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relations, with consensus***

by
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Union Effects and the Reform of Labor Relations, with Consensus.

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Abstract

We lay out a model of wage bargaining in firms without a Union, where employees bargain individually with the firm. We compare this with centralized bargaining in firms with a union and we analyze the effects on wage dispersion and wage drift. We derive a simple econometric specification from the theoretical model that allows us to estimate components of the wage-drift. We provide Gmm estimates of our specification. The theoretical model shows that labor does not always have incentives to choose the socially efficient bargaining regime. We derive optimal firing costs that induce labor to adopt the efficient regime. We find that the optimal procedure for a regulator is to set up aggregate firing costs and to let firms and employees bargain over firm-specific firing costs.

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1 Introduction

We lay out a model of a firm with a (continuous) number of employees. As opposed to the orthodox approach to union effects, we introduce two distinct features in our model. In the first place we consider ex post bargaining, as in Grout (84). This means that bargaining takes place previously to the production stage, but after certain specific investments that are not verifiable have been undertaken.

The second specific feature of our model is that we allow for the existence of ex post bargaining in firms that do not have a union. We describe wage bargaining without a union as decentralized bargaining. This means that without a union each of the employees bargains simultaneously and non-cooperatively with the firm over her own wage. We model a simple extensive form game for decentralized bargaining that yields simple solutions even if the number of employees is a continuous variable. Centralized (or Union) bargaining means that employees delegate the right to make or accept offers to a unique agent (a union leader), that coordinates the negotiation with the firm. We allow for increases in bargaining power when a union leader intervenes.

We compare in the first place wage formation under union or centralized bargaining and without union or decentralized bargaining. We find that unionization leads to wage compression in the firm. Under our characterization and abstracting from changes in bargaining power, we can express union wages as the sum of non-union wages plus a term that represents the effect on wages of changes in outside opportunities due to labor coordination. We label this latter term the scale effect and it arises from the fact that threats to the firm depend non-linearly on the number of agents that coordinate their threats to the firm. By construction, the scale effect is nihil under decentralization.

This representation of the union effect on wages has the interesting implication that it leads to a natural econometric specification of the union-wage drift. In particular, the specification points to the variables and cross product of variables that identify the effect of unions on the bargaining game of the firm. Moreover, the specification allows us to disaggregate the wage drift into two sources: increases in wages due to changes in the bargaining

power and increases due to changes in outside opportunities. We show how to estimate the components of the wage drift and we implement our specification with a panel of Spanish firms. We find that most of the wage drift should be attributed to the increment in bargaining power from unionization. Regarding the sources of our data, it should be noticed that we will not be strictly observing unions' behavior. We will be studying the effect of firm-level collective agreements (FLCA) on the bargaining game inside the firm. A discussion of the similarities and differences between unions and FLCA can be found in Freeman (94), Jimeno (95) and Palenzuela et al. (96). In what follows and for simplicity we will identify FLCB with a Union at the firm level.

Our bargaining model has additional implications as we introduce previous stage of the game to endogenize union formation and investments. We consider the case where the union formation decision (like bargaining) is ex post with respect to the exertion of specific investments. This means that labor will decide unilaterally on the bargaining regime and that this decision cannot be affected by contracts. We find conditions under which a union will be formed, given surplus and given that no union formation means that employees bargain individually ex post. The size of the firm, profitability and increasing marginal firing costs are variables that facilitate union formation.

Finally we endogenize the specific investments of employees and the firm. Clearly, the fact that bargaining is ex post introduces distortions in investment decisions. But the nature of the distortions depend on the bargaining regime. We find that, depending on firm characteristics, there is a "socially efficient" bargaining regime that minimizes distortions. Interestingly, with arbitrary firing costs, labor decision to adopt a bargaining regime will in general not coincide with the socially optimal decision, since investments have been sunk by the time to decide on union formation.

The fact that labor does not have in general the right incentives to choose the optimal regime opens the possibility of policy design to improve on this decision. Yet it is implausible that the regime can be directly monitored at the firm level by a regulator, since it depends on precise firm characteristics. We identify firing costs as the natural candidate to be a policy variable. This is because firing costs enter in the union formation decision, but do not enter in the investment decision. They can be optimally designed so as give incentives to labor to choose the bargaining regime that introduces less distortions in investment decisions, without a cost in terms of efficiency. We derive and interpret the optimal firing costs. The primary result we obtain is

that, under regularity conditions, it is optimal to provide convex firing costs when labor incentives are relatively more important and concave firing costs when owners incentives are important.

Interestingly, we find that the regulator only needs to specify aggregate firing costs and allow firm specific bargaining over firing costs at the firm level. Abstracting from considerations of informational asymmetries, we argue that this procedure is welfare increasing and that minimizes resistance from agents involved. The aggregate firing costs give a statu quo option to parties, upon which they are able to improve by implementing optimal firing costs.

Most of the empirical literature that has looked into the economic implications of trade unions has focused mainly on the measurement of the union wage premium as well as on the effects of unionization on decisions within the firm, like those about hiring and investing. The leading models to frame union effects are the efficient bargaining (EB) model and the right to manage (RTM) model¹. They have in common two characteristics: the assumption of Nash bargaining to determine surplus division and the abstraction of possible distortionary effect of ex post bargaining on ex ante investments, as in Grout (82). RTM differs with EB in that contracting is incomplete, it does not include employment decisions.

