Union Power, Insider Power and Labor Market Flexibility

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Abstract

I study and contrast the effects of labor market policies - unemployment insurance and firing costs - and institutions, such as unions, in a matching framework. I consider both a unionized and a non-unionized economy. The union premium is used to calibrate the individual worker's ability to extract surplus. As firing costs create insiders, I find that "union power" is greater than "insider power", as evidenced by a positive premium between union wages and average insider wages. In addition, unions are also blamed for the perceived lack of flexibility of European labor markets. The problem is that "flexibility" is not precisely defined, making the claim difficult to validate. I find that, for an appropriately defined notion of flexibility and for various union objective functions, unionized markets are not necessarily less flexible, despite generating higher unemployment. Finally, I show that, in fact, union members do not benefit from generous European style policies. This indicates that powerful unions cannot be the driving force behind these generous benefits. The driving force has to be found elsewhere.

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1 Introduction

The contrast between American and European labor markets has been the object of an extensive literature. European markets are generally characterized by higher unemployment and more generous government

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mandated policies. The matching literature, initiated by Pissarides (2000) and Mortensen and Pissarides (1994), has focused primarily on incorporating labor market policies into a matching framework (Millard and Mortensen (1997)), but less attention has been devoted to institutional differences, such as the fact that union presence is much more prevalent in Europe than in the U.S. (Blau and Kahn (1999), Nickell and Layard (1999)). These authors find that unions tend to increase wages and unemployment, although the extent depends on how coordinated they are and how many workers are covered by such agreements. In addition, unions are often blamed for the perceived lack of flexibility of European labor markets. The problem is that "flexibility" is not precisely defined, and thus this claim is difficult to validate.

To study the interactions of labor market policies with institutions, such as unions, I include unemployment insurance ("UI") and firing costs ("FC") into a matching model, where unions are characterized as highly coordinated, "European-style" unions. In particular, FC generate "insider" power", since the avoidance by firms of firing costs creates rents for workers protected by these regulations (Lindbeck and Snower (1986))). I can thus contrast "insider" power and "union power" and find that union power is stronger than insider power, as demonstrated by a positive premium between union wage and the average insider wage. This result is novel, since the union premium described in the literature refers to the premium between union and non-union workers. Hence, union presence increases both unemployment and wages, even relative to insiders. What about the claim that unions reduce labor market flexibility?

To answer this question, I first consider the response of unemployment and wages to changes in labor market policies, in two labor markets, one which is unionized, and another one, where wages are determined at the individual level by the worker and the firm. I also experiment with different objective functions for unions. Thus, I inquire how wage determination affects the response of the labor market. In particular, the notion of flexibility retained is the following: a wage determination mechanism is said to be more flexible when, following some change in policy, wages increase relatively less when they do increase and decrease relatively more when they do decrease. Thus, a wage mechanism is said to be more flexible when wages react to moderate an increase in unemployment. The answer is that, according to that criterion, unionized labor markets are not less flexible than non-unionized ones. It can be so, even though they generate higher unemployment. The latter is due to the fact that most of the weight of the union's objective function is on the welfare of employed workers. As far as flexibility is concerned however, unions take into account the effect of their wage demands as labor market policies change, more so than an individual would, with a fixed bargaining rule[1]. We then consider an alternative notion of flexibility: how do wages and the labor input in the unionized and non-unionized sectors react to a change in demand? We find that the labor share of income remains approximately constant in both sectors, following an increase in demand. We again view that as evidence that unionized markets are not less flexible than non-unionized ones.

Finally, after establishing that European-style unions do not hinder labor market flexibility, we show that, in fact, unions do not take advantage of their wage setting power to impose generous labor market policies. One way to support that claim is to show that unionized workers do not benefit from generous policies, despite their ability to set wages. This comes from the fact that, assuming that unions had the ability to set policies (UI or FC), their representative member would be better off without such polices[2]. This indicates that powerful unions are not the driving force behind these generous benefits. The driving force has to be found elsewhere.

A by-product of this exercise is the calibration of the rent extraction parameter, i.e. the bargaining power β to the worker, in terms of the Nash bargaining solution. We find that a value of $\beta = 0.07$ matches both the union wage premium and the empirically predicted unemployment differential between low- and high-unionization economies. This value is consistent with a number of estimated values of workers' ability to extract rents, but is somewhat lower than the value generally used in the matching literature. Since quantitative work using the Mortensen and Pissarides (1994) matching framework is clearly sensitive to how surpluses are split between workers and firms, this is a first step in better assessing β, and points out to the fact that more work is needed in that area.

Section 2 briefly reviews the literature on unions and labor market policies. We develop a model of a unionized sector in section 3.1, that we contrast with a non-unionized sector in section 3.2. We simulate these economies in section 4. Finally, we conclude and look for possible extensions in section 5.

[1] Even though, as we will see, the calibration gives relatively little bargaining power to the individual worker.

[2] Of course, with risk neutral workers, this abstracts from the insurance role of unemployment benefits.

2 Literature review

Before introducing the model, a brief review of the literature on unions and labor market policies is necessary. Relatively little attention has been devoted to the study of unions in a matching framework. Pissarides (1986), in a model with exogenous dissolution of matches, considers how a monopoly union, unilaterally setting wages, affects firms' search decision. In Mortensen and Pissarides (1999a), unions set the workers' share of the surplus and firms respond by determining employment. In both these cases, the focus is the condition under which collective bargaining can generate an efficient outcome. The focus of this paper is different. We are primarily interested in studying the effect of unions on the labor market and their interaction with polices, such as unemployment insurance and firing costs. Also, to replicate common bargaining practice (sometimes referred to as "right to manage"), we use Pissarides' approach, but endogenize the decision to break down productive matches.

In order to assess how unions affect unemployment, Nickell (1997) and Nickell and Layard (1999) focus on four main characteristics. Union density is the proportion of the workforce belonging to a union. This alone, however, might be misleading, since some countries have low union density, but high bargaining coverage, if union agreements are extended to non-union members. The extent of centralization (whether negotiations take place at the national, industry or plant level) and coordination (whether there is one main union or several) is also determinant (as per OECD 1997, coordination focuses on the degree of consensus between the collective bargaining partners). Nickell and Nickell and Layard find that union density and coverage are much higher in Europe than in the U.S. [GIVE FIGURES], and that union activity is more coordinated in Europe. In conclusion, these authors find that unemployment is positively correlated with union density and coverage and negatively correlated with union coordination. Looking at the effect of collective bargaining on wages, Blau and Khan (1999) find a positive union wage premium, although one has to be mindful of the fact that union coverage may be much higher than union density. In particular, they find that the U.S. has a much larger union wage premium (22%) than other OECD countries. Their evidence is based on Blanchflower and Freeman (1992), who find a union premium that varies between 4% and 10% in Australia, Austria, Switzerland, the United Kingdom and West Germany.

Theoretically, the effect of firing costs on unemployment is not unambiguously established. This is because, in all models, these costs affect both the firing and hiring decisions: firms are more hesitant to fire their employees, but they are also less inclined to hire new workers. Bentolila and Bertola (1990) determine a labor demand equation, in the presence of uncertainty and linear adjustment costs, in a partial equilibrium setting, and find that firing costs have more of an effect on the firing decision than on the hiring decision. In a calibrated general equilibrium model, Hopenhayn and Rogerson (1993) find that an increase in firing taxes causes job turnover to decrease, but employment to also decrease. More recently, matching models, based on Mortensen and Pissarides (1994) have been applied to this question. Blanchard and Portugal (2001), Millard and Mortensen (1997) and Mortensen and Pissarides (1999b) all find that firing costs have opposite effects on the hiring and firing decisions. When calibrated, their models find limited effects of firing restrictions on unemployment[3]. The empirical literature itself tends to find little effect of employment protection legislation on unemployment, as evidenced in Lazear (1990), Bertola (1990), and Nickell (1997). The effects of unemployment insurance, on the other hand, are much less ambiguous. Nickell (1997) finds that more generous unemployment benefits, as measured by a higher replacement rate, increases unemployment.

