Social dialogue, industrial relations and unemployment

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Abstract

We present a matching model where wages are centrally set by union and firm representatives and secured by means of a long term commitment. The commitment technology, however, is imperfect as the union is allowed to default at some exogenous rate. In addition, firms hold a distorted belief on the true rate of default.

The model proves useful to capture the notion of trust in social dialogue and industrial relations and to draw a theoretical connection between trust and unemployment as well as between trust and industrial disputes. In accordance with descriptive evidence, the model implies that unemployment decreases with trust whereas the incidence of disputes declines.

We assess the empirical consistency of the model by means of an econometric analysis based on a panel of 20 OECD countries observed over the period 1982 to 2003.

1 Introduction

Descriptive evidence suggests that labour markets are more efficient if social parts engage in intense dialogue and cooperative relations. In this paper we interpret the quality of social dialogue and industrial relations as a determinant of the performance of the labour market and propose a theoretical model to rationalise the evidence.

Intense dialogue and cooperative relations are typical of bargaining environments where conflicts of interests and hold up problems are resolved by trust. For this reason, we build a model where conflicts and hold up arise in the interplay between a union and a firm sector. In the model, firms make an irreversible investment to create jobs and become exposed to ex-post rent appropriation by the union in the form of deviations form previous wage promises. The union, in fact, has an incentive to promise low wages in order to boost job creation and to default from the promise once jobs have been created.

It is well known that, in this type of situations, the risk for the vulnerable party of being exploited leads to a suboptimal outcome and that efficiency is restored only if this risk is made ineffective. This, in turn, typically requires the availability of a commitment technology or some sort of economic incentive against opportunistic behaviour. In both cases, however, trust is conceptually ruled out since exploiting the vulnerable party is either impossible (under commitment) or disadvantageous (under incentives).

Alternatively, the vulnerable party must trust its partner in the sense that it must expect that the partner will not exploit its vulnerability. The last possibility, however, raises a conflict with the notion of rationality since the party that is trusted has an economic incentive to behave opportunistically while the party that trusts should not do so in anticipation of being exploited. In short, interactions based on trust are difficult to rationalise by means of traditional economic theory.

In this paper, we follow Rousseau et al. (1998) and model trust as the exogenous opinion of the vulnerable party (firms) regarding the behaviour of the other party (union). More specifically, we assume that the union has access to a commitment technology which allows defaults with some exogenous probability. Firms, however, are not fully informed on the parameters of this technology and hold beliefs that overestimate the true probability of defaults. In our view, it is precisely this belief that conveys the notion of trust, the lower the expectation of future defaults the higher the trust of firms towards the union.

To build a model with these features we resort to the description of the labour market popularised by D. Mortensen and C. Pissarides (1994). For our purposes, an appealing feature of this description is the irreversible nature of job-creation investments and the ensuing vulnerability of firms. The main innovation from the original model consists in substituting decentralised continuous bargaining with centralised discontinuous bargaining. At stochastic dates, firms and union representatives bargain a wage sequence for the current and for all future periods. Subsequently, the union commits to the sequence but deviations are allowed with some exogenous probability. When a deviation occurs a new bargaining round opens and a new wage sequence is decided.

The main results of the model are the following. First, the performance of the labour market improves with trust in the sense that equilibrium market tightness increases with the belief of firms concerning the expected duration of commitments. This happens not only because firms have a larger incentive to post vacancies for given committed wages but, more subtly, also because the union has a stronger incentive to moderate wage claims. Second, trust reduces the scope for disagreements during bargaining rounds. The first result represents the focus of the paper. The second result is also relevant as it establishes a link between trust and labor disputes and, as a consequence, validates the common practice of measuring the quality of industrial relation with the incidence of disputes.

The paper also presents econometric evidence on the link between trust and labour market performance based on a panel of 20 OECD countries observed over the period 1982 to 2003. We measure labour market performance through the rate of unemployment and capture trust by means of a set of indicators for the intensity of social dialogue and the quality of industrial relations. Since these indicators are mutually correlated we adopt the strategy of estimating a set of unemployment equations by adding only one indicator per equation. Results from this exercise are largely consistent with theoretical priors. Irrespective of the indicator used in regressions, the rate of unemployment appears to be *coeteris paribus* lower in countries featuring a more intense social dialogue and better quality industrial relations.

Links to previous literature

The connection between the quality of industrial relations and the performance of the labour market has been firstly analysed by Blanchard and Philippon (2006) (BP). The key theoretical mechanism of BP is a bargaining friction based on workers imperfect information on match productivity. At the beginning of bargaining firms communicate productivity to workers but the credibility of this communication depends on the exogenous 'trustworthiness' of firms. In equilibrium, the incidence of trustworthy firms determines the rate of unemployment. The model of BP may be regarded as complementary to the model built in the present paper. In fact, while in the present paper the vulnerable party are the firms, in BP the roles are inverted as the vulnerable party are the workers.

Feldman (2008) provides an empirical study on the connection between unemployment and the quality of industrial relations based on a rather large set of countries. The main finding of the study is that good industrial relations reduce unemployment. In comparison with Feldman, the empirical investigation made in the present paper uses a smaller number of countries but a larger number of social dialogue/industrial relations indicators. Feldman resorts to a unique indicator, the world economic forum (WEF) subjective assessment of industrial relations quality. By contrast, in this paper, apart from the WEF measure we also use three indicators for the institutional setting of social dialogue as well as a direct measure of trust in trade unions.

On technical grounds the paper is also linked to the contribution of Debortoli and Nunes (2010), who adapt the recursive method of Marcet and Marimon (2011) to study imperfect commitment in the conduct of tax policy. In the model we extend the framework of Debortoli and Nunes to include trust in the form of distorted beliefs on the probability of defaults.

The paper is composed of seven more sections. To motivate the analysis, in section 2 we present some preliminary evidence. In section 3 we set up the theoretical model while in sections 4 and 5 we solve the model and prove results. In section 6 we establish that the incidence of disputes lowers with trust. In section 7 we describe the data and present econometric evidence. Finally, in section 8 we make some concluding remarks.

2 Preliminary evidence

To motivate the investigation, in this section we look at the correlation between the rate of unemployment and a number of trust-related traits of the bargaining environment.

In Figure 1 we plot average unemployment over the 1982-2003 period against an index that captures country heterogeneity as for the intensity of social dialogue. The measure of unemployment is unconditional as we use the estimated country fixed effects from a standard OLS-FE unemployment regression conducted on a panel of 20 OECD economies observed over the period 1982-2003.[1] The rate of unemployment is computed for the 15-65 age group while the conditioning vector contains standard economic (output gap) and institutional determinants (union density, corporativism, labour taxation, unemployment benefits, market regulation and employment protection).[2]

The index of social dialogue intensity is derived from the Ictwss database (Visser, 2011), a very detailed source of information regarding the industrial relations context in 40 countries. The index is computed as the principal component of three sub-indicators. The first sub-indicator (RI) is a categorical variable which measures routine involvement of unions and employers in government decisions on social and economic policies. Countries exhibit full concertation if involvement is regular and frequent (RI=*2*), partial concertation if involvement is irregular and infrequent (RI=*1*) and no concertation if involvement is rare or absent (RI=*0*). The second sub-indicator (BC) is a 0-1 dummy that measures the existence of institutionalised bipartite councils of central or major union and employers organizations for purposes of wage setting, economic forecasting and/or conflict settlement. Finally, the third sub-indicator (WC) is a categorical variables which measures the existence and influence of local works councils. In this respect, countries are assigned to one of four groups. The top group consists of countries where works councils have economic and social rights including codetermination on some issues (WC=*3*). The second group incudes countries where councils have economic and social rights but their function is merely consultative (WC=*2*). The third group consists of countries were works councils have only social rights (WC=*1*). Finally, the fourth group includes countries where councils are absent or have no rights apart from some information right (WC=*0*). During the 1982-2003 interval, the first sub-indicator is time variant for 10 countries out of 20, the second changes only for Sweden while the third is time invariant. The value reported in Figure 1 is the average of the principal component over the whole time interval.

In Figure 2 we plot unemployment on a measure of industrial relations quality. The measure is built from annual interviews conducted on a panel of executives and whose results are published annually on the Global Competitiveness Report. Executives are asked to express their opinion on the statement "*Labor/employer relations are generally cooperative*", answers range from a maximum of 7 (strong agreement) to a minimum of 1 (strong disagreement). While unemployment refers to the period 1981-2003, the measure of industrial relation quality is only available from 1990. Thus, for consistency, in the figure we average the measure over the four 'central' years 1990-94.

[1] Countries included in the panel are: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Japan, Ireland, Italy, Netherlands, New Zealand, Norwey, Portugal, Spain, Sweden, Switzerland, UK, USA.

[2] See the appendix for a detailed description of variables.

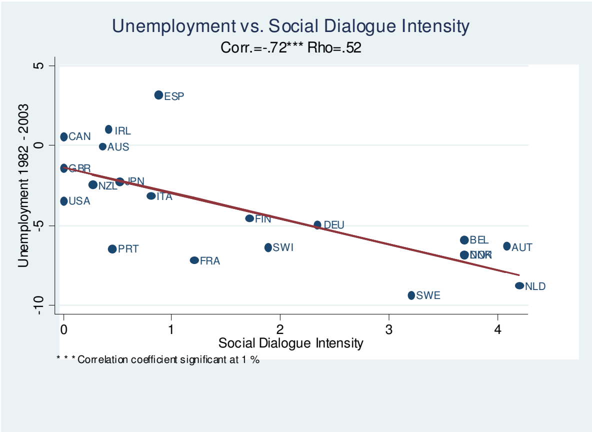

Fig. 1: Unemployment and Social Dialogue

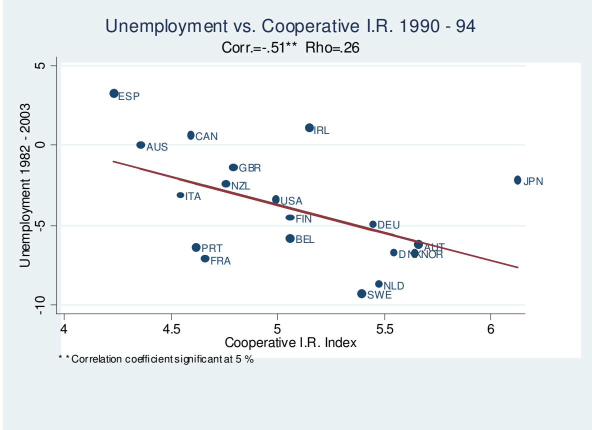

Fig. 2: Unemployment and Cooperative I.R.

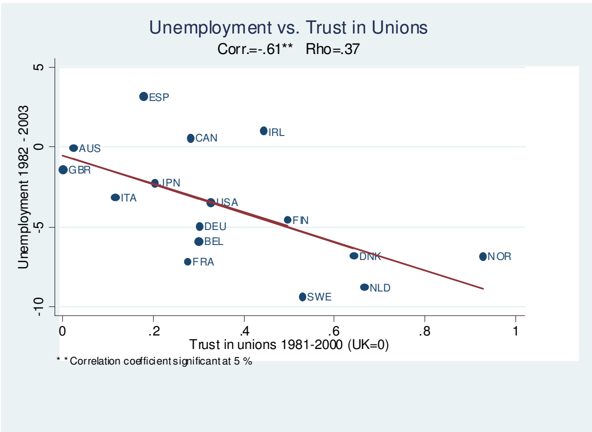

Fig. 3: Unemployment and Trust in Unions

In Figure 3 we plot unemployment against a measure of trust in unions. The measure is built from the first three waves of the World Social Survey.[3] Surveyed individuals were asked the question "How much confidence do you have on trade unions?" and could choose one out of four possible answers ('a great deal', 'quite a lot', 'not very much', 'none at all'). For each country and each wave, the survey has been conducted on a number of individuals that ranges from a maximum of 3.437 (Germany, 1990) to a minimum of 1.000 (Ireland, 1990).

