-4	11	1991-3	1995-1	14

Table 1: Timing and duration of the expansive phases

Country	Expansive Phase 1	Expansive Phase 2	Expansive Phase 3
Austria	0.054233	0.39486	0.47453
Belgium	0.014516	0.356736	
Denmark	0.297173	0.512175	0.074829
Finland	0.495743	0.137134	0.049608
France	0.106748	0.293905	0.191473
Germany	0.378667		0.400154
Ireland	0.263699		0.277425
Italy	0.169675	0.13869	
Netherlands	0.374438	0.526719	0.125185
Norway	0.165546	0.373888	0.328266
Portugal	0.140576	0.384691	0.368471
Spain			0.656561
Sweden	0.394125	0.065997	0.532275
Switzerland	0.74791	0.883144	0.243431
United Kingdom	0.222023	0.478452	0.153867
Australia	0.165529	0.940307	0.348362
Canada	0.876698	0.654055	0.569548
Japan	0.236018	0.150197	0.360991
New Zealand	0.564801		0.67611
United States	0.705666	0.617911	0.611361
Mean	0.335462	0.431804	0.334187
Standard Deviation	0.237554	0.247666	0.202384

Table 2: Output elasticity of employment over the expansive phase

The unbalanced model we end up with is given by the following equation

$$\varepsilon_{M_1x}^{it} = \alpha + \mathbf{X'}_{it}\beta + \mu_i + v_{it} \qquad i = 1, \dots, 20 \qquad t = 1, \dots, T_i \quad (30)$$

where α is the mean intercept of the regression, $\mathbf{X'}_{it}$ is a vector of k institutional and control variables, β is the vector of parameters of interest, μ_i is the time invariant individual specific random effect for the i-th country, v_{it} is the disturbance term for the it-th observation and T_i is the number of time observations on i.

The composition of vector $\mathbf{X'}_{it}$ suggested by the theory indicates employment protection (EP) and working time standards legislation (WT) as main institutional influences on the responsiveness of employment to output dynamics.

I add two other institutional variables, Union Coverage (UC) and Labour Disputes (LD), in order to control for the effects of institutions governing labour supply not included in the theoretical model I refer to. In fact it 's reasonable to assume employees' action to affect the cyclical behaviour of employment in some direction.

Finally I include two other control variables, describing the characteristics of each expansive phase. In particular I identified two main features for each phase, namely the length in quarters DU_{it} and the depth of the slump preceding the expansion SL_{it}[14]. It's worthwhile noting that if the representative firm adopts a labour hoarding strategy during slumps, and if we assume an homogeneous labour hoarding behaviour across countries, the latter will depend positively on the depth of the previous recession, i.e. on the value of SL_it. This is true if different countries react in the same way to the slump, hoarding more labour the deeper is the slump. Hence, this variable could also be considered as a proxy for labour hoarding.

The first version of the model is then the following

$$\varepsilon_{M_1x}^{it} = \alpha + \beta_1 EP_i + \beta_2 WT_i + \beta_3 UC_i + \beta_4 LD_{it} + \beta_5 DU_{it} + \beta_6 SL_{it} + \mu_i + v_{it}$$
$$i = 1, \dots, 20 \qquad t = 1, \dots, T_i \quad (32)$$

[14]The latter is calculated as the ratio of the absolute value of the Hodrick-Prescott cyclical component at the start of each phase t over the standard deviation of the cyclical component for the i-th country, i.e.

$$SL_{it} = \frac{|c_{it}\,(\text{phase start})|}{SD\,(c_t)_i}. \quad (31)$$

The cyclical component at the beginning of the expansion phase measures the depth of the recession preceding the expansion in question. The component has to be adjusted by the standard deviation of the series in order to allow for comparisons.

where

$\varepsilon^{it}_{M_1x}$: output elasticity of employment;
α : mean intercept;
EP_i : employment protection (d);
WT_i : working time standards (ϕ_u and ϕ_d);
UC_i : union coverage;
LD_{it} : labour disputes (workers involved), normalized;
DU_{it} : duration of expansive phase, in quarters;
SL_{it} : depth of the slump preceding the expansion;
μ_i : time invariant individual specific effect;
v_{it} : disturbance term.

Note that employment protection, working time standards and union coverage are constant over time. In practice, we are assuming that the relative institutional configuration of the labour market for the countries in the sample is constant over the analyzed time period[15].

3.2.3 Estimations

The results of the Variance Component Random Effects estimation are shown in Table 3.

Model 1 contains only variables with coefficients significant at the 5% level. Model 2 is instead excluding Labour Disputes from the analysis, with respect to the specification of equation (32) as embodied by Model 3. As we can see from the Table, Labour Disputes coefficient is highly insignificant (P-value=0.798), thus workers' militancy doesn't seem to affect firms' hiring behaviour during expansions.

The coefficients of Employment Protection and Working Time Standards are significant in all the three presented models. The signs are consistent with the conclusions of the theory. An increase in the strictness of working time legislation is then forcing employment growth to be higher over the expansion, while greater employment protection has an effect of opposite sign.

The Duration of Expansion positively affects the output elasticity of employment. This means that a longer expansive phase can push the accessions rate up since the utilization of labour is spread over a more extended period of time. It is worthwhile noting that even if the duration variable is calculated ex-post, it can be consider as a duration expectation proxy if we're willing to assume rational or near-rational expectations in the system. In this case the representative firm is willing to increase the hiring rate when its expectations indicate a longer duration

[15] Although this could not be true in an absolute term because of the possible institutional transformations occurred in each country in last two decades, these changes are negligible if we consider the cross sectional variations.

Dependent Variable: Output Elasticity of Employment Over the Expansion[a]			
	Model 1[b,c]	**Model 2**[b,c]	**Model 3**[b,c]
Mean Intercept	0.355875*** (0.081855)	0.575532*** (0.170454)	0.569515*** (0.172417)
Employment Protection	−0.027087*** (0.005588)	−0.019915*** (0.007608)	−0.020740** (0.008316)
Working Time Standards	0.110748** (0.054039)	0.122679** (0.061533)	0.124011** (0.061928)
Union Coverage		−0.094548 (0.071919)	−0.091251 (0.073404)
Labour Disputes			0.0000037 (0.000014)
Duration of Expansion	0.018475*** (0.006248)	0.018856*** (0.005172)	0.018936*** (0.005149)
Depth of Preceeding Slump		−0.043325 (0.028083)	−0.042688 (0.028024)
R^2	0.377763	0.426491	0.426601
Regression Standard Error	0.245082	0.243675	0.248121
Hausman Test	$\chi_{(1)} = 0.00061$ P-value=0.9802	$\chi_{(2)} = 0.0094$ P-value=0.9953	$\chi_{(3)} = 0.30290$ P-value=0.9595
LM Heteroskedasticity Test	2.02726 P-value=0.154	0.199067 P-value=0.655	0.179544 P-value=0.672
Durbin Watson Test	1.35716 (0.000,0.004)	1.40344 (0.000,0.027)	1.39939 (0.000,0.041)

Unbalanced Panel: N=20, Tmin=1, Tmax=3, number of observations=53

[a]Mean: 0.364113, Standard deviation: 0.233752

[b]Variance components random effects estimator

[c]Standard errors in parenthesis

***Significant at the 1% level, **Significant at the 5% level

Table 3: Regression explaining output elasticity of employment over the expansion phase

for the expansion.

Union Coverage is not significant in models 2 and 3 (P-value=0.189 and 0.214 respectively), hence unions' strenght doesn't seem to affect employment growth over the expansion. The negativity of coefficient's sign is expected since we could presume that unions' strenght is increasing the costs of dismissals, affecting the rate of accessions downward during the expansion. However the data show that this effect is negligible.

The coefficient of Previous Recession's Depth is significant at the 13% level in both models (P-value=0.123 and 0.128 respectively). The negative sign indicates that an increase in the depth of the preceding slump reduces the rate of growth of employment during the expansion. This could indicate the presence of labour hoarding during the slump. Of course labour hoarding is itself influenced by labour market institutions in the way we examined above. However, if we control for the duration of the expansive phase and other institutional influences, it seems that deeper slumps can induce the firm to hoard more labour.

3.2.4 Simulations

The model 1 version of the estimated equation is

$$\varepsilon_{M_1 x} = \underset{(0.081855)}{0.355875} - \underset{(0.005588)}{0.027087} \cdot EP + \underset{(0.054039)}{0.110748} \cdot WT + \underset{(0.006248)}{0.018475} \cdot DE. \tag{33}$$

Tables 4, 5 and 6 show some simulations respectively for an expansion of short, average and long duration[16].

Let us consider the case of an expansion phase of average duration. The output elasticity of employment measures the percentage of output growth during expansion that is translated into employment growth. We can see that the simulated values vary in a range between 0 and 0.735034. Some characteristic values are reported in Figure 2 for a visual comparison.

Very high employment protection together with loose working time standards can cause employment not to vary at all during the expansion. The greater labour input requirements are satisfied by means of higher actual working hours because of the greater costs of discounted dismissions. On the contrary very low employment protection accompanied by

[16] The values corresponding to very high, high, average, low, very low employment protection are respectively: $20, 15, 10, 5, 1$, considering that the average value of Employment Protection for the 20 OECD countries in the sample is 10. The Working Time Standards variable follows instead the usual values $2, 1, 0$ according to a strict, average or loose configuration of the labour market.