Some limitations of this theoretical framework, in particular, its lack of robustness, have been recently pointed out. Manning (94) shows that if a firm's decision on the nature of the technology chosen is introduced, the standard predictions of the EB and RTM models can be reversed. Other authors have taken a different strand. Card et al. (95) abandon the bargaining framework to model the union-firm relationship as a war of attrition. Chemla (96) builds on Grout's hold-up problem to have a theory of costs and benefits of union formation. Here employees are perfectly coordinated to bargain (for wages) with the firm. Forming a Union increases their bargaining power and hence their incentives to exert effort. The costs from Union formation are the worse incentives to invest of the employer.

Palenzuela and Jimeno (96) provide evidence on the costs and benefits of union power in a similar model, with uncoordinated employees. In these last two papers it is assumed that inside the firm that is not affected by a Union some form of bargaining is also taking place. The effect of Union is then to increase employees' bargaining power. Our paper is closest to Booth (95), where firing costs (or severance payments) are a variable that labor and

¹see Manning (94) for a critical review of these two models.

owners bargain over. Bargaining over firing costs improves welfare because it allows firms to attain efficient employment levels even if managers keep the "right to manage".

The paper is organized as follows. Section 2 presents the theoretical model of centralized and decentralized bargaining. Section 3 finds implications of centralizing bargaining on wage dispersion and the wage-drift. Section 4 derives conditions on union formation and investment decisions. Section 5 analyzes policy issues like optimal design of firing costs and policy implementation. Section 6 shows how to use the results in section 3 to estimate a decomposition of the wage drift. We provide estimates based in the generalized method of moments and relate the estimates to the structural parameters. Section 7 closes the paper with concluding remarks.

2 The Model

The firm is composed by three types of agents: the owner of the firm (F) a number N_I of insider workers and N_T outsider workers². At the bargaining stage ($t = 3^3$), the owner and the insider employees split a net surplus of given size $S - w_T N_T$. Temporary workers are outside of the bargaining process. They receive the wage $\bar{w}$ that is determined exogenously.

Bargaining can follow two regimes. It can either be *decentralized* (without Union) or *centralized* (with Union). Under decentralization insider employees bargain simultaneously and non-cooperatively with the firm. The decentralized bargaining game is as follows. There are N_I independent, binomial random variables p_i , $i \in [0, N_I]$ that satisfy $p_i \in \{F, i\}$ and $\text{prob}(p_i = i) = \alpha_d$. If $p_i = i$ (F) then employee i (the firm) makes a take it or leave it offer to the firm (employee i). Initially the N_I random variables are realized. Clearly, there are $\alpha_d N_I$ workers that make offers w_i^d to the firm and $(1 - \alpha_d) N_I$ workers that receive offers from the firms. All offers are made simultaneously and non-cooperatively. At the next stage, each of the $(1 - \alpha_d) N_I$ employees decide whether to accept or reject the offers they got from the firm, who in turn decides whether to accept or reject each of the $\alpha_d N_I$ offers she got from the employees with bargaining power.

Under centralization the employees delegate their decisions to a unique

²Outsider workers do not play a role in the theoretical exposition. They are introduced here because we should take them into account in the econometric specification.

³We introduce previous stages in the following sections.

agent (a Union leader) that coordinates the wage bargaining game. In this case nature gives all the bargaining power to the Union leader with probability α_c . The person that gets the right to make an offer proposes a common wage w_I^c for all the employees. Finally, the agent that receives the wage offer decides whether to accept or reject it.

The outside opportunity for the firm ($U_F(z)$) depends on the number of separations by insiders, z . When an agreement between the firm and z of the insider employees is not reached, the z workers have the possibility of threatening the firm with not deploying their human capital, what reduces surplus. The surplus that can be obtained by the firm when z employees quit the firm is given by:

$$\tau(z)S - w_T N_T \quad \text{where: } \tau(0) = 1 \text{ and } \tau'(z) < 0 \quad \forall z \quad (1)$$

The function $\tau(z)$ captures the nature agents' investments in the firm. In particular, it measures the degree to which employees' effort increases the productivity of the physical assets or of their own human capital. If agents invest in the productivity of physical assets then employees' separation does not decrease the size of the surplus ($\tau(z) \simeq 1 \forall z$). If agents invest in their own human capital, but those investments are specific to the physical assets of the firm, then separation decreases surplus sharply ($\tau(z) \simeq 0 \forall z$). For concreteness we will characterize the nature of investments in the following way:

Definition 1 *Investments are said to be in physical assets (human capital) if for all z , $\tau''(z) < 0$ ($\tau''(z) > 0$).*

Upon separation by z employees, the firm can take two actions: to pay workers the sectorial minimum wage, w_T , or to fire them at cost $G(z)$ and save the wage payment. We assume for simplicity that:

$$\text{for all } z : G(z) \leq zw_T \quad \text{and } G'(z) \geq 0$$

This implies in particular that upon a threat of separation by N_I employees the firm prefers to incur the firing costs.

We allow for economies and diseconomies of scale at firing. Diseconomies of scale arise for instance if liquidation procedures are very costly for the owner of the firm. Scale economies are the result of employment regulation regimes that facilitate payroll reduction. The following characterization will be useful:

Definition 2 *If for all z , $G''(z) > 0$, we say we are in a high liquidation costs regime. Otherwise if $G''(z) < 0$, we say we are in a soft employment regulation regime.*

The firm's outside opportunity in terms of layoffs, z ($z \geq 0$) is given by:

$$U_F(z) = \tau(z)S - G(z) - w_T N_T \quad (2)$$

Notice that the outside opportunity of the firm under z quits in (1) is different than under z layoffs, given in (2), since only in the latter case the firing costs play a role.

The outside opportunity of z insider employees that separate is: zw_T .