3 Model

In this section, I consider two economies. In section 3.1, wages are set by a single union, which can be viewed as a highly coordinated, European-style union, where wages are set for an entire sector. I briefly show in appendix A how one can extend the setup to allow for several non-coordinating unions. In section 3.2, wages are set bilaterally, by the firm and the worker. In both cases, employment protection and unemployment benefit regulations are included, allowing for the study of the interactions between policies and institutions. For all proofs and calculations, refer to the technical appendix B.

I start by a description which is common to both the unionized and the non-unionized sectors. It follows the Mortensen and Pissarides (1994) matching tradition. The economy is comprised of workers and firms. There is a mass one of workers and a continuum of firms. Workers have linear preferences, $u(c,l) = c + b(1-l)$, where $l \in \{0,1\}$ is an indicator of whether the worker is searching for a job ($l = 0$) or working ($l = 1$), b represents the value of leisure and home production and c is equal to the value of unemployment benefits if

[3] In Mortensen and Pissarides (1999b), workers are heterogeneous and the magnitude of the effect depends on the worker's skill level.

the worker is searching for a match or the wage is the worker is producing. The stochastic output of a match is given by an idiosyncratic shock x, drawn from a uniform distribution F, with range $[\underline{x}, \overline{x}]$. Following a Poisson process with arrival rate λ_1, the match may be hit by a new idiosyncratic shock.

Workers can be in either one of two states: employed and producing, or unemployed and searching for a match. Similarly, firms can either be productive or vacant. Because of search frictions, unemployed workers and vacant firms make contact randomly, as represented by a meeting function. The number of meetings per period of time between firms and workers is given by $M(N_u, N_v)$, where N_u and N_v are the number of unemployed workers and vacancies, respectively. The ratio of vacancies to unemployed workers, or market tightness, is θ. Assuming that the meeting function is increasing in both arguments and exhibits constant returns to scale, ensures that (i) the probability that a worker matches $M(N_u, N_v)/N_u = m(\theta)$, is increasing in θ, and that (ii) the probability that a vacant job is filled, $m(\theta)/\theta$, is decreasing in θ. In order to find a worker, firms have to post a vacancy at a cost κ per period of time. A free entry condition ensures that, since firms can freely enter the search pool, they do so until the value of posting a vacancy is driven to zero. Once a match is formed, the two partners go to the production pool. There, matches are governed by idiosyncratic shocks. As is standard in the literature, it is assumed that the initial value is equal to its maximum value $\overline{x}$.

Wage payments are subject to a payroll tax π, imposed symmetrically on the worker and the firm. Government mandated policies are of two forms: unemployment insurance and firing costs. UI is defined as a replacement rate ρ times wage. FC can take several forms. Since severance payments are pure transfers and hence, do not affect match surplus[4], FC are modelled as firing taxes t. Finally, we need to take into account the fact that firing costs are only due after a certain tenure with the firm[5]. It is assumed that the time at which firing regulations come into effect arrives randomly, with a Poisson arrival rate λ_0. However, once they come into effect, regulations stay in place for the duration of the match.

[4] See Delacroix (2002), Mortensen and Pissarides (1999b).

[5] For example, regulations about unfair dismissals do not take effect until completion of a trial period, whose length varies from a few months to two years, depending on the OECD country.

3.1 The unionized sector

The main difference between the unionized and non-unionized sectors is wage determination. First, the union sets the wage unilaterally, taking into account how it will influence firms' hiring and firing decisions. Second, wages are fixed, that is $w = w_u$, regardless of the idiosyncratic productivity of the match. Although all unionized workers are paid the same wage, regardless of their tenure, i.e. independently of whether or not they are subject to firing restrictions, we need to take into account the fact that the presence of such costs affects the firm's firing decision. Hence, the value of a match to a worker also depends on whether he is affected by such restrictions. A worker will be called **covered**, if his dismissal is subject to firing regulations, and **uncovered** otherwise. Denote by S^w (S^f) the value of search to an unmatched worker (firm) [in equilibrium, by the free entry condition, $S^f = 0$]. Let $M^w(x)$ ($M^f(x)$) be the value of a match to an uncovered worker (firm) under idiosyncratic productivity x. $M_c^w(x)$ ($M_c^f(x)$) is the corresponding value function, for a covered worker (firm). Firms and workers discount the future at rate r.

Conditional on the wage w_u paid to workers, the value functions are:

$$rS^w = b + \rho w_u + m(\theta)\left[M^w(\overline{x}) - S^w\right] \tag{1}$$

$$\begin{aligned} rM^w(x) &= (1-\pi)w_u \\ &+\lambda_0\left[Max\left\{M_c^w(x), S^w\right\} - M^w(x)\right] + \lambda_1 \int_{\underline{x}}^{\overline{x}} \left[Max\left\{M^w(z), S^w\right\} - M^w(x)\right] dF(z) \end{aligned} \tag{2}$$

$$rM_c^w(x) = (1-\pi)w_u + \lambda_1 \int_{\underline{x}}^{\overline{x}} \left[Max\left\{M_c^w(z), S^w\right\} - M_c^w(x)\right] dF(z) \tag{3}$$

$$rS^f = -\kappa + \frac{m(\theta)}{\theta}\left[M^f(\overline{x}) - S^f\right] = 0 \tag{4}$$

$$\begin{aligned} rM^f(x) &= x - (1+\pi)w_u \\ &+\lambda_0\left[Max\left\{M_c^f(x), S^f - t\right\} - M^f(x)\right] + \lambda_1 \int_{\underline{x}}^{\overline{x}} \left[Max\left\{M^f(z), S^f\right\} - M^f(x)\right] dF(z) \end{aligned} \tag{5}$$

$$rM_c^f(x) = x - (1+\pi) w_u + \lambda_1 \int_{\underline{x}}^{\overline{x}} \left[Max \left\{ M_c^f(z), S^f - t \right\} - M_c^f(x) \right] dF(z) \tag{6}$$

Equations (1)-(3) are the worker's value functions. The value of search is comprised of the unemployment income augmented by the option value of matching with a firm. Equation (2) is the flow value to an uncovered worker under idiosyncratic productivity x. He receives an after tax wage equal to $(1-\pi) w_u$. At rate λ_0, he becomes subject to firing regulations, in which case he has the choice of staying with the firm as a "covered" worker or returning to search. Finally, at rate λ_1, the match may be hit by a new idiosyncratic shock, in which case the worker has the choice of staying in the match (as an uncovered worker) or returning to search. Equation (3) can be interpreted in a similar fashion, except that once "covered", the worker remains so, until the match breaks down. The value functions for the firms, (4)-(6), can be interpreted in a parallel manner. The only difference is that, following a breakdown once the regulations are in place, the firm has to pay a firing tax t.

Since w_u is constant, both $M^w(x)$ and $M_c^w(x)$ are also constant. As long as M^w and M_c^w are greater than S^w, this implies unilateral match breakdowns by firms[6]. It also ensues from the fact that w_u is constant that $M^f(x)$ and $M_c^f(x)$ are strictly increasing in x, implying a reservation shock property: matches are broken down when the idiosyncratic shock governing the match falls below the values x_R and $x_{R,c}$, such that:

$$\begin{aligned} M^f(x_R) &= 0 \\ M_c^f(x_{R,c}) &= -t \end{aligned}$$

Hence, (2)-(3) can be rewritten as:

$$rM^w = (1-\pi) w_u + \lambda_0 (M_c^w - M^w) + \lambda_1 F(x_R)(S^w - M^w) \tag{7}$$

$$rM_c^w = (1-\pi) w_u + \lambda_1 F(x_{R,c})(S^w - M_c^w) \tag{8}$$

[6] This implies that, inside the integral sign in (2)-(3), the worker has the option of breaking down the match, only if the firm has not done so already.