Employment Protection	Working Time Standards	Output Elasticity of Employment
Very High	Loose	-0.09349
Very High	Average	0.017258
Very High	Strict	0.128006
High	Loose	0.041945
High	Average	0.152693
High	Strict	0.263441
Average	Loose	0.17738
Average	Average	0.288128
Average	Strict	0.398876
Low	Loose	0.312815
Low	Average	0.423563
Low	Strict	0.534311
Very Low	Loose	0.421163
Very Low	Average	0.531911
Very Low	Strict	0.642659

Table 4: Model 1 simulations for a short duration expansive phase (5 quarters)

Employment Protection	Working Time Standards	Output Elasticity of Employment
Very High	Loose	-0.001115
Very High	Average	0.109633
Very High	Strict	0.220381
High	Loose	0.13432
High	Average	0.245068
High	Strict	0.355816
Average	Loose	0.269755
Average	Average	0.380503
Average	Strict	0.491251
Low	Loose	0.40519
Low	Average	0.515938
Low	Strict	0.626686
Very Low	Loose	0.513538
Very Low	Average	0.624286
Very Low	Strict	0.735034

Table 5: Model 1 simulations for an average duration expansive phase (10 quarters)

Employment Protection	Working Time Standards	Output Elasticity of Employment
Very High	Loose	0.09126
Very High	Average	0.202008
Very High	Strict	0.312756
High	Loose	0.226695
High	Average	0.337443
High	Strict	0.448191
Average	Loose	0.36213
Average	Average	0.472878
Average	Strict	0.583626
Low	Loose	0.497565
Low	Average	0.608313
Low	Strict	0.719061
Very Low	Loose	0.605913
Very Low	Average	0.716661
Very Low	Strict	0.827409

Table 6: Model 1 simulations for a long duration expansive phase (15 quarters)

strict working time standards yields an elasticity equal to about three quarters. Hence, for example an output rate of growth of 2 percentage points over one year is accompanied by a rate of growth of employment of one and an half percentage points.

The most flexible situation with very low employment protection and loose overtime standards is characterized by an elasticity value of around 0.5, such that about one half of the output growth is translated into employment growth. This is the same result yielded by a labour market institutional configuration characterized by an average employment protection and strict working time standards or a low employment protection and average working time standards. The most rigid market is instead yielding a value of 0.220381.

The *average* labour market configuration, with average levels for both institutions, is producing an elasticity level of 0.380503. This value is not far from the outcome of the *flexible* and the *rigid* market, characterized respectively by low and high levels of both variables. This is because the effect of the flexibility on the external margin, causing an increase in the employment rate of growth over the expansion, is compensated by the flexibility on the internal margin that increases the variation in hours, reducing the one in employment.

Note that the mean empirical value of 0.364113 is comprised between

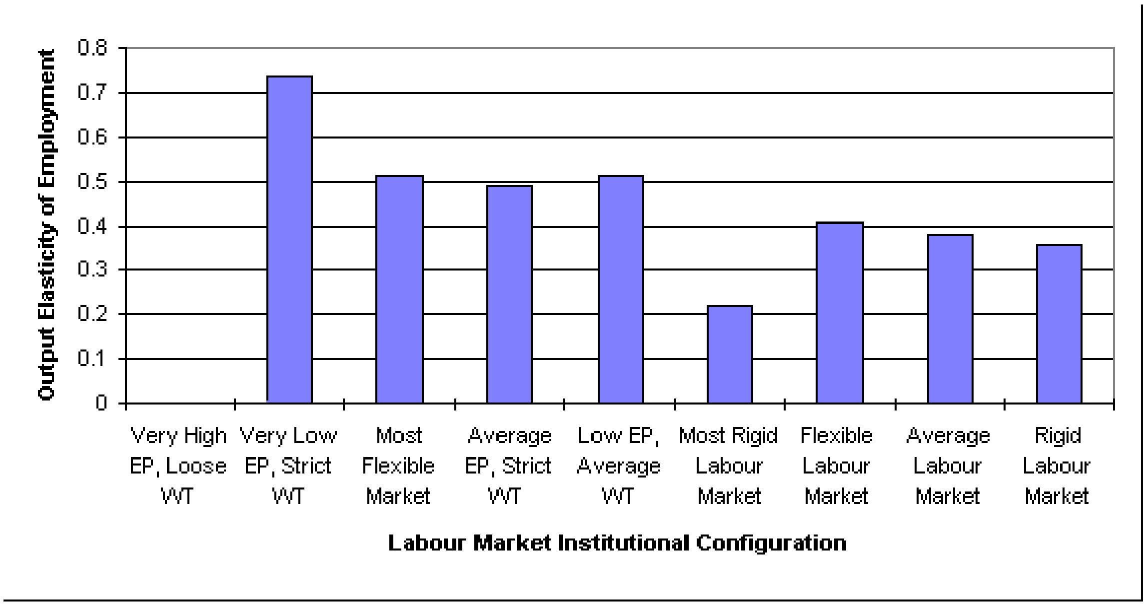

Figure 2: Selected simulated values for Output Elasticity of Employment over the expansive phase

the simulations outcomes of an average and a rigid labour market.

3.3 Recessive Phase Analysis

3.3.1 Comparative Dynamics for recessions

Given the theoretical framework above, the purpose of this section is to test empirically the impact of relevant labour market institutions on the dependent variable during the recessive phase. The comparative dynamics of the model is straightforward and follows the same logic we applied in the expansive phase analysis.

Hence, given that during the recessive phase the negative rate of growth of employment is

$$\gamma_{M_1} = \frac{\bar{M} - M}{M} \tag{34}$$

where M is the maximum level of employment over the cycle and $\bar{M}$ is the minimum level, we obtain

$$\frac{\partial \varepsilon_{M_1 x}}{\partial EP} = \left\{ \frac{1}{M} \underset{(+)}{\frac{\partial \bar{M}}{\partial d}} - \frac{\bar{M}}{M^2} \underset{(-)}{\frac{\partial M}{\partial d}} \right\} \underset{(-)}{\gamma_x} < 0 \tag{35}$$

and

$$\frac{\partial \varepsilon_{M_1x}}{\partial WT} = \underset{(-)}{\frac{1}{\gamma_x}} \left\{ -\frac{1}{M}\underset{(+)}{\frac{\partial \bar{M}}{\partial \phi_d}} + \frac{1}{M^2}\left[-\bar{M}\underset{(+)}{\frac{\partial M}{\partial \phi_u}} \right] \right\} > 0. \tag{36}$$

What equation (35) is saying is that higher level of employment protection reduce the negative rate of growth of employment during recessions. This is exactly what we would expect from an employment protection legislation framework.

On the other side equation (36) is indicating that higher levels of working time flexibility will lower the reduction in employment during recessions. In this case the firm is accommodating the decreasing levels of labour input requirements induced by the recessive phase by means of a variation in the temporal rate of utilization of the existing workforce on the internal margin. This allows the firm to reduce the total amount of firing costs during the recessive phase, and the total amount of hiring costs during the subsequent expansive phase. What the firm is doing is then balancing the costs of working time variations with the costs of reducing the existing workforce on the extensive margin during the recessive phase.

3.3.2 The Model

As stated above, in the case of the recessive phase I calculate the dependent variable values using filtered instead of actual data. This is to get rid of the productivity trend effect which is of opposite sign with respect to the negative cyclical component we are interested in. Besides, given the higher degree of reliability of actual with respect to filtered data, observations related to recessive phases that do not match with the expansive phases of previous section are deleted from the sample. The calculated elasticity values are higher on average than the ones calculated in the expansive phase case. This is due to the fact that the latter contain the trend rate of growth for output, since we use actual data to calculate them.

The unbalanced model we estimate is the following:

$$\varepsilon^{it}_{M_1x} = \alpha + \beta_1 EP_{it} - \beta_2 WT_{it} + \beta_3 UC_{it} + \beta_4 LD_{it} + \beta_5 DU_{it} + \beta_6 BO_{it} + \mu_i + v_{it}. \tag{37}$$

$i = 1, \ldots, 20 \qquad t = 1, \ldots, T_i$

where the meaning of the variables is the same of the ones in (32), except for BO, that is constructed using the formula in 31 but is now indicating the height of the boom preceding the recessive phase.

3.3.3 Estimations

Table 7 shows the regression results using Variance Components Random Effects estimator.

Model 1 is still characterized by significance of both Employment Protection and Working Time Standards, with expected signs, but the R^2 performance is quite poor. This could be due to the fact that in this case the information we are dealing with is in some sense distorted by the filter, so additional care must be taken in dealing with the numerical values of the estimates.

In all the performed estimations the coefficients of Union Coverage, Height of Preceding Boom, Phase Duration and Labour Disputes are never significant, as we can see from the example of Model 3, even though the sign of the first two is as expected, while the third is practically zero.

In all models the working time standards variable is significant at the 5% level and its coefficient's sign is consistent with the conclusion of the theory. Also the employment protection variable is significant at the same confidence level in Model 1, while its sign is consistent with the theory in all three estimates. It is interesting to notice that the employment protection coefficient is analogous to the one estimated for expansions, while the working time standards coefficient is more than doubled[17].