3 Equilibrium Wages

Under centralized bargaining insider employees have a probability (α_c) of making a take-it-or-leave-it offer to the owner (and a probability $(1 - \alpha_c)$ of receiving it). Offers under centralized bargaining are for the joint wage bill of insider employees, $w_I^c N_I$. If insider employees (respectively, firm's owners) have all the bargaining power to make an offer, the owner (insider employees) decides subsequently to accept or reject the offer received. This yields, for the wage bill of insider employees:

$$w_I^c N_I = \alpha_c [S - w_T N_T - (\tau(N_I)S - G(N_I) - w_T N_T)] + (1 - \alpha_c) w_T N_I$$

The equilibrium wage of insiders under centralized bargaining is:

$$w_I^c = (1 - \alpha_c) w_T + \alpha_c \left(\frac{(1 - \tau(N_I))S}{N_I} \right) + \alpha_c \frac{G(N_I)}{N_I} \quad (3)$$

Under decentralized bargaining the game described above takes place simultaneously N_I times, between the owner and each of the employees. This means that each of the N_I insider employees bargains individually, simultaneously and independently of the other employees. Under this specification agents anticipate (since bargaining is efficient) that in equilibrium all offers are accepted and no employees are fired. Moreover, each employee i will anticipate the wage bill paid to the other employees in equilibrium, H_{-i} . For

symmetry, each of the N_I bargaining games are characterized by a surplus to be divided and outside opportunities given respectively by:

$$\begin{aligned} S - \overline{w} N_T - H_{-i} \\ U_F(\varepsilon_i) &= \tau(\varepsilon_i) S - \overline{w} N_T - G(\varepsilon_i) - H_{-i} \\ U_I(\varepsilon_i) &= \overline{w} \varepsilon_i \end{aligned}$$

where we have divided the segment $[0, N_I]$ in $\frac{N_I}{\varepsilon}$ intervals of size $\varepsilon > 0$.

Since in equilibrium there are no quits or layoffs, the threat of firing is credibly realized by the firm to each employee as if he was the only one possibly fired. From this we have that

$$\begin{aligned} \varepsilon_i w_I^d &= \alpha_d (S - w_T N_T - H_{-i} - (\tau(\varepsilon_i) S - w_T N_T - G(\varepsilon_i) - H_{-i})) \\ &\quad + (1 - \alpha_d) \varepsilon_i w_T \end{aligned}$$

Taking the limit as $\varepsilon \rightarrow 0$, we have:

$$w_I^d = (1 - \alpha_d) w_T + \alpha_d G'(0) N_I - \alpha_d \tau'(0) S \quad (4)$$

Notice that the terms $G'(0)$ and $\tau'(0)$ in (4) are not the result of a Taylor expansion. Expression (4) is the exact wage under decentralization when ε is arbitrarily small.

3.1 Effects of centralizing bargaining

3.1.1 Effects on wage dispersion.

Given the structure of the bargaining regimes it is straightforward to show in the first place that the dispersion of equilibrium wages is degenerate at w_I^c for centralized bargaining, but has positive variance under decentralization. More precisely, we have:

Remark 1 *Under union bargaining (centralization) the set of wages has expectation (3) and zero variance.*

Under non-union bargaining (decentralization), realized wages have expectation (4) and positive variance:

$$\text{Var}(w_I^d) = (1 - \alpha_d) [G'(0) - \tau'(0) S - w_T]^2$$

In contrast with remark 1, other approaches to union effects that model the firm without a union as a wage-taking firm (like the *Right to Manage* model) imply degenerate wage dispersion also in the no-union case. Our approach has the good feature of associating greater wage dispersion under no-union than under union bargaining.

3.1.2 Effects on average wages

In order to compare the wage effects from centralization in a firm with N_I insider employees and surplus S , we can use (3) and (4) to find the wage drift in Union firms, $\Delta w_I \equiv w_I^c - w_I^d$:

$$\begin{aligned} \Delta w_I = & \Delta\alpha(-\bar{w}) + \alpha_c \frac{G(N_I)}{N_I} - \alpha_d G'(0) \\ & + \alpha_c \left(\frac{(1 - \tau(N_I))}{N_I} \right) S + \alpha_d \tau'(0) S \end{aligned} \quad (5)$$

From (5) the following result follows directly:

Remark 2 *Consider the case where $\alpha_c = \alpha_d$. If investments are in human capital ($\tau'' < 0$) and liquidation costs are high ($G'' > 0$), the wage drift is positive and it increases with the size of the firm. On the other hand, if investment are in physical capital ($\tau'' > 0$) and the employment regulation regime is soft ($G'' > 0$), the wage drift is negative and it decreases with the size of the firm.*

As a proof of the previous claim, consider the following definition:

$$w_I(k, \bar{z}) \equiv \frac{1}{\bar{z}} \alpha_k [U_F(z=0) - U_F(z=\bar{z})] + (1 - \alpha_k) w_T$$

A second order Taylor expansion of the term $U_F(z=\bar{z})$ yields:

$$\simeq \frac{1}{\bar{z}} \alpha_k \left[-\frac{\partial U_F(z=0)}{\partial z} \bar{z} - \frac{1}{2} \frac{\partial^2 U_F(z=0)}{\partial z^2} \bar{z}^2 \right] \quad (6)$$

We can show in particular that:

$$\begin{aligned} w_I^d &= \lim_{z \rightarrow 0} w_I(k=d, z) = -\alpha_d \frac{\partial U_F(z=0)}{\partial z} \\ w_I^c &= w_I(k=c, z=N_I) \simeq \alpha_c \left[-\frac{\partial U_F(z=0)}{\partial z} - \frac{1}{2} \frac{\partial^2 U_F(z=0)}{\partial z^2} N_I \right] \end{aligned} \quad (7)$$

An interesting implication of (7)⁴ is that it gives a simple description of wages under both regimes. Abstracting from changes in bargaining power due to coordination ($\Delta\alpha$), wages under centralization can be approximated as equal to the wages under decentralization (the first order term in the approximation) plus a second order term in a Taylor expansion. Wages under decentralization are not susceptible of a Taylor approximation, since they are given in exact form in (4). The fact that union wages can be expressed in this way facilitates the econometric specification problem at testing the effects of unions over wages. We develop a simple procedure to test for wage effects in section 6.