Similarly, (5)-(6) can be rewritten as:

$$rM^{f}(x) = x-(1+\pi)w_{u}+\lambda_{0}\left[Max\left\{M_{c}^{f}(x),-t\right\}-M^{f}(x)\right]+\lambda_{1}\left[\int_{x_{R}}^{\overline{x}}M^{f}(z)\,dF(z)-M^{f}(x)\right] \tag{9}$$

$$rM_{c}^{f}(x) = x-(1+\pi)w_{u}+\lambda_{1}\left[F(x_{R,c})(-t)+\int_{x_{R_{c}}}^{\overline{x}}M_{c}^{f}(z)\,dF(z)-M_{c}^{f}(x)\right] \tag{10}$$

Writing (10) at x and $x_{R,c}$, one finds that:

$$M_{c}^{f}(x)=\frac{x-x_{R,c}}{r+\lambda_{1}}-t \tag{11}$$

which, plugged back in (10), implies that:

$$x_{R,c}+\frac{\lambda_{1}}{r+\lambda_{1}}\sigma(x_{R,c})+rt=(1+\pi)w_{u} \tag{12}$$

where $\sigma(x)=\int_{x}^{\overline{x}}(z-x)\,dF(z)$. This is the job destruction condition for covered jobs. It differs from the usual expression, because wage determination does not imply privately efficient breakdowns. Given the wage determined by the union, firms lay covered workers off, when the productivity shock $x_{R,c}$ is such that match output plus the option value of being hit by a higher shock (which accrues entirely to the firm, given the constant wage), net of the opportunity cost of match continuation $(-rt)$, is just enough to cover wage payment and payroll taxes.

Writing (9) at x and x_{R}, and using (11):

$$(r+\lambda_{0}+\lambda_{1})M^{f}(x)=x-x_{R}+\lambda_{0}\left[Max\left\{\frac{x-x_{R,c}}{r+\lambda_{1}},0\right\}-Max\left\{\frac{x_{R}-x_{R,c}}{r+\lambda_{1}},0\right\}\right] \tag{13}$$

It is shown in appendix B.1 that assuming $x_{R}\leq x_{R,c}$ leads to a contradiction. Hence:

$$x_{R,c}<x_{R}$$

implying that workers and firms separate less frequently, once the regulations are in place. I show in appendix B.1 that:

$$x_{R}+\frac{\lambda_{1}}{r+\lambda_{1}}\sigma(x_{R})+\lambda_{0}\left(\frac{x_{R}-x_{r,c}}{r+\lambda_{1}}-t\right)=(1+\pi)w_{u} \tag{14}$$

This is the job destruction condition for "uncovered" jobs. After noticing that (14) can be rewritten as $x_R + \frac{\lambda_1}{r+\lambda_1}\sigma(x_R) + \lambda_0 M_c^f(x_R) = (1+\pi)\,w_u$, it can be easily interpreted. Given w_u, firms lay "uncovered" workers off, when the productivity shock is such that match output plus the option value of being hit by a higher shock, plus the option value of becoming a "covered" match, is just enough to cover wage payment and payroll taxes.

Using the free entry condition, we get the job creation condition (see appendix B.1):

$$\kappa \frac{\theta}{m(\theta)} = \frac{\overline{x} - x_R}{r + \lambda_1} \tag{15}$$

Unions choose w_u so as to maximize the ex-ante welfare of their members. For that, they need to anticipate how their wage demands affects the firms' hiring and firing decisions. From (12)-(15), one gets:

$$\frac{dx_{R,c}}{dw_u} = (1+\pi)\frac{r+\lambda_1}{r+\lambda_1 F(x_{R,c})} > 0 \tag{16}$$

$$\frac{dx_R}{dw_u} = \frac{r+\lambda_0+\lambda_1 F(x_{R,c})}{r+\lambda_0+\lambda_1 F(x_R)}\frac{dx_{R,c}}{dw_u} > 0 \tag{17}$$

$$\frac{d\theta}{dw_u} = \frac{m^2(\theta)}{\kappa(\theta m'(\theta) - m(\theta))}\frac{dx_R}{dw_u} < 0 \tag{18}$$

There are three types of workers: unemployed ones, employed and uncovered ones, and employed and covered ones. Denote by U, E and E_c their respective masses (see appendix B.1). Since we are considering a fully unionized sector, we assume that unions maximize the ex-ante welfare of their members $U \cdot S^w + E \cdot M^w + E_c \cdot M_c^w$. The union maximization problem is thus:

$$\underset{w_u}{Max}\; U \cdot S^w + E \cdot M^w + E_c \cdot M_c^w$$
$$s.t. \quad (12) - (15) \text{ and } (28) - (30)$$

Note that, as a robustness check for the simulation, we also consider the possibility that the union maximizes the welfare of the employed workers $E/(E+E_c) \cdot M^w + E_c/(E+E_c) \cdot M_c^w$. However, given that we have a single union, covering the entire sector, the base case was assumed to maximize the ex-ante welfare of the representative worker.

3.2 The sector without unions

In this section, the firms and workers negotiate wages bilaterally. Again, labor market regulations affect individual wage determination, and we therefore need to differentiate between wage of covered workers ($w_c(x)$) and uncovered workers ($w(x)$). Denote by $\widetilde{w}$ the average wage, by $\widetilde{w}_o$ the average wage of uncovered workers ("outsiders") and by $\widetilde{w}_i$ the average wage of covered workers ("insiders") (see appendix B.2 for calculations).

The value functions are identical to the unionized case, except for wage determination. In particular, since wages are not constant anymore, unemployment benefits are based on a proportion ρ of the average wage $\widetilde{w}$, and w_u should be replaced by $w(x)$ or $w_c(x)$, as appropriate, in (2)-(3) and (5)-(6). We assume that wages are determined, so as to split the total surplus ($S(x)$ or $S_c(x)$) created by a match. Using the Nash bargaining solution, with bargaining powers β $(1-\beta)$ for the worker (firm), $M^w(x) - S^w = \beta S(x)$, $M^f(x) = (1-\beta) S(x)$ and $M_c^w(x) - S^w = \beta S_c(x)$, $M_c^f(x) + t = (1-\beta) S_c(x)$, where $S(x) = M^w(x) - S^w + M^f(x)$ and $S_c(x) = M_c^w(x) - S^w + M_c^f(x) + t$.

The derivation of the equilibrium equations is relegated to appendix B.2. An equilibrium is a quadruple $(x_R, x_{R,c}, \theta, S^w)$ satisfying the following equations:

$$(1+\pi) rS^w = (1-\pi)\left[x_{R,c} + \frac{\lambda_1}{r+\lambda_1}\sigma(x_{R,c}) + rt\right] \tag{19}$$

$$(1+\pi) rS^w = (1-\pi)\left[x_R + \frac{\lambda_1}{r+\lambda_1}\sigma(x_R) + \lambda_0\left(\frac{x_R - x_{R,c}}{r+\lambda_1} - t\right)\right] \tag{20}$$

$$\kappa\frac{\theta}{m(\theta)} = (1-\beta)\frac{1-\pi}{1-\pi+2\beta\pi}\frac{\overline{x} - x_R}{r+\lambda_1} \tag{21}$$

$$rS^w = b + \rho\widetilde{w} + m(\theta)\beta\frac{1-\pi}{1-\pi+2\beta\pi}\frac{\overline{x} - x_R}{r+\lambda_1} \tag{22}$$

Equations (19) and (20) represent the job destruction conditions for covered and uncovered jobs, respectively. Equation (21) is the free entry condition, while (22) is the value of search to workers.

It is also possible to compute equilibrium wages, and confirm the empirical prediction that the presence of firing regulations implies a rising wage profile between employees not yet covered by regulations ("outsiders") and the ones already covered ("insiders"). In fact, the "insider-outsider premium" is given by:

$$\forall x \geq x_R, \; w_c(x) - w(x) = \frac{(r + \lambda_0)\,\beta t}{1 - \pi + 2\beta\pi} \tag{23}$$

4 Simulations

In this section, both economies are simulated. I choose reasonable parameter values, which fall in the range typical of the literature. In this instance, actually calibrating the model would be difficult, due to the fact that we can only observe unemployment in partially unionized economies. In addition, there are reasons to believe that the skill level is not homogenous across unionized and non-unionized workers. Hence, I use parameters commonly used in the literature, and focus instead on the parameters that are central to wage determination.