Despite a certain degree of inaccuracy induced by the filtered nature of the data, the empirical analysis seems to give some confirmations of the way the employment dynamics is shaped by the institutional configuration of the labour market. In particular, an employment protective framework is in fact reducing the level of dismissals increasing the firing costs level. A similar effect is performed by an higher degree of working time flexibility.

3.4 Phase Segments

3.4.1 The Model

In this subsection we present the results of the analysis of the employment dynamics over different segments of the same cyclical phase. In practice we want to know

1. if output elasticity of employment is systematically different over

[17] Although this fact could confirm that working time regulations act asymmetrically along the cycle, as hypothesized by the theoretical model, the two numbers are not trivially comparable, because of the filtered nature of recessive phase data.

Dependent Variable: Output Elasticity of Employment Over the Recessive Phase		
	Model 1[a,c,e,f]	**Model 3**[a,c,e,f]
Mean Intercept	0.869544*** (0.200703)	1.30772*** (0.400537)
Employment Protection	−0.032641*** (0.012813)	−0.019227 (0.01734)
Working Time Standards	0.280403** (0.123936)	0.317305** (0.141804)
Union Coverage		−0.217142 (0.164605)
Duration of Contraction	0.008792 (0.016712)	−0.002633 (0.013370)
Height of Preceeding Boom		0.041193 (0.061145)
R^2	0.155531	0.206603
Regression Standard Error	0.570398	0.575690
Hausman Test	$\chi_{(1)} = 2.9939$ P-value=0.0836	$\chi_{(2)} = 0.25613$ P-value=0.8798
LM Heteroskedasticity Test	0.239035 P-value=0.625	0.52359 P-value=0.419
Durbin Watson Test	1.20048 (0.000,0.000)	1.26599 (0.000,0.002)

[a]Unbalanced Panel: N=20, Tmin=1, Tmax=3, number of observations=49

[c]Mean of dependent variable: 0.839386, Standard Deviation:0.456827
[d]Mean of dependent variable: 0.869470, Standard Deviation:0.622028
[e]Variance components random effects estimator
[f]Standard errors in parenthesis
***Significant at the 1% level, **Significant at the 5% level

Table 7: Regression explaining output elasticity of employment over the recessive phase

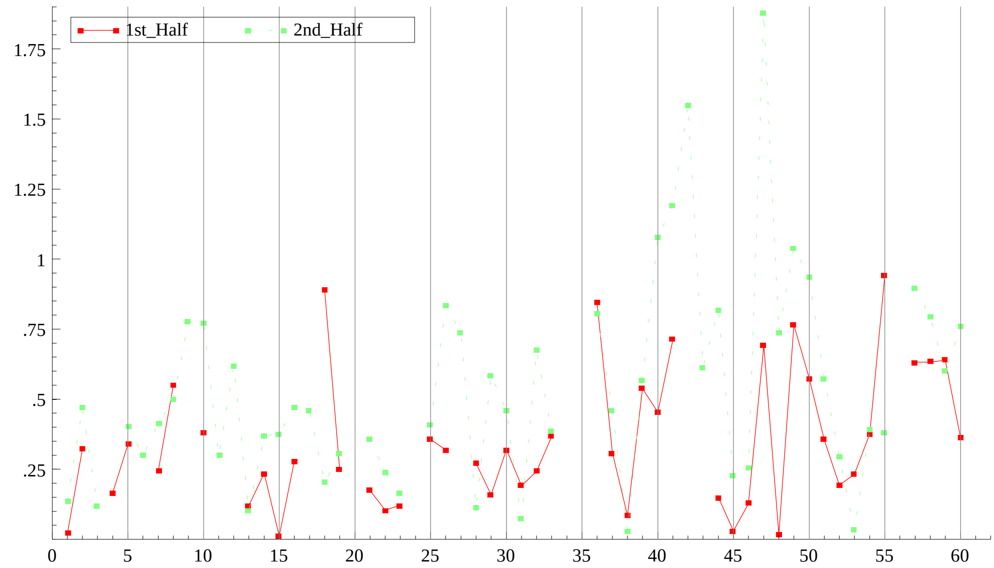

Figure 3: Output elasticities of employment over different segments of the expansion phase

the different phase segments;

2. if labour market institutions have a different impact on employment dynamics over the segments.

The investigation is focused on the expansive phase panel analysed in previous sections. I consider the two halves of each expansion, and calculate the elasticity variable for each half.

The evidence seems to show a particular dynamic pattern for employment over the two phase segments, with higher output elasticity values over the second half, as we can see in the figure. As we can notice, some observations on the second half are greater than unity, meaning that in that cases the rate of growth of employment is even greater than the rate of growth of output.

As a first raw answer to the first question, there seem to be a systematic greater impulse for employment to grow over the last segment of the expansion phase. In order to deepen the investigation of this effect, I estimated the following model

$$\varepsilon^{it}_{M_1x} = \alpha + \beta_1 EP_{it} + \beta_2 WT_{it} + \beta_3 UC_{it} + \\ + \beta_4 \varphi_{it} + \beta_5 (\varphi_{it} EP_{it}) + \beta_6 (\varphi_{it} WT_{it}) + \mu_i + v_{it} \quad (38)$$

where φ_{it} is a dummy variable taking the value 1 if the elasticity is calculated in the first half of the expansion phase, 0 if it is calculated in the second half, i.e.

$$\begin{array}{ll} \varphi_{it} = 1 & \text{if } i \in \{\text{first segment}\} \\ \varphi_{it} = 0 & \text{if } i \in \{\text{second segment}\}. \end{array} \tag{39}$$

Let us explain the rationale of the above equation.

The coefficients α, β_1, β_2 and β_3 are the same of equations (32) and (37), measuring respectively the mean intercept and the coefficients of employment protection, working time regulations and union coverage.

Coefficient β_4 measures the mean intercept effect of the first segment dummy, while the parameters β_5 and β_6 indicates its slope effects on employment protection and working time regulations.

3.4.2 Estimations

The panel data estimates are presented in Table 8.

To avoid any distortion, the estimations of Model 1 and 2 are based on a sample constituted by observations that show a positive output elasticity of employment for both segments. This choice is not going to change radically the results of the investigation, but is only yielding more precision to the estimates, as we can see below, in comparison with Model 3 which is estimated using a sample built on the same criteria as previous sections. Model 2 corresponds to the estimation of equation (38). As we can see from the table, UC_{it} and most importantly the slope dummies $(\varphi_{it}EP_{it})$ and $(\varphi_{it}WT_{it})$, are all not significant. This means that the influence of the previously examined labour market institutions on employment dynamics over the cycle is not asymmetrically distributed over the expansive phase. In other words, these institutional constraints are uniformly binding over the phase.

Once we drop the non significant variables from the regression, we obtain the estimation of Model 1, where both Employment Protection and Working Time Standards are significant (P-value of the second is 0.063) and their signs are consistent with the theoretical model. We can notice that Model 1 yields more precise estimates with respect to Model 3.

Finally, the β_4 coefficient is negative and significant in all three models. This means that the output elasticity of employment is lower in the first half of the expansion with respect to the second half. In practice, the output elasticity of employment varies over the cycle, with lower values in correspondence of the beginning of each expansion and higher values toward the end.

However, three additional remarks must be made.

Dependent Variable: Output Elasticity of Employment Over the Expansion's Segments			
	Model 1^{a,c,e,f}	**Model 2**^{a,c,e,f}	**Model 3**^{b,d,e,f}
Mean Intercept	0.520516*** (0.092929)	0.633259*** (0.182470)	0.738329*** (0.072961)
Employment Protection	−0.028358*** (0.006387)	−0.033697*** (0.009704)	−0.027123*** (0.006522)
Working Time Standards	0.115141** (0.061953)	0.128077* (0.086365)	0.10351* (0.063214)
Union Coverage		−0.024817 (0.067341)	
Duration of Segment	0.036498*** (0.013379)	0.034864*** (0.14257)	0.020757 (0.018420)
First Segment Dummy	−0.168374*** (0.060476)	−0.282824*** (0.116078)	−0.301040*** (0.123647)
WT Slope First Segment Dummy		−0.019987 (0.120511)	
EP Slope First Segment Dummy		−0.13523 (0.012265)	
R^2	0.288541	0.302691	0.265582
Regression Standard Error	0.371704	0.380586	0.373546
Hausman Test	$\chi_{(1)} = 0.04212$ P-value=0.8374	$\chi_{(1)} = 0.000207$ P-value=0.9885	$\chi_{(1)} = 0.17162$ P-value=0.6787
LM Heteroskedasticity Test	1.72584 P-value=0.189	1.53125 P-value=0.216	4.31945 P-value=0.038
Durbin Watson Test	1.24556 (0.000,0.000)	1.27136 (0.000,0.000)	1.19303 (0.000,0.000)

[a]Unbalanced Panel: N=40, Tmin=1, Tmax=3, number of observations=90
[b]Unbalanced Panel: N=40, Tmin=1, Tmax=3, number of observations=100
[c]Mean of dependent variable: 0.43845, Standard deviation:0.31679
[d]Mean of dependent variable: 0.45103, Standard deviation:0.32775
[e]Variance components random effects estimator
[f]Standard errors in parenthesis
***Significant at the 1% level, **Significant at the 5% level ,*Significant at the 10% level

Table 8: Regression explaining output elasticity of employment over the expansion's segments

The first one is related to the shape of working time flexibility over the cycle. In fact we saw that the empirical measure WT corresponds to the two theoretical variables ϕ_u and ϕ_d. For this reason we cannot disentangle the specific effect of each of the two institutions on the cyclical dynamics of employment. However it seems that on average[18] working time regulations over the main industrialized countries are particularly devoted to the management of upward flexibility while working time flexibility during slumps doesn't seem to be a common practice. For this reason the average hours level during the slump should be higher than what predicted by the model. Following this framework, the only possible strategy for the firm to decrease its labour input during the slump is either temporary layoffs or labour hoarding, without the possibility of substituting the latter measure by means of a temporary reduction of payed hours under the standard level[19]. The choice between these two measures should be influenced by the employment protection level, with countries facing a lower level of employment protection recurring to temporary layoffs and viceversa. Indeed, while we are including the effects of employment protection in the regression, it is not clear whether the working time standards variable is able to capture the influence of the downward flexibility parameter ϕ_d, if its effect exists in practice. Hence, it could be the case that the β_4 parameter estimate is measuring the effect of labour hoarding during the slump. In practice, as output begins to raise over the expansive phase, the firm is adjusting its labour input lowering the labour hoarding level, with the result that the output elasticity of employment is lower in the first half of the phase, with respect to the second[20].