To compute country means and to account for relevant individual heterogeneity we run the following

[3] The first wave of the survey was realised in 1981-1982. The second was realised in 1990 but we attribute to this wave the 1995 survey for Australia. Finally, the third wave was realised in 1999-2000. We attribute to the third wave the 1996 survey for Norway and the 2005 survey for Australia. The first three waves of the survey were not performed in Austria, New Zealand, Portugal and Switzerland.

probit regression:

$$P(trustuion_{i,j,t} = 1) = F\left[\alpha + \beta \mathbf{X}_{i,j,t} + D_{j,t} + \varepsilon_{i,j,t}\right]$$
$$i : individual \qquad j : country \qquad t : wave$$

In this expression, the depend variable *trustunion* is a dummy which takes the value 1 if the individual trusts unions (answer: 'a great deal' or 'quite a lot') and zero otherwise. The vector $\mathbf{X}_{i,j,t}$ contains information on demographics (age, age squared, years of education) and labour market status (inactivity and unemployment). The measure of trust plotted in the figure is obtained by averaging country fixed effects $D_{j,t}$ over the tree waves.

The overall picture that arises from the three figures is that variables that capture the intensity of social dialogue as well as the quality of industrial relations are highly correlated to country residuals from a standard unemployment regression. We claim that this evidence is suggestive of a causal link. Thus, in the remainder of the paper, to support this claim we first develop a theoretical model then we present econometric evidence.

3 The Economy

The model consists of a search and matching economy (Mortensen and Pissarides, 1994) with three key modifications. First, wage bargaining is centralised at the industry/economy level instead of being decentralised at the level of worker-firm pairs. Second, bargaining occurs at stochastic dates instead of being continuous in time. Third, at bargaining rounds wages are not set through a surplus sharing rule but are determined unilaterally by the union provided the surplus accruing to firms lies above an exogenous threshold. This threshold may be thought of as corresponding to the exogenous relative bargaining power of the standard textbook model.

3.1 Search and Matching

There is a unit mass of workers with linear utility that can be either employed or in search of employment. The employed produces an output flow p and receives a wage w_t while the unemployed receives a benefits flow b ($p > b$). There is a large mass of single-job firms but only some of them participate in market activity. Those that do not participate can access the market by posting vacancies and searching for workers. Holding a vacancy entails a constant per-period cost c. Time is discrete, worker-firm matches that initiate at time t become productive at time $t + 1$. However, from $t + 2$ onwards, matches may be hit by a shock that triggers immediate destruction. Shocks occur with a per-period probability ρ.

Labour market frictions are described according to an urn-ball matching process similar to Pissarides (1979), Blanchard and Diamond (2004), Burdett et. al (2001) and Smith and Zenou (2003). We use $p(\theta_t)$ to represent the matching probability of workers and $q(\theta_t)$ the probability of firms. These probabilities depend on market tightness θ_t which, in turn, is given by the ratio between the number of vacancies v_t and the number of unemployed workers $1-n_t$. We make the following assumptions as for the contact and matching technology: a) unemployed workers and searching firms come in contact thanks to signals sent by firms, b) a firm sends only one signal in any period, c) a signal arrives only to one unemployed worker, d) firms do not coordinate so that some workers receive more than one signal whereas some others receive no signal at all, e) workers respond only to current signals and, in case of many signals, choose randomly one of them, f) after a worker responds to a signal the pair matches and the job is created. Under these assumptions, the functions $q(\theta_t)$ and $p(\theta_t)$ are given by the formulas

$$p(\theta_t) \quad = \quad 1-e^{-\theta_t} \qquad q(\theta_t) = p(\theta_t)/\theta_t \tag{1}$$

$$q(\theta_t),\, p(\theta_t) \quad \in \quad [0,1] \qquad p'(\theta_t) > 0,\, q'(\theta_t) < 0 \qquad \lim_{\theta_t \longrightarrow 0} q(\theta_t) = 1$$

These expressions represent a large population version of matching probabilities that are computed by Smith and Zenou (2003) in a small population environment. We thus refer to this paper for details. The matching probability of workers increases with respect to market tightness while that of firms declines. A property that will be used in the paper concerns the behaviour of the elasticity of $q(\theta_t)$ with respect to θ_t. Let $\eta(\theta_t)$ represent this elasticity in absolute value, it can be easily shown that $\eta(\theta_t)$ increases with respect to θ_t while remaining below 1:

$$\eta(\theta_t) \in (0,1) \qquad \eta'(\theta_t) > 0 \tag{2}$$

As a consequence, the elasticity of $p(\theta_t)$ $[1-\eta(\theta_t)]$ is decreasing with respect to θ_t.

3.2 Entry

We assume that entry is free. Thus, if entry entails positive net returns, free entry drives these returns to zero. By contrast, if entry entails zero or negative returns, the number of posted vacancies is nil. Let V_t represent the market value of a vacant firm, the free entry condition is

$$\text{a) } V_t \leq 0 \qquad \text{b) } \theta_t \geq 0 \qquad \text{c) } V_t\theta_t = 0 \tag{3}$$

Let J_t represent the market value of a matched firm. Assets V_t and J_t solve the following Bellman equations:

$$V_t = -c + \beta q(\theta_t) E_t J_{t+1} \tag{4}$$

$$J_t = (p - w_t) + \beta(1 - \rho) E_t J_{t+1} \tag{5}$$

In these equations, $\beta(< 1)$ represents the discount factor. The first equation clarifies that the value of a vacant firm is due to the chance of matching in the current period and becoming productive from the next period onward. The second equation implies that the value of a matched firm coincides with the discounted stream of profits. Discounting in this case is due to time preference as well as to exogenous job destruction. Both equations embed the free entry condition. In fact, since $\max(0, V_{t+1}) = 0$, the continuation value after unsuccessful search or after a negative shock is nil.

In principle, in addition to exogenous job destruction, the stream of profits may also be interrupted by a union wage policy so aggressive that firms prefer exit. In formulating equation 5, however, we conjecture that such an aggressive policy is not implemented in equilibrium.

3.3 Wage Setting

Wages are set as follows. At the time of bargaining, the union formulates a proposal unilaterally. This proposal consists of a wage profile for the current and for all future periods. Firms, in turn, may accept or reject the proposal. If firms accept, bargaining terminates and the union commits to the proposed wage profile. If the firms reject, a temporary wage is set only for the current period and the union is required to make a new proposal at the beginning of the next period.

We assume that firms are always able to impose a wage at current time such that their current market value is equal to the exogenous level H. Thus, for consistency, firms accept a proposal made at time t if and only if along the proposed policy their market value does not fall below H:

$$E_t [J_s] \geq H \qquad s \geq t \tag{6}$$

The threshold H may be regarded as the parameter that sets implicitly the bargaining power of the two sides. There are two natural boundaries for H: $H \in [H_{\min}, H_{\max}]$. The upperbound $H_{\max}$ stands for the maximum bargaining power of firms consistent with the unemployed willing to search for a job in steady state:

$$H_{\max} = \frac{p-b}{1-\beta(1-\rho)}$$

The unemployed searches for a job only if the wage is at least as large as the unemployment benefit b. The RHS of the expression gives the present value of profits in a steady state where the wage is equal to the unemployment benefit.

The lowerbound $H_{\min}$ stands for the lowest bargaining power of firms such that the constraint may potentially bind in a steady state with positive job creation:

$$H_{\min} = \frac{c}{\beta}$$

Notice that c represents the minimum expected search cost, i.e. the search cost when market tightness is nil and, as a consequence, the firm probability of matching is 1. Thus, in a steady state with positive market tightness, the expected cost of search is larger than c so that the expected value of firms must be larger than c/β otherwise destroyed jobs are not replaced by new jobs. This immediately implies that if H falls short of $H_{\min}$ the constraint can never be binding in a steady state with positive job creation.

The parameter restriction which guaranties that the set $[H_{\min}, H_{\max}]$ is non-empty is

$$c < \beta \frac{p-b}{1-\beta(1-\rho)} \tag{7}$$

This restriction has an obvious interpretation, the lowest expected search cost must fall below the highest search return. The highest search return arises when workers are paid a wage equal to the unemployment benefit. If this restriction does not hold, the economy can not exhibit positive steady state employment.

When making a wage proposal, the objective of the union is to maximise the discounted stream of workers utility. In this respect, we assume that the union weights equally the welfare of all workers and uses the same discount factor of firms:

$$\mathcal{U} = E_0 \sum_{t=0}^{\infty} \beta^t \left[n_t w_t + (1-n_t) b\right] \tag{8}$$

This expression represents the expected discounted stream of union utility from time 0 onwards.

3.4 Commitment

Once a proposal is accepted, the union commits to the proposed wage profile. We assume, however, that the commitment technology is loose in the sense that the union may default in the future with an exogenous per-period probability $1-\gamma$ $[\gamma \leq 1]$. Once a default takes place, a new bargaining round starts and a new wage proposal is put forth by the union. A possible interpretation of this assumption is that the incumbent leaders of the union can not commit over the wage policy that will be adopted by future leaders. In this case, γ represents the probability of the incumbent to retain office in the next period[4].

We also assume that firms do not possess full knowledge on the commitment technology of the union and hold the belief that defaults take place with a per-period probability $1-\alpha$. In addition, we assume that this belief may underestimate the true probability of defaults, i.e. $\gamma \geq \alpha$. As a consequence, the difference $\gamma - \alpha$ can be interpreted as a measure of firms distrust on the ability of the union to comply with the proposed plan.

In the next two sections we solve for the equilibrium level of employment and study the comparative statics with respect to α. The main result of this exercise is that unemployment increases with respect to the distrust of firms. This result connects the model to the above preliminary evidence. We hold in fact that distrust tends to be moderate in labour markets where social dialogue is intense and industrial relations are cooperative.

4 Equilibrium

4.1 The Union Problem

The assumptions that describe the bargaining environment imply that the union has a limited monopoly power in wage setting. Power is limited because the firm value constraint 6 adds to the traditional (dynamic) labour demand constraint conveyed by the free entry condition 3 and the asset equation 5.

In this sub-section we rearrange the objective function of the union 8 and the asset equation 5 with the purpose of eliminating the expectation operator. Then we set up formally the problem facing the union when making a proposal.

