

Job protection, industrial relations and employment

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Abstract

We show that with wage commitment firing costs have a small and ambiguous impact on the level of employment. By contrast, with no-commitment, firing costs reduce the level of employment under very general conditions regarding the curvature of workers utility.

Since commitment-like equilibria are more likely in cooperative bargain environments, these results suggest a role in (un)employment regressions for the interaction between the EPL index and a measure of industrial relations quality. Evidence on OECD countries appears to be consistent with the predictions of the model.

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1 Introduction

In spite of a long debate among academics as well as in the society at large the consequences of employment protection still draw the attention of economists. Some results are by now conclusive. There are no doubts, for instance, that employment protection compresses job market flows and increases long term unemployment. Other results, however, are still controversial. Notably, theoretical as well as empirical works do not seem to offer a clear-cut perspective on the relationship between protection and unemployment.

In this paper we study the unemployment impact of Epl (employment protection legislation) by means of a model which emphasises the roles of wage bargaining and industrial relations.

The relevance of wage bargaining can be assessed from a brief survey of some previous major contributions. In a famous early paper, Lazear (1990) clarifies that what matters for firing restrictions to affect employment is whether they increase the cost of labour. Due to the focus on those Epl components that can be described as employer-employee transfers such as severance payments, Lazear shows that Epl reduces employment only to the extent transfers are not undone through lower bargained wages at entry. In contrast with Lazear, Bertola and Bentolila (1990) focus on those Epl components that can be described as pure firing taxes, i.e. costs supported by the employer with no gain for the dismissed employee. The response of wages, however, continues to exert a pivotal role in the sense that employment decreases only if wages increase as a consequence of higher taxes. Bertola and Bentolila show that firing taxes compress job creation and destruction and, as a consequence, reduce labour turnover. More importantly, since they assume exogenously fixed wages, the sign of the impact of firing taxes on average employment is inherently uncertain as it depends on the size of parameters. Liumqvist (2002) clarifies that the nexus between fixed wages and the uncertain employment impact of firing taxes carries over to general equilibrium models with search and matching. In these models, the impact of firing taxes on unemployment depends crucially on whether taxes are assumed to strengthen the bargaining power of workers. If firing taxes are not allowed to affect the split of match surplus, which is akin to assuming fixed wages, unemployment does not display any predictable variation following an increase in protection. The sign of the variation depends on non-core elements of the model. Mortensen and Pissarides (1999) and Burda (1992) both share the same basic setting with a fixed split of match surplus but have

different assumptions regarding the stochastic process that drives match productivity. In the first case, unemployment decreases following higher firing taxes whereas, in the second case, unemployment increases. By contrast, if firing taxes are allowed to contribute to the bargaining position of workers, wages increase as a consequence of a more favourable split of match surplus and employment unambiguously falls (Saint-Paul, 1995)¹.

Thus, if wages represent the main channel that conveys the link between Epl and unemployment, a natural question to ask is under what conditions higher firing costs lead to higher bargained wages. In this paper, we take the view that the relationship between firing costs and wages depends on whether wage setters can enter long-term commitments or, more concretely, on whether the industrial relations environment favour long-term cooperative interactions between workers and firms. The reason lies in a classical hold-up problem. Firing costs strengthen the bargain power of insiders and allow rent extraction in the form of higher wages. Firms, in turn, anticipate the opportunistic behaviour of workers and reduce labour demand during business expansions. It follows that unemployed workers can boost the probability of being recruited only if they are able to commit ex-ante to future wage moderation. Within this perspective, cooperative industrial relations are expected to offer an environment which permits long term commitments through informal agreements. Enforcement, in fact, is provided by the costs associated to interrupting the cooperation. By contrast, adversarial relationships represent the natural backstage for the opportunistic behaviour which lies at the core of the hold-up problem. Thus, in our view, the quality of industrial relations plays a role in determining the overall wage and unemployment impact of firing restrictions.

The model at the core of the paper borrows from the setting of Bertola (1990) but substitutes exogenously fixed wages with endogenous wage-setting operated by a union in an industry with atomistic firms. The assumption of a monopolistic union facing many competitive firms simplifies the analysis and, for this reason, is also common to many previous contributions². Nevertheless, in the real world unions do not possess unlimited bargaining power in wage negotiations so that the assumption should be used only in contexts where results do not hinge on the degree of union power. We believe that this is

¹Of course, the contributions that have been cited represent only a small part of a large body of literature. A non-exhaustive list would also include Hopenhayn and Rogerson (1993), Bentolila and Saint-Paul (1994), Millard and Mortensen (1994), Bertola and Rogerson (1997), Pissarides (2000).

²Just browsing within the set of papers cited in this introduction, the monopoly union assumption has been used by Kennan (1988), Modesto and Thomas (2001) and Garibaldi and Violante (2005).

the case in the present study. After all, what is relevant for the substantive implications of the model is the fact that the union possesses *some* power in wage negotiation and that firing taxes interact with this power by offering a support for rent extraction.

In addition to endogenous wages, the model exhibits two other distinctive features, a stochastic dynamic environment and firing taxes that are proportional to the number of layoffs. We believe that these ingredients are useful to capture the essential traits of regulated labour markets. The reasons are the following. First, firing restrictions are commonly regarded in the world of business to be detrimental to the ability of firms to cope with unforeseen contingencies. This view suggests the use of a stochastic dynamic environment as a natural setting for the investigation. Second, in almost all countries, legislation commands per-worker provisions (Emerson, 1988; OECD, 1999). This fact obviously translates into taxes that are proportional to the size of workforce adjustments. Furthermore, the empirical literature based on micro-level data appears to be supportive of linear as opposed to convex specifications; workforce adjustments of single firms appear to be discrete and infrequent instead of being small and continuous (Hamermesh, 1989; Burda, 1991).

We analyse this setting both under union commitment and no-commitment on future wages and find results that can be summarised as follows. First, in the equilibrium under commitment, firing restrictions reduce workforce turnover but the impact on employment and wages turns out to be ambiguous as it depends on the shape of workers preferences. Second, in the equilibrium under no-commitment, firing restrictions exert an additional impact that is absent under commitment. This impact relates to the hold-up problem and is obviously absent under commitment. Thus, in comparison with the commitment case, firing restrictions lead to higher wages and lower employment levels.

Using the conjecture that long-term commitments overlap with the notion of cooperative industrial relations, we test these results using OECD data for unemployment and unemployment determinants together with World Economic Forum (WEF) information on the quality of industrial relations in different countries. Results turn out to be in line with theoretical predictions. More specifically, we find that EPL reduces unemployment in countries with cooperative industrial relations but turns out to be neutral in adversarial contexts.

Related literature

Close to the present paper are the works of Kenman (1988) and Modesto and Thomas (2001). Both contributions feature endogenous wages setting, a monopoly union and a sector of many competitive firms subject to workforce adjustment costs. These papers, however, depart from the linear cost tradition and build on the analytically friendly but unrealistic assumption of quadratic symmetric costs. Their main concern is to study connections between the characteristics of the wage bargaining process and the speed of adjustment of employment to its long run equilibrium level. The model in Modesto and Thomas is also non-stochastic so that adjustments are interpreted as following from a once-and-for-all perturbation. Finally, in Modesto and Thomas the equilibrium under commitment coincides with the one under no-commitment if firing costs are linear proving that the quadratic cost assumption is crucial for their results.

Since we focus on an interaction between Epl and the institutional environment of wage bargaining a contribution which we regard close in spirit to the present work is the paper by Garibaldi and Violante (2005). These authors, in fact, show that a further relevant interaction is the one between Epl and the degree of centralisation in wage bargaining. In their setting, firing costs are modeled as transfers so that centralisation matters in that it prevents full undoing of these transfers through decentralised bargaining. In spite of the difference between the two settings, however, their point is similar to the one made in the present paper. To understand the effects of Epl one needs to uncover the interplay between firing provisions and the characteristics of the bargaining environment.

The plan of the paper is as follows. In section 2 we present the theoretical environment. In sections 3 and 4 the firms-union interaction is studied respectively with and without a commitment on wages. In section 5 we analyse the interaction between firing costs and the ability to commit while in section 6 we check whether theoretical results are empirically consistent. Section 7 contains some concluding remarks.

2 Model

2.1 Assumptions

A single wage-setting union and a unit mass of identical competitive firms operate in the same industry. Business conditions, i.e. demand and productivity conditions, are common to all firms and are subject to stochastic changes. Firms maximise the discounted cash

flow by adapting their workforce to changing business and wage conditions. In making these decisions, however, they are obliged to pay to a third party a firing cost for any dismissed worker. Production is realised through a labour-only technology, the current cash flow cf is given by the difference between current revenues and labour costs:

$$cf(\alpha_t, w_t, l_{t-1}, l_t) = (\alpha_t - \frac{d}{2}l_t)l_t - w_t l_t - I_{l_t \leq l_{t-1}} F (l_{t-1} - l_t)$$

Revenues $(\alpha_t - \frac{d}{2}l_t)l_t$ depend on the level of firm's employment l_t and on the shifter α_t which indexes business conditions during period t . The value of the shifter may change from period t to period $t + 1$. We assume that the motion is governed by a two-states Markov process, α cycles between an high value α_g and a low value α_b ($< \alpha_g$) with a constant per-period transition probability q (< 1). Labour costs are given by the wage bill $w_t l_t$ plus total firing costs. F represents the firing cost for a single dismissed worker while $I_{l_t \leq l_{t-1}} (l_{t-1} - l_t)$ gives the total mass of dismissed workers. The dummy $I_{l_t \leq l_{t-1}}$ switches from 1 to 0 if current employment becomes higher than past employment.