Secondly, the main assumption of chapter two is that the firm has perfect knowledge of the cyclical dynamics of the economy. Although this is a useful simplifying device in order to analyse the main features of employment dynamics over the cycle, this is clearly unrealistic. In fact firm's hiring policy is largely affected by the degree of uncertainty about the future. As shown by Bentolila and Bertola (1990), one of the main effects of uncertainty is to delay firm's hiring and firing behaviour over the cycle. In other words, if the cycle is subject to a random

[18]See Butter, Franz, Schettkat and Soskice (1995) and Bettio, Del Bono and Smith (1997).

[19]Note that the ϕ_d parameter is in fact governing the level of hours during the period $\{t_2, \tilde{t}_2\}$, i.e.when $h \leq \bar{h}_1$.

[20]This could be confirmed by the fact that if we include the slump depth variable SL in each of the estimations, the β_4 coefficient becomes insignificant. This is true in both cases of SL calculated at the beginning of the *expansion* for each segment (i.e. for both the first and the second segment) and SL calculated at the beginning of each *segment*.

process the firm develops a zone of inactivity because of the inability of forecasting correctly the cyclical dynamics of output. However, if we follow this framework in the explanation of the sign of coefficient β_4 , we might have to hypothesize that the effects of uncertainty is asymmetrically distributed over the cycle, i.e. the period of inactivity could be longer during the slump than during booms. Following this scenario, at the beginning of each expansive phase, as demand begins to raise, the increase in labour input requirements is first satisfied on the internal margin, i.e. varying the intensity of utilization of the existing employees, through an increase in effort and/or actual working hours, and only secondarily through a raise in the employment level.

A third possible explanation for the effect we found in the data is related to what is know in the literature as the *cleansing effect* of recessions. Following Caballero and Hammour (1994) and Nickell, Nicolitsas and Patterson (1997), the threat of bankruptcy could induce the firm to a reorganization of production during recessions, with a subsequent increase in the productivity level. As the expansive phase begins, this could be reflected in a slower increase in accessions, especially during the first half, reducing the output elasticity of employment with respect to the second half.

These three remarks are indeed related, in the sense that they all hypothesize that the firm intervenes on the intensive margin asymmetrically during the cycle. One possible way to discriminate among them is the analysis of the cyclical behaviour of hours and effort. However this is not easy, given the data we dispose of. Apart from the obvious difficulties of dealing with the measurement of effort, the quarterly series of hours are also not very informative.

The *actual hours for employees* series from BSDB, for example, although measuring the actual level of hours and not the standard level, in some cases don't show any cyclical pattern for some countries.

It is the case of France, as we can see in Fig. 4, where the actual hours series seem to reflect the decennial downward trend in standard hours, more than any cyclical variation. This outcome seems to be related of course to the sources and the kind of aggregation used to construct the actual hours indicator. Besides, the series in question furnishes data about only a few of the 20 OECD countries in the sample, and it was not possible to carry any empirical analysis using homogeneous quarterly data about actual hours[21].

[21] The only possibility in this sense,was to build an hours dataset, using quarterly BSDB as well as yearly *OECD Main Economic Indicators Series* data over one expansive phase of 18 OECD countries, consisting of all countries in the sample except Belgium and New Zealand. The resulting OLS estimation (standard errors in paren-

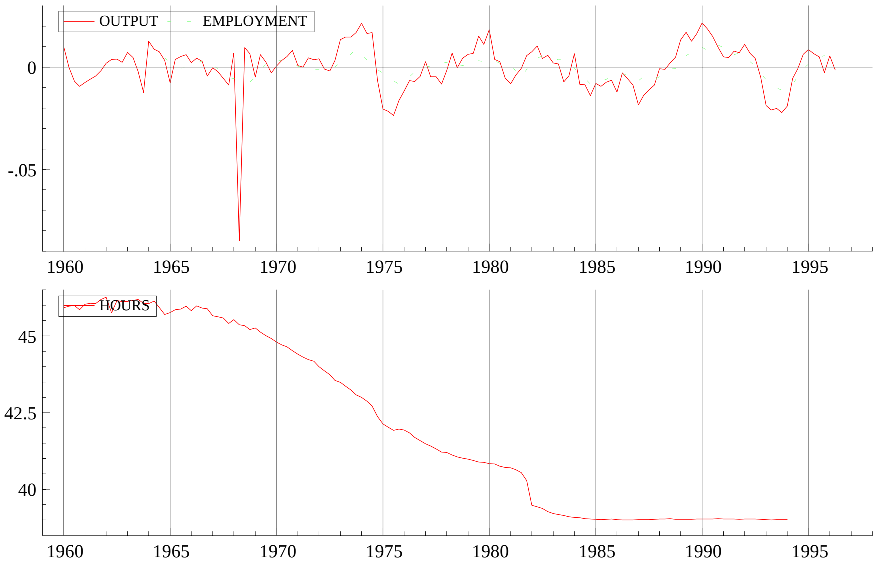

Figure 4: Cyclical behaviour of Output and Employment, and level of Actual Hours for France (1960-1997)

However, looking at Fig. 5 and 6 we can see that in the cases of United States and Canada, the dynamics of hours over the expansive phase of the cycle is as expected, with an increase concentrated especially during the first half of the phase.

3.5 Institutions Affecting Labour Supply

Finally, it is worthwhile to spend some words on the effects of labour supply related institutional variables. One of the possible reasons explaining the start of a cyclical downturn, is that firms are unable to exert the needed productive effort in order to face the increase in demand during booms. This could be related to the difficulty of hiring during the peak of the cycle, because of the increasing competition among firms in the attraction of workers in presence of a lower unemployment rate.

thesis) is the following

$$\varepsilon_{hx} = \underset{(0.53966)}{-0.39408} \underset{(0.20743)}{-0.38765WT} \underset{(0.22582)}{+0.39144UC}. \tag{40}$$

This simple regression does not show more than a negative correlation between output elasticity of hours ε_{hx} and Working Time Standards and a positive correlation with Union Coverage. Indeed, the way the data are constructed doesn't make this result too reliable, as confirmed by the lack of significance of the Employment Protection coefficient.

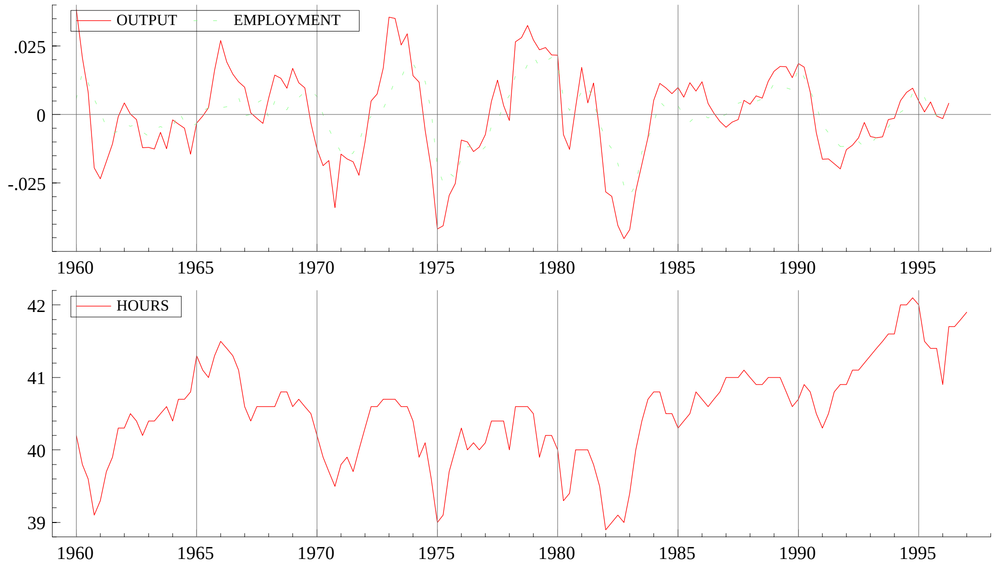

Figure 5: Cyclical behaviour of Output and level of Actual Hours for United States (1960-1997)