To rearrange the objective function of the union, let $\widetilde{W}(n_t)$ represent the optimal discounted stream of utility accruing to the union from time t onwards *if* a proposal is made and accepted at time t. $\widetilde{W}$ is conditional on the level of employment n_t since the latter, due to search frictions, represents the only state variable of the economy. Next, let $P(t)$ represent the probability that a committed plan that starts at time 0 terminates with a default at time t:

$$P(t) = \gamma^{t-1}(1-\gamma) \qquad t \geq 1$$

By using P and $\widetilde{W}$, the union welfare from a proposal made and accepted at time 0 can be expressed as

[4] For a similar interpretation of loose commitments in the context of tax policy see Debortoli and Nunes (2010).

follows

$$\mathcal{U} = nw_0 + (1-n)b + \sum_{t=1}^{\infty} P(t) \left[\sum_{j=1}^{t-1} \beta^j \left[n_j w_j + (1-n_j)b \right] + \beta^t \widetilde{W}(n_t) \right] \tag{9}$$

The general term in the square brackets represents the discounted stream of utility if the commitment made at time 0 terminates at time t. This term is multiplied by the corresponding probability of duration. Thus, the expectation operator in 8 is transformed into a sum of infinite terms corresponding to all possible durations for the current plan. Finally, substitute the expression for $P(t)$ in the latter and rearrange (see the appendix for details):

$$\mathcal{U} = \sum_{t=0}^{\infty} (\gamma\beta)^t \left\{ \left[n_t w_t + (1-n_t)b \right] + (1-\gamma)\beta\widetilde{W}(n_{t+1}) \right\} \tag{10}$$

This equation implies that the objective of the union consists of a flow of infinite terms representing the sum of current utility plus continuation value in case of default. The flow is discounted at a rate that combines time preference and probability of default.

To rearrange the asset equation 5 let $\varphi_t \equiv E_t J_{t+1}$ represent the next-period expected firm value. Then run forward the expression 5 and use the law of iterated expectation:

$$\varphi_t = E_t \sum_{j=1}^{\infty} \left[\beta(1-\rho) \right]^{j-1} (p - w_{t+j}) \tag{11}$$

The next-period value is given by the expected discounted profit flow from $t+1$ onwards. Discounting accounts for time preference as well as for the exogenous probability of destruction. As we have done with the objective function of the union, the purpose here is to eliminate the expectation operator from equation 11. For this reason, let $\widetilde{\varphi}(n_t)$ and $\widetilde{w}(n_t)$ represent the default next-period value and the default wage respectively, i.e. the optimal φ and w in the first period of a new plan. By using these functions the expression for φ_t may be restated in a recursive manner (see the appendix for details):

$$\varphi_t = \alpha \left[(p - w_{t+1}) + \beta(1-\rho)\varphi_{t+1} \right] + (1-\alpha) \left[(p - \widetilde{w}(n_{t+1})) + \beta(1-\rho)\widetilde{\varphi}(n_{t+1}) \right] \tag{12}$$

This expression is intuitive, the next-period value is given by a probability-weighted average of the value in case of continuation and the value in case of deviation from the current plan. In both cases, the value is given by next-period profits plus expected continuation value.

Having defined the functions $\widetilde{W}(n_t)$, $\widetilde{w}(n_t)$ and $\widetilde{\varphi}(n_t)$, we now proceed *as if* these functions were known. Under this working assumption, the problem facing the union is the following:

$$
\begin{aligned}
\widetilde{W}(n_0) \quad &= \quad \max_{\{w_t\}} \sum_{t=0}^{\infty} (\gamma\beta)^t \left\{ [n_t w_t + (1-n_t)b] + (1-\gamma)\beta \widetilde{W}(n_{t+1}) \right\} \\
\text{free entry} \quad &: \quad \text{a) } \frac{c}{q(\theta_t)} \geq \beta\varphi_t \qquad \text{b) } \theta_t \geq 0 \qquad \text{c) } \theta_t \left[\frac{c}{q(\theta_t)} - \beta\varphi_t \right] = 0 \\
\text{Firm value constraint} \quad &: \quad (p - w_t) + \beta(1-\rho)\varphi_t \geq H \\
\text{Employment dynamics} \quad &: \quad n_{t+1} = (1-\rho)n_t + p(\theta_t)(1-n_t) \qquad n_0 = \overline{n} \\
\text{Next-period exp. value} \quad &: \quad \varphi_t = \alpha \left[(p - w_{t+1}) + \beta(1-\rho)\varphi_{t+1} \right] + (1-\alpha) \left[(p - \widetilde{w}(n_{t+1})) + \beta(1-\rho)\widetilde{\varphi}(n_{t+1}) \right]
\end{aligned}
\tag{13}
$$

At time 0, the union inherits employment n_0 and announces a wage policy $w(n_0, t)$ with the purpose of maximising the expected flow of utility. For consistency with the definition of $\widetilde{W}$, the flow under the optimal policy turns out to be equal to $\widetilde{W}(n_0)$. In setting the policy, the union needs to take account of two dynamic constraints. The first is backward looking and concerns the evolution of employment. The second is forward looking and concerns the determination of the next-period value φ_t. The expression for the next-period value makes clear that φ_t depends on wages from $t+1$ onwards. On the other hand, the free entry condition clarifies that φ_t represents the driver for current job creation. Thus, to enhance current and future job creation the union needs to set future wages at a moderate level.

The dynamics of employment is consistent with the conjecture that job destruction may only take place for exogenous reasons. However, we are now able to prove that the conjecture is true. In fact, due to the firm value constraint, the discounted stream of profits can never fall below the non-negative amount $H_{\min}$ along the equilibrium path. Thus, job destruction will never be induced by wages that are too high.[5]

4.2 Recursive Formulation and Solution

Due to the forward dynamic constraint, the union problem is non-recursive and the optimal sequence $w(n_0, t)$ does not take the form $w(n_t)$. Thus, to compute the solution we adopt the Lagrangian method of Marcet and Marimon (2011) and transform the problem into a recursive one by introducing the fictitious

[5] Indeed, we can show that the union never induces job destruction even if it were allowed to do so, i.e. even if H was negative. Suppose that the union sets at time 0 a wage policy that induces a sudden exit of all firms at time s. This policy is dominated by an alternative policy which exhibits the same wages from 0 to $s-1$ and wages equal to p from s onwards. Along the alternative policy, employment is driven to zero only asymptotically as a consequence of exogenous job destruction. The welfare of the union is therefore larger.

state variable A_t. The Bellman for the recursive problem is the following (see appendix for derivation):

$$W(n, A) = \min_{\mu,\ \lambda,\ \zeta\geq 0,\ \sigma\geq 0}\ \max_{w,\ \varphi,\ \theta\geq 0} \Big\{ [nw + (1-n)b] + (1-\gamma)\beta\widetilde{W}(n') + (\zeta - \mu\theta)\,[c/q(\theta) - \beta\varphi] + \tag{14}$$

$$+\sigma\,[(p-w) + (1-\rho)\,\beta\varphi - H] - \lambda\varphi + A\,(p-w) + A\tfrac{1-\alpha}{\alpha}\,[p - \widetilde{w}(n) + (1-\rho)\beta\widetilde{\varphi}(n)]\Big\} + \gamma\beta W(n', A')$$

$$n' = (1-\rho)\,n + p(\theta)(1-n) \qquad A' = \frac{\alpha}{\gamma}\,[(1-\rho)\,A + \lambda/\beta] \qquad n_0 = \overline{n} \qquad A_0 = 0 \tag{15}$$

In this Bellman, ζ and μ represent the current value Lagrangian multipliers for the free entry condition [part a) and c) respectively], σ represents the multiplier for the firm value constraint and, finally, λ represents the multiplier attached to the expression that defines the next-period value φ. The fictitious state variable A_t represents the marginal cost in terms of lower employment from a small change in $w(n_0, t)$. In fact, if the union increases marginally the wage $w(n_0, t')$ along the optimal policy, the value of firms prior to time t' decreases and this reduces job creation from time 0 to time $t' - 1$. This explains the reason for A_t to exhibit a cumulative dynamics in the sense that its value increases as planning moves further into the future. Notice that, if a default occurs at some future period τ, the plan is reoptimised and A_τ is reset to zero since the new wage $\widetilde{w}(n_\tau)$ does not affect previous job creation.

Once one solves the Bellman problem, the vector of policy function is in the form $\mathbf{x}_t = \mathbf{x}(n_t, A_t)$ whith $\mathbf{x} \equiv [w, \varphi, \theta, \mu, \zeta, \sigma, \lambda]$. In turn, the policy vector $\mathbf{x}$ and state dynamics 15 induce a correspondence from the current state to the next period state:

$$n' = F(n, A) \qquad A' = G(n, A) \tag{16}$$

Thus, starting from the initial state $(\overline{n}, 0)$ equations 16 allow computation of the whole sequence of states (n_t, A_t) $t \geq 0$. In turn, once the state sequence is known, applying the policy function $w(n, A)$ to the sequence gives the wage profile $w(\overline{n}, t)$ proposed by the union at time 0.

4.3 Characterisation

In this section we discuss three results that summarise the main features of the solution of the Bellman problem. The proof of these results as well as the focs and Euler's conditions of the problem are provided in the appendix.

Result 1: In the first period of the plan the firm value constraint is binding.

Result 2: If $\theta > 0$ and if the firm value constraint is not binding, optimal wage setting satisfies the condition

$$\beta\left[(1-\gamma)\widetilde{W}_n(n')+\gamma W_n(n',A')\right]p'(\theta)=\frac{\lambda}{\beta}\frac{-cq'(\theta)}{q^2(\theta)}\frac{1}{1-n} \tag{17}$$

Result 3: The state in the next-period does not depend on the current value of A:

$$F_A = G_A = 0$$

Result 1 is descriptive of the behaviour of the union. The result clarifies that the union exploits the full scope of its discretionary power at the beginning of the plan. In fact, entry decisions only depend on profits from the second period onwards. Thus, charging high wages in the first period is of no consequence for job creation.

Result 1 is also important from a technical perspective. In formulating the union problem we have proceeded *as if* $\widetilde{w}(n)$ and $\widetilde{\varphi}(n)$ were known. However, $\widetilde{w}(n)$ and $\widetilde{\varphi}(n)$ are truly unknown since they are part of the solution. For consistency, the wage and the next-period value at the time of reoptimisations must coincide with the optimal wage and the optimal next-period value upon setting $A = 0$, i.e. $\widetilde{w}(n) = w(n, 0)$ and $\widetilde{\varphi}(n) = \varphi(n, 0)$. This means that we face a circularity in the sense that we need to know the solution to be able to find the solution.

Typically, when facing this type of circularity one needs to resort to some computational routine starting from a candidate solution and reiterating until convergence (Debortoli and Nunes, 2010). In this respect, Result 1 is remarkable because it allows to bypass the circularity and avoid computations. The result implies that the firm value constraint is binding at times of reoptimisation:

$$p-\widetilde{w}(n)+\beta(1-\rho)\widetilde{\varphi}(n)=H \tag{18}$$

Thus, one may substitute H in place of the unique term that contains the two unknown functions in the Bellman so that these functions completely disappear from the problem.

Result 2 gives the condition for efficient wage setting. Efficiency requires a balance between the marginal cost and the marginal benefit from inducing the creation of an extra vacancy. The LHS of 17 represents the marginal benefit. An extra vacancy at current time increases next-period employment by $p'(\theta)$. In turn, the value of an extra employed worker is equal to $W_n(n', A')$ if the plan continues and to $\widetilde{W}_n(n')$ if the plan is reoptimised. By contrast, the RHS of the equation represents the marginal cost. If vacancies are posted at a positive rate, the free entry condition requires $c/q(\theta) = \beta\varphi$. Thus, to induce the creation of an extra vacancy the union needs to increase φ by $\frac{-cq'(\theta)}{q^2(\theta)}\frac{1}{1-n}\frac{1}{\beta}$. In the equation, this variation is multiplied through λ since the latter represents the (current) utility cost of a marginal increase in φ.