The union maximizes a discounted utility flow by adopting an optimal wage policy (monopoly union), per-period utility $U(w_t, L_t)$ depends on the wage level w_t and on aggregate employment L_t . We assume that the union is utilitarian:³

$$U(w_t, L_t) = L_t v(w_t) + (m - L_t) v(\bar{w}) \tag{1}$$

In this expression, m represents union membership, which we assume to be fixed, and $(m - L_t)$ the number of unemployed members. The utility of each member v depends on the union wage w_t for those who happen to be employed and on the “alternative” exogenous wage \bar{w} for the unemployed. We assume that v belongs to the CARA or DARA families, i.e. the coefficient of absolute risk aversion $-v''/v'$ is either constant or decreasing with respect to the wage. We exclude functions displaying increasing absolute risk aversion (IARA) on the basis of the argument that they imply implausible risk behaviour.⁴ Belonging to the CARA or DARA families also implies that v is concave with a positive third derivative.

³The utilitarian objective function has been widely used in the union literature. The obvious reference is Oswald (1985).

⁴With IARA preferences, low wage individuals are less averse to absolute risk than high wage individuals.

2.2 The employment policy

In any period firms choose the level of employment after having observed the current state of business conditions and the current wage. Both variables are regarded to be exogenous by any (small) firm. The optimal employment sequence or, equivalently, the optimal hiring and firing sequence, solves the Bellman problem

$$V(\alpha_t, w_t, l_{t-1}) = \max_{l_t} cf(\alpha_t, w_t, l_{t-1}, l_t) + \frac{1}{1+r} E_t [V(\alpha_{t+1}, w_{t+1}, l_t)]$$

The value of the firm is given by the current cash flow plus the expected discounted continuation value. In addition to current wages and business conditions the value also depends on lagged employment due to the presence of firing costs.

To characterise the employment policy we introduce the notion of the shadow value of labour. We define the shadow value $S(\alpha_t, w_t, l_t)$ as the value accruing to the firm from a worker permanently added to its workforce. This value is computed along the optimal policy. Thus, the shadow value corresponds to the increase in firm value V due to a marginal upward shift in the employment path $\{l_{-1}, l_t, \dots\}$:

$$S(\alpha_t, w_t, l_t) = \alpha_t - d l_t - w_t + \frac{1}{1+r} E_t [S(\alpha_{t+1}, w_{t+1}, l_{t+1})] \quad (2)$$

The shadow value is given by a recursive relationship since it equals the current net marginal revenue of labour plus the expected discounted next period shadow value. Due to the linearity of firing costs, for a given current employment l_t , $S(\alpha_t, w_t, l_t)$ is unrelated to lagged employment l_{t-1} . In this sense S is a pure forward looking variable corresponding to the expected discounted sum of net marginal labour products:

$$S(\alpha_t, w_t, l_t) = \sum_j \left(\frac{1}{1+r} \right)^j E_t (\alpha_{t+j} - d l_{t+j} - w_{t+j}) \quad (3)$$

Equation 3 has been obtained by running forward the recursive expression in 2 and by conjecturing asymptotic boundedness for the shadow value. This conjecture turns out to be correct along the optimal employment path.

Since laying off a single worker costs F while a recruit costs nothing, firms choose inaction when the shadow value *under inaction* - i.e. $S(\alpha_t, w_t, l_{t-1})$ - lies within the interval $[-F, 0]$. In this case, in fact, neither hiring nor firing yield a net positive reward.

Workforce adjustments occur only when $S(\alpha_t, w_t, l_{t-1})$ falls outside the inaction interval $[-F, 0]$. If $S(\alpha_t, w_t, l_{t-1})$ is positive, optimality requires recruiting new workers. Further, hiring must take place up to the point the marginal recruit becomes valueless or, more formally, up to the point the shadow value is brought to the upper boundary of the inaction interval, i.e. $S(\alpha_t, w_t, l_t) = 0$ if $l_t > l_{t-1}$. On the other hand, if $S(\alpha_t, w_t, l_{t-1})$ is lower than $-F$, optimality requires a reduction in workforce. In particular, this reduction must be such that firing an extra worker entails no net positive value, this happens when the shadow value is brought to the lower boundary of the inaction interval, i.e. $S(\alpha_t, w_t, l_t) = -F$ if $l_t < l_{t-1}$. This confirms the conjecture that the shadow value is bounded along the optimal policy.

We conclude this section with a formal description of the optimal employment policy which will turn useful when we analyse union behaviour. For this purpose, we define two threshold levels for w_t which serve to specify whether the current wage triggers hiring, firing or inaction. Thus, let $\bar{w}(\alpha_t, l_{t-1})$ and $\underline{w}(\alpha_t, l_{t-1})$ represent respectively the *maximum* and the *minimum* wage consistent with inaction, these thresholds are defined as follows:

$$\bar{w}(\alpha_t, l_{t-1}) = \alpha_t - d l_{t-1} + \frac{1}{1+r} E_t [S(\alpha_{t+1}, w_{t+1}, l_{t+1})] + F \quad (4)$$

$$\underline{w}(\alpha_t, l_{t-1}) \equiv \bar{w}(\alpha_t, l_{t-1}) - F \quad (5)$$

Equations imply that if the current wage w_t is equal to \bar{w} then the shadow value under inaction $S(\alpha_t, w_t, l_{t-1})$ is equal to $-F$ whereas if the current wage is equal to \underline{w} the shadow value is nil. Thus, if the current wage lies inside the interval $[\underline{w}, \bar{w}]$ firms choose inaction. Notice also that the thresholds depend upon the expected next period shadow value and, through this channel, upon expected future wage rates. This means that higher future wages reduce both \underline{w} and \bar{w} and make firing a more likely occurrence for any given current wage w_t . Or, from a reversed perspective, lower expected future wages allow the union to charge higher current wages without incurring into a reduction in the number of employed workers.

Using the wage thresholds we can express the optimal employment policy as follows:

$$I_{w_t \leq \underline{w}(\alpha_t, l_{t-1})} S(\alpha_t, w_t, l_t) = 0 \quad (6)$$

$$I_{w_t \geq \bar{w}(\alpha_t, l_{t-1})} [S(\alpha_t, w_t, l_t) + F] = 0 \quad (7)$$

$$I_{\underline{w}(\alpha_t, l_{t-1}) \leq w_t \leq \bar{w}(\alpha_t, l_{t-1})} (l_{t-1} - l_t) = 0 \quad (8)$$

In these equations, the dummy $I(\cdot)$ is equal to 1 when the attached condition is true and to 0 otherwise. The first equation describes firm behaviour when the current wage is set equal or below \underline{w} . If $w_t = \underline{w}$ the shadow value S is equal to zero by definition whereas, if $w_t < \underline{w}$, firms increase employment so as to reset S to zero. The second and the third equations have similar interpretations.

2.3 The wage policy

In the first part of this section we analyse the strategy of the union under the assumption that it can precommit to a particular wage policy. At the end of the section we deal with the no-commitment case.

2.3.1 The wage policy under commitment

Let $h_t = (\alpha_0, \alpha_1, \dots, \alpha_t)$ represent the history of exogenous business conditions from period 0 up to period t and H_t the set of all possible vectors h_t , we assume that the union commits by announcing a sequence of history contingent wages $w_t(h_t)$, $t = 0, 1, \dots$, for all $h_t \in H_t$. The announcement is made at the beginning of period 0 and, therefore, is conditioned on the observation of current business conditions α_0 and lagged aggregate employment L_{-1} . The union chooses the wage sequence so as to maximise the discounted utility flow under the constraints posed by the employment decisions of firms. Formally, this amounts to state that the union is faced with solving the Lagrangian problem

$$\mathcal{L} = E_0 \left\{ \sum_t \left(\frac{1}{1+r} \right)^t [U(w_t, L_t) + \sigma_t I_t^H S_t + \lambda_t I_t^F (S_t + F) + \gamma_t I_t^L (L_{t-1} - L_t)] \right\} \quad (9)$$

Multipliers $[\sigma_t, \lambda_t, \gamma_t]$ have been used to embed into the program the constraints 6-8 that follow from the employment policy of firms. For ease of notation, $S(\alpha_t, w_t, L_t)$ has been substituted with S_t while the dummies in constraints 6-8 have been substituted respectively with I_t^H , I_t^F and I_t^I . Since the mass of firms has a unit measure, aggregation implies $l_t = L_t$. Thus, l_t needs to be substituted with L_t when one refers to the constraints arising from the aggregate employment policy.

Despite the appearance, the problem in 9 can not be solved through dynamic programming since the shadow value S_t and the dummy vector $[I_t^H, I_t^F, I_t^I]$ depend upon (the expected value of) future wages. Equation 3 illustrates the forward nature of S_t while equations 4 and 5 illustrate the forward nature of the wage thresholds \bar{w} and \underline{w} which, in turn, determine the dummy vector. Intuitively, future wages affect the current union welfare by determining the current value for firms of an extra worker added to the workforce. This value, in turn, determines whether firms fire, hire or stay inactive at current time and, in the first two cases, how many workers are involved in the adjustment.