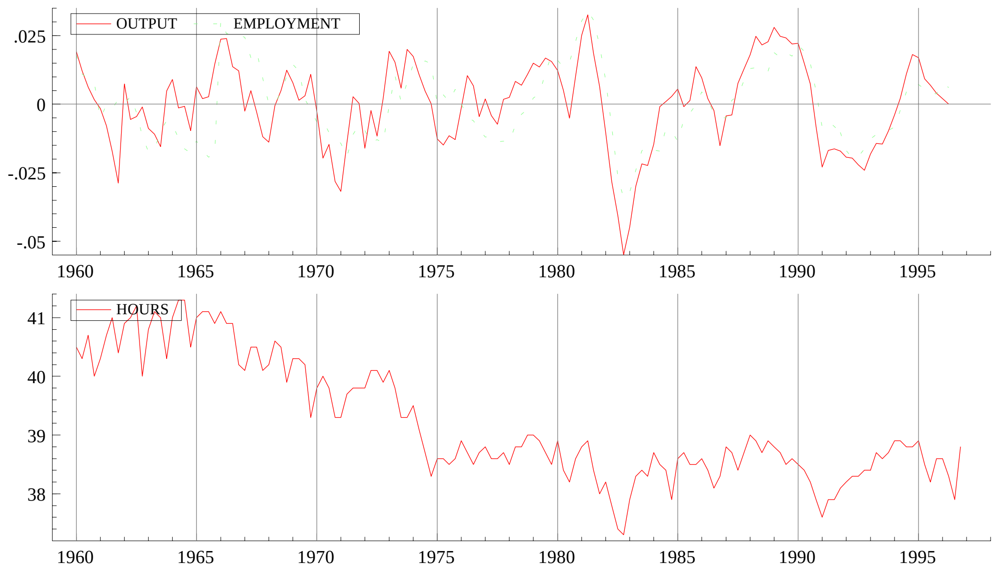

Figure 6: Cyclical behaviour of Output and Employment and level of Actual hours for Canada (1960-1997)

In this sense, higher unemployment benefits could reduce the willingness to work of inactive individuals, contributing to reduce firms' hiring margins. However this mechanism is not confirmed by my analysis, as the amount and duration of benefits are never significant in the models estimated over the whole expansive and recessive phases as well as over each phase segment.

These results could indicate the possibility that during booms either firms on average are not labour supply constrained, or that the difficulties in producing the amount of output demanded are related to the overall organization of the production process, concerning in particular machines investment levels. This line of research needs further investigation though.

4 Concluding Remarks

I presented a theoretical model based on Nickell (1978) in order to evaluate the effects of labour market institutions on the dynamics of employment and hours over the cycle, focusing on working time standards in addition to employment protection. In particular, I considered the role of overtime regulations as well as downward working time flexibility during the slump.

In section three I considered a sample of 20 OECD countries and defined the cyclical behaviour of output and employment by means of Hodrick-Prescott filter, using quarterly data. I then estimated the effects of labour market institutions on employment dynamics over the cycle, and found that the regressions' results are consistent with the theoretical model. In particular, employment protection coefficient has a negative effect on the responsiveness of employment to output, while working time standards has a positive influence. Unions' effects are instead negligible. These results have been confirmed in the analysis of expansive as well as recessive phases. Besides an analysis of different segments of the expansive phase was provided, identifying a particular dynamic pattern for employment during the phase, with an higher rate of growth during the second half of the expansion. This pattern can also be explained by the theoretical model.

Labour market institutions seem to have a significant effect on the cyclical dynamics of employment. These effects seem to balance over the whole cyclical period in the case of employment protection. In other words if a lower employment protection level is shown to increase the output elasticity of employment during expansions, it is also true that during the recessive phase the effect on employment will be negative, causing an higher decrease during the phase[22].

If we consider overall working time flexibility we have a similar pattern. However, in this case there seems to be no reason for working time to be regulated in the same fashion during slumps and during booms. Slumps are characterized by average levels of actual hours that are lower than the standard amount. Booms are instead characterized by positive levels of overtime. The more flexible are hours during slumps, the lower will be their average level during that particular phase of the cycle. The more flexible are hours during booms, the higher will be the average amount of cyclical overtime. These two kind of working time flexibility are distinct, and have distinct effects on employment dynamics over the cycle. Differently from what happens for employment protection, higher downward working time flexibility is going to increase the minimum level of employment over the cycle during slumps, without affecting the maximum level during booms. Viceversa for upward working time flexibility (overtime standards). However downward working time flexibility is not a common practice among OECD countries, while overtime regulations are. This could affect average employment levels and firm's costs structure during slumps. In fact, it could be the case that the firm is unable to intervene on the intensive margin during slumps through a reduction of actual working hours, letting labour hoarding be the only possible measure to reduce the amount of actual worked hours under the standard level. An increase of downward working time flexibility is then going to reduce firms' labour costs and to increase the average level of employment during slumps[23]. It's worthwile noting that the burden of this measure is allocated on the employed workers, that should accept a lower weekly wage in exchange of higher job security during slumps[24].

Where overtime standards regulation is concerned, the analysis is reversed. In fact, in this case, stricter overtime regulations produce higher average levels of employment during booms[25]. However they also affect firm's costs structure during booms, because an additional worked

[22]This doesn't mean that the effect on the average level of employment over the cycle is negligible. However, with respect to this point, the empirical results of Nickell (1997) and Nickell and Layard (1997) show that employment protection "does not appear to have serious implications for average levels of unemployment".

[23]Note that,as we noted in section two, given the analytical structure of the model, nothing can be said about the average level of employment over the cycle without making further assumptions.

[24]There is no way of measuring the net impact of this measure on workers' utility unless we formally specify their preferences. We should then take into account the induced reduction in the average probability of being laid off during the slump, the reduction in the salary and the increase in leisure time.

[25]Again, nothing can be said about average employment levels over the whole cycle.

hour above the standard level is going to be more expensive[26]. In this case, the burden of the measure is then carried by the firm[27], even if this should be partly offset by the reduction in the excess demand period.

Finally, the simulations of section 3 show that similar levels of output elasticity of employment over the expansive phase can be obtained with different combinations of labour market institutions. In particular, we showed that, in the case of an expansive phase of average duration, the outcome of the most flexible labour market configuration is almost identical to the outcome of a market characterized by average levels of employment protection and strict working time standards Besides what we defined as a flexible labour market is yielding elasticity values that are comparable to the ones of a rigid one.

These results derive from the fact that the impact of labour market institutions on the cyclical dynamics of employment has two dimensions. The first is related to the different sources of labour input variation, namely the intensive margin through working time regulations, and the extensive margin through employment protection. The second is instead connected with the timing of the cyclical phases in which the institutional constraints are enforced. What matters is then the specific combination of rigidities and flexibilities over the intensive and extensive labour utilization margins as well as over the different phases of the cycle.

5 Appendixes

A The Solution of the Theoretical Model

A.1 The Dynamic Optimization problem

The dynamic optimization problem of equation (1) subject to the constraints (2), (3), (4) and (5), is simply solved augmenting the Hamiltonian into a Lagrangian function, obtaining:

$$L = e^{-rt}\left\{phM_1 - W(h)M_1 - aA - dD\right\} + \lambda_1 (A - D) + \mu_1 (M - M_1) + \mu_2 (M - M_1) \tag{41}$$

where A, D, $h$are the control variables, and $M_1$is the state variable.

[26]Besides, if employment is higher during booms, the firm is going to spend more in hiring and firing costs over the whole cyclical period.

[27]It is also true that the rent percieved by employed workers during booms, by means of higher overtime salary, is affected. We have two opposite effects: the first, positive, measured by the increase in overtime premia, the second, negative, measured by the lower levels of worked overtime hours, with an ambiguous net effect on the total salary percieved by each worker.

The first order conditions are the following:

$$\frac{\partial L}{\partial A} \equiv -ae^{-rt} + \lambda_1 \leq 0, \qquad A \geq 0, \qquad A\frac{\partial L}{\partial A} = 0, \tag{42}$$

$$\frac{\partial L}{\partial D} \equiv -de^{-rt} - \lambda_1 \leq 0, \qquad D \geq 0, \qquad D\frac{\partial L}{\partial D} = 0, \tag{43}$$

$$\frac{\partial L}{\partial h} \equiv e^{-rt} \{p - W'(h)\} - \mu_2 \leq 0, \quad \text{if} \;\; M_1 > 0, \qquad h \geq 0, \qquad h\frac{\partial L}{\partial h} = 0, \tag{44}$$

$$\dot{M}_1 = \frac{\partial L}{\partial \lambda_1} \equiv A - D; \tag{45}$$

$$\dot{\lambda}_1 = -\frac{\partial L}{\partial M_1} \equiv -\left\{e^{-rt}\left[ph - W(h)\right] - \mu_1 - h\mu_2\right\}; \tag{46}$$

$$\frac{\partial L}{\partial \mu_1} \equiv M - M_1 \geq 0, \qquad \mu_1 \geq 0, \qquad \mu_1\frac{\partial L}{\partial \mu_1} = 0, \tag{47}$$

$$\frac{\partial L}{\partial \mu_2} \equiv x - hM_1 \geq 0, \qquad \mu_2 \geq 0, \qquad \mu_2\frac{\partial L}{\partial \mu_2} = 0, \tag{48}$$

Substituting $\mu_2$from condition (44) into (46) we end up with

$$\dot{\lambda}_1 = \mu_1 - Z(h)\, e^{-rt} \tag{49}$$

where $Z(h) = hW'(h) - W(h)$.