Result 3 implies that for the state at time $t+1$ it is irrelevant whether the plan continues or it is reoptimised at time t. A corollary of this result is that vacancy posting and the dynamics of employment is not affected by the actual sequence of defaults. The intuition for this result is the following. Vacancy posting depends on future wages not on current wages. Thus, if a default is allowed, the union exploits the chance of pushing firms onto the constraint uniquely by increasing current wages. Future wages are not revised at all and, as a consequence, vacancy posting is not affected.

The relevant implication of result 3 is that convergence to the steady state is not perturbed by events that trigger a default. Thus, the steady state is reached asymptotically along a path that does not depend on the actual history of defaults. Thanks to this result, we may proceed as it is customary in the search and matching literature and focus on the properties of the steady state.

4.4 Steady State

The following expressions give employment, market tightness and the next-period firm value at the steady state:

$$\overline{n} = \frac{p(\overline{\theta})}{\rho + p(\overline{\theta})} \tag{19}$$

$$\frac{c}{q(\overline{\theta})} = \beta\overline{\varphi} \tag{20}$$

$$\overline{\varphi} = \frac{\alpha(p - \overline{w}) + (1-\alpha)H}{1 - \alpha\beta(1-\rho)} \tag{21}$$

The first derives from the dynamics of employment, the second from the free entry condition, the third from Result 1 and the forward dynamics of φ. The system is recursive. Once the steady state wage $\overline{w}$ is given, equation 21 solves for the next-period firm value, equation 20 for market tightness and, finally, equation 19 for the level of employment.

The determination of $\overline{w}$ depends on whether the firm value constraint is binding at the steady state. If the constraint is binding the wage $\overline{w}$ is determined straightforwardly by the constraint itself:

$$(p - \overline{w}) + \beta(1-\rho)\overline{\varphi} = H \tag{22}$$

By constrast, if the constraint is non-binding, the wage $\overline{w}$ is determined by the efficient condition 17. To use this condition, however, we first need to solve for the steady state level of λ. For this purpose, notice that λ enters the dynamics of A and observe that, if the constraint is non-binding ($\sigma = 0$), A and n must be equal at the steady state. Intuitively, this happens because n represents the marginal benefit from a small increase in the steady state wage while, with a non-binding constraint, A represents the marginal cost. The upshot of these remarks is that the dynamics of A implies the following value for $\overline{\lambda}$:

$$\overline{\lambda} = \beta \left[\frac{\gamma}{\alpha} - (1-\rho) \right] \overline{n} \tag{23}$$

A second difficulty with condition 17 relates to the fact that it contains the steady state derivatives of $W(n, A)$ and $\widetilde{W}(n)$ with respect to n. In fact, while the function $W(n, A)$ is defined by the Bellman, the function $\widetilde{W}(n)$ is truly unknown. However, for consistency, $\widetilde{W}(n)$ coincides with $W(n, A)$ upon setting $A = 0$. We may therefore exploit this property and compute the two required derivatives (details in the appendix):

$$(1-\gamma)\widetilde{W}_n(\overline{n}) + \gamma W_n(\overline{n}, \overline{n}) = \frac{(1-\gamma)\left[p - b + (1-\rho)\beta\overline{\varphi} - H\right] + \gamma\left(\overline{w} - b\right)}{1 - \beta\left[1 - \rho - p(\overline{\theta})\right]} \tag{24}$$

5 Comparative Statics

5.1 Binding Constraint

If the constraint is binding at the steady state, the equilibrium wage and tightness arise from the system 19-21 plus equation 22:

$$\overline{w}^b = p - \left[1 - \beta(1-\rho)\right] H \tag{25}$$

$$\frac{c}{q(\overline{\theta}^b)} = \beta H \tag{26}$$

These equations imply that (dis-)trust does not affect the equilibrium. In fact, when the constraint is binding it is as if wages were decided by firms at a level that strictly satisfies the firm value constraint. This means that the union commitment is truly immaterial so that it is irrelevant whether firms hold an high or a low belief on the union ability to keep promises. In this case, the key parameter that affects the equilibrium is the bargaining strength of firms, which is summarised by H. It is straightforward to prove that the wage decreases with respect to H while market tightness increases.

5.2 Non-binding Constraint

If the constraint is non-binding, to compute the equilibrium we first substitute 23 and 24 in 17 then merge the resulting expression with the system 19-21:

$$\frac{c}{q(\overline{\theta}^{nb})} = \beta \frac{\alpha(p - \overline{w}^{nb}) + (1-\alpha)H}{1 - \alpha\beta(1-\rho)} \tag{27}$$

$$\frac{\alpha(\overline{w}^{nb} - b) - (1-\gamma)H}{\alpha(p - \overline{w}^{nb}) + (1-\alpha)H} = \Gamma(\gamma, \alpha, \overline{\theta}^{nb}) \tag{28}$$

$$\Gamma(\gamma, \alpha, \theta) \equiv \frac{1 - \beta\left[1 - \rho - p(\theta)\right]}{1 - \beta\alpha\left(1-\rho\right)} \frac{\gamma - \alpha\left(1-\rho\right)}{\rho} \frac{\eta(\theta)}{1 - \eta(\theta)} - \frac{1-\gamma}{1 - \beta\alpha\left(1-\rho\right)}$$

In the search and matching literature, equation 27 is often referred as the job-creation condition and may be thought of as determining market tightness for a given wage level. The RHS of the expression represents the market value of firms at the steady state while the LHS is the expected cost of search. By constrast, equation 28 is similar to a traditional wage-setting schedule and may be interpreted as a condition that determines wages for given market tightness. The expression coincides with its textbook counterpart if one assumes that the union has access to a perfect commitment technology ($\gamma = 1$) and that firms hold beliefs that are correct ($\alpha = 1$). In this case, the condition simplifies as follows:

$$\frac{\overline{w}^{nb} - b}{1 - \beta\left[1 - \rho - p(\overline{\theta}^{nb})\right]} \Bigg/ \frac{p - \overline{w}^{nb}}{1 - \beta\left(1-\rho\right)} = \frac{\eta(\overline{\theta}^{nb})}{1 - \eta(\overline{\theta}^{nb})} \tag{29}$$

The LHS of 29 represents the ratio between the worker's value from being employed and the value of a matched firm. By constrast, the RHS gives the ratio between the firm and the worker matching elasticities. Thus, the expression reproduces the so called Hosios condition for efficient wage setting in presence of search externalities. The intuition for this result is as follows. Since the utility of the employed and of the unemployed are weighted equally, the union is concerned with maximising the flow of total net production. For this reason, it commits to a wage policy that induces the same allocation commanded by a utilitaristic benevolent planner.

In the remainder of this section we study the comparative statics of $\overline{w}^{nb}$ and $\overline{\theta}^{nb}$ for the general case of loose commitment ($\gamma \leq 1$) and distrust ($\alpha \leq \gamma$). For this purpose, we interpret conditions 27 and 28 as defining a couple of implicit functions with $\overline{w}^{nb}$ as dependent variable:

$$\text{Condition 27 (job creation):} \qquad \overline{w}^{nb} = z(\overline{\theta}^{nb}; H, \alpha)$$
$$\text{Condition 28 (wage setting):} \qquad \overline{w}^{nb} = l(\overline{\theta}^{nb}; H, \alpha, \gamma)$$

In the appendix we study the schedules z and l and prove the following proposition:

Proposition 1

Part a): z is decreasing with respect to θ, l is increasing: $z_\theta < 0$, $l_\theta > 0$.

Part b): z is increasing with respect to α, l is decreasing: $z_\alpha > 0$, $l_\alpha < 0$.

Part c): z does not depend on γ, l is increasing: $z_\gamma = 0$, $l_\gamma > 0$.

Part d): z and l are both increasing with respect to H: $z_H = \frac{1-\alpha}{\alpha}$, $l_H = \omega \frac{1-\alpha}{\alpha}$ with $\omega \equiv \frac{\frac{1-\gamma}{1-\alpha}+\Gamma}{1+\Gamma} \leq 1$.

Proof: see appendix.$\diamond$

5.2.1 Trust

Preliminary evidence documents that countries with a more intense social dialogue and more cooperative industrial relations exhibit a better labour market performance. Here we show that the model is able to rationalise the evidence. More specifically, we show that equilibrium market tightness increases if firms become more confident on the ability of the union to keep promises.

Figure 4 depicts the job creation line z and the wage setting line l and illustrates the effects of an increase in trust, i.e. an increase in α holding γ constant.

The job creation condition is downward sloping ($z_\theta < 0$) since an higher wage discourages entry and reduces market tightness. By contrast, the wage setting schedule is upward sloping ($l_\theta > 0$). The main mechanism underlying this positive slope can be grasped by looking at equation 29. As market tightness increases, the probability of re-matching after being fired increases too. In turn, this reduces the net gain from being employed and requires an increase in wages to restore the efficient sharing of match surplus.[6].

The figure illustrates that an improvement in trust moves the job creation condition upward ($z_\alpha > 0$). To explain this effect recall that, since the firm-value constraint is non-binding, the market value of firms lies above H when the plan continues and drops to H when a default occurs. Thus, defaults are negative events from the perspective of firms. This implies that a lower perceived probability of defaults increases the expected flow of profits and leads to a more sustained entry. The job creation condition moves upward because, with a larger α, the same level of market tightness is attained through higher wages.

The figure also illustrates that the wage setting condition moves downward following an increase in α

[6] In a decentralised equilibrium with Nash-bargaining the wage setting line is upward sloping because higher market tightness improves the fallback option of workers and sustain higher wage claims.

($l_\alpha < 0$). This effect represents a major result of the analysis since it rationalises the common perception that wage moderation arises with cooperative industrial relations. The intuition for the result is as follows. When trust is low, defaults are expected to take place with high frequency by firms so that they discount profits at a very high rate along the promised wage profile. Discounting, in fact, combines pure time preference with the belief that the current plan will hold in the future. From the perspective of the union this means that low wages are not so effective in stimulating current job creation. By contrast, when trust is high, future profits are discounted at low rates along the plan and wages are very effective for current vacancy posting. The upshot of these remarks is that an improvement in trust tilts the union trade-off between wages and job creation and boosts incentive towards wage moderation. This explains the reason for the wage setting schedule to move downward.

As a result of the shift of the two schedules, the equilibrium market tightness increases so that trust proves to be beneficial for the overall performance of the labour market.

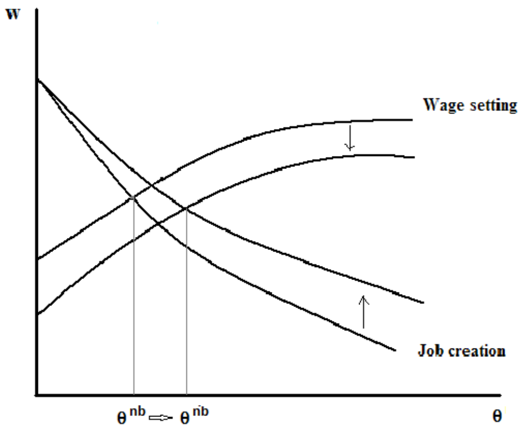

Fig. 4: The impact of α on market tigthness.

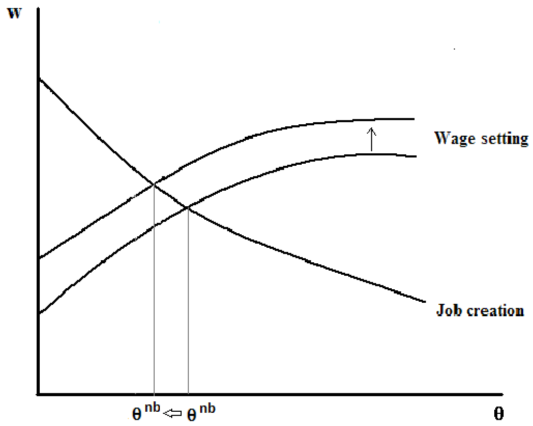

Fig. 5: The impact of γ on market tightness.

5.2.2 Loose commitment

The (dis-)trust of firms on the ability of the union to keep promises is measured by the difference $\gamma - \alpha$. While in the previous section we have studied the effects of a variation in trust due to a change in α, in this section we study the effects of a variation in trust due to a change in γ. The exercise is meaningful since a different economic mechanism is at work. In any case, we will end up again with the conclusion that more distrust - i.e. a larger difference $\gamma - \alpha$ - implies lower market tightness.

Figure 5 illustrates the impact of an increase in γ holding α constant. The job creation condition is not affected ($z_\gamma = 0$) while the wage setting schedule moves upwards ($l_\gamma > 0$). As a consequence, equilibrium wages increase and market tightness decrease. The intuition for this result is as follows. From the point of view of the union, defaults are similar to a lump-sum non-distorsive taxation on firms. The larger the number of firms the larger the revenue from the tax. Thus, as γ increases, the frequency of taxation decreases so that the benefit from having a large tax base is lower. For this reason, the union has a lower incentive towards wage moderation and job creation.

In contrast with the result depicted in figure 5, in the standard hold-up literature an improvement in the commitment technology usually leads to a better market performance. This is mainly because tying own hands implies by itself an improvement in the belief concerning the soundness of promises. In figure 5, however, this mechanism is completely ruled out since the increase in γ is not accompanied by an increase in α. As a consequence, following the reduction in the frequency of reoptimisations, the union charges higher wages but firms do not boost job creation. Put it differently, if we assume perfect knowledge on the commitment technology ($\alpha = \gamma$), the increase in γ shifts upward not only the wage setting line but also the job creation line. As a consequence, the wage increases as in figure 5 but market tightness may increase or decrease depending on parameters.

However, even if beliefs do not change following the improvement in technology, the welfare of the union can not decrease. To prove this property, let $[\widetilde{w}(n;\gamma,\alpha),\ w(n,t;\gamma,\alpha)]$ represent the optimal wage policy under technology (γ,α) and let $\widetilde{W}(n;\gamma,\alpha)$ represent the ensuing union welfare. Next, consider an improvement in technology whereby the probability of default decreases from $1-\gamma_1$ to $1-\gamma_2$ ($\gamma_1 < \gamma_2$). The property holds because, under γ_2, the union is able to replicate the equilibrium that arises under γ_1. In fact, under γ_2 the union can commit to a *mixed policy* that has wages equal to default wages $\widetilde{w}(n;\gamma_1,\alpha)$ with a per-period probability $p \equiv \gamma_1/\gamma_2$ and equal to $w(n,t;\gamma_1,\alpha)$ with a probability $1-p$. This policy induces the same wage and employment sequence arising in equilibrium under γ_1. Thus, since the replication policy does not need to be optimal, it follows that[7]

$$\widetilde{W}(n;\gamma_2,\alpha) \geq \widetilde{W}(n;\gamma_1,\alpha)$$

5.2.3 Firms bargaining power

We conclude the comparative statics analysis by studying the impact of a change in the bargaining power of firms. The job creation condition implies that, for given wages, firms are more willing to create jobs if H increases ($z_H = \frac{1-\alpha}{\alpha}$). By contrast, the wage setting line implies that, for given market tightness, wages increase with respect to H ($l_H = \omega\frac{1-\alpha}{\alpha}$). The first effect is due to the fact that a larger H makes the union less able to extract value from firms at times of default. The second effect can be grasped by resorting to the above tax methafor. Since with a larger H the default-tax rate is lower, the union has a lower incentive to enlarge its tax base through moderate wages.

The upshot of these remarks is that an increase in the bargaining power of firms produces a counter-

[7] Here we have adapted to the present context a proof developed by Debortoli and Nunes (2010).

intuitive increase in wages and a minor impact on market tightness. If we set $\alpha = \gamma$, then the two lines shift upward by the same amount ($z_H = l_H$) so that equilibrium market tightness holds unchanged. This happens because the increased willingness to create jobs is fully counteracted by a more aggressive wage policy. By contrast, if $\alpha < \gamma$, the job creation line shifts upward to a larger extent ($z_H > l_H$). As a result, equilibrium market tightness increases with the bargaining power of firms.

6 Trust and distributive conflict

A distributive conflict arises when workers and firms disagree on wages. Typically, during a conflict, industrial relations are adversarial and characterised by episodes of strike and lockout. In our setting, it is quite natural to interpret a situation of conflict as the one arising when the constraint imposed by the bargaining power of firms is binding. Thus, the purpose of this section is to study under what conditions the constraint binds and, henceforth, to provide a theoretical analysis on the determinants of industrial conflict.

The main result of the section is that conflicts are less likely if the bargaining power of firms is moderate and if trust is high. Thus, the key message from the analysis is that the quality of industrial relation and the intensity of social dialogue determine the incidence of labour market disputes. This finding is consistent with the practice of measuring trust resorting to indicators of conflict (Blanchard and Philippon, 2006).

We organise the analysis around the definition of two schedules. Let $\theta^b(H)$ represent the relationship between steady state market tightness and firm power *if* the constraint is binding. This relationship is implicitly defined by equation 26. By contrast, let $\theta^{nb}(H, \alpha)$ represent the relationship between tightness, firm power and trust *if* the constraint is not binding. This relationship is implicitly defined by the system 27-28. Since market tightness increases with the value of firms the constraint turns out to be binding in steady state if and only if $\theta^{nb}(H, \alpha) < \theta^b(H)$. Thus, to characterise under what conditions the constraint binds we need to study the shape of these two schedules. The following proposition describes their properties.

Proposition 2

Part a): the schedule $\theta^b(H)$ is characterised by the following properties:

1. $\theta^b_H(H) > 0$
2. $\lim\limits_{H \longrightarrow H_{\min}} \theta^b(H) = 0$
3. $\frac{c}{q\left[\theta^b(H_{\max})\right]} = \beta H_{\max}$

Part b): if $\alpha < \gamma$, the schedule $\theta^{nb}(H, \alpha)$ is characterised by the following properties:

4. $\theta^{nb}_H(H, \alpha) > 0$

5. $\theta_{\alpha}^{nb}(H,\alpha) > 0$

6. $\lim\limits_{H \longrightarrow H_{\min}} \theta^{nb}(H,\alpha) > 0$

7. $\theta^{nb}(H_{\max},\alpha) < \theta^{b}(H_{\max})$

Proof: See appendix$\diamond$

Figure 6 depicts the two schedules according to the properties enlisted in Proposition 2 and illustrates the shift in $\theta^{nb}(H,\alpha)$ due to an increase in trust (property 5.) Let $H(\alpha)$ represent the level of firms bargaining power at which the two schedules cross. The figure clarifies that for any H falling within the set $(H_{\min},\ H(\alpha)]$ the constraint is non-binding. The key result arising from the figure is that this sets enlarges if α increases from α_1 to α_2 $[\alpha_2 > \alpha_1]$.

Less formally, industrial conflict is unlikely if trust is high and/or firm power is low. The mechanism underlying this finding is the fact that trust induces the union to moderate wage claims. With high trust, in fact, future wages become very effective in stimulating current job creation. In turn, moderate wages are likely to be consistent with the profit requirement of firms. In short, more trust leads to less scope for conflict.

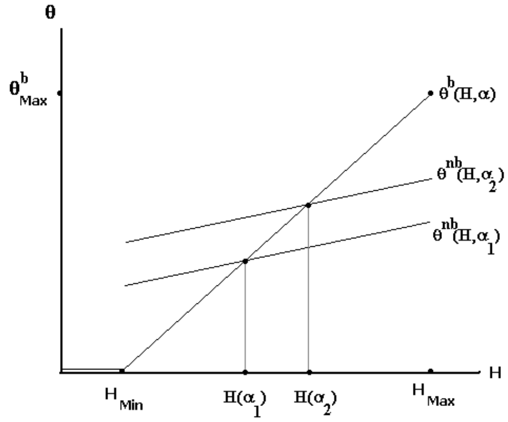

Fig. 6: The scope for conflict shrinks with trust.

7 Econometric Evidence

7.1 Empirical strategy and data

Using descriptive evidence, in section 2 we have documented that trust and social dialogue variables are negatively correlated with unemployment in a set of Oecd countries. Subsequently, we have taken this evidence as causal and have proposed a theoretical mechanism to rationalise correlations. In this section we make a step forward and look at econometric evidence.

To perform this task we estimate the following unemployment regression:

$$u_{i,t} = b_0 + \mathbf{b}_1 \mathbf{Y}_{i,t} + b_2 T_{i,t} + v_i + \varepsilon_{i,t}$$

The dependent variable is the rate of unemployment for the 15-64 age group. The vector $\mathbf{Y}$ contains the main drivers of unemployment, i.e. the output gap and a set of institutional variables. The set includes a measure of union density, a measure of corporativism, the unemployment benefit replacement rate, the rate of total labour taxation, an index for product market regulation and an index for the stringency of employment protection.[8] A detailed description of these variables is provided in the appendix.

The variable T represents our key addition to an otherwise standard conditioning vector. Depending on the specific regressor that is used, in some regressions T captures the intensity of social dialogue while, in other regressions, it captures the degree of cooperation in industrial relations or the degree of trust towards unions. Since all these variables are good proxies of firms beliefs concerning union promises, the prediction of the model is $b_2 < 0$.

The term v_i captures country unobserved heterogeneity. When all regressors are time-variant, we account for unobserved heterogeneity through fixed effect estimation. In some cases, however, the added regressor T is time invariant so we are forced to adopt random effects estimation. It is well known that random effects are based on the assumption that v_i is uncorrelated with all regressors. We check whether v_i is uncorrelated with time varying regressors by computing the Hausman statistic. However, we can not check whether v_i is uncorrelated with T. For this reason, whenever the added regressor T is time-invariant, we also resort to an instrumental variable procedure.

Since the model suggests that trust/cooperation determine whether the equilibrium exhibits distributive conflict, the instrument used in regressions is the incidence of industrial conflicts during the 70's.

7.2 Evidence

We use 5 different but highly correlated additional regressors. In regressions presented in columns II-V of Table 1 we add the three sub-indicators that were used in section 2 to compute the index for the intensity of social dialogue (*RI*, *BC* and *WC*). In columns VI-VII we add the WEF measure of cooperation in industrial relations averaged over the 'central years' 1990 to 1994. Finally, in columns VIII-IX we add the WSS measure of trust described in section 2.