We can write the wage drift as:

$$\Delta w_I = \Delta\alpha \left(-\frac{\partial U_F(z=0)}{\partial z} \right) + \alpha_c \left(-\frac{1}{2} \frac{\partial^2 U_F(z=0)}{\partial z^2} \bar{z} \right) \equiv \Delta\alpha m_o + \alpha_c \sigma \quad (8)$$

where $\Delta\alpha \equiv \alpha_c - \alpha_d$, and where:

$$\sigma \equiv G''(0) N_I - \tau''(0) S N_I \quad (9)$$

Notice that the term m_o in (8) does not depend on the number of insiders, N_I and it is equal to zero when $\alpha_c = \alpha_d$. Moreover, expression (9) explains directly remark 2.

Equation (5) decomposes the effect of Union on wages in two effects, a *power effect* due to changes in bargaining power, and a *scale effect*, σ .

From (8) σ in (5) should be interpreted as a scale effect arising from the fact that employees bargain as a block and therefore have an effect of an additional order on the firm's utility change, due to separation. Whether the scale effect hurts or benefits employees will depend on whether the firm has economies of scale of firing and the extent of specificities between human and physical capital.

We expect m_o in (8) to be positive⁵. The wage drift then can arise from increments in bargaining power ($\Delta\alpha$), or a positive scale effect (σ), or both. We explore below the implications of different sources of the drift.

⁴Notice that we are not simply writing w_I^d as a first order approximation and w_I^c as a second order approximation. Instead, wages under decentralization exactly coincide with the first term of the approximation to wages under centralization.

⁵See section 8 for estimates.

4 Applications

In this section we endogenize the union formation decision by labor and the decisions to invest under the two bargaining regimes.

4.1 Union Formation

We consider the employees' decision on what bargaining regime to follow. We assume that previously to the bargaining stage $t = 3$ that we analyzed in the previous section, the set of insiders unilaterally decide at $t = 2$ on the bargaining regime, so as to maximize the wage bill. We assume union formation is costless and that there are no coordination problems among employees.

Under these assumptions the condition to form a union is given simply by:

Remark 3 *A union is formed previously to the bargaining stage, if and only if:*

$$\alpha_c \frac{G(N_I)}{N_I} - \alpha_d G'(0) + \alpha_c \left(\frac{(1 - \tau(N_I))}{N_I} \right) S + \alpha_d \tau'(0) S \geq \Delta \alpha \bar{w} \quad (10)$$

From this inequality is clear that factors that facilitate union formation are the same that factors that increase the wage drift, that are summarized in remark 2. In particular we point out that, under *investments in human capital*, greater surplus increases the incentives for union formation. Under those conditions larger firms are more likely to develop centralized bargaining, since coordinated threats enjoy scale economies.

Condition (10) points to profitability (S), increases in bargaining power due to coordination ($\Delta\alpha$) and the *high liquidation costs* regime as factors that predict union formation.

Notice that we are assuming that the bargaining regime is not a variable that agents can contract upon with the firm, previously to $t = 2$. Employees will coordinate at $t = 2$ as long as condition (10) is met.

4.2 The bargaining game and the incentives to invest

We have taken so far the surplus to be divided as given. In this section we introduce additional assumptions that allow us to endogenize the surplus. We

now consider one more stage (the investment stage, $t = 1$), that is previous both to the union formation ($t = 2$) and to the bargaining ($t = 3$) stages.

The firm owner and labor (as one agent) can both make ex ante investments that increase gross surplus:

$$S = \psi(N_I)(e_F + e_W) \quad \text{where } e_k \in [0, \bar{e}], k \in \{W, F\}$$

The cost of undertaking the investment, $C(e_k)$ is linear: $C(e_k) = e_k/\theta_k$.

The socially optimal investment in this setting is straightforward from the linearity assumptions. The conditions are simply given, for $k = \{W, F\}$, by:

$$e_k = \begin{cases} \bar{e} & \text{if } \theta_k \geq \psi(N_I) \\ 0 & \text{if } \theta_k < \psi(N_I) \end{cases} \quad (11)$$

Under either regime of ex post bargaining condition (11) will in general not hold. The incomplete contracts approach to labor relations (Grout (84)) has emphasized in particular the underinvestment in productivity enhancing actions that arises from the mutual hold-up problem. The existence of unions implies in particular a transfer of ex post bargaining power from the firm to labor. A consequence of this is that in firms with a union the employees have better incentives in the margin to undertake surplus improving investments. This goes at the expense of worse incentives for owners and managers.

Although in our setting investment decisions are not optimal, the basic underinvestment result does not necessarily hold. In particular overinvestment is a possible result. The precise effects of coordinated bargaining will depend on the nature of those investments and of firing costs. It could well be the case (if investments are in physical assets) that owners have better incentives than employees to invest under centralization, and employees have better incentives than the firm under decentralization.

The investment decisions under both regimes are given by:

Remark 4 *Under centralized bargaining, the first-order conditions for equilibrium investment are given by:*

$$\begin{aligned} \text{Workers} & : e_W^c = \bar{e} \Leftrightarrow \alpha_c \frac{1 - \tau(N_I)}{N_I} \psi(N_I) - \frac{1}{\theta_W} \geq 0 \\ \text{Firm} & : e_F^c = \bar{e} \Leftrightarrow [1 - \alpha_c(1 - \tau(N_I))] \psi(N_I) - \frac{1}{\theta_F} \geq 0 \end{aligned} \quad (12)$$

Under decentralized bargaining the corresponding conditions are:

$$\begin{aligned} \text{Workers} \quad : \quad e_W^d = \bar{e} &\Leftrightarrow -\alpha_d \tau'(0) \psi(N_I) - \frac{1}{\theta_W} \geq 0 \\ \text{Firm} \quad : \quad e_F^d = \bar{e} &\Leftrightarrow [1 + \alpha_d \tau'(0)] \psi(N_I) - \frac{1}{\theta_F} \geq 0 \end{aligned} \quad (13)$$

Remark 4 implies that the bargaining regime is non-neutral in terms of welfare. Whether centralization or decentralization is chosen has implications on the investments exerted, that will depend on the functional form of the loss from separation function, $\tau(z)$, but will not depend on firing costs. The following observation always holds.

Remark 5 *If $\tau'(z) < 0$, under both centralized and decentralized bargaining, the firm underinvests.*

The comparison of labor incentives under the two bargaining regimes with the first best incentives is ambiguous, since it is possible that $|\tau'(0)| > 1$.

We can derive the bargaining regime that maximizes joint net surplus, subject to the conditions in Remark 4.

Remark 6 *Under high liquidation costs ($\tau'' < 0$) centralization is optimal if and only if:*

$$\psi(N_I) \{1 + \tau'(0) \alpha_d N_I - [\alpha_c (1 - \tau(N_I))]\} \leq \frac{1}{\theta_F} - \frac{1}{\theta_W} \quad (14)$$

Otherwise decentralization is optimal.

An important and direct implication of Remark 6 is the fact that the union formation condition (10) will in general *not* implement the second-best condition (14). The union formation decision will in general introduce distortions in marginal incentives to invest, relative to the case where the bargaining regime could be contracted upon.

5 Policy implications

5.1 Optimal firing costs

Interestingly, it is clear from Remark 4 that firing costs do not affect the equilibrium conditions for investment. On the other hand the firing cost function $G(z)$ affects the union formation decision and the equilibrium payoffs in (3) and (4). This fact opens the possibility of designing optimally the firing cost mapping $G(z)$ so as to induce agents to choose the socially efficient bargaining regime. We derive that optimal policy in this section. The program that maximizes welfare is to choose a mapping $G(z)$ such that condition it is always the case that condition (10) is met if and only if condition (14) is satisfied. That is, firing costs are designed so as to induce labor to choose the bargaining regime that introduces less distortions, in the sense of Remark 6. The optimal mapping $G^*(z)$ is given by:

Proposition 3 *The function $G^*(z)$ induces an optimal bargaining regime if and only if:*

$$\begin{aligned} G^{*'}(0) &= w_T - \frac{1}{\Delta\alpha} e\Theta\psi'(0) \\ \frac{G^*(N_I)}{N_I} &= \frac{\alpha_d}{\alpha_c} G^{*'}(0) + w_T \frac{\Delta\alpha}{\alpha_c} - \frac{1}{\alpha_c} e\Theta \frac{\psi(N_I)}{N_I} \\ &= w_T - \frac{1}{\alpha_c} e\Theta \left[\frac{\alpha_d}{\Delta\alpha} \psi'(0) + \frac{\psi(N_I)}{N_I} \right] \end{aligned}$$

where $e \equiv e_W + e_F$ and where $\Theta \equiv \left(1 + \frac{1}{\theta_W} - \frac{1}{\theta_F}\right)$.

Proposition 3⁶ characterizes the exact firing cost mapping as a function of the number of employees and of firm characteristics. Since $\psi(N_I)$ is concave, it is straightforward to derive the functional form of the optimal firing policy. That functional form depends crucially on the relative importance of the firm and labor investments:

⁶The proof of the proposition is straightforward. Notice in the first place that under $\tau'' < 0$, workers incentives are better in (13) than in (12), and inversely so for firm's incentives. This yields Remark 6. Substituting the optimal firing costs in proposition (3) in (10) proves the claim.

Remark 7 *If labor's investment is important (unimportant) relative to the firm's investment, that is, if θ_W/θ_L is large (small) enough, the optimal firing cost mapping G^* is concave (convex), i.e., the high liquidation cost (soft employment regulation) regime is preferred.*

In order to understand Remark 7 consider for instance the case where the firm's investment is important (θ_F is large relative to θ_W : Θ is negative), when there are no firing costs. Then, condition (14) is not satisfied and therefore decentralization is socially efficient (is relatively less distortive of incentives to invest). But from the high liquidation costs condition ($\tau'' < 0$), labor will choose to coordinate bargaining (irrespective of the magnitude of the θ_F/θ_L ratio, since the bargaining regime decision is posterior to the investment decision). This implies that at the investment stage $t = 1$ agents anticipate that ex post labor will coordinate bargaining and that the marginal investment conditions are given by (12), that is inefficient.

The optimal firing costs in Proposition 3 have the effect of precisely avoiding the inefficient selection of bargaining regime by labor at $t = 2$. Notice that in this case we are considering, it is preferred that labor chooses not to unionize, so as to give better investment incentives to the firm. Since Θ is negative, the optimal firing costs are concave. This introduces a disincentive to coordinate bargaining: individual bargaining benefits workers from a (relatively) high cost of firing one employee only (high $G^{*'}(0)$).

In summary, Proposition 3 yields an intuitive recommendation: when labor incentives are important, it is better to have convex firing costs, so as to protect labor. If firm's investments are important, it is preferred to have concave firing costs, so as to destroy labor incentives to coordinate bargaining ex post, what would discourage the owner's incentives.

5.2 Implementation of regulatory reforms

Proposition 3 and Remark 7 have a number of implications regarding the implementation of policy reform. These results rely on the firm and the employees being able to agree on a firing cost mapping at the start of the economic relationship (" $t = 0$ ").

- There are theoretical and empirical arguments that lead us to believe that agents do not always choose the optimal institutions to regulate labor relations. Freeman (94) shows a relationship between firm union

development and firm decline. Palenzuela and Jimeno (96) find lower firm productivity growth associated to the development of a union in the firm. In this paper we have shown in Remark 3 that labor will in general not choose the institutions that gives best incentives for specific investments to be undertaken. We have shown as well that in our setting of imperfect contractibility, the fact that firing costs (and the act of firing) are verifiable introduces the issue of its optimal design. Firing costs affect incentives to form a union, but do not (directly) affect incentives to invest. They can be used to direct agents to the socially efficient bargaining regime without a cost in terms of investments. This opens the question of how to introduce firing costs in an economy that does not make optimal use of them.

- The optimal firing costs depend on many of the firm characteristics. This means that the contract on firing costs at $t = 0$ should optimally be written at the firm level, rather than at the sectorial level. Clearly, the more aggregate the ex ante negotiation over firing costs, the smaller will be the welfare gain associated to their optimal design.
- The previous remark implies that if an economy has a given (non-optimal) regulation on firing costs at the aggregate level, allowing for firm-specific bargaining over firing costs in the firm can only increase efficiency, and moreover it should be generally accepted. This is because agents inside the firm have as an option the statu quo of keeping the aggregate firing costs (the original situation). Upon that they can attain welfare improvements implied by Proposition 3.
- The advantage of regulating bargaining regimes through outside opportunities like firing costs is that the contract has a self-enforcing nature. The role of the policy maker is simply to set aggregate (or sectorial) firing costs that affect the distribution of net surplus among agents. Subsequent negotiation implies firm-specific firing costs, that lead to the efficient bargaining regime and efficient investments in the second best sense of remark 4.

6 Empirical Implications

The two bargaining games described above have different implications on the functional form of the expectation of wages conditioned on observables like the ex post surplus to be divided, the number of long term employees and total employees. We model average wages in firms with and without Union and nest the conditional expectation for both types of firms in one equation. Since we observe the total surplus that is divided each year in the firm, we do not need to make assumptions about the production function of the firm. On the other hand we should think of all variables in the model as endogenous variables. We will consider generalized method of moments estimators that optimally take care of endogeneity bias problems.

6.1 Average Wage Equations

Given the nature of our data base⁷, we will be interested in predicting average firm wages. For $k = \{c, d\}$, $w^k = \frac{1}{N} (w_T N_T + w_I^k N_I) = w_T (1 - f) + w_I^k f$, where $N = N_T + N_I$ and $f \equiv \frac{N_I}{N}$. Average wages in firms with centralized bargaining are:

$$w^c = w_T(1 - f) + [(1 - \alpha_c) w_T + \alpha_c G'_o] f + \alpha_c G''_o N_I f - \alpha_c \tau'_o N_I \tilde{S} - \frac{1}{2} \alpha_c \tau''_o N_I^2 \tilde{S} \quad (15)$$

where we use the subscript $_o$ as the function evaluated at zero. Average wages in firms with decentralized bargaining are:

$$w^d = w_T (1 - f) + [(1 - \alpha_d) w_T + \alpha_d G'_o] f - \alpha_d \tau'_o N_I \tilde{S} \quad (16)$$

where $\tilde{S} \equiv \frac{S}{N}$. The key point is that average wages should have a different functional form with respect to observables $(f, N_I, \tilde{S})$ in firms with centralized and decentralized bargaining. This implication will let us test the existence of different bargaining games through an specification test.

From (15) and (16) it is clear that the effect of labor cooperation (Union) has two effects on its ability to exert pressure on employers for higher wages. First, by increasing its bargaining power (α_c is expected to be higher than α_d), they increase the chance of making a take it or leave it offer. And

⁷Only firms's total wage bill is observed, together with N_I and N_T .

second, by lowering the outside opportunity of owners through the threat of separation. This effect can take place through two channels: changes in the marginal cost of firing an employee ($G'(z)$) with the number of fired employees, and changes in the marginal inefficiency of separations ($\tau'(z)$) with the number of fired employees. Our focus in the next section will be to characterize the relative importance of these channels in a sample of spanish firms.

Comparison of equations (15) and (16) point to an econometric specification for observed wages and to a number of tests about the effects of Union on the bargaining game. Let c_{it} be an indicator variable that is equal to 1 if firm i in year t has a collective agreement and is equal to 0 otherwise. Then average firm wages, w_{it} , can be written as:

$$\begin{aligned} w_{it} = & (w_T) [1] + (\alpha_d (G'_o - w_T)) [f_{it}] + ((\alpha_c - \alpha_d) (G'_o - w_T)) [f_{it}c_{it}] \\ & + (\alpha_c G''_o) [N_{Iit}f_{it}c_{it}] + (-\alpha_c \tau'_o) [N_{Iit}\tilde{S}_{it}] \\ & + (- (\alpha_c - \alpha_d) \tau'_o) [N_{Iit}\tilde{S}_{it}c_{it}] + \left(-\frac{1}{2}\alpha_c \tau''_o\right) [c_{it}\tilde{S}_{it}N_{Iit}^2] \end{aligned} \quad (17)$$

where we have written coefficients in brackets and observables in square brackets.

Equation (17) has implications on the signs of the coefficients when estimating a regression of average firm wages on observable firm characteristics and its cross products (observable variables are marked in square brackets in (17)).

The coefficient of the variable $[f_{it}]$ is $(\alpha_d (G'_o - w_T))$ and it is expected to be negative (recall that the model is built under the assumption that the firm prefers to fire employees than paying them when workers are not deploying their human capital: $w_T > G'_o$).

Remark 8 *If $(\alpha_d (G'_o - w_T))$ is negative then: $G'_o < w_T$ and $\alpha_d > 0$.*

The coefficient of the variable $[f_{it}c_{it}]$ has a similar interpretation and is also expected to be negative, since we are assuming that $\alpha_c \geq \alpha_d$.

Remark 9 *If $((\alpha_c - \alpha_d) (G'_o - w_T))$ is negative then: $G'_o < w_T$ and $\alpha_c > \alpha_d$.*

These two remarks together yield a value for the ratio $\Delta\alpha/\alpha_c$

Remark 10 Let $\beta_d \equiv \alpha_d (G'_o - w_T)$ and $\Delta\beta \equiv (\alpha_c - \alpha_d) (G'_o - w_T)$, then $\Delta\alpha/\alpha_d = \Delta\beta/\beta_d$. In particular: $\Delta\beta > 0 \Rightarrow \alpha_c > \alpha_d$.

The coefficients of $[N_{it}f_{it}c_{it}]$ captures the product of the bargaining power in Union firms and the derivative of firing costs per employee at the origin, $(\alpha_c G''_o)$. Although we expect G'_o to be positive, we do not have a prior for G''_o . A negative value means that the marginal cost of firing employees is decreasing. This could be the consequence of the availability to the firm of certain mechanisms that reduce the cost of firing a number of employees or the cost of liquidation.

The coefficients on $[c_{it}N_{it}\tilde{S}_{it}]$ and $[c_{it}N_{it}\tilde{S}_{it}]$ are expected to be non-negative (since the model is based on τ'_o being non-positive), although possibly of different magnitude.

Finally the sign of τ''_o can be captured by the coefficient on the variable $[c_{it}\tilde{S}_{it}N_{it}^2]$. Clearly, $\tau''_o < 0$ favors employees, since it implies increasing returns to scale in the technology of threats. Expected signs will be compared to the signs of the estimated coefficient from an estimation of equation (17) by ordinary least squares.

7 Description of the data⁸

In order to provide empirical evidence on main predictions of the model, we collect data on the existence of formal firm-level bargaining in Spanish firms. In Spain, unlike other countries, there are no surveys on firms regarding industrial relations. Thus, a comprehensive statistical source on industrial relations and firms' characteristics is not available. The main statistical source on Spanish collective bargaining is the *Collective Agreement Statistics (Estadística de Convenios Colectivos)*, developed from the register of collective agreements kept by the Spanish Ministry of Employment⁹. Data from this source provide information on the number of firms with formal bargaining and the number of workers affected by them, since 1981. However, they do not provide information on relevant economic variables (like wages, productivity, surplus, etc.) of firms with formal bargaining. Thus, data from the

⁸The data used corresponds to the same data base than the one used in Palenzuela and Jimeno (96). We briefly describe the variables definition following the data section in that paper.

⁹Collective agreements must be registered in the Ministry of Employment in order to be legally enforceable.

Collective Agreement Statistics has to be supplemented by a data set with firm-level economic characteristics, that contains firms under both regimes (with and without formal bargaining).

The supplementary data source that we use is the *Bank of Spain's Survey on Firm's Balance Sheets (Central de Balances del Banco de España)*. This is a survey conducted by the Bank of Spain since 1982, that has information on relevant economic variables (like employment, production, labor costs, profits, etc.)¹⁰. Matching these two data sources we have a sample of firms under the two regimes, formal bargaining and no formal bargaining. We perform the matching using the information for 1990. Hence, in our sample, a firm with formal bargaining is a firm which has a collective agreement registered in 1990 and was covered by the *Bank of Spain's Survey on Firm's Balance Sheets*¹¹. A firm with no formal bargaining is a firm without a collective agreement registered in 1990, and covered by the *Bank of Spain's Survey on Firm's Balance Sheets*¹².

¹⁰Bentolila and Dolado (1994) use this database to estimate a insider-outsider model of wage determination in Spanish firms.

¹¹A complete description about sampling methodology, variables definition, and variables descriptive statistics of variables for each year can be found in the publication by Banco de España: "*Central de Balances: resultados anuales de las empresas no financieras*", 1982 to 1994.

¹²The matching is performed by identifying firms in both registries according to their names and using instructions in SAS to match alphabetic strings. As could be expected the correspondence between both data sets is not one-to-one, resulting from coding errors in firms' names. This implies that about 40% of the firms in the balance sheets registry had to be dropped. In principle, though, it seems plausible that these errors are purely random.

Table 1:
Descriptive statistics of variables and regressors

variable	mean	std.dev.
log wage (w). 10^{-1}	0.2495	0.0957
Union (c)	0.2694	0.44375
Number of long term employees (N_I). 10^{-3}	0.5323	1.5928
Surplus per employee ($\tilde{S}$). 10^{-5}	3.4855	2.9121
proportion of insider employees $[1 - f]$	0.0718	0.1133
$f * c$	0.2510	0.4166
$[f * (1 - c)]$	0.6770	0.4233
$(N_I * f * c)$	0.2510	1.0769
$(1 - c) * N_I * \tilde{S}$	1.8134	5.9299
$c * N_I * \tilde{S}$	0.9058	4.3393
$c * N_I^2 * \tilde{S}$	4.3654	39.1351

8 Estimation

Equation (17) implies that the expectation of average wages, conditioned on observable variables like surplus per employees, number of long term employees and proportion of temporary employees over total number of employees in firms is a nonlinear function of these variables and that this function is different in firms with and without Union. This is hypothesis that we want to test. In order to estimate coefficients in (17) we use the optimal generalized method of moments estimator of Arellano and Bond (91). Equation (17) is estimated in levels The results of the estimation are in table 2:

Table 2.
Gmm estimation of (17)

variable	coefficient	coef.	std.error	p-value
$const.$	w_T	1.4749	0.1062	0.0001**
f	$\alpha_d (G'_o - w_T)$	-1.2965	0.1134	0.0001**
$[fc]$	$(\alpha_c - \alpha_d) (G'_o - w_T)$	-0.1370	0.0579	0.0179*
$N_I f c$	$(\alpha_c G''_o)$	-0.0968	0.0771	0.2094
$N_I \tilde{S}$	$-(\alpha_d \tau'_o)$	0.0174	0.0101	0.0836*
$c N_I \tilde{S}$	$-((\alpha_c - \alpha_d) \tau'_o)$	0.0152	0.0215	0.4789
$c N_I^2 \tilde{S}$	$-\left(\frac{1}{2} \alpha_c \tau''_o\right)$	-0.0025	0.0018	0.1553

(**) coefficient is statistically significant w.r.t. standard error at 1% level

(*) coefficient is statistically significant w.r.t. standard error at 5% level

Interpretation of Table 2 is straightforward from the remarks in subsection 6.1.

The estimates in Table 3 are non-linear functions of our structural parameters. In order to do inference on the structural parameters we should recover the standard errors of those parameters through consistent methods like the delta method. In our case the system is not identified: it is not possible to recover the structural parameters from the estimates in Table 2. We use the information in Table 2 to infer some properties of the structural parameters.

- Few of the coefficients in Table 2 are significant. The coefficient related to the constant is interpreted as w_T and it is found to be positive..
- The term $\beta_d \equiv \alpha_d (G'_o - w_T)$ is estimated as negative (-1.29) and significant. Since $G'_o < w_T$, bargaining power under decentralization has to be positive and significant. Moreover, since the value of w_T is 1.47 and since $\alpha_d \in [0, 1]$, the value of marginal firing costs at the origin G'_o has to be bounded so that $G'_o \in [0, 0.18]$. That is, at most, average firing costs are one seventh of average wages.
- The term $\Delta\beta \equiv (\alpha_c - \alpha_d) (G'_o - w_T)$ is found to be equal to -0.13, and significant, what implies that bargaining power increases under centralization. This yields an approximation (namely, $\Delta\beta/\beta_d$) for the growth

rate of bargaining power when the regime changes from decentralization to decentralization, of about 10%.

- The other coefficients are not significant at the 5% level. This is compatible with the terms G''_o , τ'_o and τ''_o being equal to zero. This implies that changes in bargaining regime yield rents that arise from the increment in bargaining power, but not from changes in the outside opportunity or *scale effects*, following the notation on expression (8).

9 Conclusion

Ex post bargaining within firms is usually thought of as a source of transaction costs, through the distortions it imposes in non-contractible ex ante investments. Property rights are usually thought of as a determinant of agents' bargaining position ex post (See Hart (95) for a survey). In this paper we show the role of the specificities between physical and human capital and the role of other institutions (Union) in affecting ex post negotiation.

In our model, a firm union (Union) not only changes bargaining power between the firm and employees, but possibly modifies the whole bargaining game. In particular, it implies that long term employees coordinate their offers, what allows them to change the ability to make offers. It also subjects the firm to a different threatpoint, since under decentralized bargaining the firing costs per employee is the marginal cost of firing only one employee and under centralized bargaining it is the average cost of firing all employees.

We show that how exactly Union changes the bargaining power and the outside opportunity has important consequences for the firm's factor's accumulation. The firm is not neutral about the source of a possible union wage premium. Investment and firing decisions are different depending on whether the union premium is the result of increased bargaining power or modified outside opportunities.

Moreover, we have specified a simple wage bargaining model with empirical implications. The model points to two types of effects from labor coordination on wages: the *power effect*, due to the increase of labor bargaining power and the *scale effect*, due to employees restrictions on the owners' outside opportunities, through coordinated threats. We find that all restrictions imposed by the model on the estimated coefficients are met. In particular we find a significant although small increase in employees bargaining power

when they are organized under Union. Without Union the probability of making offers is about 10% lower than the probability of making offers under Union. We find in particular that the source of the Union wage premium arises through increased bargaining power, in spite of similar outside opportunities to employees.

We have shown that the union formation decision is not necessarily optimal from the viewpoint of welfare. Firing costs can be optimally designed to induce labor to adopt the efficient bargaining regimes. We derive conditions for consensus driven adoption of this type of regulation.

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