A.2 Identification of The Phases of The System's Dynamics

From the conditions above it is possible to split the dynamics of the system in five main phases:

Phase I: $\{0, t_0\} \cup \{t_5, 2\tau\}$

$D > S \Longrightarrow x - hM_1 > 0$

During this phase the firm is not able to satisfy all demand. From (48) it is $\mu_2 = 0$, and (44) gives $p = W'(h)$. Hence $h$is constant at, say, h^*. Assuming that the firm chooses Msuch that the machines unused during this phase are zero, we have also: $M - M_1 > 0$, and then $A = D = 0$.

Phase II: $\{t_0, t_1\} \cup \{t_4, t_5\}$

$D = S \Longrightarrow x - hM_1 = 0, \qquad M - M_1 = 0$

Demand is all satisfied, and supply is adjusted to the cycle via variation in hours, being M_1fixed at M.

Phase III: $\{t_1, t_2\}$

$D = S \Longrightarrow x - hM_1 = 0, \qquad M - M_1 > 0, \qquad D > 0$

From (47) we have $\mu_1 = 0$, that substituted in (43) gives $\lambda_1 = -de^{-rt}$. Differentiating it with respect to time and substituting it into (49) we obtain $Z(h) = -rd$. Hence $h$is constant at h_d, say.

The result is that, being $h$constant, the cyclical demand is accommodated by the reduction in employment, via a positive rate of dismissions, following the dynamic constraint $x(t) = h_d M_1(t)$.

Phase IV: $\{t_2, t_3\}$

$D = S \Longrightarrow x - hM_1 = 0, \qquad M - M_1 > 0, \qquad D = A = 0$

The reduction in $M_1$of phase III ends at a level $\bar{M}$, say. Being M_1constant at that level, the cycle is accommodated by a variation of hours, following the dynamic constraint $x(t) = h(t)\bar{M}$. Hours will then fall in the interval $\{t_2, \tau\}$and rise in the interval $\{\tau, t_3\}$.

Phase V: $\{t_3, t_4\}$

$D = S \Longrightarrow x - hM_1 = 0, \qquad M - M_1 > 0, \qquad A > 0$

From (47) we have $\mu_1 = 0$, that substituted in (42) yields $p_1 = ae^{-rt}$. Differentiating it with respect to time and substituting it into (49) we obtain $Z(h) = ra$that says that $h$is constant at h_a, say. As in phase III, given the constancy of the level of hours, the firm adapts its supply to the increasing demand by an increase in the employment level, via a positive rate of accessions, following the dynamic constraint $x(t) = h_a M_1(t)$.

The timing of the system dynamics is then characterized by the following relations:

$x(t_0) = h^* M, \qquad x(t_1) = h_d M, \qquad x(t_2) = h_d \bar{M},$

$x(t_3) = h_a \bar{M}, \qquad x(t_4) = h_a M, \qquad x(t_5) = h^* M.$

A.3 The Determination of $\bar{M}$and M

The phase structure of the system's dynamics is only generated if $\bar{M} \neq M$.

Optimal $\bar{M}$

If we consider phase IV, where $\mu_3 = 0$, integrating both sides of (49) we obtain $\int_{t_2}^{t_3} \dot{\lambda}_1 dt = -\int_{t_2}^{t_3} Z\{h(t)\} e^{-rt} dt$, where $h(t) = x(t)/\bar{M}$. Defining $\tilde{t}_2$, with $t_2 < \tilde{t}_2 < t_3$, the time instant in which hours are equal to the standard level $\bar{h}_1$, we have that actual hours are such that:

$h \leq \bar{h}_1$ in time interval $\{t_2, \tilde{t}_2\}$, and

$\bar{h}_1 < h < \bar{h}_2$ in time interval $\{\tilde{t}_2, t_3\}$.

Then, using (42) and (43), we end up with (10):

$$-\left(ae^{-rt_3} + de^{-rt_2}\right) = \int_{t_2}^{\tilde{t}_2} w\bar{h}_1 (\phi_d - 1) e^{-rt} dt$$

since $Z(h) = 0$for $\bar{h}_1 < h < \bar{h}_2$, and $Z(h) = w\bar{h}_1(\phi_d - 1)$for $h \leq \bar{h}_1$.

Equation (10) together with the conditions

$$\bar{M} = \frac{x(t_2)}{\bar{h}_1} = \frac{x(t_3)}{\bar{h}_2}, \tag{50}$$

determines the optimal values of $\bar{M}$and of time instants $t_2$and t_3.

Optimal M

For what concerns M, first of all we have to consider all the components of the firm's discounted profits over the cycle.

Revenue:

$$R(M) = \int_0^{t_0} pMh^* e^{-rt} dt + \int_{t_0}^{t_5} pxe^{-rt} dt + \int_{t_5}^{2\tau} pMh^* e^{-rt} dt \tag{51}$$

with: $x(t_0) = x(t_5) = Mh^*$.

Capital Costs:

$$CC(M) = \int_0^{2\tau} qMe^{-rt} dt \tag{52}$$

where $q$is the capital rental price.

Wage Costs:

$$WC\left(M,\bar{M}\right)=\int_{0}^{t_0}W\left(h^*\right)Me^{-rt}dt+\int_{t_0}^{t_1}W\left(h\right)Me^{-rt}dt+\int_{t_1}^{t_2}W\left(h_d\right)M_1e^{-rt}dt+ \tag{53}$$

$$+\int_{t_2}^{t_3}W\left(h\right)\bar{M}e^{-rt}dt+\int_{t_3}^{t_4}W\left(h_a\right)M_1e^{-rt}dt+\int_{t_4}^{t_5}W\left(h\right)Me^{-rt}dt+$$

$$+\int_{t_5}^{2\tau}W\left(h^*\right)Me^{-rt}dt$$

Adjustment Costs:

$$AC\left(M,\bar{M}\right)=-d\int_{t_1}^{t_2}\frac{\dot{x}}{h_d}e^{-rt}dt+a\int_{t_3}^{t_4}\frac{\dot{x}}{h_a}e^{-rt}dt \tag{54}$$

The present value of profits is then: $\Pi=R\left(M\right)-CC\left(M\right)-WC\left(M,\bar{M}\right)-AC\left(M,\bar{M}\right)$, and $M$is set to maximize this expression.

Considering that $x\left(t_1\right)=Mh_d$and $x\left(t_4\right)=Mh_a$, the partial derivatives of all the profits' components are the following:

$$\frac{\partial R}{\partial M}=\int_{0}^{t_0}W'\left(h^*\right)h^*e^{-rt}dt+\int_{t_5}^{2\tau}W'\left(h^*\right)h^*e^{-rt}dt \tag{55}$$

$$\frac{\partial CC}{\partial M}=\int_{0}^{2\tau}qe^{-rt}dt \tag{56}$$

$$\frac{\partial WC}{\partial M}=\int_{0}^{t_0}W\left(h^*\right)e^{-rt}dt-\int_{t_0}^{t_1}Z\left(h\right)e^{-rt}dt+ \tag{57}$$

$$-\int_{t_4}^{t_5}Z\left(h\right)e^{-rt}dt+\int_{t_5}^{2\tau}W\left(h^*\right)e^{-rt}dt$$

$$\frac{\partial AC}{\partial M}=de^{-rt}+ae^{-rt} \tag{58}$$

We assume that the time instant $\tilde{t}_0$, with $t_0<\tilde{t}_0<t_1$, is the one in which hours are equal to the $\bar{h}_2$level.

Working hours will then be:

$h\geq\bar{h}_2$ in time interval $\left\{t_0,\tilde{t}_0\right\}$, and
$\bar{h}_1<h<\bar{h}_2$ in time interval $\left\{\tilde{t}_0,t_1\right\}$.

Combining the expressions above in the first order condition $\Pi_M = 0$ we finally obtain that optimal M must satisfy (15):

$$\int_0^{t_0} \phi_u \Psi(h^*) e^{-rt} dt + \int_{t_0}^{\tilde{t}_0} \phi_u \Psi(h) e^{-rt} dt + \int_{t_4}^{t_5} \phi_u \Psi(h) e^{-rt} dt +$$
$$+ \int_{t_5}^{2\tau} \phi_u \Psi(h^*) e^{-rt} dt = q \int_0^{2\tau} e^{-rt} dt + a e^{-rt_4} + d e^{-rt_1}$$

since $Z(h) = 0$for $\bar{h}_1 < h < \bar{h}_2$, and $Z(h) = \phi_u \Psi(h)$for $h \geq \bar{h}_2$, with $\Psi(h) = \left[g'\left(h - \bar{h}_2\right) h - g\left(h - \bar{h}_2\right)\right]$.