The routine involvement indicator (*RI*) and the bilateral council dummy (*BC*) are time-variant so we use fixed-effect estimation. By contrast, the works councils indicator (*WC*), the WEF measure of cooperation (*Coop. I.R.*) and the WSS measure of trust (*Trust*) are time invariant so we use both

[8] For a similar specification see Bassanini and Duval (2006).

random-effect and random-effect IV estimation. The instrument is represented by an indicator computed from data on labour market disputes collected annually by the ILO since 1970. Resorting to these data we build the ratio between the number of workers involved in strikes and lockouts in a given year and the corresponding level of employment. Then, we average this ratio over the 1971-1980 period and compute a conflict indicator by using quartile thresholds. According to this indicator, countries are classified along a 4-points scale (1,2,3,4). The minimum corresponds to a very low conflict intensity (below the 25° percentile), the maximum to a very high conflict intensity (above the 75° percentile).

In column I we present the baseline regression, i.e. the regression without any social dialogue, cooperation or trust variable. With the exception of EPL, all coefficients exhibit the sign that is consistent with theoretical priors as well as with previous empirical literature. The negative sign of the EPL coefficient, however, is not at odds with theoretical arguments. Employment protection, in fact, not only reduces job creation but also job destruction (Bertola, 1990). In addition, it may serve as a device to overcome a number of market failures that are harmful for job creation.[9] Thus, there is no clearcut theoretical prediction for the sign of the coefficient.

In columns II and III we add to baseline regressors the index for routine involvement (RI) and the index for bilateral councils (BC) respectively. Estimations show that unemployment tends to be lower in countries where unions and firms are more involved in social dialogue at central level both in the form of participation to government decisions and in the form of institutional participation to bilateral councils. Social dialogue, however, takes place not only at central level but at local level too. For this reason, in columns IV and V, we add to baseline regressors the index that measures the existence and influence of local works councils (WC). Works councils are elected bodies of workforce representatives - set up on the basis of laws or collective agreements - that have the objective of promoting cooperation within the firm through some form of participation of workers to managerial decisions. The evidence on social dialogue at local level is coherent with the one at aggregate level. Unemployment tends to be lower in countries where works councils exist and are endowed with decision powers (codetermination) as opposed to countries where councils have a mere consultative role or are only endowed with information rights. Thus, the overall evidence of columns II-V appears to be consistent with the basic prediction of the model. In labour markets where social dialogue is intense there is less scope for overestimating the probability that unions will default from their promises. According to the model, this promotes wage moderation and job creation so that the expected impact of social dialogue is to reduce unemployment.

Social dialogue indicators capture elements of the institutional environment that reduce the scope for asymmetric information. Analogously, indicators for trust and the quality of industrial relations capture

[9] Fella (2000), for instance, shows that employment protection reduces equilibrium wages and increases employment in an efficiency-wage model with shirking. Wasmer (2006) shows that employment protection increases incentives towards job-specific training.

elements of the 'behavioural environment' that contribute to further reduce asymmetric information. This is because trust and cooperation enhance credible communications between the two parties. A deviation from cooperation in the form of false communication is in fact punished by a collapse in cooperative attitudes.

In columns VI-IX we augment the conditioning vector by inserting the cooperation and trust indicators. Results are close to those obtained in previous empirical studies [Blanchard and Philippon (2006), Feldman (2008)]. Consistently with the main prediction of the model, regressions show that unemployment tends to be lower in countries characterised by more cooperative industrial relations and more trust towards workers organisations.

8 Concluding Remarks

Descriptive evidence suggests that labour markets exhibit a better performance if industrial relations are characterised by cooperation, intense social dialogue and trust towards unions. In this paper we regard this evidence as causal and build a model that rationalises correlations.

The key ingredient of the model is an informational disadvantage of firms regarding the ability of the union to commit to an announced wage plan. Firms are not fully informed on the commitment technology and base their investment decisions on some exogenous belief regarding the probability of default. In equilibrium, wages and employment turn out to depend on this belief. If defaults are regarded as likely then the union has low incentives to announce and implement moderate wages. The reason being that distrust on the fulfillment of the plan disconnects job creation from the announced wages. By contrast, if defaults are considered as unlikely, then the union has a large incentive towards wage moderation. For, in this case the announced wages are relevant when deciding upon the opening of vacancies.

In our view this mechanism rationalises the evidence because trust, cooperation and social dialogue are all good measures of firms confidence towards union promises. On the one hand, trust towards the union may be thought of as a direct measure of confidence. On the other hand, cooperation and social dialogue intensity may be regarded as close proxies. In fact, being a consequence of asymmetric information, confidence tends to be sustained in environments where parties engage in frequent exchanges of credible information.

In the econometric section of the paper we test the empirical consistency of the model by augmenting a standard unemployment equation with variables that capture key features of the bargaining environment. Some of these additional regressors measure institutional elements, others measure behavioural and attitudinal traits. In any case, these regressors are mutually correlated across countries and speak of a deep connection between attitudes, behaviour and institutions. This motivates the strategy of inserting one single regressor for any estimated equation. On the other hand, the strong mutual correlation calls for an explanation as for its source. This is beyond the scope of the present paper and is therefore left to future research. In any case, a promising avenue appears to be the argument that institutional and behavioral/attitudinal elements co-evolve in time so that countries tend to group in rather homogeneous clusters (Aghion et al., 2011).

Table 1: Social Dialogue, Cooperation, Trust and Unemployment

Dep.Unemployment

Method	FE	FE	FE	RE	RE-IV	RE	RE-IV	RE	RE-IV
Output Gap	.54***	.53***	.53***	.55***	.54***	.55***	.55***	.58***	.58***
	(.04)	(.04)	.04	(.04)	(.04)	(.04)	(.04)	(.04)	(.05)
Un. Density	-.01	-.01	-.01	-.02	-.01	-.03	-.03*	.00	.01
	(.02)	(.02)	(.02)	(.02)	(.02)	(.02)	(.02)	(.02)	(.03)
Highcorp	-1.53***	-1.18***	-1.51***	-1.41***	-1.42***	-1.22***	-1.19***	-1.21***	-1.19***
	(.40)	(.40)	(.39)	(.38)	(.40)	(.39)	(.41)	(.40)	(.45)
Benefits	.08***	.08***	.08***	.08***	.08***	.06***	.06***	.07***	.07***
	(.02)	(.02)	(.02)	(.02)	(.02)	(.02)	(.02)	(.02)	(.02)
Taxes	.30***	.28**	.31***	.30***	.31***	.29***	.29***	.30***	.31***
	(.03)	(.03)	(.03)	(.03)	(.03)	(.03)	(.03)	(.03)	(.03)
PMR	.51**	.62***	.53***	.53**	.50**	.46**	.45*	.52**	.49**
	(.22)	(.22)	(.22)	(.21)	(.22)	(.23)	(.24)	(.25)	(.26)
EPL	-1.41***	-1.53***	-1.39***	-1.34***	-1.26***	-1.53***	-1.52***	-1.59***	-1.46***
	(.34)	(.35)	(.35)	(.35)	(.35)	(.33)	(.31)	(.39)	(1.39)
RI		-.79***							
		(.23)							
BC			-1.63**						
			(.79)						
WC				-1.39**	-2.86*				
				(.66)	(1.75)				
Coop I.R.						-2.98***	-3.57***		
						(.33)	(1.58)		
Trust								-7.45**	-13.28*
								(3.18)	(7.13)
Year D. and Const.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N. Obs.	440	440	440	440	440	418	418	352	352
N. Countries	20	20	20	20	20	19	18	16	16
R^2	.35	.45	.44	.48	.40	.53	.53	.40	.37
Standard Error	3.42	3.11	3.14	3.02	3.38	2.85	2.87	3.34	3.63
Hausman (χ^2)				1.07		3.53		3.06	

FE: Fized Effect
RE: Random Effects, GLS Swamy-Arora procedure
RE-IV: instrumental variable RE, two-stage random-effect estimator
Robust standard errors in parenthesis; *** 1% significance,** 5% significance, * 10% significance.

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A Derivation of equation 10

Substitute $P(t)$ in 9 and use u_t for the per-period union utility $n_t w_t + (1-n_t)b$:

$$\mathcal{U} = u_0 + \Omega + \sum_{t=1}^{\infty} (\gamma\beta)^{t-1}\beta(1-\gamma)\widetilde{W}(n_t) \qquad \Omega \equiv \sum_{t=1}^{\infty} \gamma^{t-1}(1-\gamma)\sum_{j=1}^{t-1}\beta^j u_j \tag{30}$$

Expand Ω:

$$\begin{aligned}
\Omega &= (1-\gamma)\sum_{j=1}^{0}\beta^j u_j + \gamma(1-\gamma)\sum_{j=1}^{1}\beta^j u_j + \gamma^2(1-\gamma)\sum_{j=1}^{2}\beta^j u_j + \gamma^3(1-\gamma)\sum_{j=1}^{3}\beta^j u_j + \ldots = \\
&= (1-\gamma)\cdot 0 + \gamma(1-\gamma)\cdot[\beta u_1] + \gamma^2(1-\gamma)\cdot\left[\beta u_1 + \beta^2 u_2\right] + \gamma^3(1-\gamma)\cdot\left[\beta u_1 + \beta^2 u_2 + \beta^3 u_3\right] + \ldots
\end{aligned}$$

Collect terms with the same time index:

$$\Omega = \beta u_1 \cdot \sum_{t=1}^{\infty}\gamma^t(1-\gamma) + \beta^2 u_2 \cdot \gamma \cdot \sum_{t=1}^{\infty}\gamma^t(1-\gamma) + \beta^3 u_3 \cdot \gamma^2 \cdot \sum_{t=1}^{\infty}\gamma^t(1-\gamma) + \ldots$$

Observe that $\sum_{t=1}^{\infty}\gamma^t(1-\gamma) = \gamma$ and rearrange:

$$\Omega = \sum_{t=1}^{\infty}(\beta\gamma)^t u_t$$

Substitute this expression in 30 and simplify to obtain equation 10 in the main text:

$$\mathcal{U} = \sum_{t=0}^{\infty}(\beta\gamma)^t\left[u_t + \beta(1-\gamma)\widetilde{W}(n_{t+1})\right]$$

B Derivation of equation 12

Define the indicator I_t as follows:

$$I_t = \begin{cases} 1 & \text{if the plan continues at time } t \\ 0 & \text{if the plan is defaulted at time } t \end{cases}$$

Write 11 as follows:

$$\begin{aligned}\varphi_t &= \alpha\left[E_t\left(\left.(p-w_{t+1})\right| I_{t+1}=1\right)+E_t\left(\left.\sum_{j=2}^{\infty}[\beta(1-\rho)]^{j-1}(p-w_{t+j})\right| I_{t+1}=1\right)\right]+\\ &\quad +(1-\alpha)\left[E_t\left(\left.(p-w_{t+1})\right| I_{t+1}=0\right)+E_t\left(\left.\sum_{j=2}^{\infty}[\beta(1-\rho)]^{j-1}(p-w_{t+j})\right| I_{t+1}=0\right)\right]\end{aligned}$$

Use the law of iterated expectations and change the index of summations ($s=j-1$):

$$\begin{aligned}\varphi_t &= \alpha\left[(p-w_{t+1})+\beta(1-\rho)E_t\left(E_{t+1}\left(\left.\sum_{s=1}^{\infty}[\beta(1-\rho)]^{s-1}(p-w_{t+1+s})\right| I_{t+1}=1\right)\right)\right]+\\ &\quad +(1-\alpha)\left[(p-\widetilde{w}(n_{t+1}))+\beta(1-\rho)E_t\left(E_{t+1}\left(\left.\sum_{s=1}^{\infty}[\beta(1-\rho)]^{s-1}(p-w_{t+1+s})\right| I_{t+1}=0\right)\right)\right]\end{aligned}$$

Use the definition of φ_t and $\widetilde{\varphi}_t$:

$$\varphi_t=\alpha\left[(p-w_{t+1})+\beta(1-\rho)E_t\left(\varphi_{t+1}\right)\right]+(1-\alpha)\left[(p-\widetilde{w}(n_{t+1}))+\beta(1-\rho)E_t\left(\widetilde{\varphi}(n_{t+1})\right)\right]$$

Notice that φ_{t+1} and $\widetilde{\varphi}(n_{t+1})$ are both non-stochastic at time t. Thus, the latter is similar to equation 12 in the main text.

C Recursive Formulation

Express the next-period firm value as a sum of infinite terms:

$$\varphi_t=\sum_{j=0}^{\infty}[\alpha\beta(1-\rho)]^j g_{t+1+j} \qquad g_s\equiv\alpha(p-w_s)+(1-\alpha)\left[(p-\widetilde{w}(n_s))+(1-\rho)\widetilde{\varphi}(n_s)\right]$$

Let $(\gamma\beta)^t\zeta_t$, $(\gamma\beta)^t\mu_t$, $(\gamma\beta)^t\sigma_t$, $(\gamma\beta)^t\lambda_t$ represent the Lagrangian multipliers associated to the free entry condition part a), the free entry condition part c), the firm value constraint and the next-period firm value respectively. The Lagrangian for the problem 13 is

$$\mathcal{L}=\sum_{t=0}^{\infty}(\gamma\beta)^t\left\{\Phi_t+\lambda_t\sum_{j=0}^{\infty}[\alpha\beta(1-\rho)]^j g_{t+1+j}\right\}$$

$$\Phi_t \equiv [n_t w_t+(1-n_t)b]+(1-\gamma)\beta\widetilde{W}(n_{t+1})+(\zeta_t-\mu_t\theta_t)\left[\frac{c}{q(\theta_t)}-\beta\varphi_t\right]+\sigma_t\left[(p-w_t)+(1-\rho)\beta\varphi_t-H\right]-\lambda_t\varphi_t$$

Expand the summation and collect Φ and g terms with the same time index:

$$
\begin{aligned}
\mathcal{L} \;=\;& \Phi_0 + \\
&+(\beta\gamma)\left\{\Phi_1+\lambda_0\frac{g_1}{\beta\gamma}\right\}+ \\
&+(\gamma\beta)^2\left\{\Phi_2+\left[\lambda_0\frac{\alpha}{\gamma}(1-\rho)+\lambda_1\right]\frac{g_2}{\beta\gamma}\right\}+ \\
&+(\gamma\beta)^3\left\{\Phi_3+\left[\lambda_0\left[\frac{\alpha}{\gamma}(1-\rho)\right]^2+\lambda_1\frac{\alpha}{\gamma}(1-\rho)+\lambda_2\right]\frac{g_3}{\beta\gamma}\right\}+...
\end{aligned}
$$

Set

$$
A_t=\frac{\alpha}{\gamma}\left[(1-\rho)A_{t-1}+\lambda_{t-1}/\beta\right] \qquad A_0=0
$$

Use A_t and rearrange the Lagrangian:

$$
\mathcal{L}=\sum_{t=0}^{\infty}(\gamma\beta)^t\left\{\Phi_t+\frac{1}{\alpha}A_t g_t\right\}
$$

The recursive formulation 14 in the main text follows from this expression, the definition of Φ_t and the dynamics of A_t.

D Recursive Problem: FOCs and Euler Equations

The FOCs are the following:

$$
w: \quad n-\sigma-A=0 \tag{31}
$$

$$
\theta: \quad \begin{gathered} -(\zeta-\mu\theta)\frac{cq'(\theta)}{q^2(\theta)}+\mu\left[\beta\varphi-\frac{c}{q(\theta)}\right]+\beta\left[(1-\gamma)\widetilde{W}_n(n')+\gamma W_n(n',A')\right]p'(\theta)(1-n)\leq 0 \\ \theta\geq 0 \qquad + \text{compl. slack.} \end{gathered} \tag{32}
$$

$$
\varphi: \quad -(\zeta-\mu\theta)+\sigma(1-\rho)=\lambda/\beta \tag{33}
$$

$$
\zeta: \quad \frac{c}{q(\theta)}-\beta\varphi\geq 0 \quad \zeta\geq 0 \qquad + \text{compl. slack.} \tag{34}
$$

$$
\mu: \quad \theta\left[\frac{c}{q(\theta)}-\beta\varphi\right]=0 \tag{35}
$$

$$
\sigma: \quad (p-w)+(1-\rho)\beta\varphi-H\geq 0 \quad \sigma\geq 0 \qquad + \text{compl. slack.} \tag{36}
$$

$$
\lambda: \quad -\varphi+\alpha W_A(n',A')=0 \tag{37}
$$

The Euler's equations are the following:

$$n: \quad W_n(n,A) = (w-b) + \beta\left[(1-\gamma)\widetilde{W}_n(n') + \gamma W_n(n',A')\right][1-\rho-p(\theta)] \tag{38}$$

$$A: \quad W_A(n,A) = (p-w) + \tfrac{1-\alpha}{\alpha}H + \beta\alpha\,(1-\rho)\,W_A(n',A') \tag{39}$$

E Proofs of Results 1-3

Proof of Result 1

If a plan starts at time t, A_t is set to zero and 31 implies

$$\sigma_t = n_t > 0$$

Since $\sigma_t > 0$, the firm value constraint is binding.$\diamond$

Proof of Result 2

If $\theta_t > 0$, due to the slackness condition the expression in 32 holds as an equality. In addition, the term $\beta\varphi_t - c/q(\theta_t)$ drops due to 35. Finally, since the firm value constraint is non-binding, $\sigma_t = 0$ and, from 33, $-(\zeta - \mu\theta) = \lambda/\beta$. Substitute this result in 32 and obtain equation 17 in the main text.$\diamond$

Proof of Result 3

Recall the dynamics of state variables from equation 16:

$$n' = F(n,A) = (1-\rho)\,n + p\,[\theta(n,A)]\,(1-n) \tag{40}$$

$$A' = G(n,A) = \frac{\alpha}{\gamma}\,[(1-\rho)\,A + \lambda(n,A)/\beta] \tag{41}$$

Observe that equation 37 implies that φ depends on the current state (n,A) only through the impact of the latter upon the next period state (n',A'). Moreover, equation 35 implies that θ depends only upon φ while equation 34 implies that ζ depends only upon φ and θ. Finally, notice that equation 32 implies that μ depends only upon φ, θ, ζ, the next-period state (n',A') and current employment n. These observations can be summarised by writing the policy functions $\theta(n,A)$, $\zeta(n,A)$ and $\mu(n,A)$ as follows:

$$\theta(n,A) = \widehat{\theta}(F(n,A), G(n,A)) \tag{42}$$

$$\zeta(n,A) = \widehat{\zeta}(F(n,A), G(n,A)) \tag{43}$$

$$\mu(n,A) = \widehat{\mu}(F(n,A), G(n,A), n) \tag{44}$$

Next, observe that from 31 the policy function $\sigma(n,A)$ is

$$\sigma(n,A) = n - A \tag{45}$$

Substitute equations 42-45 in 33 and restate $\lambda(n,A)/\beta$ as follows

$$\lambda(n,A)/\beta = -\widehat{\zeta}(F(n,A), G(n,A)) + \widehat{\mu}(F(n,A), G(n,A), n)\ \widehat{\theta}(F(n,A), G(n,A)) + (n-A)(1-\rho) \tag{46}$$

Substitute 42 in 40 and 46 in 41, then differentiate $F(n,A)$ and $G(n,A)$ with respect to A:

$$F_A = p'(\theta)(1-n)\left[\frac{\delta\widehat{\theta}}{\delta F}F_A + \frac{\delta\widehat{\theta}}{\delta G}G_A\right]$$

$$G_A = \frac{\alpha}{\gamma}(1-\rho) + \frac{\alpha}{\gamma}\left[-\frac{\delta\widehat{\zeta}}{\delta F}F_A - \frac{\delta\widehat{\zeta}}{\delta G}G_A + \widehat{\mu}\frac{\delta\widehat{\theta}}{\delta F}F_A + \widehat{\mu}\frac{\delta\widehat{\theta}}{\delta G}G_A + \widehat{\theta}\frac{\delta\widehat{\mu}}{\delta F}F_A + \widehat{\theta}\frac{\delta\widehat{\mu}}{\delta G}G_A - (1-\rho)\right]$$

The last derivative can be straighforwardly simplified so that all terms that remain contain either F_A or G_A. Thus, the last two equations represent an homogeneous system with respect to F_A and G_A. Since the equations are also linearly independent, the unique solution is $F_A = G_A = 0.\diamond$

F Derivation of equation 24

To find the term $(1-\gamma)\widetilde{W}_n(\overline{n}) + \gamma W_n(\overline{n}, \overline{A})$ proceed through the following steps.

First, use the bellman 14 to compute$W(n,0)$:

$$W(n,0) = n\left[p + (1-\rho)\beta\varphi - H\right] + (1-n)b + (1-\gamma)\beta\widetilde{W}(n') + (\zeta - \mu\theta)\left[c/q(\theta) - \beta\varphi\right] - \lambda\varphi + \gamma\beta W(n', A')$$

In this expression we have taken account of Result 1. If $A = 0$ the firm value constraint is binding. As a consequence, the current wage corresponds to the content of the first square brackets of the formula.

Second, use the identity $\widetilde{W}_n(n) \equiv W_n(n,0)$ and compute the derivative of the expression with respect to n (envelope theorem). Then, evaluate the derivative at the steady state:

$$\widetilde{W}_n(\overline{n}) = (p-b) + (1-\rho)\beta\overline{\varphi} - H + \left[(1-\gamma)\beta\widetilde{W}(\overline{n}) + \gamma\beta W_n(\overline{n}, \overline{A})\right]\left[1 - \rho - p(\overline{\theta})\right]$$

Third, evaluate the Euler's condition 38 at the steady state:

$$W_n(\overline{n}, \overline{A}) = (\overline{w} - b) + \beta \left[(1-\gamma)\widetilde{W}_n(\overline{n}) + \gamma W_n(\overline{n}, \overline{A})\right] \left[1 - \rho - p(\overline{\theta})\right]$$

Finally, solve the system composed by the last two equations with respect to $\widetilde{W}_n(\overline{n})$ and $W_n(\overline{n}, \overline{A})$ and find equation 24 in the main text.

G Proof of Proposition 1

The function $\overline{w}^{nb} = z(\overline{\theta}^{nb}, H, \alpha)$ is implicitly defined by the job creation condition, which is reproduced below for convenience:

$$\frac{c}{q(\overline{\theta}^{nb})} = \beta \frac{\alpha(p - \overline{w}^{nb}) + (1-\alpha)H}{1 - \alpha\beta(1-\rho)} \tag{47}$$

Derivatives z_i $i = \theta, H, \gamma, \alpha$ are computed through the implicit function theorem. Results $z_\theta < 0$, $z_H = \frac{1-\alpha}{\alpha}$ and $z_\gamma = 0$ are straightforward. By constrast, proving that $z_\alpha > 0$ requires some algebra. First, differentiate totally 47 with respect to $\overline{w}^{nb}$ and α:

$$-\frac{c}{q(\overline{\theta}^{nb})}(1-\rho) = \left[p - \overline{w}^{nb} - H\right] - \alpha \cdot z_\alpha$$

Second, substitute equation 47 and rearrange:

$$z_\alpha \alpha \left[1 - \alpha\beta(1-\rho)\right] = p - \overline{w}^{nb} - \left[1 - \beta(1-\rho)\right] H \tag{48}$$

The fact that the constraint is not binding at the steady state implies

$$p - \overline{w}^{nb} - \left[1 - \beta(1-\rho)\right] H > 0 \tag{49}$$

Thus, the RHS of 48 is positive and, as a consequence, $z_\alpha > 0$.

The function $\overline{w}^{nb} = l(\overline{\theta}^{nb}, H, \alpha, \gamma)$ is implicitly defined by the wage setting condition, which is reproduced below for convenience:

$$\frac{\alpha(\overline{w}^{nb} - b) - (1-\gamma)H}{\alpha(p - \overline{w}^{nb}) + (1-\alpha)H} = \Gamma(\gamma, \alpha, \overline{\theta}^{nb}) \tag{50}$$

Since Γ is increasing both with respect to θ and γ a simple inspection of 50 is sufficient to establish that l_θ and l_γ are both positive. Furthermore, notice that H does not enter the argument of Γ. Thus, it is straightforward to establish that $l_H = \frac{1-\alpha}{\alpha}\frac{\frac{1-\gamma}{1-\alpha}+\Gamma}{1+\Gamma}$.

To compute l_α, differentiate totally 50 with respect to $\overline{w}^{nb}$ and α:

$$\frac{\alpha\,(1+\Gamma)}{\alpha(p-\overline{w}^{nb})+(1-\alpha)H} l_\alpha = \Gamma_\alpha + \frac{\left[p-\overline{w}^{nb}-H\right]\Gamma-(\overline{w}^{nb}-b)}{\alpha(p-\overline{w}^{nb})+(1-\alpha)H} \tag{51}$$

Use 50 to substitute Γ on the RHS and rearrange:

$$RHS = \Gamma_\alpha - H\frac{(1-\gamma)\left[p-\overline{w}^{nb}-H\right]+(\overline{w}^{nb}-b)}{\left[\alpha(p-\overline{w}^{nb})+(1-\alpha)H\right]^2}$$

Use 49 to substitute the term $\left[p-\overline{w}^{nb}-H\right]$:

$$RHS < \Gamma_\alpha + \frac{(1-\gamma)\beta(1-\rho)H^2}{\left[\alpha(p-\overline{w}^{nb})+(1-\alpha)H\right]^2} - \frac{(\overline{w}^{nb}-b)H}{\left[\alpha(p-\overline{w}^{nb})+(1-\alpha)H\right]^2}$$

Use 49 again to substitute the term $\left[\alpha(p-\overline{w}^{nb})+(1-\alpha)H\right]^2$:

$$RHS << \left[\Gamma_\alpha + \frac{(1-\gamma)\beta(1-\rho)}{\left[1-\beta\alpha\,(1-\rho)\right]^2}\right] - \frac{(\overline{w}^{nb}-b)H}{\left[\alpha(p-\overline{w}^{nb})+(1-\alpha)H\right]^2} \tag{52}$$

Compute the term in the square brackets by differentiating Γ with respect to α:

$$\Gamma_\alpha + \frac{(1-\gamma)\beta\,(1-\rho)}{\left[1-\beta\alpha\,(1-\rho)\right]^2} = -\frac{1-\beta\left[1-\rho-p(\overline{\theta}^{nb})\right]}{\left[1-\beta\alpha\,(1-\rho)\right]^2}\frac{\eta(\overline{\theta}^{nb})}{1-\eta(\overline{\theta}^{nb})}\frac{1-\rho}{\rho}(1-\gamma\beta) < 0$$

Finally, substitute this expression in 52 and conclude that the RHS of 51 is negative. This proves that $l_\alpha < 0$.$\diamond$

H Proof of Proposition 2

Properties are proved as follows.

- **Property 1**: differentiate equation 26 with respect to θ and H and apply the implicit function theorem.

- **Property 2**: by the definition of the threshold $H_{\min}$.

- **Property 3**: this property holds as a definition of $\theta^b(H_{\max})$.

- **Property 4**: the function $\theta^{nb}(H,\alpha)$ is induced implicitly by the equality

$$z(\theta^{nb},H,\alpha)=l(\theta^{nb},H,\alpha,\gamma) \tag{53}$$

Differentiate 53 with respect to H and θ and apply the implicit function theorem:

$$\theta^{nb}_H(H,\alpha)=\frac{l_H-z_H}{z_\theta-l_\theta}$$

By Proposition 1, the denominator is negative while the numerator is negative if $\gamma>\alpha$. This proves the property.

- **Property 5**: differentiate 53 with respect to α and θ and apply the implicit function theorem:

$$\theta^{nb}_\alpha(H,\alpha)=\frac{l_\alpha-z_\alpha}{z_\theta-l_\theta}$$

By Proposition 1, both the numerator and the denominator are negative. This proves the property.

- **Property 6**: we need to prove that

$$z(0,H_{\min},\alpha)-l(0,H_{\min},\alpha)>0 \tag{54}$$

In fact, since $\theta^{nb}(H,\alpha)$ is implicitly defined by $z-l=0$ and since $z_\theta-l_\theta<0$, the inequality 54 is necessary and sufficient for $\theta^{nb}(H_{\min},\alpha)>0$.

Use equation 47 to express $z(0,H_{\min},\alpha)$ as follows:

$$z(0,H_{\min},\alpha)=p-\frac{c}{\beta}\left[1-\beta(1-\rho)\right] \tag{55}$$

Next, use equation 50 and $\lim\limits_{\theta\to 0}\eta(\theta)=1$ to express $l(0,H_{\min},\alpha)$ as follows:

$$l(0,H_{\min},\alpha)=\left\{(1-\gamma)\frac{c}{\beta}\left[1-\beta(1-\rho)\right]-(1-\gamma)\,p+b\left[1-\alpha\beta(1-\rho)\right]\right\}/\left[\gamma-\alpha\beta(1-\rho)\right] \tag{56}$$

Substitute 55 and 56 in 54 and verify that the inequality is true iif

$$\frac{p-b}{1-\beta(1-\rho)}\beta>c$$

This is the parameter restriction that is necessary and sufficient for $H_{\max}>H_{\min}$, see equation 7 in the main text. This proves the property.

- **Property 7**: we need to prove that

$$z(\theta^b_{\max}, H_{\max}, \alpha) - l(\theta^b_{\max}, H_{\max}, \alpha) < 0 \tag{57}$$

In fact, since $\theta^{nb}(H_{\max}, \alpha)$ is defined by the equality $z(\theta, H_{\max}, \alpha) - l(\theta, H_{\max}, \alpha) = 0$ and since $z_\theta - l_\theta < 0$, the inequality 57 is both necessary and sufficient for $\theta^{nb}(H_{\max}, \alpha) < \theta^b(H_{\max})$.

It is straightforward to show that $z(\theta^b_{\max}, H_{\max}, \alpha) = b$. By contrast, once one uses equation 50, $l(\theta^b_{\max}, H_{\max}, \alpha)$ is implicitly defined as follows:

$$\frac{\alpha\left[l(\theta^b_{\max}, H_{\max}, \alpha) - b\right] - (1-\gamma)\beta\frac{p-b}{1-\beta(1-\rho)}}{\alpha\left[p - l(\theta^b_{\max}, H_{\max}, \alpha)\right] + (1-\alpha)\beta\frac{p-b}{1-\beta(1-\rho)}} = \Gamma(\theta^b_{\max}, \gamma, \alpha)$$

Since Γ is positive, it must be true that $l(\theta^b_{\max}, H_{\max}, \alpha) > b$, otherwise the LHS would be negative. This proves the property and concludes the proof of Proposition 2.$\diamond$

Data appendix

Unemployment *Definition*: standardised aggregate rate of unemployment for the 15-64 age group. *Source*: OECD, Database on Labour Force Statistics and Annual Labour Force Statistics;

Output Gap *Definition*: OECD measure of the gap between actual and potential output as a percentage of potential output. *Source*: OECD, Economic Outlook 76, December 2004.

Union Density *Definition*: share of workers affiliated to a trade union out of the total labour force. *Source*: OECD, Employment Outlook 2004. Missing years are obtained by linear interpolation or by extrapolation in case of end-of-sample missings.

Highcorp *Definition*: 0-1 indicator of the degree of centralisation/co-ordination of the wage bargaining processes. The indicator takes values 1 for centralised and coordinated processes and zero otherwise. *Source*: Bassanini and Duval (2006), "Employment Patterns in OECD Countries: Reassessing the Role of Policies and Institutions", OECD Economics Department Working Paper No. 486.

Benefits *Definition*: weighted average of the gross unemployment benefit replacement rates across two earnings levels (100% and 67% of APW earnings), three family situations (single, with dependent spouse, with spouse in work) and three durations of unemployment (1^{st} year, 2^{nd}- 3^{rd} years and $4^{th}5^{th}$ year of unemployment). *Source*: OECD, Benefits and Wage database. Data are only available for odd years. Data for even years are computed by interpolation.

Taxes *Definition*: tax wedge between the labour cost to the employer and the corresponding net take-home pay of the employee for a single-earner couple with two children earning 100% of APW earnings. Source: OECD, Taxing Wages.

PMR *Definition*: Product Market Regulation, OECD summary indicator of regulatory impediments to product market competition in seven non-manufacturing industries. The data used in this paper cover regulations and market conditions in seven energy and service industries: gas, electricity, post, telecoms (mobile and fixed services), passenger air transport, railways (passenger and freight services) and road freight. *Source*: Conway, De Rosa, Nicoletti, and Steiner (2006), "Regulation, competition, and productivity convergence", OECD Economics Department Working Paper n??.

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

RI *Definition*: 0-2 indicator for routine involvement of unions and employers in government decisions on social and economic policy. The indicator takes value 0 if involvement is rare, 1 if it is irregular and infrequent and 2 if it is regular and frequent. *Source*: Ictwss database, Visser (2011).

BC *Definition*: 0-1 indicator for the existence of a bipartite council of central or major union and employers organizations for purposes of wage setting, economic forecasting and/or conflict settlement. The indicator takes value 1 if an institutionalised council exists and 0 otherwise. *Source*: Ictwss database, Visser (2011).

WC *Definition*: 0-3 indicator for the rights of works councils. The indicator takes value 3 if councils have economic and social rights, including codetermination on some issues, value 2 if councils have only consultation rights on economic and social issues, value 1 if councils have only social rights and, finally, value 0 if councils have no rights or do not exist. *Source*: Ictwss database, Visser (2011).

Cooperative Industrial Relations *Definition*: subjective assessment of cooperation in I.R. through executive panel interviews. *Source*: World Economic Forum, World Competitiveness Report, issues 1990-2003. Adjustments have been made to account for changes in the scale of responses.

Trust *Definition*: share of individuals that declare to trust unions. *Source*: World Social Survey. Treatment of original data is described in the main text.