We choose the following parameters, as derived from Millard and Mortensen (1997). They also fall in the range of values used in Garibaldi (1998), Mortensen (1994a,b) and Mortensen and Pissarides (1999b). The meeting technology is assumed to be Cobb-Douglas, and can thus described by an intercept term A and an elasticity with respect to vacancies η [η is estimated in Blanchard and Diamond (1989)]:

b	κ	A	η	r	$\underline{x}$	$\overline{x}$	λ_1
.3	.3	1	.6	.01	0	1	.1

We also choose the following policy parameters. The replacement rate is equal to .3, which is the average across OECD countries (OECD Database on Unemployment Benefit Entitlements and Replacement Rates). Although firing taxes are difficult to quantify, since they represent administrative costs, we choose $t = .5$. Since the value of t affects the insider-outsider premium, we also experiment with different values. Finally, we choose $\pi = .1$, an average across European countries, based on OECD 1995.

Since the exercise is essentially to contrast two wage setting mechanisms, union wage setting and bilateral bargaining, two parameters are particularly important for the simulation and deserve special attention. As seen in section 3.2, when wages are bargained bilaterally, the fact that regulations do not come into effect at the very beginning of the match creates a wage differential between workers protected by firing regulations and those not yet covered (equation (23)). Hence, the period of time before firing regulations come into play, as represented by λ_0, affects the "insider-outsider premium". In addition, the bargaining power β represents the ability of individual workers to retain the rent created by matching frictions, and thus is determinant in the union premium, which we define as the difference between the union wage w_u and the average non-union wage $\widetilde{w}$. Looking at OECD 1999, the time before firing regulations come into place varies much across countries, anywhere between 1 to 24 months. We choose $\lambda_0 = .25$ as our base case, which corresponds to an average time before regulations become effective of 12 months.

We choose β to replicate the union premium. We vary the two parameters λ_0 and t that may affect it, over a range of values, and choose β to replicate a 7% union premium, based on Blanchflower and Freeman (1992), who find a union premium that varies between 4% and 10% in Australia, Austria, Switzerland, the United Kingdom and West Germany. We thus find that $\beta = 0.07$ best replicates the union premium[7]. Of course, higher values of λ_0 or t increase the insider-outsider premium, but do not affect the union premium much[8].

U.P. ($w/\ \beta = .07$)	$t = 0$	$t = .5$	$t = 1$
$\lambda_0 = .05$	6.9%	6.9%	6.7%
$\lambda_0 = .25$	6.9%	6.8%	6.5%
$\lambda_0 = .5$	6.9%	6.7%	6.5%

I/O P. ($w/\ \beta = .07$)	$t = 0$	$t = .5$	$t = 1$
$\lambda_0 = .05$	0%	0.2%	0.4%
$\lambda_0 = .25$	0%	1.1%	2.4%
$\lambda_0 = .5$	0%	2.4%	5.0%

[*U.P.*: union premium, *I/O P.*: insider/outsider premium]

It is worth noticing that this value of β is somewhat smaller than the values typically used in the literature, which are generally chosen between 0.3 and 0.5. For example, due to a lack of empirical evidence, Mortensen (1994a) and Mortensen and Pissarides (1994) suggest the choice of $\beta = 0.5$, for reasons of symmetry. Millard and Mortensen (1997) choose $\beta = 0.3$. This is not without consequence, however. For example, Mortensen (1994b) acknowledges that the magnitude of the effects of the labor market policies he considers is sensitive to the choice of β. However, actual estimates of rent splitting parameters are much lower than that, as evidenced in Blanchflower, Oswald and Sanfey (1996), Christofides and Oswald (1992), and Hildreth and Oswald (1997),

[7] We find the same value of β whether we assume that the union maximizes the ex-ante welfare of the representative worker or of the representative employed worker.

[8] From (23), we know that the insider-outsider is approximately proportional to $\lambda_0 \beta t$.

who find profit-per-employee elasticity of wages ranging from 0.01 to 0.08. To take into account the possible simultaneity of profits and pay, these authors use a combination of specifications (instrumental variables or regressing pay on past profits per employee). It is to be noted that Abowd and Lemieux (1993) and Van Reenen (1996), using IV estimates find higher values (around 0.2). Their data sets, however, does not allow them to control for workers' characteristics, which Blanchflower, Oswald and Sanfey can do. In any case, even these estimates are smaller than the values generally calibrated in the matching literature. In fact, we think that using the union premium to pin β down validates our choice of the rent-splitting parameter.

The benchmark case is derived using the parameters selected above, and assuming that the union's objective function is to maximize the ex-ante welfare of the representative worker ($U \cdot S^w + E \cdot M^w + E_c \cdot M_c^w$). We find the following:

w_u	$\widetilde{w}$	$\widetilde{w}_o$	$\widetilde{w}_i$	$\%U_{union}$	$\%U_{indiv}$
.854	.798	.794	.803	10.2%	3.1%

[$\widetilde{w}_o$: avg. outsider wage, $\widetilde{w}_i$: avg. insider wage]

We can see that the union wage is higher than the insider wage, evidence that union power is greater than insider power. This is still true as firing taxes are increased, as we can see in figure 1. Hence, not only is there a positive wage premium between union and non-union workers, but there is also a premium between union workers and insiders. Not surprisingly, this implies a significantly higher unemployment rate in the unionized sector, which is consistent with higher unemployment rate in Europe than in the U.S., since European countries are characterized by either high union density or high union bargaining coverage. In fact, the unemployment differential between the fully unionized and the non-unionized economies is consistent with Layard and Nickell's (1999) regressions of unemployment on various policy and unionization measures. These authors find that predicted unemployment increases by a factor of 3 when union density increases from 0% to 100%. We view this as another validation of the rent extraction parameter β.

Hence, even highly coordinated European-style collective bargaining implies higher wages, and consequently higher unemployment. But, it is often claimed that unions in Europe hinder labor market flexibility.

This claim, however, does not logically result from the fact that unions generate high levels of wages and unemployment. Rather, since we are interested in the interactions between institutions and policies, we are going to test this claim by looking at the response of unemployment and wages to changes in labor market policies, firing costs and unemployment insurance. For that purpose, we carry out two simulations. In the first one, we fix firing costs and let the generosity of unemployment (ρ) benefits vary. In the second one, we fix the replacement rate, but allow the level of firing taxes to vary. Since, as was just established, unionized and non-unionized sectors are characterized by very different unemployment rates, looking at absolute unemployment variations following the changes considered may be misleading. Instead, the notion of flexibility that we impose is the following. A wage determination mechanism is more flexible if, following an exogenous change in policy, wages increase less when they increase, and decrease more when they decrease, i.e. when wages react to moderate an increase in unemployment. We find that, as ρ becomes higher, unemployment increases in both sectors (see figure 2). However, wages increase relatively less in the unionized than in the non-unionized sector (see figure 3), making the unionized sector more flexible in response to a change in unemployment benefits. The second simulation reveals that an increase in firing taxes results in very little movement in unemployment in either sector (see figure 4). However, this does not mean that wages are not adjusting. In fact, in both sectors, wages decrease when firing taxes increase. Given the expression for insider and outsider wages[9], since both these wages are decreased by firing taxes, it must be the case that the value of search S^w decreases with t in the non-unionized sector. This is due to the fact that firing taxes decrease the profitability of posting a vacancy. As a result, firms are less active searching for workers. The same is true in the unionized sector. Figure 5 shows that both w_u and $\widetilde{w}$ decrease with t in a proportional manner. Hence, unionized markets are as flexible as non-unionized ones in response to a change in firing costs. Hence, in conclusion, according to our criterion, unionized markets are not necessarily less flexible than non-unionized ones, despite generating higher unemployment.