The fact that future wages affect current employment decisions causes the optimal policy to be time inconsistent. The union has an incentive to announce low future wages and then to renege on the announcement. On technical grounds, program 9 is non-recursive and can not be solved with the Bellman format. For this reason, we transform the program and make it recursive by adopting the method of Marcet and Marimon (1992). This method consists of introducing fictitious state variables - Abel-variables in the words of Ljungqvist and Sargent (2004, chap 15) - which force the planner to implement the ex-ante optimal policy while behaving in time consistent fashion.

Let Σ represent the Abel-variable associated to S in constraint 6 and Λ the one associated to S in constraint 7, the definition of these variables is as follows⁵:

$$\Sigma_t = \Sigma_{t-1} + \sigma_t I_t^H \quad \Lambda_t = \Lambda_{t-1} + \lambda_t I_t^F \quad \Sigma_0 = \Lambda_0 = 0 \quad (10)$$

Let $Y_t = (\alpha_t, L_{t-1}, \Sigma_{t-1}, \Lambda_{t-1})$ represent the vector of state variables at time t and $W(Y_t)$ the discounted payoff flow along the optimal policy. Further, conjecture that the dummy

⁵Note that S is not the only forward looking variable in the program. As observed in the text, the dummy vector also depends on the expectation over future wage and employment levels. However, when evaluating alternative wage policies, changes in these dummies do not affect the discounted welfare of the union. The reason is straightforward. Whenever a dummy is "active" the attached multiplier is nil since it represents the relevant first order condition for firms. Thus, if a dummy moves between zero and one as a consequence of a small change in the wage policy there is no impact on the discounted summation in 9

vector $[I_t^H, I_t^F, I_t^I]$ is a function only of the current state Y_t . Under this conjecture, the law of motion in 10 implies that $W(Y_t)$ follows the Bellman recursion

$$\begin{aligned}
W(Y_t) = & \max_{\{w_t, L_t, \sigma_t, \lambda_t, \gamma_t\}} U(w_t, L_t) + (\Sigma_t + \Lambda_t)(\alpha_t - dL_t - w_t) + \\
& + \lambda_t I_t^F F + \gamma_t I_t^I (L_{t-1} - L_t) + \frac{1}{1+r} E_t W(Y_{t+1})
\end{aligned} \tag{11}$$

As a result of recursivity, the solution of the program is represented by a set of *time invariant* functions of Y_t :

$$f_t = f(Y_t) \quad f = w, L, \sigma, \lambda, \gamma \tag{12}$$

For given initial conditions $Y_0 = [\alpha_0, L_{t-1}, 0, 0]$, the evolution of the state vector Y_t is governed by these policy functions and by the stochastic exogenous motion of business conditions α . This implies that for any α -history $h_t = (\alpha_0, \alpha_1, \dots, \alpha_t)$ one can compute the corresponding state vector Y_t by applying functions $f(Y_t)$ recursively. More formally, these policy functions introduce a correspondence from the set of history vectors H_t to the set of state vectors $\{Y_t\}$. Thus, for any given history h_t the optimal wage under commitment $w_t(h_t)$ is equal to the time invariant function $w(\cdot)$ computed for the corresponding state vector Y_t .

Time invariance of policy functions also validates the conjecture for the vector $[I_t^H, I_t^F, I_t^I]$ being only dependent on the current state Y_t . In fact, given the current state Y_t , policy functions $f(\cdot)$ map probabilities over the future evolution of business conditions into probabilities over future states. This means that Y_t is the only determinant of expectations concerning future wage and employment levels, i.e. Y_t is the only determinant of current wage thresholds, \bar{w}_t and \underline{w}_t , and of the current dummies.

2.3.2 The wage policy under no-commitment

In the absence of a commitment wages are chosen period by period. This prevents the union from implementing the policy that is optimal as of the beginning of the game. Technically, behaving in a time-consistent not optimal fashion amounts to setting Σ_{t-1} and Λ_{t-1} equal to zero at the beginning of any period t so that the state vector collapses

from $(\alpha_t, L_{t-1}, \Sigma_{t-1}, \Lambda_{t-1})$ to (α_t, L_{t-1}) . For this reason, the wage and employment policies can be summarised as follows:

$$w_t = w(\alpha_t, L_{t-1}, 0, 0) \equiv \tilde{w}(\alpha_t, L_{t-1}) \quad (13)$$

$$L_t = L(\alpha_t, L_{t-1}, 0, 0) \equiv \tilde{L}(\alpha_t, L_{t-1}) \quad (14)$$

3 Wages and employment under commitment

3.1 The equilibrium under commitment

In this section we define the equilibrium under commitment and characterise the wage and the employment paths along such an equilibrium. The treatment is quite general as it does not relate to the particular law of motion which governs the exogenous dynamics of α . In the next subsection, we show how employment and wages evolve if α follows the two-states Markov chain described above.

Definition A commitment equilibrium is defined as follows:

- i) *Optimal firm behaviour*: any firm sets employment l_t period by period according to equations 6-8;
- ii) *Optimal union behaviour*: the union sets wages by precommitting at time 0 to the sequence $w_t(h_t) = w(Y_t)$, where Y_t is the state vector corresponding to h_t ;
- iii) *Aggregation*: aggregate employment is the sum of employment in all firms: $l_t = L_t$.

On the basis of this definition, it is straightforward to see that the equilibrium path for wages and employment results from functions $w_t = w(Y_t)$ and $L_t = L(Y_t)$. These, in fact, can be interpreted as mutual best responses: $w(Y_t)$ is, by construction, the optimal commitment policy face to firms employment behaviour whereas $L(Y_t)$ derives from a program which is constrained by equations 6-8.

In the appendix, we solve the program 11 and provide some formal statements which serve to characterise the $w(Y_t)$ and $L(Y_t)$ sequences. We reach two main results:

Result 1: Under commitment, if employment is constant from one period to the other, wages are also constant (lemma 1).

Result 2: Under commitment, if business conditions do not change from one period to the other - i.e. $\alpha_t = \alpha_{t-1}$ - then employment and, by result 1, wages do not change.

(proposition A1).

Result 1 is explained as follows. The objective function of the union is concave with respect to the wage. Thus, if employment is constant along a portion of the equilibrium path, the union strictly prefers to commit to a sequence of constant wages along this portion rather than to equivalent sequences with changing wages. For equivalent sequences we mean wage sequences that bring forth the same expected discounted value and, as a consequence, the same expected employment levels.

Result 2 is due to the fact that the cost of adjusting employment is linear not convex. Therefore, *providing* firms decide to adapt employment to new business and wage conditions, there is no gain for them to delay the adjustment or spread the adjustment over many periods. Thus, considering that wages change only if employment does (result 1), employment and wages change only at business turns - if they change at all - but not within a spell of constant business conditions.

3.2 Wages and employment

While the analysis conducted so far holds for any process driving business conditions in this section we restrict our attention to the simple stochastic cycle of good and bad conditions. Recall that results 1 and 2 imply that employment and wages can only change at business turns but not within a spell of constant business conditions. Furthermore, it may also be possible that employment and wage do not change at all. This may happen, for instance, if firing costs are prohibitively large; a case, however, which we regard as implausible from an empirical point of view. After all, even in countries with very strict employment protection workforce responds to idiosyncratic firms conditions (OECD, 1994). Thus, in the remainder of this section we focus on an equilibrium which exhibits hiring at the beginning of good spells and firing at the beginning of bad spells⁶. We first show how to compute wage and employment levels along such an equilibrium and then study under what parameter restrictions positive workforce adjustments take place. Towards the end of the section we discuss the employment impact of firing costs.

Let us define with L_g^c and w_g^c [c : *commitment*] the employment and wage levels along

⁶Hiring at the beginning of bad spells (as a consequence of very low wages) and firing at the beginning of good spells (as a consequence of very high wages) can not be part of an equilibrium. Wages and employment are normal goods for the union (see the discussion below), thus the two variables increase (decrease) jointly when demand conditions improve (deteriorate).

a good spell and with L_b^c and w_b^c the corresponding values along a bad spell. Despite the vector $[L_g^c, L_b^c, w_g^c, w_b^c]$ can be formally computed from program 11 we opt for a more intuitive derivation by noticing that positive workforce adjustments imply that the program of the union is separable across good and bad spells. In other words, when choosing w_g^c at the beginning of a good spell, the union knows that L_g^c has no impact on its own returns once business conditions turn bad. This is because linear adjustment costs and positive firing imply that the subsequent choice on L_b^c by the firm sector only depends upon w_b^c but not on L_g^c .⁷ For analogous reasons, when choosing w_b^c at the beginning of a bad spell the union knows that L_b^c has no impact on the continuation value in case business conditions turn good.

Since current employment does not affect returns in subsequent spells, the union sets the wage so as to maximise the discounted utility flow only over the current spell. Furthermore, as employment and wages are constant within spells, this boils down to solving a couple of static programs:

$$\max_{w_g^c} U(w_g^c, L_g^c) \quad (15)$$

$$L_g^c = \frac{1}{d} \left[\alpha_g - \frac{q}{1+r} F - w_g^c \right] \quad (16)$$

$$\max_{w_b^c} U(w_b^c, L_b^c) \quad (17)$$

$$L_b^c = \frac{1}{d} \left[\alpha_b + \frac{r+q}{1+r} F - w_b^c \right] \quad (18)$$

In these programs, labour demands 16 and 18 have been obtained from equation 2 after substituting the relevant values of S . Constant employment and wages within spells lead to constant values of S . Thus, S is equal to 0 at all times within good spells and to $-F$ at all times within bad spells.⁸

⁷Of course, L_g^c has no impact on union returns but has an impact on firms returns if business conditions turn bad since an higher level L_g^c means more dismissals and higher dismissal costs.

⁸According to these programs, the dynamic equilibrium under commitment results from a simple collection of purely static equilibria. The similarity with the static case, however, should not be interpreted literally. For, in a static context, the position of labour demand is exogenous whereas, in the present setting, the position of labour demand is endogenously determined by the wage policy to which the union

Labour demands 16 and 18 clarify under what conditions positive hiring and firing arise in equilibrium. Due to the strict convexity of indifference curves generated by $U(w, L)$ and the linearity of labour demands, wages and employment are "normal goods" for the union. Thus, since positive adjustments require $L_g^c > L_b^c$, a necessary and sufficient condition for positive adjustments (and for $w_g^c > w_b^c$) is that labour demand in good times lies above labour demand in bad times. By inspecting demand schedules this amounts to impose the following restriction on parameters:

$$\alpha_g - \alpha_b > \frac{r + 2q}{1 + r} F \quad (19)$$

Intuitively, positive adjustments arise if firing costs are sufficiently low and/or the change in business conditions sufficiently large. Further, notice that firing costs enter the inequality in combination with the transition rate q . An higher transition probability makes business spells less durable and reduce incentives to workforce adjustments. Thus, for given firing costs, positive adjustments tend to arise when q is small.

Having characterised the determination of employment and wages we now focus on the impact of firing costs on these variables.

We begin with the impact of firing costs on workforce turnover and wage fluctuations.⁹ Observe that firing costs shift labour demand up in bad times and down in good times. The first effect is straightforward as it relates to the protection role of firing costs. The second is more subtle; for a given wage level, higher firing costs reduce incentives to hiring in good times as firms expect a reversal in business conditions in the future. Thus, more recruits in good times mean more dismissals - and higher dismissal costs - when bad conditions return. The consequences of these demand shifts in terms of employment and wage levels are straightforward. Since employment and wages are normal goods for the union, a lower labour demand in good times leads to lower levels of both variables. By contrast, an higher labour demand in bad times leads to higher employment and wage levels. The upshot of these effects is that firing costs tend to dampen wage and employment fluctuations that take place at business turns.

has committed.

⁹The impact of firing costs on turnover has been firstly analysed by Bertola (1990) and Bentolila and Bertola (1990) in models with exogenous wages.

Smaller employment fluctuations, however, are not accompanied by clear-cut changes in their average level. These changes, in fact, depend on a “discounting effect”, governed by r , and on a “curvature effect” which is governed by the shape of union indifference curves.

Discounting makes firing costs more relevant for firing decisions than for hiring decisions. Formally, the multiplier of F in equation 16 is smaller in absolute size than the one in equation 18 by an amount which increases with respect to r . As a consequence, the upward shift of the schedule in bad times is more pronounced in comparison to the downward shift in good times. This effect - taken alone - obviously leads to an increase in average employment following an increase in firing costs.

In contrast with the *positive* discounting effect the curvature effect is *negative*, at least under standard specifications of the utility function of workers. The curvature effect is related to the shape of union indifference curves. In a stochastic cycle of low and high demand schedules the shape of these curves clearly matters in determining average employment. Setting aside the discounting effect ($r = 0$), the position of labour demand is determined by the “adjusted” business index $\alpha_g - qF$ in the good state and by $\alpha_b + qF$ in the bad state. Thus, higher firing costs reduce the volatility of labour demand by reducing the fluctuations of the adjusted index while preserving the average value. It follows that if union wages are concave with respect to the index, higher firing costs tend to increase the average wage and to decrease average employment. By contrast, if wages are convex with respect to the index, higher firing costs decrease the average wage and increase employment.

The set of functions $v(w)$ in use in this paper (DARA and CARA) is too general to establish whether wages are convex or concave with respect to the adjusted index. However, when we focus on the subset of DARA and CARA functions that are commonly used in the union literature (exponential, isoelastic and logarithmic), we find that wages are concave so that, through the curvature effect, firing costs exert a *negative* impact on employment. The details of this result are spelled out in the appendix (proposition A2).

Summing up, under commitment the impact of firing costs on average employment is of uncertain sign. Firing costs increase employment through the discounting effect but decrease employment, under standard preferences, through the curvature effect.

4 Wages and employment under no-commitment

4.1 The equilibrium under no-commitment

In this subsection we define the equilibrium under no commitment and characterise the wage and employment sequence for any stochastic process governing the evolution of business conditions. In the next subsection we focus on the Markov cycle of good and bad states.

Definition A no-commitment equilibrium is defined as follows:

i) *Optimal firm behaviour*: any firm sets employment l_t period by period according to equations 6-8;

ii) *Optimal union behaviour*: the union sets wages period by period by using the wage setting function $w_t = \tilde{w}(\alpha_t, L_{t-1})$ (see equation 13).

iii) *Aggregation*: aggregate employment is the sum of employment in all firms: $l_t = L_t$.

As for the commitment case, it is straightforward to see that, under no-commitment, the equilibrium sequences of wages and employment are described by $\tilde{w}(\alpha_t, L_{t-1})$ and $\tilde{L}(\alpha_t, L_{t-1})$. By construction, these functions represent mutual best responses in a game where the current state encapsulates all relevant information for predicting future variables. The ensuing equilibrium can thus be termed as Markov subgame perfect (Maskin and Tirole, 1988). In the appendix we formally study the characteristic of this equilibrium, below we report the main results from this analysis.

Result 3: Under no-commitment, the union sets $w_t = \bar{w}_t$ - i.e. the maximum wage consistent with employment inaction - if inaction prevails at time t (lemma 4).

Result 4: Under no-commitment, employment *may* change only at business turns but not within a spell of constant business conditions (proposition A3).

Result 5: Under no-commitment, the wage is constant along spells that start with dismissals. By contrast, along spells that start with recruits, the wage increases by F from the first to the second period of the spell and remains at the higher level until the end of the spell. (lemma 7).

Result 3 is crucial to understand the characteristics of the equilibrium. Intuitively, the union does not possess the technology to commit to future low wages and, through this way, to sustain current labour demand. As a consequence, firms expect that if there are margins to increase wages in some future state without affecting employment in that

state, then the union will fully exploit these margins. Indeed, in equilibrium, the union does not gain from contradicting this expectation. There is no gain from not increasing the wage up to \bar{w} if this does not harm current employment nor the continuation value of the game.

The motivation of employment inaction within spells (result 4) is similar to the one given for the commitment equilibrium. With linear adjustment costs there is no reason for firms not to adjust immediately to new business and wage conditions.

Finally, result 5 is closely related to the fact that the union pushes firms onto the firing barrier in all states where inaction prevails (result 3) and to the fact that inaction prevails for sure within a spell of constant business conditions (result 4). This means that the union sets wages so as to push firms onto the firing barrier at all times during a spell that starts with dismissals. Thus, along these spells the wage is constant. By contrast, for spells that start with recruits, the shadow value lies, by definition, on the hiring barrier in the first period and on the firing barrier thereafter. This shift in the shadow value is only possible if the union increases the wage by F from the second period onwards. Intuitively, after firms have recruited new workers, the union fully exploits the margins for a wage increase that are guaranteed by firing costs.

4.2 Wages and employment

Results 3-5 do not require any restriction on the stochastic process that drives exogenous business conditions. In this section we return to the cycle of good and bad conditions and analyse what are the implications of these results in such a simplified setting.

Result 4 suggests that in the two-states cycle the equilibrium may either exhibits employment inaction at all times or positive employment adjustments but only at the beginning of business spells. As for the commitment case, which equilibrium prevails depends on the size of firing costs and on how large are the swings of business condition. With reasonable firing costs and/or reasonably wide cycles workforce adjusts at positive rates. In this case, employment fluctuates between an high level L_g^{nc} (*nc : non committment*) and a low level L_b^{nc} . Furthermore, wages are set so as to keep the shadow value on the firing barrier at all times with the exception of the first period of a good spell. In particular, the wage is constant at level w_b^{nc} along bad spells whereas, along good spell, it is set at the level w_g^{nc} in the first period and at level $w_g^{nc} + F$ in the following periods (result 5).

As for the commitment case, with positive adjustments the union program is separable across good and bad spells. This means that the union sets the wage in the first period of any spell so as to maximise the discounted per-period utility flow only over the spell. Employment and wages can thus be thought of as being determined through the following programs:

$$\max_{w_g^{nc}} \frac{r+q}{1+r} U(w_g^{nc}, L_g^{nc}) + \frac{1-q}{1+r} U(w_g^{nc} + F, L_g^{nc}) \quad (20)$$

$$L_g^{nc} = \frac{1}{d} \left[\alpha_g - \frac{F}{1+r} - w_g^{nc} \right] \quad (21)$$

$$\max_{w_b^{nc}} U(w_b^{nc}, L_b^{nc}) \quad (22)$$

$$L_b^{nc} = \frac{1}{d} \left[\alpha_b + \frac{r+q}{1+r} F - w_b^{nc} \right] \quad (23)$$

Labour demands 21 and 23 derive from equation 2 after substituting the relevant values for the shadow value of labour. Observe that labour demand in bad spells is the same in both equilibria. This is due to the fact that in both cases the shadow value S lies on the firing barrier at all times. Since the objective function of the union is also equal one may conclude that, along bad spells, the two equilibria are similar. Intuitively, the inability of enter a wage commitment is irrelevant when workers opportunism is not an issue, i.e. following workforce dismissals.

By contrast, the two equilibria differ when it comes to good spells. First, labour demand under no-commitment is lower than that under commitment. Firms anticipate the wage increase in the second period and, as a consequence, are more reluctant to hire for any given first period wage. Second, the F -shift of wages along good spells modifies the objective function of the union which, under no-commitment, turns out to be a weighted sum of the utility in the first and in all subsequent periods. The main implication of this change is the fact that the union is more willing to trade off a lower (first period) wage against higher employment.¹⁰

¹⁰To see this, assume $w_g^{nc} = w_g^c$ and $L_g^{nc} = L_g^c$ and compute the marginal rate of substitution for the two functions in 15 and 20.

How large need to be firing costs to prevent positive adjustments under no-commitment? Since the union is more willing to exchange lower wages for higher employment, a *sufficient condition* for $L_g^{nc} > L_b^{nc}$ is that labour demand 21 does not lie below labour demand 23:

$$\alpha_g - \alpha_b \geq \frac{1 + q + r}{1 + r} F \tag{24}$$

As for the equilibrium under commitment, this inequality requires F not to be too large with respect to the change in marginal productivity. Further, despite the condition appears to be more stringent than that arising under commitment one can not conclude that positive adjustments are less likely under no-commitment. Strictly speaking, the two conditions are not comparable since the restriction in 19 is necessary and sufficient while the restriction in 24 is only sufficient.

The impact of firing costs on employment and wage fluctuations is qualitatively similar to what we have seen under commitment. An increase in firing costs dampens the swings in labour demand and reduces fluctuations. By contrast, the impact of firing costs on employment and wage levels may be very different when one compares the two equilibria. We deal with this issue in the next section.

5 Comparing equilibria

The no-commitment equilibrium exhibits many elements that trace back to the classic insider-outsider theory (Lindbeck and Snower, 1988). The union increases the wage by the whole amount of firing costs after new workers have been hired. Firms, in turn, anticipate the wage increase and hire less workers for given "entry" wages. Obviously, the union is harmed by firms reluctance to hire and, if possible, it would promise not to exploit the margins guaranteed by firing costs. Yet, in the absence of a commitment device, subgame perfection rules out any promise that does not result to be credible. Indeed, promising wage moderation is not credible. After new workers have been hired, the union can safely increase the wage by the amount F without paying any cost in terms of dismissed workers and in terms of a deterioration in the continuation value.

However, in spite of the similarities with the insider-outsider theory, one can not immediately conclude that the insider-outsider mechanism leads to a lower employment level under no-commitment. For, in this case, firing costs not only move labour demand down-

wards but also bend the shape of union indifference curves in the $w_g^{nc}-L_g^{nc}$ space (equation 20). In particular, F reduces the union marginal return from w_g^{nc} and increases that from L_g^{nc} leading to an incentive to exchange lower wages for higher employment. This induces the union to counteract the negative impact of firing costs on labour demand through low wages. Thus, if firing costs exert under no-commitment an extra negative employment effect which adds to the discounting and curvature effects under commitment is ex-ante undetermined. To establish whether the union fully neutralises the reluctance of firms to hiring through low entry wages one needs to study the determination of L_g^{nc} and L_g^c in some more detail.

Solving for L_g^{nc} and L_g^c requires to compute the first order condition from the corresponding programs and to combine these conditions with labour demand. Below, we present the expressions that result from these manipulations where, for the sake of simplicity, we have made two substitutions, $a = \frac{r+q}{1+r}$ and $R = \alpha_g - dL$:

$$\alpha_g - R = \frac{v \left[a \left(-\frac{1}{1+r} F + R \right) + (1-a) \left(\frac{r}{1+r} F + R \right) \right] - v(\bar{w})}{v' \left[a \left(-\frac{1}{1+r} F + R \right) + (1-a) \left(\frac{r}{1+r} F + R \right) \right]} \quad (L_g^c)$$

$$\alpha_g - R = \frac{a v \left(-\frac{1}{1+r} F + R \right) + (1-a) v \left(\frac{r}{1+r} F + R \right) - v(\bar{w})}{\left[a v' \left(-\frac{1}{1+r} F + R \right) + (1-a) v' \left(\frac{r}{1+r} F + R \right) \right]} \quad (L_g^{nc})$$

Observe first that if v were linear [$v'' = 0$], the two conditions would coincide and the employment level would be the same no matter whether the union is able to commit or not. This result stands in sharp contrast with the insider-outsider contention that the opportunistic behaviour of workers always reduces the level of employment. Intuitively, when the utility function is linear, the union is not concerned with the actual path of wages but only with the discounted value from the whole wage flow. Thus, the union does not find it costly to charge a particularly low wage in the first period that completely counteracts the reluctance of firms to hiring. The commitment outcome can be replicated at no cost through a mechanism which is equivalent to paying in advance those rents that will accrue in future bargaining.

The class of functions in use, however, imply that v is concave with a positive third derivative. In this case, by the Jensen's inequality, the numerator on the RHS of the

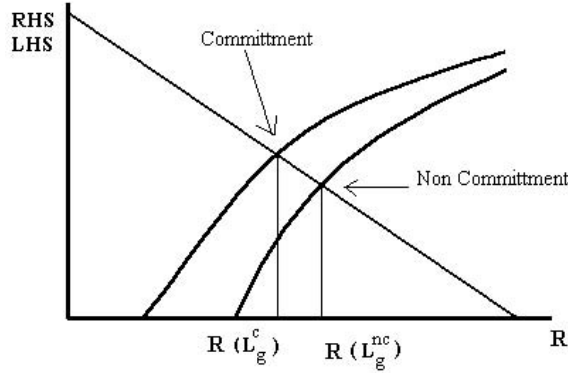


Figure 1: Commitment vs. No-commitment

first expression is higher than the numerator of the second. By contrast, the denominator is lower. This means that the RHS of the first expression is always higher than that of the second. Further, if one regards the RHSs of the two expressions as functions of R , straightforward differentiation shows that the two RHSs increase and become closer as R increases. In figure 2 we depict the RHS and the LHS of the two expressions as functions of R .

Notice that the marginal revenue R is lower under commitment. Thus, we conclude that the employment level is higher under commitment, a result which is consistent with the insider-outsider theory. By the same argument, since firms equate the discounted flow of marginal revenues to the discounted flow of wages plus adjustment costs, wages are on average lower under commitment.

What happens when the utility function is concave? Concavity implies aversion towards anticipated sharp changes in the wage profile of the type that take place in the no-commitment case. Workers are harmed in that a flat wage profile with equal discounted value is strictly preferred to the actual one, which presents an increase of size F from the second period onwards.

This fact does not explain by itself the reasons for the union to choose a lower employment level, and higher wages, in the no-commitment case. It is not difficult to see, however, how this outcome results both from a lower return for the union from the employment level as well as from an higher return from the wage level. The wage shift of size F from the first to the second period reduces the utility of each single employed worker and, henceforth, reduces the gain from being employed as opposed to being unemployed.

<i>Curvature</i>	$\gamma = 0.1$	$\gamma = 0.5$	$\gamma = 0.7$
Committment	0.01	0	0
Non-Committment	0.01	-3.8	-6

Table 1: Change in average employment (percent) if firing costs increase from $F=1$ to $F=5$. Parameters: $\alpha_g = 10$, $\alpha_b = 6$, $q = 0.3$, $r = 0.02$, $d = 2$, $\bar{w} = 4$

This means that the union faces a lower benefit from having a large number of employed workers. This effect is captured by the numerators of the expressions above. On the other hand, since the shift is fixed in size it becomes relatively less harmful in terms of utility if wages are particularly high. It follows that the union faces an higher return from a wage increase. This effect is captured by the denominator. Thus, both channels explain why concavity leads to higher wages and lower employment levels in the no-commitment case.¹¹

In Table 1 we compute the employment effect from an increase in firing costs when the utility function is isoelastic: $v(w) = \frac{w^{1-\gamma}}{1-\gamma}$, $0 < \gamma < 1$. As γ increases utility becomes more concave, i.e. individuals suffer more for given expected jumps in the wage path. In the table we compute the proportional change in average employment $L_i = 0.5L_g^i + 0.5L_b^i$ $i = c, nc$ due to an increase in firing cost from $F = 1$ to $F = 5$.¹²

Observe that when the utility function is almost linear [$\gamma = 0.1$] the two equilibria present the same variation in average employment. In spite of the absence of a commitment, the union is capable of replicating (almost) the same employment outcome arising under commitment. In addition, the overall employment effect is positive but very small. When the curvature increases, the insider-outsider mechanism becomes more effective. We notice that average employment decreases by 3.8% in the no-commitment equilibrium if $\gamma = 0.5$ and by 6% if $\gamma = 0.7$. No employment reduction takes place in the commitment equilibrium.

¹¹Modesto and Thomas (2001) show that the no-commitment equilibrium exhibits a lower employment level even if they assume $v'' = 0$. Their result, however, is driven by a different mechanism deeply rooted in the assumption of quadratic adjustment costs.

In contrast with linear costs, quadratic costs reduce the elasticity of labour demand in the short run but not that in the long run. As a consequence, the union charges higher wages when it deals with the short run labour demand, i.e. in the no-commitment case.

¹²With $F = 5$, firing costs are slightly lower than the average wage arising in the no-commitment equilibrium (with $\gamma = 0.7$). In high employment protection countries the amount of firing costs is estimated to be almost equal to the annual wage bill (OECD, 1994).

6 Empirical analysis

A summary of theoretical results

The model predicts that firing costs exert an additional effect on employment - of negative sign - when one compares the equilibrium under no-commitment with the one under commitment. The reason is a classic hold up problem. Firing costs offer workers the opportunity of extracting high rents once they have been hired. Firms anticipate the opportunistic behaviour of workers and refrain from hiring too much during an upturn. Ex post, workers have no better choice than that of validating firms expectations.

In principle, firm reluctance to hiring could be overcome by particularly low entry wages. Low entry wages, however, may turn out to be very costly in utility terms if workers dislike sharp wage changes. That is, if they are risk averse and credit constrained. Thus, in a world with risk aversion, credit market imperfections and with no-commitment, firing costs feed into wages and decrease employment below the level that would arise under commitment.

This insider-outsider effect adds to the employment impact of firing cost under commitment. The latter, however, is not clear-cut since it results from the combination of two countervailing effects, the discounting and the curvature effect. Thus, the model does not offer any prediction on the overall employment impact of firing costs but only on the differential impact between commitment and no-commitment equilibria.

Empirical Implications

How do these results translate into empirically testable predictions? A major difficulty in testing the model relates to finding information on long-term wage commitments. Explicit wage contracts are clearly short termed as these contracts usually span two or three years for most bargain contexts and across all the economies. Relying on explicit contracts, however, would be too compelling since commitment-like equilibria can be also supported by implicit contracts or through long term relationships based on trust.

Contrary to explicit contracts, implicit contracts cannot be enforced by third parties, such as courts. Only the parties involved in the contract can determine whether the agreement has been violated and, eventually, decide for actions intended to punish deviations. Enforcement then typically involves the threat of interrupting cooperative relationships. In the context of this analysis, for instance, firms and workers could agree for a plan of actions that replicate the commitment equilibrium with the understanding that

firms revert to the non-commitment strategies if workers should ever defect. Indeed, it is straightforward to show that if the discount rate is sufficiently small the union will never defect.

Agreements that are governed by implicit contracts are self-enforcing. By contrast, relationships supported by trust are not self-enforcing since the party that trusts is, by definition, vulnerable to opportunism but expects that the other party will not exploit this vulnerability (James, 2002). Or, more in line with the theory of incentives, the party that trusts is confident that the other party will not exploit vulnerability due to the penalties that would otherwise be inflicted in some other dimension of social interactions. In our context, trust means that firms expect that workers do not exploit the protection guaranteed by firing costs after they have been hired.

In the real world, the notions of trust and implicit contracts overlap with that of cooperation. Indeed, James (2002) explains that implicit contracts and trust represent two ways to obtain a pareto-efficient cooperative solution in a prisoner dilemma context. Thus, from the perspective of our model, we conjecture that an equilibrium similar to the one under commitment tends to coincide with cooperative industrial relations whereas no-commitment equilibria tend to be associated with adversarial relations. As a consequence, we expect that *coeteris paribus, the impact of firing costs on employment is less negative - or more positive - in contexts featuring more cooperative industrial relations*. For this reason, in the empirical analysis below we mainly focus on the interaction between employment protection and cooperation in industrial relations as a determinant of aggregate unemployment.

Data

We test the consistency of the model by exploiting time-series and cross-country variability in unemployment, employment protection and quality of industrial relations. The panel spans 20 OECD countries and 15 years, from 1990 to 2004; annual data, however, have been averaged over 5-years periods in order to clear for short run movements¹³.

Information regarding the rate of unemployment and its determinants - inflation, unemployment benefits, labour taxation, employment protection, bargain institutions - is the one provided by the OECD and largely used in the macro empirical literature. Thus, given widespread use in former works, we do not give any detail here and invite the interested

¹³This is the strategy adopted, among several others, by Nickell (1998), Belot and VanOurs (2004) and Garibaldi and Violante (2005).

reader to look at the data appendix for the exact definition of variables and their source.

The OECD, however, does not provide systematic information on the climate of industrial relations for member countries. To fill the gap we have resorted to the index of "perceived" cooperation in industrial relations computed by the World Economic Forum (WEF). This index is constructed by asking a panel of qualified operators to quantify over a given scale the degree of cooperation in their country. For instance, in 1997 respondents were asked to express their opinion on the sentence "Labor-employer relations are generally cooperative" (answers: 1=strongly disagree, 7=strongly agree).

Due to the subjective nature of these answers doubts may arise regarding the reliability of the index. This issue, however, has been already addressed by Blanchard and Philippon (2004), who use the same index in unemployment regressions. They conclude that the index is a good approximation for an ideal objective measure in light of the high correlation with lagged measures of strike activity. The WEF index is available annually for a large number of countries since 1985. However, the wording of the question asked by the interviewers has changed over time, especially in early years. Thus, to preserve a certain degree of uniformity, we have decided to drop observations for years 1985-1989. This explains why our data begin with the year 1990.

Finally, for the purpose of estimation, a weakness of the WEF indicator is the small degree of variability which, coupled with the small variability of the EPL index, leads to collinearity when one conditions on the two variables plus their interaction. To get around this problem we re-scale the index over a 4-points array (0,1,2,3) by using quartile thresholds.

Results

Empirical findings are summarised in table 2. In model I we regress unemployment on a traditional "Phillips curve" set of regressors plus regressors that represent our focus variables: the EPL index, the WEF index of cooperation (Coop) and their interaction. In model II we add a set of union controls: coverage, density and coordination. Observe that most coefficients are of expected sign. Unemployment decreases with respect to the acceleration in inflation and increases with respect to labour taxation and the degree of centralisation in wage bargaining. Contrary to expectations, the impact from unemployment benefits (replacement rate) is negative (but not in model II). More importantly, the strictness of employment protection and the degree of cooperation in industrial relations

Dependent variable: unemployment				
<i>Model</i>	I	II	III	IV
Dinflation	-.996* (0.551)	-.992 (0619)	-1.001* (0.552)	-.990 (0.610)
Replacement Rate	-.045* (0.026)	-.048 (0.029)	-.047* (0.024)	-.047* (0.026)
Labour Taxation	.128** (0.041)	.118** (0.049)	.130** (0.041)	.118** (0.049)
Centralisation	.751** (0.343)	.820** (0.356)	.768** (0.331)	.813** (0.343)
Epl	.096 (0.779)	.262 (0.841)	0.192 (0.553)	.225 (0.584)
Coop	-.218 (0.751)	.083 (0.886)		
Inter. Epl-Coop	-.680* (0.397)	-.646* (0.423)	-.772** (0.148)	-.730** (0.149)
Union controls	No	Yes	No	Yes
Rsq.	0.56	.56	.56	.56
Nr. Obs.	60	60	60	60

Table 2: Robust standard errors in parenthesis; ** 5% significance, * 10% significance.

do not affect unemployment but the interaction between them *reduces* unemployment, albeit only at a 10% significance level. Since the cooperation index is not significant nor it plays any autonomous role in the theoretical model, we exclude it in specifications III and IV. These represent our preferred estimations since the exclusion increases the significance of the negative interaction coefficient.

Although we have not dealt with possible sources of endogeneity, we believe that these results suggest that the employment effect of worker protection is determined by the industrial relations environment. Taken at their face value, point estimates imply that a unit increase in the EPL index reduces unemployment by $(0.75 \cdot Coop)$ percentage points. This means that in countries with adversarial relations ($Coop = 0$) EPL does not exert any appreciable impact on unemployment whereas, in countries with highly cooperative relations ($Coop = 3$), a point increase in EPL reduces unemployment by more than 2%. In the light of these results, we believe that our model receives some empirical support.

7 Concluding remarks

In spite of the large attention over the last two decades, there is still a lack of consensus regarding the employment impact of mandated job protection. In models of dynamic labour demand with fixed wages - Bertola and Bentolila (1990), for instance - firing costs reduce workforce turnover but have an ambiguous impact on the level of employment. By contrast, the traditional insider-outsider theory - Lindbeck and Snower (1988) - suggests that wages represent an important channel for the overall employment impact of Epl. In particular, high firing costs strengthen the bargaining position of insiders and lead, as a consequence, to higher wages and lower employment. General equilibrium extensions confirm that the reaction of wages to firing costs is crucial for the overall employment effect of these costs. Empirical findings are also controversial. In the works of Lazear (1990) and Djankov *et al.* (2003), for instance, dismissal regulations increase unemployment. By contrast, Bertola (1990), the OECD (1999) and others find that aggregate employment levels are not affected by the stringency of legal provisions.

In this paper we offer new theoretical insights on the issue and show that the relationship between firing costs and employment is crucially influenced by the existence of a commitment on future wages. Under commitment, the relationship can have either sign depending on the discount rate, on the volatility of business conditions and on worker preferences over different wage and employment bundles. Under no commitment, firing costs add an extra effect of negative sign due to higher wages.

These results suggest that previous theoretical work has disregarded a potentially relevant interaction between Epl and those features of the wage bargaining process that determine whether workers can commit over future wages. A major implication is that employment protection combines with the quality of industrial relation in determining the rate of unemployment. Following an increase in Epl, unemployment tends to increase less (or decrease more) in contexts characterised by more cooperative industrial relations.

This prediction proves to be consistent with the evidence from 20 OECD countries observed over the 1990-2004 period. The interaction term between Epl and the index of cooperation turns out to affect unemployment with a negative sign implying that Epl is neutral for unemployment in adversarial contexts but decreases unemployment with cooperation.

A further implication of the model that has not been explored in this paper concerns

the interaction between employment protection and the efficiency of credit markets. Well functioning credit markets favour consumption smoothing. In turn, improved smoothing translates, in reduced form, into a less concave worker utility. Finally, lower concavity implies that the equilibrium under no-commitment tends to replicate the employment sequences that obtains under commitment. An empirical test of this prediction is left to future research.

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Technical Appendix

The union program

The first order conditions for problem 10-11 are:

$$w_t: \quad -(\Sigma_t + \Lambda_t) + U_w(w_t, L_t) = 0 \quad (A1)$$

$$L_t: \quad -d(\Sigma_t + \Lambda_t) + U_L(w_t, L_t) - \gamma_t I_t^I + \frac{1}{1+r} E_t W_L(Y_{t+1}) = 0 \quad (A2)$$

$$\sigma_t: \quad I_t^H \left[\alpha_t - d L_t - w_t + \frac{1}{1+r} E_t W_\Sigma(Y_{t+1}) \right] = 0 \quad (A3)$$

$$\lambda_t: \quad I_t^F \left[\alpha_t - d L_t - w_t + F + \frac{1}{1+r} E_t W_\Lambda(Y_{t+1}) \right] = 0 \quad (A4)$$

$$\gamma_t: \quad I_t^I (L_t - L_{t-1}) = 0 \quad (A5)$$

The Euler conditions are:

$$\Sigma_{t-1} : \quad W_\Sigma(Y_t) = \alpha_t - d L_t - w_t + E_t \frac{1}{1+r} W_\Sigma(Y_{t+1}) \quad (A6)$$

$$\Lambda_{t-1} : \quad W_\Lambda(Y_t) = \alpha_t - d L_t - w_t + E_t \frac{1}{1+r} W_\Lambda(Y_{t+1}) \quad (A7)$$

$$L_{t-1} : \quad W_L(Y_t) = \gamma_t I_t^I \quad (A8)$$

Run forward equations A6 and A7, impose asymptotic convergence and substitute respectively in A3 and A4 to obtain the constraints 6 and 7 which arise under positive firing and hiring. Equation A5 gives the constraint 8. Thus, equations A3-A7 reproduce the program constraints.

Equation A1 governs the dynamics of wages while equations A2 and A8 regulate the dynamics of employment. Notice that by combining A2 and A8 one obtains a stochastic dynamic equation:

$$\gamma_t I_t^I = [U_L(w_t, L_t) - dU_w(w_t, L_t)] + \frac{1}{1+r} E_t [\gamma_{t+1} I_{t+1}^I] \quad (A9)$$

The equilibrium under commitment

Lemma 1 In the commitment equilibrium, if $L_t = L_{t-1}$ then $w_t = w_{t-1}$.

Proof

$L_t = L_{t-1}$ means inaction at time t . Inaction, in turn, is only possible if the wage w_t lies in the interval $[\underline{w}_t, \bar{w}_t]$. In this interval the hiring and firing constraints 6-7 are not 'active', i.e. $I_t^F = I_t^H = 0$. As a consequence, by equation 10, $\Sigma_t = \Sigma_{t-1}$ and $\Lambda_t = \Lambda_{t-1}$. In turn, by equation A1 25:

$$U_w(w_t, L_t) = U_w(w_{t-1}, L_{t-1})$$

The latter implies that $L_t = L_{t-1}$ is only possible if $w_t = w_{t-1}$. ◦

Lemma 2 In the commitment equilibrium, if $L_t \neq L_{t-1}$ then

$$U_L(w_t, L_t) = dU_w(w_t, L_t) \quad (A10)$$

Proof

Multiply both sides of equation A9 by I_t^I and notice that $(I_t^I)^2 = I_t^I$, then run the equation forward:

$$\gamma_t I_t^I = \sum_j \left(\frac{1}{1+r} \right)^j E_t \left\{ \prod_{i=0}^j I_{t+i}^I [U_L(w_{t-1}, L_{t-1}) - dU_w(w_{t-1}, L_{t-1})] \right\} \quad (A11)$$

In this expression employment is set at the constant level L_{t-1} since $\prod_{i=0}^j I_{t+i}^I$ is equal to 1 if employment remains constant from $t-1$ to $t+j$ and 0 otherwise. By lemma 1, constant employment implies constant wages. Thus the wage is also fixed at level w_{t-1} . As a consequence of constant employment and wages, equation A11 can be rewritten as follows:

$$\gamma_t I_t^I = B [U_L(w_{t-1}, L_{t-1}) - dU_w(w_{t-1}, L_{t-1})] \quad \text{with} \quad B = \sum_j \left(\frac{1}{1+r} \right)^j E_t \left(\prod_{i=0}^j I_{t+i}^I \right)$$

Finally, use the latter in equation A9:

$$\gamma_t I_t^I = [U_L(w_t, L_t) - dU_w(w_t, L_t)] \left[1 + \frac{1}{1+r} B \right] \quad (A12)$$

If employment changes at time t , then $I_t^I = 0$ so that equation A10 follows immediately from equation A12. ◦

Lemma 3 In the commitment equilibrium, $\alpha_t = \alpha_{t-1}$ and employment inaction at $t-1$ imply employment inaction at t .

Proof

Inaction at time $t-1$ means $L_{t-1} = L_{t-2}$ and, as noticed in the proof of Lemma 1, $\Sigma_{t-1} = \Sigma_{t-2}$ and $\Lambda_{t-1} = \Lambda_{t-2}$. Thus, if $\alpha_t = \alpha_{t-1}$, it follows immediately $Y_t = Y_{t-1}$. L_t is equal to L_{t-1} since $L(Y_t) = L(Y_{t-1})$. ◦

Proposition 1A

In the commitment equilibrium, if $\alpha_t = \alpha_{t-1}$ then $L_t = L_{t-1}$.

Proof

Here it is only proved by contradiction that $L_t > L_{t-1}$ and $\alpha_t = \alpha_{t-1}$ can not be part of an equilibrium. The proof for $L_t < L_{t-1}$ is similar and, henceforth, omitted.

Suppose that $L_t > L_{t-1}$ with $\alpha_t = \alpha_{t-1}$. Lemma 3 dictates $L_{t-1} \neq L_{t-2}$, in fact $\alpha_t = \alpha_{t-1}$ and $L_{t-1} = L_{t-2}$ would imply $L_t = L_{t-1}$. Thus, by lemma 2, the equality in

A10 holds both at $t - 1$ and t . In turn, equation A10 and $L_t > L_{t-1}$ imply

$$w_t > w_{t-1} \tag{A13}$$

Next, use equation 2 to subtract labour demand at time $t - 1$ from labour demand at time t :

$$w_t - w_{t-1} = (\alpha_t - \alpha_{t-1}) - d(L_t - L_{t-1}) - (S_t - S_{t-1}) + 1/(1+r)(E_t S_{t+1} - E_{t-1} S_t)$$

The inequality $L_t > L_{t-1}$ implies $S_t \geq S_{t-1}$ since $S_{t-1} \in [-F, 0]$ and $S_t = 0$. Furthermore, the inequality implies $E_t S_{t+1} \leq E_{t-1} S_t$ since inheriting an higher employment level does not increase the expected shadow value of labour. Putting together these results with the equality $\alpha_t = \alpha_{t-1}$ it easy to see that above equation requires

$$w_t < w_{t-1} \tag{A14}$$

Inequalities in A14 and A13 are contradictory.◦

Proposition A2

If $r = 0$ and $v(w)$ is CARA, isoelastic or logarithmic then average employment decreases with F .

Proof

Set $r = 0$, use equation 1 and solve the two programs 15-16 and 17-18 with respect to the wage:

$$G(w_j^c) \equiv w_j^c + \frac{v(w_j^c) - v(\bar{w})}{v'(w_j^c)} = X_j \quad j = g, b \quad X_g = \alpha_g - qF \quad X_b = \alpha_b + qF$$

Since labour demand is linear and F enters symmetrically in the two schedules (with $r = 0$), an increase in F does not affect average employment *for a given average wage*. Thus, average employment decreases only if the average wage increases as a consequence of higher firing costs. In turn, the average wage increases with F by the Jensen's inequality if $G^{-1}(X)$ is concave or, equivalently, if $G(w)$ is convex.

Define $\bar{v} = v(\bar{w})$ and $\Theta = -v''/v'$ and compute the first derivative of $G(w)$:

$$G' = 1 + \frac{(v')^2 - v''(v - \bar{v})}{(v')^2} = 2 + \Theta \frac{v - \bar{v}}{v'} > 0$$

If v is CARA, the coefficient of absolute risk aversion Θ is constant; G'' is positive as $(v - \bar{v})/v'$ is increasing with respect to w . Next, if v is isoelastic, Θ/v' is proportional to $1/v$ since $w\Theta$ is constant and wv' is proportional to v ; G'' is positive as $(v - \bar{v})/v$ is increasing. Finally, if v is logarithmic, $\Theta/v' = 1$; G'' is positive as $v - \bar{v}$ is increasing.◦

The equilibrium under no-commitment

Lemma 4 In the no-commitment equilibrium, if $L_t = L_{t-1}$ then $w_t = \bar{w}(\alpha_t, L_{t-1})$.

Proof

Under no-commitment - $\Sigma_{t-1} + \Lambda_{t-1} = 0$ - the union program 11 becomes

$$\begin{aligned} W(\alpha_t, L_{t-1}) = & \max_{w_t, L_t, \sigma_t, \lambda_t, \gamma_t} U(w_t, L_t) + (\sigma_t I_t^H + \lambda_t I_t^F) (\alpha_t - dL_t - w_t) + \\ & + \lambda_t I_t^F F + \gamma_t I_t^I (L_{t-1} - L_t) + \frac{1}{1+r} E_t W(\alpha_{t+1}, L_t) \end{aligned}$$

If in state (α_t, L_{t-1}) the union chooses a wage w_t such that employment does not change from the previous level, i.e. $I_t^H = I_t^F = 0$ and $L_{t-1} = L_t$, the discounted flow of returns $W(\alpha_t, L_{t-1})$ becomes:

$$W(\alpha_t, L_{t-1}) = U(w_t, L_{t-1}) + \frac{1}{1+r} E_t W(\alpha_{t+1}, L_{t-1})$$

The wage w_t appears only in the utility function U . Thus, the union has no incentive to choose a wage below the maximum consistent with inaction.◦

Lemma 5 In the no-commitment equilibrium, the value for the union of lagged employment is decreasing with respect to lagged employment:

$$\frac{d\gamma_t I_t^I}{dL_{t-1}} < 0 \tag{A15}$$

Proof

By lemma 4 equation A11 becomes:

$$\begin{aligned} \gamma_t I_t^I &= \sum_j \left(\frac{1}{1+r} \right)^j E_t \left\{ \prod_{i=0}^j I_{t+i}^I [U_L(\bar{w}, L_{t-1}) - dU_w(\bar{w}, L_{t-1})] \right\} = \\ &= B [U_L(\bar{w}, L_{t-1}) - dU_w(\bar{w}, L_{t-1})] \end{aligned}$$

Differentiate $\gamma_t I_t^I$ with respect to L_{t-1} and observe that, by equation 4, $d\bar{w}/dL_{t-1} = -d$:

$$\frac{d\gamma_t I_t^I}{dL_{t-1}} = B [U_{LL} - 2dU_{wL} + d^2U_{ww}] \tag{A16}$$

Equation A15 is true since $U_{LL} - 2dU_{wL} + d^2U_{ww} < 0$.◦

Lemma 6 In the no-commitment equilibrium, if $\alpha_t = \alpha_{t-1}$, employment inaction at time $t - 1$ implies employment inaction at time t .

Proof

Equalities $\alpha_t = \alpha_{t-1}$ and $L_{t-1} = L_{t-2}$ imply that state vectors at the beginning of periods t and $t - 1$ are the same. As a result, the wage chosen by the union and the employment level are the same.◦

Proposition 3A

In the no-commitment equilibrium, if $\alpha_t = \alpha_{t-1}$ then $L_t = L_{t-1}$.

Proof

Here it is only proved by contradiction that $L_t > L_{t-1}$ and $\alpha_t = \alpha_{t-1}$ can not be part of an equilibrium. The proof for $L_t < L_{t-1}$ is similar and, henceforth, omitted.

Thus, suppose that $L_t > L_{t-1}$ and $\alpha_t = \alpha_{t-1}$. As in the proof of proposition A1, consistency with the optimal behaviour of firms requires

$$w_t < w_{t-1} \tag{A17}$$

Next, consider the union optimal behaviour. The inequality $L_t > L_{t-1}$ implies $\gamma_t I_t^I = 0$. Further, by lemma 6, $L_{t-1} \neq L_{t-2}$ and, as a consequence, $\gamma_{t-1} I_{t-1}^I = 0$. Use these results in equation A9:

$$\begin{aligned} dU_w(w_{t-1}, L_{t-1}) - U_L(w_{t-1}, L_{t-1}) - \frac{1}{1+r} E_t [\gamma_t I_t^I] &= 0 \\ dU_w(w_t, L_t) - U_L(w_t, L_t) - \frac{1}{1+r} E_t [\gamma_{t+1} I_{t+1}^I] &= 0 \end{aligned}$$

The expression $dU_w - U_L - \frac{1}{1+r} E [\gamma I^I] = 0$ can be thought of as an implicit functions of w in terms of L . Apply the implicit function theorem and use equation A16

$$\frac{\partial w}{\partial L} = - \frac{dU_{wL} - U_{LL} - \frac{1}{1+r} B [U_{LL} - 2dU_{wL} + d^2U_{ww}]}{dU_{ww} - U_{wL}} > 0$$

Thus, $L_t > L_{t-1}$ implies

$$w_t > w_{t-1} \tag{A18}$$

Equations A17 and A18 are contradictory. ◦

Lemma 7

In a no-commitment equilibrium,

a) for spells that start with hiring, the wage increases by F in the second period and remains constant until the end of the spell.

b) for spells that start with firing, the wage is constant throughout the spell.

Proof

a) Suppose that in state (α_t, L_{t-1}) a new spell starts and suppose that the spell starts with hiring. Further, suppose that the spell lasts for at least two periods: $\alpha_t = \alpha_{t+1}$. Finally, notice that under no-commitment the shadow value $S(\alpha_t, w_t, L_{t-1})$ can be written as $S(\alpha_t, L_{t-1})$ since $w_t = w(\alpha_t, L_{t-1})$.

As the spell starts with hiring at time t , the shadow value of labour is $S(\alpha_t, L_{t-1}) = 0$. By contrast, Proposition 3A and Lemma 4 imply that at time $t + 1$ $S(\alpha_{t+1}, L_t) = -F$. Use these results in equation 2 and derive labour demand at t and $t + 1$:

$$\begin{aligned} 0 &= \alpha_t - dL(\alpha_t, L_{t-1}) - w(\alpha_t, L_{t-1}) + \frac{1}{1+r} E_t [S(\alpha_{t+1}, L_t)] \\ -F &= \alpha_{t+1} - dL(\alpha_{t+1}, L_t) - w(\alpha_{t+1}, L_t) + \frac{1}{1+r} E_{t+1} [S(\alpha_{t+2}, L_{t+1})] \end{aligned}$$

Observe that: 1) by assumption $\alpha_{t+1} = \alpha_t$, 2) by proposition 3A $L(\alpha_{t+1}, L_t) = L(\alpha_t, L_{t-1})$ and 3) by the Markov property $E_t [S(\alpha_{t+1}, L_t)] = E_{t+1} [S(\alpha_{t+2}, L_{t+1})]$. Use these equalities and subtract the first from the second equation:

$$w(\alpha_{t+1}, L_t) = w(\alpha_t, L_{t-1}) + F$$

Notice that, if the spell continues in period $t+2$, i.e. $\alpha_{t+1} = \alpha_{t+2}$, it is easy to see that $w(\alpha_{t+2}, L_{t+1}) = w(\alpha_{t+1}, L_t)$. By induction, this implies that, once the wage has increased at $t+1$, it remains constant until the end of the spell.

b) For spells that start with firing, the shadow value lies on the firing barrier in the first and in all other periods. Proving part b) is straightforward. ◻

Data appendix

Unemployment *Source:* OECD, Standardised Unemployment Rates, Quarterly Labour Force Statistics, Economic Outlook 2000 and 2005;

Inflation *Definition:* Annual Change in the GDP Deflator; *Source:* OECD, Economic Outlook 2006 (1), 2004 (1), 1999 (1).

Cooperative Industrial Relations (index) *Source:* World Economic Forum, Global Competitiveness Report from the 1996 issue to the 2004-5 issue and World Competitiveness Report from the 1990 issue to the 2005 issue. *Note:* even if the wording of the question has changed from time to time, in all years but 1996 (omitted) the purpose of the question has been that of assessing the degree of cooperation in industrial relations. The index ranges between 1 and 7 as respondents are required to report 1 in case of ID "generally confrontational" and 7 if ID are "generally cooperative".

Tax Wedge *Definition:* Income tax plus employee and employer contributions (as a % of the labour costs), single person without children. *Source:* OECD, Taxing Wages 2004/2005, Table D.1 pag.448.

Replacement Rate *Definition:* weighted average of the gross unemployment benefit replacement rates for two earnings levels, three family situations and three durations of unemployment. *Source:* OECD, Tax-Benefits models, OECD website. *Note:* the information provided by the OECD does not cover all years between 1990 and 2004. Thus, for the 1990-94 period we have averaged data referred to 1991 and 1993, for 1995-1999 we have averaged data referred to 1995, 1997 and 1999 and, finally, for 2000-2004 we have averaged data referred to 2001 and 2003.

EPL index *Definition:* summary index for the stringency of legal restrictions to the freedom of hiring and firing permanent as well as temporary workers. *Source:* OECD, Employment Outlook 2004 chap. 2. *Note:* the OECD computes 2 Epl indexes. Index 1 does not account for cross-countries heterogeneity in collective dismissals regulations while index 2 does. On the other hand, index 1 has been computed in 1990, 1998 and 2003 while index 2 has only been computed in 1998 and 2003. For this reason we use index 1 in our estimation.

Centralisation, Density, Coverage, Coordination *Source:* OECD, Employment Outlook 2004 ch. 3