A.4 Sensitivity Analysis

A.4.1 Employment Levels

Employment Protection Parameter d

From (10) we have

$$\frac{\partial t_3}{\partial d} = \frac{e^{-rt_2}}{are^{-rt_3}} > 0, \tag{59}$$

and hence, from (50) we obtain

$$\frac{\partial \bar{M}}{\partial d} = \underbrace{\frac{\dot{x}(t_3)}{\bar{h}_2}}_{(+)} \underbrace{\frac{\partial t_3}{\partial d}}_{(+)} > 0. \tag{60}$$

Besides, from equation (15) it is also clear that

$$\frac{\partial M}{\partial d} = -\frac{M}{\phi_u} e^{-rt_1} \left\{ \int_{t_0}^{\tilde{t}_0} g'' h^2 e^{-rt} dt + \int_{t_4}^{t_5} g'' h^2 e^{-rt} dt \right\}^{-1} < 0 \tag{61}$$

Overtime Standards Legislation Parameter ϕ_u

Considering equations (10) and (50) we see that the level of $\bar{M}$is unaffected by ϕ_u.

Otherwise from equation (15) we have

$$\frac{\partial M}{\partial \phi_u} = \frac{M}{\phi_u} \frac{\left\{ \int_0^{t_0} \Psi(h^*) e^{-rt} dt + \int_{t_0}^{\tilde{t}_0} \Psi(h) e^{-rt} dt + \int_{t_4}^{t_5} \Psi(h) e^{-rt} dt + \int_{t_5}^{2\tau} \Psi(h^*) e^{-rt} dt \right\}}{\left\{ \int_{t_0}^{\tilde{t}_0} g'' h^2 e^{-rt} dt + \int_{t_4}^{t_5} g'' h^2 e^{-rt} dt \right\}} > 0 \tag{62}$$

where $\Psi(h) = \left[g'\left(h - \bar{h}_2\right) h - g\left(h - \bar{h}_2\right)\right] > 0$, since $g' > g/h \; \forall h$, being $g$convex.

Working Time Reduction Flexibility Parameter ϕ_d

From equation (15) we see that $M$is unaffected by the parameter ϕ_d. Concerning $\bar{M}$, if we differentiate equation (10) we obtain

$$\frac{\partial t_3}{\partial \phi_d} = \left\{ \int_{t_2}^{\tilde{t}_2} w\bar{h}_1 e^{-rt} dt \right\} \left(are^{-rt_3} \right)^{-1} > 0. \tag{63}$$

Then, differentiation of (50) yields

$$\frac{\partial \bar{M}}{\partial \phi_d} = \underbrace{\frac{\dot{x}(t_3)}{\bar{h}_2}}_{(+)} \underbrace{\frac{\partial t_3}{\partial \phi_d}}_{(+)} > 0. \tag{64}$$

A.4.2 Timing of The System's Dynamics

Employment Protection Parameter d

Being $x(t_0) = h^* M$, $x(t_1) = \bar{h}_2 M$, $x(t_4) = \bar{h}_2 M$ and $x(t_5) = h^* M$, and considering the result of (61) we have

$$\frac{\partial t_0}{\partial d} = \underbrace{\frac{h^*}{\dot{x}(t_0)}}_{(-)} \underbrace{\frac{\partial M}{\partial d}}_{(-)} > 0 \tag{65}$$

$$\frac{\partial t_1}{\partial d} = \underbrace{\frac{\bar{h}_2}{\dot{x}(t_1)}}_{(-)} \underbrace{\frac{\partial M}{\partial d}}_{(-)} > 0 \tag{66}$$

$$\frac{\partial t_4}{\partial d} = \underbrace{\frac{\bar{h}_2}{\dot{x}(t_4)}}_{(+)} \underbrace{\frac{\partial M}{\partial d}}_{(-)} < 0 \tag{67}$$

$$\frac{\partial t_5}{\partial d} = \underbrace{\frac{h^*}{\dot{x}(t_5)}}_{(+)} \underbrace{\frac{\partial M}{\partial d}}_{(-)} < 0. \tag{68}$$

Besides from equation (59)[28] we have

$$\frac{\partial t_3}{\partial d} > 0$$

[28]Note that in the case of unspecified convex wage schedule it's just $\frac{\partial t_3}{\partial d} = \underbrace{\frac{\bar{h}_2}{\dot{x}(t_3)}}_{(+)} \underbrace{\frac{\partial \bar{M}}{\partial d}}_{(+)} > 0.$

while nothing can be said about the effects of $d$on $t_2$without making further assumptions.

Then an increase in $d$causes respectively:
an increase in the length of period $\{t_5, t_0\}$(when $D > S$and $h = h^*$),
an increase in the length of period $\{t_4, t_1\}$(when $M_1 = M$),
an ambiguous effect in the length of period $\{t_2, t_3\}$(when $M_1 = \bar{M}$),
a decrease in the length of period $\{t_3, t_4\}$(when $\dot{M}_1 > 0$),
an ambiguous effect in the length of period $\{t_1, t_2\}$(when $\dot{M}_1 < 0$).

Overtime Standards Legislation Parameter ϕ_u

Following the same simple technique we obtain

$$\frac{\partial t_0}{\partial \phi_u} = \underbrace{\frac{h^*}{\dot{x}(t_0)}}_{(-)} \underbrace{\frac{\partial M}{\partial \phi_u}}_{(+)} < 0 \tag{69}$$

$$\frac{\partial t_1}{\partial \phi_u} = \underbrace{\frac{\bar{h}_2}{\dot{x}(t_1)}}_{(-)} \underbrace{\frac{\partial M}{\partial \phi_u}}_{(+)} < 0 \tag{70}$$

$$\frac{\partial t_4}{\partial \phi_u} = \underbrace{\frac{\bar{h}_2}{\dot{x}(t_4)}}_{(+)} \underbrace{\frac{\partial M}{\partial \phi_u}}_{(+)} > 0. \tag{71}$$

$$\frac{\partial t_5}{\partial \phi_u} = \underbrace{\frac{h^*}{\dot{x}(t_5)}}_{(+)} \underbrace{\frac{\partial M}{\partial \phi_u}}_{(+)} > 0. \tag{72}$$

$$\frac{\partial t_2}{\partial \phi_u} = \frac{\partial t_3}{\partial \phi_u} = 0. \tag{73}$$

Then an increase in $\phi_u$causes respectively:
a reduction in the length of period $\{t_5, t_0\}$(when $D > S$and $h = h^*$),
a reduction in the length of period $\{t_4, t_1\}$(when $M_1 = M$),
no effect in the length of period $\{t_2, t_3\}$(when $M_1 = \bar{M}$),
an increase in the length of period $\{t_3, t_4\}$(when $\dot{M}_1 > 0$),
an increase in the length of period $\{t_1, t_2\}$(when $\dot{M}_1 < 0$).

Working Time Reduction Flexibility Parameter ϕ_d

From the above results[29] we obtain:

$$\frac{\partial t_3}{\partial \phi_d} > 0$$

$$\frac{\partial t_2}{\partial \phi_d} = \underbrace{\frac{\bar{h}_1}{\dot{x}\left(t_2\right)}}_{(-)}\underbrace{\frac{\partial \bar{M}}{\partial \phi_d}}_{(+)} < 0. \tag{74}$$

$$\frac{\partial t_0}{\partial \phi_d} = \frac{\partial t_1}{\partial \phi_d} = \frac{\partial t_4}{\partial \phi_d} = \frac{\partial t_5}{\partial \phi_d} = 0 \tag{75}$$

Then an increase in $\phi_u$causes respectively:
no effect in the length of period $\{t_5, t_0\}$(when $D > S$and $h = h^*$),
no effect in the length of period $\{t_4, t_1\}$(when $M_1 = M$),
an increase in the length of period $\{t_2, t_3\}$(when $M_1 = \bar{M}$),
a reduction in the length of period $\{t_3, t_4\}$(when $\dot{M}_1 > 0$),
a reduction in the length of period $\{t_1, t_2\}$(when $\dot{M}_1 < 0$).

B The Data: Definitions and Sources

The output and employment data are taken from *OECD Business Sector Database (BSDB)*, that contains quarterly data for 25 OECD member countries defined for the business sector and the total economy. The series are seasonally adjusted. The countries in the sample are the same as the ones considered in the previous cited analysis[30]:

1=Austria, 2= Belgium, 3=Denmark, 4=Finland, 5=France, 6=Germany, 7=Ireland, 8=Italy, 9=Netherlands, 10=Norway, 11=Portugal, 12=Spain, 13=Sweden, 14=Switzerland, 15=United Kingdom, 16=Australia, 17=Canada, 18=Japan, 19=New Zealand, 20=United States.

The series are *Gross Domestic Product (market prices), Volume* for output and *Total Employment* for employment. Since the BSDB provides aggregate data for West and East Germany after 1991-1, I used data for West Germany from 1991-1 onward taken from *Quarterly National Accounts*, GDP Volume, seasonally adjusted and *OECD Main Economic Indicators Series*, Total Employment, seasonally adjusted by the author[31].

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[29] See equation (63).

[30] See Layard, Nickell and Jackman (1991), Nickell (1997), Nickell and Layard (1997) and Nickell and Nunziata (1999).

[31] A five period centered moving average procedure was used. The latter series for employment is systematically greater than the one furnished by BSDB for the

The characteristics and sources of the variables containing information about the institutional configuration of the labour market are the following.

Employment Protection

It corresponds to the parameter d of the theoretical model of section two. The source is OECD Jobs Study (1994), Part II, Table 6.7, column 5. It is a ranking index, ranging from 1 to 20, based on the strength of the legal framework governing hiring and firing, with 1 indicating the less strictly regulated country.

Working Time Standards

It corresponds to the degree of institutional regulation of working time. The source is OECD Employment Outlook (1994), Table 4.8, column 1, extended by Nickell (1997) for Australia, Japan and New Zealand.

The index ranges from 0 (lax or no legislation) to 2 (strict legislation) and is one of the five dimensions of which is constituted the labour standards comprehensive variable, column 6 of the same Table.

It plays the role of overall working time standards, therefore comprising both parameters ϕ_u and ϕ_d of the theoretical model. We cannot disentangle their individual weight in the construction of the index.

Fig. 7 shows the cross sectional variability for the employment protection and working time legislation (adjusted in mean and range) indexes.

Other institutional variables included in the analysis as controls are the following:

Union Coverage

The index indicates the percentage of workers covered by collective bargaining, with 3 meaning over 70 percent, 2 meaning from 25 to 70 percent and 1 under 25 percent. The source is Layard, Nickell, Jackman (1991).

Labour Disputes

It corresponds to the yearly number of workers involved in strikes and lockouts in thousands. The source is the ILO Yearbook of Labour Statistics.

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time period in which they overlap. For this reason it was necessary to adjust it by a correction factor calculated for the period 1981-1/1991-1

$$CF = \text{average}\left\{\text{Total Employment (MEIS)} - \text{Total Employment (BSDB)}\right\} \quad (76)$$

with the result that

$$\text{Total Employment after 1991-1} = \text{Total Employment (MEIS)} - CF \quad (77)$$

The same chaining procedure was performed for GDP.

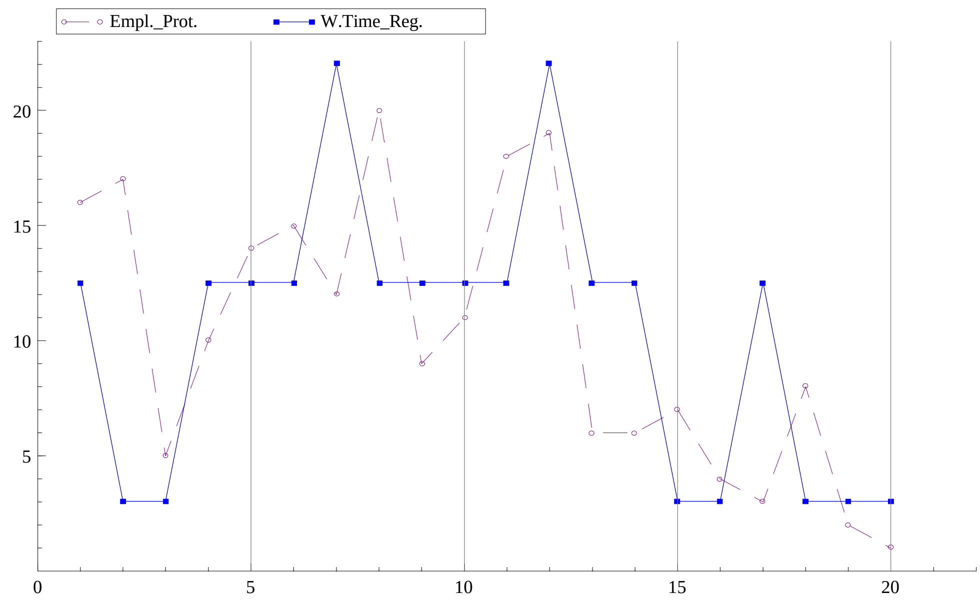

Figure 7: Employment Protection and Working Time Legislation (adjusted in mean and range) for 20 OECD countries, 1989-1994

References

[1] Baltagi B. (1995), *Econometric Analysis of Panel Data*, John Wiley & Sons;

[2] Bentolila S., Bertola G. (1990),"Firing costs and labour demand: how bad is eurosclerosis?", *Review of Economic Studies*, 57;

[3] Bertola G. (1998) "Microeconomic Perspectives on Aggregate Labor Markets", *EUI Working Papers, 98/23;*

[4] Bettio F., Del Bono E., Smith M. (1997), *Employment and Working Time Policies: a Gender Perspective*, Università degli Studi di Siena, Dipartimento di Economia Politica, mimeo;

[5] Buttler F., Franz W., Schettkat R., Soskice D. (1995), *Institutional Frameworks and Labor Market Performance*, Routledge;

[6] Caballero R., Hammour M. (1996), "The cleansing effect of recessions", *American Economic Review*, 84(5);

[7] Calmfors L., Hoel M. (1989), "Worksharing, employment and shiftwork", *Oxford Economic Papers*, 41;

[8] Cogley T., Nason J.(1995), "Effects of the Hodrick-Prescott filter on trend and difference stationary time series: Implications for business cycle research", *Journal of Economics Dynamics and Control*, 19;

[9] Fuller W., Battese G.(1973), Transformation for estimation of linear models with nested error structure, *Journal of the American*

Statistical Association, 68;
[10] Fuller W., Battese G (1974), Estimation of linear models with cross-error structure, *Journal of Econometrics*, 2;
[11] Hamermesh D. (1993), *Labor Demand*, Princeton University Press;
[12] Hart R. (1987), *Working Time and Employment*, Allen & Unwin;
[13] Harvey A., Jaeger A. (1993), "Detrending , stilized facts and the business cycle", *Journal of Monetary Economics*, 21;
[14] Hausman J. (1978), "Specification tests in econometrics", *Econometrica*, 46;
[15] Hodrick R., Prescott E. (1997), "Postwar U.S. business cycles: an empirical investigation", *Journal of Money, Credit and Banking"*;
[16] Hoon H. (1995), "Economic effects of worksharing in a dynamic labor turnover model", *Politica Economica*;
[17] Hsiao C. (1986), *Analysis of Panel Data*, Cambridge University Press;
[18] King R., Rebelo S. (1993), "Low frequency filtering and real business cycles", *Journal of Economics Dynamics and Control*, 17;
[19] ILO, *Year Book of Labour Statistics*, ILO, Geneva;
[20] Layard R., Nickell S., Jackman R. (1991), *Unemployment, Macroeconomic Performance and the Labour Market*, Oxford University Press;
[21] Màtyàs L., Sevestre P., eds. (1992) *The Econometrics of Panel Data: handbook of theory and applications*, Kluwer Academic Publishers;
[22] Millard S., Scott A., Sensier M. (1997), *The Labour Market Over The Business Cycle: Can Theory Fit The Facts?*, CEPR;
[23] Nerlove M., Balestra P. (1992), "Formulation and estimation of econometric models for panel data" in Màtyàs and Sevestre, eds., *The Econometrics of Panel Data: handbook of theory and applications*, Kluwer Academic Publishers;
[24] Nickell S., Layard R. (1997), *Labour Market Institutions and Economic Performance*, Leverhulme Trust Discussion Paper Series on The Labour Market Consequences of Technical and Structural Change;
[25] Nickell S., Nicolitsas D., Patterson M. (1997), *Does Doing Badly Encourage Management Innovation?*, IES, University of Oxford, mimeo;
[26] Nickell S. (1978), "Fixed costs, employment and labour demand over the cycle", *Economica*, November;
[27] Nickell S. (1986), "Dynamic models of labour demand" in Ashenfelter and Layard, eds, *Handbook of Lbour Economics*, North-Holland Press;
[28] Nickell S. (1997), "Unemployment and labor market rigidities: Eu-

rope versus North America", *Journal of Economic Perspectives*, Summer;

[29] Nickell S. (1997b), *Employment Dynamics and Labour Market Institutions*, IES, University of Oxford, mimeo;

[30] Nickell S., Nunziata L. (1999), *Employment Patterns in OECD Countries*, paper prepared for the conference on "Technology, Regulation and Employment" in Madrid, June 19-21 1999;

[31] OECD (1994), *Employment Outlook*, Paris, OECD;

[32] OECD (1994), *Jobs Study: Evidence and Explanations*, Paris, OECD;

[33] OECD (1997), *Business Sector Database*, OECD, Paris;

[34] OECD and IEA (1997), *OECD Statistical Compendium*, CD ROM version, Paris, OECD;

[35] Pini P. (1991), *Cambiamento Tecnologico e Occupazione*, Il Mulino, Bologna;

[36] Santamaki T. (1983), *The Overtime Pay Premium, Hours of Work and Employment*, Helsinki School of Economics Working Paper, F-75;

[37] Santamaki T. (1984), *Employment and Hours Decision, and the Willingness to Work Overtime Hours*, Helsinki School of Economics Working Paper, F-86;

[38] Staffolani (1992), "La flessibilità quantitativa nel rapporto di lavoro: un'analisi teorica", *Economia e Lavoro*, 4;

[39] Wansbeek T., Kapteyn A. (1982), "A simple way to obtain the spectral decomposition of variance components models for balanced data", *Communications in Statistics*, A11;

[40] Wansbeek T., Kapteyn A. (1983), "A note on spectral decomposition and maximum likelihood estimation of ANOVA models with balanced data", *Statistics and Probability Letters*, 1.