One could also use another notion of flexibility, as considered in Blau and Kahn (1999). Many economists view a more flexible economy, as one in which the labor input varies more in response to changes in demand. In the context of the model, this is similar to looking at the response of unemployment to a change in $\overline{x}$. When we do that, letting $\overline{x}$ increase from .75 to 1.5, we find that the unemployment rate decreases both in

[9] We have that: $(1-\pi+2\beta\pi)\,w_c(x) = \beta(x+rt) + (1-\beta)\,rS^w$ and $(1-\pi+2\beta\pi)\,w(x) = \beta(x-\lambda_0 t) + (1-\beta)\,rS^w$.

the unionized and non-unionized economies, from 16.0% to 6.9% in the former and from 5.1% to 2.0% in the latter. As unemployment is higher in the unionized economy, it is maybe not surprising that it would also decrease more. But, looking at the variation in wages, one can see that the wage-to-maximum-output-ratio, a proxy for the labor share of income, remains relatively constant in both cases ($w_u/\overline{x}$ stays between 84.9% and 86.3%, while $\widetilde{w}/\overline{x}$ stays between 80.0% and 80.8%). Hence, comparable wage adjustments imply that the unionized economy is as flexible as the non-unionized one, in response to changes in demand. Thus, as per both notions of flexibility, unionized markets are at least as flexible as markets where wages are set at the individual level. Even though most of the weight in the objective function is on the welfare of employed workers (implying higher unemployment), the wage demands are moderated by the fact that the union takes into account the effect of the wage it sets on firms' job creation activity.

Insert figures 1-5.

These considerations lead us naturally to our next question. The endogenous determination of labor market policies is generally thought of as a political economy process (Hassler and Rodriguez Mora (1999), Saint-Paul (2000)). Instead, given unions' wage setting power and the fact that collective bargaining agreements extend to a majority of workers in Europe, we want to examine the possibility that unions are "behind" the generous European policies. Put differently, if unions have strong wage setting power, yet moderate their wage demands in response to an increase in firing costs and/or unemployment benefits, do they in fact benefit from such changes? If the response is no, then we can affirm that unions are not the driving force behind the generous European policies. To this effect, we simulate the model and see how the union's objective function varies when we change ρ and t. Because the funding of unemployment insurance is central to this question, we assume that benefits are financed through the payroll tax, and hence for the purpose of answering this question, assume that π is proportional to ρ (see appendix C). When we start from $t = .5$ and progressively increase ρ from 0 to 0.4, we find that the union's objective function decreases from 88.3 to 71.2. Similarly, when we start from $\rho = .3$ and increase t from 0 to 1, we find that the objective function decreases from 77.1 to 72.3. Hence, union members do not benefit from an increase in the generosity of either policy.

*** LOOK AT OECD 1995 TO SEE IF COUNTRIES WHERE $\pi_f \gg \pi_w$ ARE ALSO COUNTRIES WITH HIGH ρ. (???) ***

Let us consider first the choice of unemployment compensation (ρ) by the union. We see from (28)-(30) that the masses of unemployed workers (U), outsiders (E) and insiders (E_c) only depend on the parameters $(x_R, x_{R,c}, \theta)$ determining the flows between the different labor market states, which themselves only depend on w_u, and not ρ[10]. However, the various value functions S^w, M^w and M_c^w clearly depend on ρ. This is the channel through which the generosity of unemployment benefits affects the choice of wage[11]. The union is forward looking and realizes that its wage demands affect the firms' incentive to post vacancies. Let us first consider the welfare of unemployed workers. With a high ρ, an increase in wage makes the unemployed that much better off, since benefits are proportional to wage, but it also induces less vacancy posting by firms, who see their profits diminish. This reduces the unemployed' prospects of finding a job, and hence has a negative effect on their value of search S^w. Clearly, employed workers are better off with a higher wage (as long as these wage demands do not have too negative an effect of S^w). However, the welfare of employed workers also depends on the financing of unemployment compensation. In fact, a concurrent increase in payroll taxes π makes both matched workers and firms worse off, by reducing net wages and profits[12]. As firms are less active looking for workers, this makes unemployed workers worse off. As evidenced in appendix C, if payroll taxes are kept constant, the union increases its wage demands, making the representative union member better off. However, if a higher ρ implies a higher π, then the union moderates its demands[13], and the average member is in fact worse off. Notice that, regardless of financing, more generous unemployment benefits always increase unemployment. Let us now consider the optimal choice of t. It is easy to show that firms anticipate the possible payment of firing taxes in the future, reducing their vacancy return, and hence that $\frac{d\theta}{dt} < 0$, that is firms are less active looking for workers, as t increases. Thus, with a higher t, unions have to moderate their wage demands, reducing the ex-ante welfare of the representative member, as evidenced in appendix C. The results presented in the appendix also show that all the above conclusions also apply when we consider that unions only care about the welfare of their employed members.

[10] Hence, $\frac{dU}{dw_u}$, $\frac{dE}{dw_u}$ and $\frac{dE_c}{dw_u}$ do not depend on ρ.

[11] This does not mean, of course, that in equilibrium, ρ does not affect unemployment.

[12] We assume that $\pi = \gamma\rho$. An actual budget constraint would be $2\pi\left[E\widetilde{w}_o + E_c\widetilde{w}_i\right] = \rho\widetilde{w}U$. Since $\widetilde{w}$, $\widetilde{w}_o$ and $\widetilde{w}_i$ are relatively close, this can be approximated as $\pi = \frac{\rho}{2}\frac{U}{1-U}$. As ρ increases, U increases and thus π increases more than proportionately (less receipts, but more outlays). Of course, all our results would still hold, if we took into account that π increased faster than ρ.

[13] Sattinger (1995) similarly finds that an increase in UI may have a negative effect on wages, under budget balance.

To check how sensitive the model's implications are to the assumptions underlying wage determination, we considered another objective function, namely that unions maximize the welfare of the employed workers $(E/(E+E_c) \cdot M^w + E_c/(E+E_c) \cdot M_c^w)$. Unreported simulations indicate that unions would choose a wage w_u, which is very close to the one they would select, were they to also take the welfare of unemployed workers into account. In fact, the unemployment rate would only be higher by a few tenths of a percentage point. Hence, all the results established under one objective function still apply under the alternative one. We also experimented with different β's[14]. We chose $\beta = 0.2$, a value in the range estimated in Abowd and Lemieux (1993) and Van Reenen (1996). As shown in figures 3 and 5, union wage setting still exhibited more flexibility than bilateral bargaining (with $\beta = 0.2$) to changes in UI and FC. With regards to changes in demand, the labor share of income remained approximately constant both under union or bilateral bargaining.

5 Conclusion

We built a matching model with unions and labor market policies. Unions were modeled as highly coordinated European-style unions. The model was calibrated to reproduce the average union premium. The presence of firing costs generated insiders. However, we found that union power was greater than insider power. Nonetheless, we showed that this did not imply that unionized markets were necessarily less flexible, using several notions of flexibility. We even showed that unions did not wish to take advantage of their wage setting power to impose generous labor market policies.

The source of insider power we considered was firing costs. We showed that even though insiders were able to extract a higher wage than outsiders, this did not imply more unemployment, since firms were able to finance higher wages later, by lower wages initially, for a given worker. Hence, in a dynamic setting, insider power does not necessarily imply more unemployment. It would be interesting to consider other sources of insider advantage, such as screening and training costs. Another implication of the model is the magnitude of the union versus the insider-outsider premium, that can be tested empirically.

We established that the strong European unions could not be behind the generous labor market policies

[14] A value of $\beta = 0.3$ is needed for insider power to be as strong as union power (i.e. $w_u = \widetilde{w}_i$). Of course, in that case, the predicted union premium (1.2%) is not compatible with estimated values.

in Europe. This raises the question of how to explain the fact that Europe tends to be characterized by both high replacement rates and high firing costs (although there are some exceptions), while the opposite holds in the U.S. An automatic candidate is the political-economy process. But this raises some points. An explanation based on multiple equilibria would not be satisfactory. Also, simulations indicate that, in the non-unionized sector as well, generous policies have a negative enough effect on vacancy posting, and thus on wages, to decrease the welfare of both insiders and outsiders[15]. Thus, generous policies cannot be the result of a political economy process in this simple model. Hence, one has to look for some other fundamental difference between the U.S. and Europe. Since β represents the individual worker's ability to extract rent, it is not clear why this parameter should vary significantly between the U.S. and Europe. Then, one must be looking for another institution that differ in the two economies and which interacts with the political-economy determination of (ρ, t). This is left for future research.

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A A simple matching model of unions

Suppose there are n unions, $\{U_i\}_{i=1...n}$. I assume that each union has the same membership $1/n$. As is the case in practice, the negotiations only take place over wages. Unions make wage demands according to an objective function. Since the negotiated wage is to be applied to all workers in a sector, the wage actually implemented is the average $\widehat{w}$ of all the union wage demands ($\widehat{w} = \frac{1}{n}\sum_{i=1}^{n} w_i$). Then firms, taking this wage as given, decide how many job offers to post. Given that unions are not monopolists in this setting, they have to take into account the wage demands of other unions. We introduce the following notation: r: discount rate, b: unemployment income, κ: vacancy posting cost, y: output, δ: breakdown rate, θ: market tightness, $m(\theta)$: meeting rate for a worker, $m(\theta)/\theta$: meeting rate for a firm).

Denote by w_i the wage demand of union U_i, and by w_{-i} the wage demands of all other unions . Let S^f be the value of search to the firm and M^f the value of a match to the firm, contingent on $\widehat{w}$. Let $M^w(w_i;w_{-i})$ and $S^w(w_i;w_{-i})$ be the values of a match and search to a member of U_i. Firms take θ parametrically, and because of free entry, $S^f = 0$. We have that:

$$\begin{aligned} 0 &= -\kappa + \frac{m(\theta)}{\theta} M^f \\ rM^f &= y - \widehat{w} - \delta M^f \end{aligned}$$

and, in equilibrium:

$$\kappa \frac{\theta}{m(\theta)} = \frac{y - \widehat{w}}{r + \delta} \tag{24}$$

We have that:

$$rS^w(w_i;w_{-i}) = b + m(\theta(w_i;w_{-i}))\left[M^w(w_i;w_{-i}) - S^w(w_i;w_{-i})\right] \tag{25}$$

$$rM^w(w_i;w_{-i}) = w_i + \delta\left[S^w(w_i;w_{-i}) - M^w(w_i;w_{-i})\right] \tag{26}$$

What is of interest is how the choice by U_i of w_i, given w_{-i}, affects $\theta(w_i; w_{-i})$. From (24), one gets:

$$\frac{d}{dw_i}\theta(w_i; w_{-i}) = \frac{1}{n}\frac{1}{\kappa(r+\delta)}\frac{m^2(\theta)}{\theta m'(\theta) - m(\theta)} \tag{27}$$

Because of the constant return to scale assumption on the meeting function, $\frac{d}{dw_i}\theta(w_i; w_{-i}) < 0$.

The union maximizes the ex-ante welfare of its members, i.e. maximizes $uS^w(w_i; w_{-i}) + (1-u)M^w(w_i; w_{-i})$, where $u = \frac{\delta}{\delta + m(\theta)}$ is the unemployment rate. With a little algebra, this is equivalent to:

$$\underset{w_i}{Max}\frac{\delta b + m(\theta)w_i}{\delta + m(\theta)}$$

The first order condition is:

$$n\kappa(r+\delta)[\theta m'(\theta) - m(\theta)][\delta + m(\theta)] = \delta m(\theta)m'(\theta)[b - y + \kappa(r+\delta)\theta/m(\theta)]$$

For simplicity, assume that the matching function is Cobb-Douglas, hence that $m(\theta) = \theta^\eta$. In that case, one can show that:

$$\frac{d\theta}{dn} < 0 \; or \; \frac{dU\%}{dn} > 0$$

Hence, higher union coordination (lower n) reduces unemployment.

B Technical appendix

B.1 Unionized economy

Let us show that $x_{R,c} < x_R$. Suppose instead that $x_R \leq x_{R,c}$. Then, (13) implies that:

$$(r + \lambda_0 + \lambda_1)M^f(x) = x - x_R + \lambda_0 Max\left\{\frac{x - x_{R,c}}{r + \lambda_1}, 0\right\}$$

Plugging this expression for $M^f(x)$ into (9), we get:

$$\begin{aligned}(r+\lambda_0+\lambda_1)M^f(x) &= x-(1+\pi)w_u+\lambda_0 Max\left\{M_c^f(x),-t\right\}+\lambda_1\int_{x_R}^{\overline{x}}\frac{z-x_R}{r+\lambda_0+\lambda_1}dF(z)\\ &+\frac{\lambda_0\lambda_1}{r+\lambda_0+\lambda_1}\int_{x_R}^{\overline{x}}Max\left\{\frac{z-x_{R,c}}{r+\lambda_1},0\right\}dF(z)\end{aligned}$$

which, expressed at $x=x_R$ gives:

$$x_R-\lambda_0 t+\frac{\lambda_1}{r+\lambda_0+\lambda_1}\sigma(x_R)+\frac{\lambda_0\lambda_1}{r+\lambda_0+\lambda_1}\frac{1}{r+\lambda_1}\sigma(x_{R,c})=(1+\pi)w_u$$

Using (12) to replace $(1+\pi)w_u$, we get that:

$$x_R+\frac{\lambda_1}{r+\lambda_0+\lambda_1}\sigma(x_R)=(r+\lambda_0)t+x_{R,c}+\frac{\lambda_1}{r+\lambda_0+\lambda_1}\sigma(x_{R,c})$$

Since $x+\frac{\lambda_1}{r+\lambda_0+\lambda_1}\sigma(x)$ is an increasing function, this leads to a contradiction.

Let us derive (14). Since $x_{R,c}<x_R$, equation (13) implies that:

$$(r+\lambda_0+\lambda_1)M^f(x)=x-x_R+\lambda_0 Max\left\{\frac{x-x_{R,c}}{r+\lambda_1},0\right\}-\lambda_0\frac{x_R-x_{R,c}}{r+\lambda_1}$$

Plugging this expression into (9), after some algebra and evaluating it at $x=x_R$, we get (14).

Let us derive (15). Free entry implies that $\kappa\frac{\theta}{m(\theta)}=M^f(\overline{x})$. Given the expression for $M^f(x)$:

$$(r+\lambda_0+\lambda_1)M^f(\overline{x})=\overline{x}-x_R+\lambda_0\frac{\overline{x}-x_{R,c}}{r+\lambda_1}-\lambda_0\frac{x_R-x_{R,c}}{r+\lambda_1}$$

we find that $M^f(\overline{x})=\frac{\overline{x}-x_R}{r+\lambda_1}$ and finally (15).

Let us derive expressions for U, E and E_c conditional on the Poisson parameters governing the transitions between the various labor states. In steady state, flows in and out of each of the pools of (i) unemployed, (ii) non-covered, employed and (iii) covered, employed workers must be equal. Hence:

$$\begin{aligned}m(\theta)U &= \lambda_1F(x_R)E+\lambda_1F(x_{R,c})E_c\\ m(\theta)U &= [\lambda_0+\lambda_1F(x_R)]E\\ \lambda_0E &= \lambda_1F(x_{R,c})E_c\end{aligned}$$

Combined with the fact that $U + E + E_c = 1$, solving the above system of equations results in:

$$U = \frac{m(\theta)\lambda_1 F(x_{R,c})}{m(\theta)[\lambda_0 + \lambda_1 F(x_{R,c})] + \lambda_1 F(x_{R,c})[\lambda_0 + \lambda_1 F(x_R)]} \quad (28)$$

$$E = \frac{m(\theta)\lambda_0}{m(\theta)[\lambda_0 + \lambda_1 F(x_{R,c})] + \lambda_1 F(x_{R,c})[\lambda_0 + \lambda_1 F(x_R)]} \quad (29)$$

$$E_c = \frac{\lambda_1 F(x_{R,c})[\lambda_0 + \lambda_1 F(x_R)]}{m(\theta)[\lambda_0 + \lambda_1 F(x_{R,c})] + \lambda_1 F(x_{R,c})[\lambda_0 + \lambda_1 F(x_R)]} \quad (30)$$

B.2 Non-unionized economy

Adding (3) and (6) [replacing w_u by $w_c(x)$], one obtains the following expression:

$$(r + \lambda_1) S_c(x) + r(S^w - t) = x - 2\pi w_c(x) + \lambda_1 \int Max\{S_c(z), 0\} dF(z) \quad (31)$$

Bilateral bargaining implies that $(1-\beta)[M_c^w(x) - S^w] = \beta\left[M_c^f(x) + t\right]$. Multiplying this equation by $(r + \lambda_1)$, using (3), (6) and the definition of $S_c(x)$, one gets an expression for the wage of covered workers:

$$(1 - \pi + 2\beta\pi) w_c(x) = \beta(x + rt) + (1-\beta) rS^w \quad (32)$$

Inserting (32) into (31), one sees that $S_c(x)$ is increasing and affine in x, implying a reservation shock property. Covered matches are broken down when x falls below $x_{R,c}$ such that $S_c(x_{R,c}) = 0$. Expressing $S_c(x)$ at x and $x_{R,c}$, one gets that:

$$S_c(x) = \frac{1-\pi}{1-\pi+2\beta\pi}\frac{x - x_{R,c}}{r + \lambda_1} \quad (33)$$

From (31) and (33) expressed at $x = x_{R,c}$, one obtains (19).

Using a similar procedure [using (2) and (5) - replacing w_u by $w(x)$, instead of (3) and (6)], one finds:

$$(r + \lambda_0 + \lambda_1) S(x) + rS^w + \lambda_0 t = x - 2\pi w(x) + \lambda_0 Max\{S_c(x), 0\} + \lambda_1 \int Max\{S(z), 0\} dF(z) \quad (34)$$

$$(1 - \pi + 2\beta\pi) w(x) = \beta(x - \lambda_0 t) + (1-\beta) rS^w \quad (35)$$

$$S(x) = \frac{1-\pi}{1-\pi+2\beta\pi}\frac{x - x_R}{r + \lambda_0 + \lambda_1} + \frac{\lambda_0}{r + \lambda_0 + \lambda_1}[Max\{S_c(x), 0\} - Max\{S_c(x_R), 0\}] \quad (36)$$

We can check from there that $S(x)$ is increasing, implying a reservation strategy for uncovered matches, defined by x_R, such that $S(x_R)=0$. Using (34) and (36) at $x=x_R$, we obtain:

$$(1+\pi)\,rS^w=(1-\pi)\left[\begin{array}{c} x_R-\lambda_0 t+\frac{\lambda_1}{r+\lambda_0+\lambda_1}\sigma(x_R)+\lambda_0\left(1-\frac{\lambda_1}{r+\lambda_0+\lambda_1}(\overline{x}-x_R)\right)Max\left\{\frac{x_R-x_{R,c}}{r+\lambda_1},0\right\} \\ +\frac{\lambda_0\lambda_1}{r+\lambda_0+\lambda_1}\int_{x_R}^{\overline{x}}Max\left\{\frac{z-x_{R,c}}{r+\lambda_1},0\right\}dF(z)\end{array}\right]$$

We can again show by contradiction that $x_{R,c}<x_R$. Given this, the above expression simplifies as (20).

Writing (36) at $x=\overline{x}$, using (33) and the fact that $x_{R,c}<x_R$, we find that $S(\overline{x})=\frac{1-\pi}{1-\pi+2\beta\pi}\frac{\overline{x}-x_R}{r+\lambda_1}$. Using this expression and recognizing that (1) [replacing w_u by $\widetilde{w}$] and (4) can both be expressed with $S(\overline{x})$, we obtain (21)-(22).

Let us calculate $\widetilde{w}$, $\widetilde{w}_o$ and $\widetilde{w}_i$. The calculations are outlined. More detailed ones may be provided upon request. Denote by $E_c(x)$ ($E(x)$) the mass of covered (uncovered) workers employed in a match governed by idiosyncratic productivity x, and by E_c (E) their total mass. By definition:

$$\begin{aligned}\int_{x_{R,c}}^{\overline{x}}w_c(x)\,dE_c(x)+\int_{x_R}^{\overline{x}}w(x)\,dE(x) &= (E+E_c)\,\widetilde{w}\\ \int_{x_{R,c}}^{\overline{x}}w_c(x)\,dE_c(x) &= E_c\widetilde{w}_i\\ \int_{x_R}^{\overline{x}}w(x)\,dE(x) &= E\widetilde{w}_o\end{aligned}$$

We take advantage of the fact that the economy is in steady state to compute the masses of workers.

Movements of covered workers:

Inflow into group of covered workers belonging to $[x,x+dx]$, $x\geq x_{R,c}$:

$\lambda_1 dF(x)\int_{\substack{x_{R,c}\leq y\leq\overline{x}\\ y\notin[x,x+dx]}}dE_c(y)+\lambda_0 dE(x)=\lambda_1 dF(x)\left[E_c-dE_c(x)\right]+\lambda_0 dE(x)$, where the second term only appears if $x\geq x_R$.

Outflow out of group of covered workers belonging to $[x,x+dx]$: $\lambda_1(1-dF(x))\,dE_c(x)$. In steady state, the two flows are equal:

$$\lambda_1 dF(x) E_c + \lambda_0 dE(x) = \lambda_1 dE_c(x)$$

where the second term only appears if $x \geq x_R$.

Movements of uncovered workers:

Suppose first that $x \neq \overline{x}$.

Inflow into group of uncovered workers belonging to $[x, x + dx]$:

$\lambda_1 dF(x) \int_{\substack{x_R \leq y \leq \overline{x} \\ y \notin [x, x+dx]}} dE(y) = \lambda_1 dF(x) [E - dE(x)]$.

Outflow out of group of uncovered workers belonging to $[x, x + dx]$: $\lambda_1 (1 - dF(x)) dE(x) + \lambda_0 dE(x)$. In steady state, the two flows are equal:

$$\lambda_1 dF(x) E = (\lambda_0 + \lambda_1) dE(x), \; x \neq \overline{x}$$

Suppose now that $x = \overline{x}$.

Inflow into group of uncovered workers belonging to $[\overline{x} - d\overline{x}, \overline{x}]$:

$\lambda_1 dF(\overline{x}) \int_{x_R \leq y \leq \overline{x} - d\overline{x}} dE(y) + m(\theta) U = \lambda_1 dF(\overline{x}) [E - dE(\overline{x})] + m(\theta) U$.

Outflow out of group of uncovered workers belonging to $[\overline{x} - d\overline{x}, \overline{x}]$: $\lambda_0 dE(\overline{x}) + \lambda_1 (1 - dF(\overline{x})) dE(\overline{x})$. In steady state, the two flows are equal:

$$\lambda_1 dF(\overline{x}) E + m(\theta) U = (\lambda_0 + \lambda_1) dE(\overline{x})$$

These expressions can be solved for $dE(x)$, $x_R \leq x \leq \overline{x}$, and for $dE_c(x)$, $x_{R,c} \leq x \leq \overline{x}$. These can be used in connection with (28)-(30) and (32) and (35) to derive $\widetilde{w}$, $\widetilde{w}_o$ and $\widetilde{w}_i$, as functions of the various Poisson parameters and S^w. Because of that last dependence, the system cannot be fully solved analytically, and one has to rely on simulations.

C Choice of policy parameters by the union

Optimal choice of ρ by the union - Three cases: Balanced budget requirement [$\pi = \gamma\rho$] - No balanced budget requirement [$\pi = \overline{\pi} = 0.1$]. The union's objective function is the welfare of the representative member [$Obj.\ (S^w, M^w, M_c^w)$] or the welfare of the employed workers [$Obj.\ (M^w, M_c^w)$].

	$(t = 0.5)$	$\rho = 0$	$\rho = 0.2$	$\rho = 0.4$
$\pi = \gamma\rho$	$Obj.\ (S^w, M^w, M_c^w)$	88.33	78.81	71.18
	w_u	.923	.874	.837
	U%	6.4%	8.2%	15.1%
$\pi = \overline{\pi}$	$Obj.\ (S^w, M^w, M_c^w)$	72.63	73.90	75.68
	w_u	.841	.849	.860
	U%	6.8%	8.6%	13.1%
$\pi = \gamma\rho$	$Obj.\ (M^w, M_c^w)$	87.84	78.83	71.20
	w_u	.921	.875	.837
	U%	6.5%	8.3%	15.4%

Optimal choice of t by the union - Two cases: The union's objective function is the welfare of the representative member [$Obj.\ (S^w, M^w, M_c^w)$] or the welfare of the employed workers [$Obj.\ (M^w, M_c^w)$]. The balanced budget requirement is maintained.

$(\rho = 0.3)$	$t = 0$	$t = 0.5$	$t = 1$
$Obj.\ (S^w, M^w, M_c^w)$	77.14	74.70	72.28
w_u	.883	.854	.825
U%	10.0%	10.2%	10.3%
$Obj.\ (M^w, M_c^w)$	77.21	74.72	72.30
w_u	.884	.854	.826
U%	10.1%	10.3%	10.4%

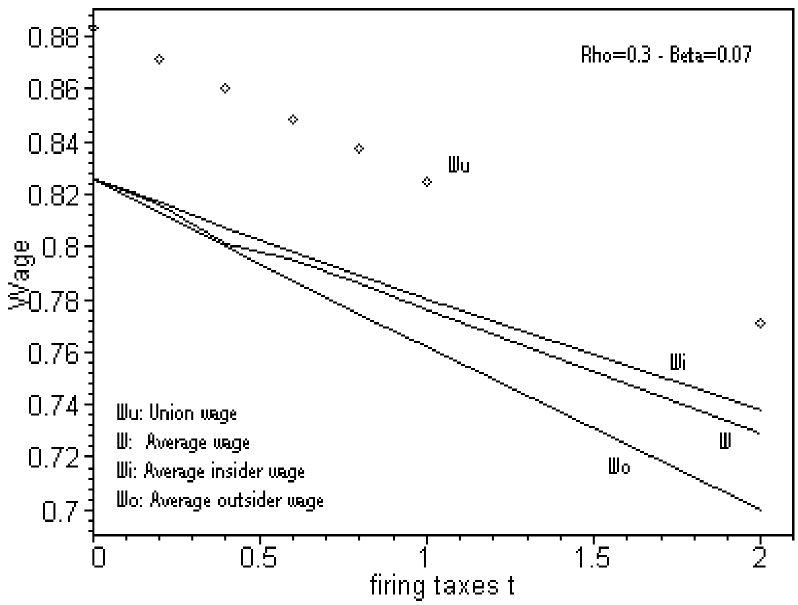

Figure 1:

D Figures

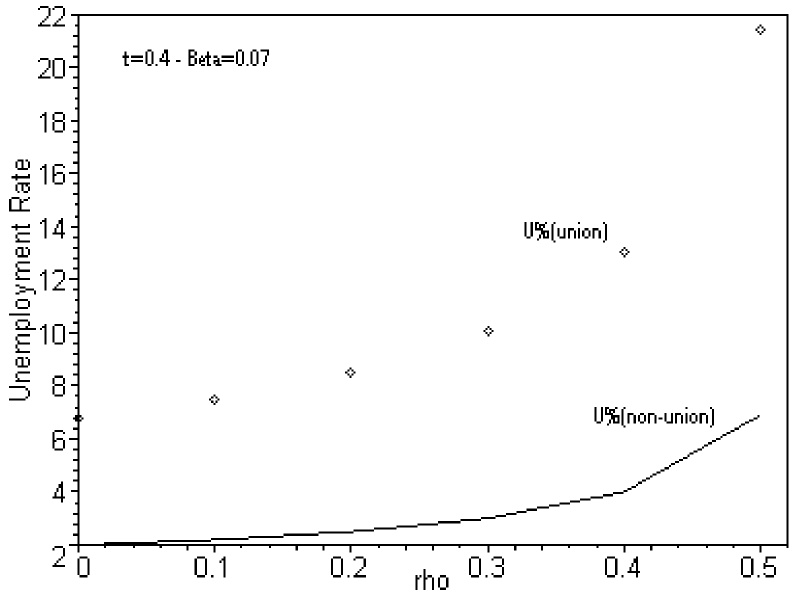

Figure 2:

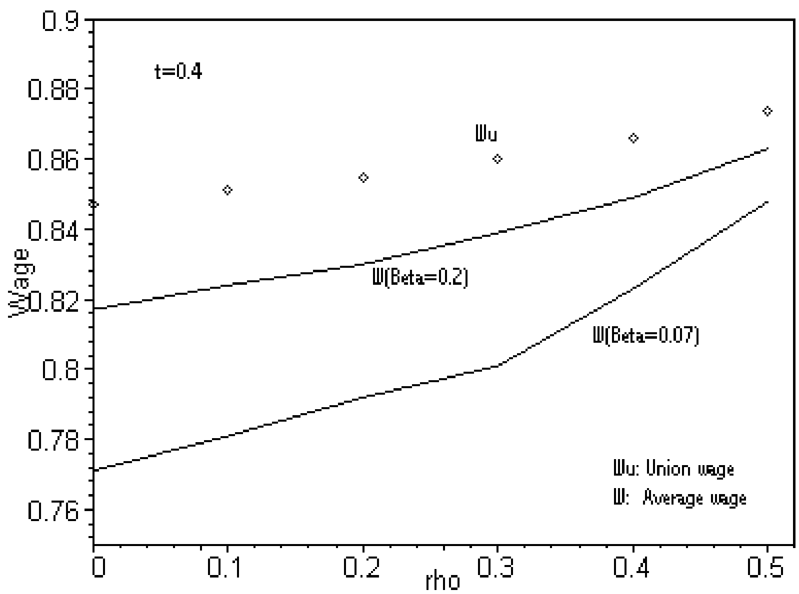

Figure 3:

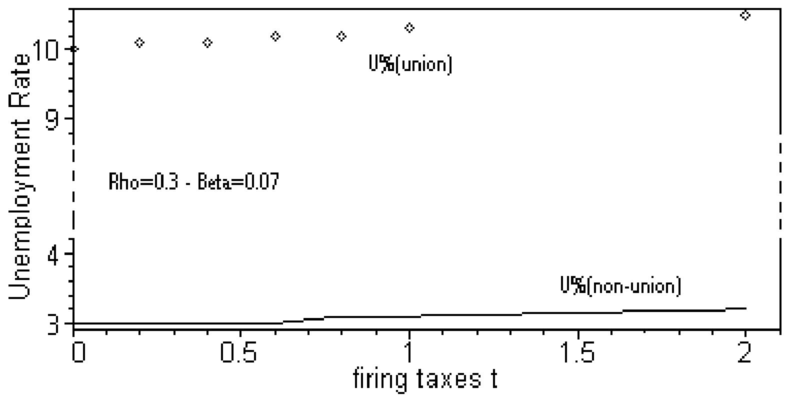

Figure 4:

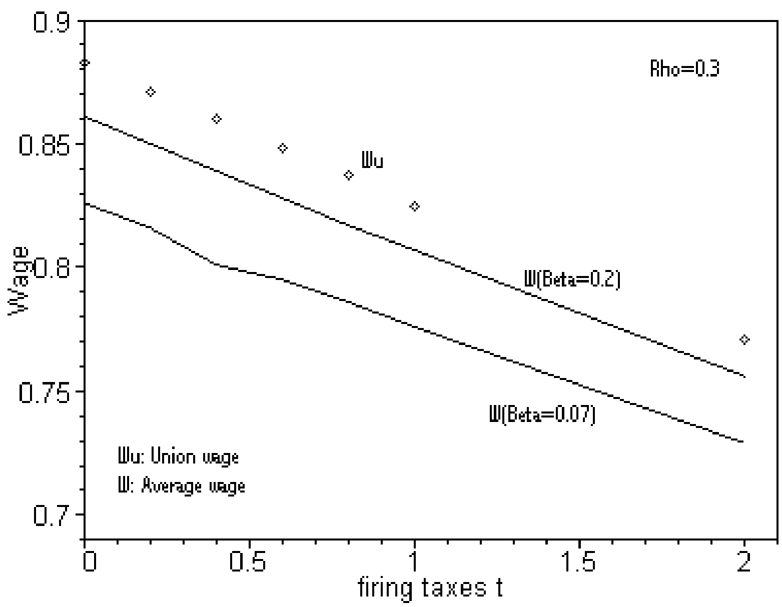

Figure 5: