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Endogenous wage bargaining institutions in oligopolistic sectors*

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Summary. This paper explores the endogenous emergence of wage bargaining institutions in a union-oligopoly framework. Technological asymmetries among firms are shown to be the driving force for the emergence of alternative wage bargaining centralization structures that are observable in real life. As wage deals at the sector-level obtain the consensus of all unions and the efficient firms, a regulator has an incentive to authorize those deals by activating/establishing a *Minimum Sectoral Wage Institution* (*MSWI*). If productivity differences are high enough, wage setting above the established wage floor may subsequently occur in efficient firms. Otherwise, a completely centralized wage bargaining structure emerges and the sector-level wage deal is simply confirmed as the firms' wage rate. If, however, productivity asymmetries are rather insignificant, firms and unions have conflicting interests and a completely decentralized wage bargaining regime prevails in equilibrium.

Keywords and Phrases: Wage negotiations, Bargaining institutions, Unions, Oligopoly, Minimum wage.

JEL Classification Numbers: J50, J31, L13.

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1 Introduction

Contemporary labor market institutions display substantial variability regarding the level of wage negotiations. In USA, Canada and Japan, collective and/or individual bargaining over wages occurs at the firm-level alone. In Europe, however, wage negotiations are often conducted at various levels. They are typically centralized at the sector-level in Italy, the Netherlands, Spain, France and Portugal, while they are centralized at both the national and the sector-level in Germany and the Scandinavian countries. Moreover, collective bargaining over wages is carried out at all three levels (national-, sector-, and firm-level) in Belgium and Greece. On the other hand, wage negotiations are mainly decentralized, at the firm-level, in UK and Ireland (see e.g. Layard et al. [20]; Hartog and Theeuwes [17]). Under this light, an interesting two-fold question arises: why such a striking cross-country variety of wage bargaining institutions prevails, and how do these alternative institutional structures emerge?

Economic theory has, up to date, hardly addressed such inquiries. Yet, the received literature has assigned a crucial role on the degree of wage centralization since it has been shown to have a significant impact on the equilibrium outcomes in unionized labor markets (see e.g. Davidson [8]; Dorwick [11]; Corneo [7]; Padilla et al. [25]) If, for instance, firm-union bargaining over wages takes place independently at the firm level, wages are typically lower and aggregate employment higher than under wage centralization at the sector level.[1] The bulk of the literature on the bargaining structure and minimum wages, however, treats wage centralization as an exogenous institutional feature.[2] Moreover, only the cases of *complete centralization* or *complete decentralization* are explicitly considered (see e.g. Vannetelbosch [32]; Grandner [13]), while there has been little attempt to explain the circumstances under which each of those two polar cases emerges, or to provide reasons about why collective firm-union wage agreements may be carried out at various levels (see e.g. Yang [34]).

In this paper we develop a framework of endogenous determination of alternative wage bargaining structures that builds on a fundamental game-theoretic postulate: a collective arrangement can be established only if a "winning" coalition among the agents involved in that arrangement finds its establishment beneficial. In the context of unionized labor markets, it is clear that the firms and the unions in a particular sector are the agents who are directly involved in the issue of the determination of the level of wage bargaining in that sector. Yet, since in real life an official institutional resolution/amendment is necessary for the authorization of any collective arrangement, we claim that the level of wage bargaining is decided upon by a regulator who however takes into account whether, or not, his decision would be approved by a majority of those agents. It is only under these circumstances

[1] This holds true whenever the scope of negotiations covers only wages (*Right-to-Manage* model) and the product market is imperfectly competitive. This is so, because agents inside each firm/union bargaining unit do not fully internalize the market-wide effects of their decisions and as a result, competitive wage under-cutting incentives drive bargained wages downwards.

[2] See e.g. McCallum [21], Bruno and Sachs [2], Layard and Nickell [19], Calmfors and Horn [5, 6], Newell and Symons [23], Calmfors and Driffill [4], Bryson et al. [3], Lavin and Oren [18], De Fraja [9], Sobel [31], Metcalf [22].

that the "winning" coalition among the involved agents can guarantee that its preferred arrangement becomes an official institution. In this framework, our analysis suggests that asymmetries in productive efficiency among firms may effectively determine the level of wage bargaining in a particular sector.

To elaborate on our ideas, we consider a homogeneous good sector where technologically asymmetric firms compete *a lá Cournot* in the product market. In the labor market, sector-level bargaining over wages is conducted only so long as a *"Minimum Sectoral Wage Institution"* (*MSWI*) has been established/activated by a government's regulator. Firm-level wage negotiations that are subsequently conducted may result to simply confirm the sector-level wage deal, or to lift the firm-specific wage rates above the established wage floor. If, on the contrary, a sector-level wage deal has not been authorized by the regulator, firm-specific wages are determined through completely decentralized wage bargaining.

Our main insight is that we have identified the firms' productivity asymmetries as the driving force that may lead to the endogenous determination of alternative wage bargaining structures. The reasoning is as follows. Under a completely decentralized wage setting regime, efficient firms pay higher wages than their inefficient rivals. As a result, the efficient firms' relative advantage in productivity is partially dissipated due to their higher relative wage costs. A sector-level wage deal may then play an important role in the rivalry among efficient and inefficient firms. Once established, less productive firms would be obliged to remunerate their employees with, at least, that wage rate. In line with the "Raising Rivals' Costs" literature (Salop and Scheffman [29, 30]; Williamson [33]), efficient firms thus have a strategic incentive to opt for a high enough sector-level wage deal in order to reduce their relative cost disadvantage, "steal" market share from their inefficient rivals and increase their own profits. Clearly, their workers' unions share this interest with their employers, because such a wage floor raises both their own wages and jobs. More interestingly, the inefficient firms' workers' unions can also benefit from such an arrangement, provided that the established wage floor does not drastically reduce their employers' market shares. This is so, because the higher rent per union member would more than compensate those unions for the ensuing job losses. Therefore, centralized wage negotiations are expected to lead to a binding, albeit not too high, sector-level wage deal. Hence, since inefficient firms are the only labor market agents that are expected to suffer from a wage centralization regime, efficient firms have an incentive to seek partnership from all unions in order to form a "winning" coalition that could provide a self-motivated regulator with the right incentives to activate a default *MSWI* (or establish it in case it is absent).

Our analysis leads to three variations of the wage bargaining structure. If productivity differentials are *ceteris paribus* high enough, firm-level union wage setting will take place too, but only in efficient firms, while the unions of the inefficient firms will simply confirm the sector-level wage deal as their firm-specific wage rate. This case portrays a *partially centralized wage bargaining structure*, which is quite often observed in real life. In contrast, if productivity differentials among firms are small enough, the sector-level wage deal will be simply confirmed by all unions and firm-level wage setting will never take place. This case resembles a *completely centralized wage bargaining structure.* Finally, if productivity asymmetries

are rather insignificant, firms and unions have conflicting interests regarding the establishment of a sector-level wage floor, making thus the regulator reluctant to activate/establish a *MSWI*. In this case, a *completely decentralized wage bargaining structure* is expected to emerge in the particular sector.

The rest of the paper is organized as follows. In Section 2, a union – oligopoly bargaining model with monopoly unions is presented. In Section 3 the decentralized union wage setting case is analyzed. In Section 4 the strategic role that a sector-level wage deal may play in the rivalry among technologically asymmetric firms is highlighted and the preferences over alternative wage deals of firms and unions are specified. Moreover, the interest of a majority coalition among those agents to establish a binding wage floor in the particular sector is demonstrated. In Section 5, the sector-level wage deal is derived and the establishment/activation of the *MSWI* is demonstrated as optimal choices of a regulator – public manager whose objective is to obtain maximum possible, explicit or implicit, consensus from the sector's agents for his decisions. Section 6 discusses the implications of the alternative endogenous wage bargaining structures for wage differentials, production patterns, aggregate employment and consumer welfare. Finally, Section 7 concludes.

2 The model

We consider a homogeneous good sector where two firms compete *a lá Cournot*. We assume that their production technologies exhibit *constant returns to scale* and require only labor input to produce the good.[3] Firm i's production function is $y_i = k_i N_i$, where y_i denotes the output, N_i the labor input and k_i the productivity of labor in firm i. Firm 2 may possess a superior technology than firm 1 i.e. $k_2 \geq k_1$. Normalizing $k_1 = 1$ and setting $k_2 = k$, k measures the relative efficiency of technologies. We call firm 1 "inefficient" and firm 2 "efficient," and assume that $k < 5/3$, i.e. that technological asymmetries are not so excessive that only the efficient firm survives in the market. Finally, for tractability, we assume that the market demand is linear, $P(Y) = a - Y$, where $Y = y_1 + y_2$ is the aggregate output.

The labor market in this sector is unionized. Workers are assumed to be organized into two, separate, firm-specific unions. This is reasonable since different technologies may require workers of distinct skills and this often creates conflicting interests among the firms' employees. Let union i be the firm i's union. We assume that each union is of *utilitarian* type, maximizing the sum of its (risk-neutral) members' utilities, given fixed union membership (see e.g. Oswald [24]; Booth [1]; Pencavel [26]). That is, union i's objective is to maximize

$$U_i = (w_i - w_0)N_i \tag{1}$$

where w_i is the firm i's wage rate and w_0 is the workers' outside option.[4] To guarantee that firms' outputs and profits are positive whenever a wage floor above

[3] This is equivalent to a two-factor Leontief technology where the amount of capital is fixed in the short run and is large enough not to induce zero marginal product of labor.

[4] Assuming that the sector is small relative to the aggregate economy, the impact of the unions' actions on the aggregate price index is negligible and thus unions care only about nominal wage rates.

w_0 exists in the sector, we assume that the workers' (normalized) outside option is not too high, i.e. $w_{0n} \equiv w_0/a < \bar{w}_{0n}(k)$, where $\bar{w}_{0n}(k) = k(5-3k)/2(2k-1)$. Note that $\bar{w}_{0n}(1) = 1$, $\bar{w}_{0n}(5/3) = 0$ and $d\bar{w}_{0n}/dk < 0$. (Alternatively, we could assume that, for given $w_{0,}$ technological asymmetries cannot be too high, i.e. $k < \bar{k}(w_{0n})$, where $\bar{k}(w_{0n})$ is the inverse function of $\bar{w}_{0n}(k)$.) We further assume that each union possesses all the power to set its firm-specific wage rate and that employment decisions are left to the firms' discretion (*Monopoly Union* model).[5]

We postulate that the *MSWI* is a *default* institution, but it is at the government regulator's discretion to activate it, or to keep it idle. Equivalently, when the *MSWI* is absent, the regulator may, or may not, have an incentive to establish such an institution for the sector. The regulator is envisaged to be a manager of the public sector with a managerial-type objective function, i.e.

$$U_R = P(\nu^+)V - \varepsilon \tag{2}$$

where $V$is the discounted sum of the regulator's future benefits (above a standard salary) from being a successful public manager, and $P(\nu^+)$ is the probability of being successful. This probability is assumed to depend on the excess of the *"yes"* over the *"no"* votes (ν^+) that an adopted policy is, explicitly or implicitly, expected to obtain from the involved agents. Further, $\varepsilon > 0$ (but small enough) represents the fixed bureaucratic costs of adopting and administering that policy. We assume that $P(\nu^+ \leq 0) = 0$ and $P'(\nu^+ > 0) > 0$. Therefore, the regulator has an incentive to adopt the policy that is expected to obtain the maximum possible social consensus. Moreover, since ε is strictly positive, in case that the expected "*yes*" and "*no*" votes are deadlocked the policy under consideration will not be adopted. The above can be also envisaged in a principal-agent context where the government in-office, aiming at maximizing potential votes in the forthcoming elections, designs an incentive contract with its regulator. In our set up the policy is the activation/establishment of the *MSWI* and the involved agents are the unions' and the firms' representatives.[6] The government's goal is then to guarantee that the *MSWI* will not be activated/established, unless such a decision is expected to receive *ex post* the approval of, at least, a simple majority of the sector's economic agents.

Effectively, in case that the regulator decides not to activate the default institution, the labor market institution is *completely decentralized* union wage setting. In the opposite case, where the *MSWI* has been activated, firms and unions should collectively settle a minimum wage rate w_m for the sector, before any firm-level union wage setting takes place. To simplify the analysis, we assume that the regulator

[5] In real life the wage rate and (possibly) the employment level is determined via firm-union negotiations. This model assumes that the union has all the power in wage negotiations, while the firm all the power to set the employment level. This allocation of bargaining power is justified as an approximation to reality where unions have typically more power in setting wages than do firms, and vice versa for the determination of employment.

[6] Note that the firms' and the unions' representatives do not actually vote in favor or against any institutional resolution. Nonetheless, this is done implicitly, through their vote in the second stage, where a vote in favor or against a proposed sector-level wage rate is essentially a positive or negative vote for the authorization of the wage layer per se.

(or a committee of experts under his auspices) proposes a wage rate and the firms' and unions' representatives vote in favor, or against, the proposal. We assign the same number of votes (for simplicity, one vote) to the representatives of each firm's shareholders and each union's members. We assume that the regulator's objective takes the following *lexicographic* form:

Choose a w_m proposal to:[7]

(a) Maximize the excess of the "*yes*" over the "*no*" votes
(b) Given (a), maximize the welfare of the firm or the union whose representative will be the first to change his vote from "*yes*" to "*no*" (i.e., maximize the welfare of the "*pivotal voter*".)

This objective is consistent with the regulator's managerial utility function given in (2). A proposal will not be approved and become effective, unless it receives at least a simple majority of the votes of the sector's agents. In addition, the approval of the regulator's w_m proposal is implicitly an *ex post* approval of his decision to activate the *MSWI* in the first stage. Finally, maximization of the pivotal voter's welfare guarantees that the optimal proposal is uniquely determined, according to a plausible criterion. If the regulator's proposal is approved, then *partial,* or *complete, wage bargaining centralization* emerges in the sector. The latter refers to the situation where unions simply confirm the minimum wage established in the previous stage as their firm-specific wage rates, while the former refers to the mixed case where one union confirms, while the other sets a higher firm-specific wage rate than the minimum wage. The sequence of events is as follows.

- *Stage 1:* The government's regulator decides to *activate*, or *keep idle*, the *default MSWI* for the particular sector. (Equivalently, he decides to establish, or not, a *MSWI* in the sector.)
- *Stage 2:* If the *MSWI* has been activated, the regulator proposes a wage rate and the firms' and the unions' representatives vote in favor, or against, the proposal. A minimum wage deal is reached whenever the regulator's proposal obtains at least a simple majority of votes.[8] The approval of the regulator's proposal acts also as an *ex post* approval of his decision to activate the *MSWI*.
- *Stage 3:* Unions simultaneously set their firm-specific wage rates, which, under the presence of a sector-level minimum wage, cannot be lower than the established wage floor.
- *Stage 4:* Firms simultaneously decide on their employment levels and outputs.

We restrict attention to subgame perfect equilibria of the above game.

[7] We are especially grateful to an anonymous referee who suggested to us this lexicographic-type objective for the regulator.

[8] The procedure by which a new labor market institution is established in real life is often along these lines. In Spain and Greece, for instance, a group of firms and unions, representing a majority of shareholders and workers, have the power to establish a new institution (see, e.g., Jimeno [15]; Petrakis and Vlassis [28]).

3 Union wage setting equilibrium

Consider first the last stage of the game. Given its rival's output and the wage deal of the previous stage, firm i chooses its quantity (hence, employment) to maximize profits, $\pi_i = (a - y_i - y_j)y_i - w_i N_i = (a - y_i - y_j)y_i - \omega_i y_i$, where $\omega_i = w_i/k_i$ represents firm i's wage per efficiency unit of labor (*wef*). The equilibrium outcome of this standard *Cournot* game is given by $i, j = 1, 2$,

$$\begin{aligned} y_i^*(\omega_i, \omega_j) &= (a - 2\omega_i + \omega_j)/3; \\ \pi_i^*(\omega_i, \omega_j) &= [y_i^*(\omega_i, \omega_j)]^2 \ . \end{aligned} \tag{3}$$

Then $N_i^*(\omega_i, \omega_j) = [y_i^*(\omega_i, \omega_j)]/k_i$. Substituting N_i^* into the union i's objective (given in (1)), it can be checked that $\partial^2 U_i/\partial w_i \partial w_j > 0$, i.e. wages are strategic complements from the unions' point of view. An increase in the rival's wage rate improves firm i's competitiveness in the market and thus makes more profitable for union i to opt for an increase in its firm-specific wage, since it will not lose as much in terms of employment.

Consider next the third – union wage setting – stage. Union i sets its firm-specific wage rate w_i to maximize (1), given the wage set by its rival firm's union and that w_i cannot be lower than the sector-level wage deal w_m approved in the previous stage (if any). The *completely decentralized* union wage setting regime can subsequently be treated by setting w_m to the reservation wage of the union members' w_0 (i.e., to a wage rate that is never binding for any union). Taking the logarithm of (1) and using (3), the first order condition of the union i's unrestricted problem turns out to be,

$$\frac{1}{\left(\omega_i - \frac{w_0}{k_i}\right)} = \frac{2}{(a - 2\omega_i + \omega_j)} \ . \tag{4}$$

The union i's reaction function in terms of *wef* is then:

$$\omega_i(\omega_j) = \max\left[\frac{w_m}{k_i}, \frac{a + \omega_j + 2w_0/k_i}{4}\right] \ . \tag{5}$$

Therefore, if union wage setting is completely decentralized, firm i's *wef* in equilibrium is,

$$\omega_i^d = \frac{5a + [2/k_j + 8/k_i]\, w_0}{15} \ . \tag{6}$$

And the equilibrium firm-specific wage rates are given by,

$$w_1^d = \frac{5a + [2/k + 8]w_0}{15} \qquad w_2^d = \frac{5ak + [2k + 8]w_0}{15} \ . \tag{7}$$

It can be checked that, if $k > 1$ and $w_0 > 0$, then $\omega_2^d < \omega_1^d = w_1^d < w_2^d = k\omega_2^d$. That is, the efficient firm's wage rate is higher than its inefficient rival's wage in equilibrium. Moreover, due to the completely decentralized wage setting institution, the efficient firm's relative technological advantage is partially dissipated (i.e., $\omega_2^d < \omega_1^d < k\omega_2^d$). Interestingly, if $w_0 = 0$, both firms face the same marginal cost in equilibrium, $\omega_1^d = \omega_2^d$, and thus the technological advantage of the efficient firm is totally dissipated. Proposition 1 summarizes.

Proposition 1. *Under the completely decentralized union wage setting regime,* $\omega_2^d \leq \omega_1^d = w_1^d < w_2^d = k\omega_2^d$ *for all* $k > 1$. *Moreover,* $w_2^d - w_1^d$ *and* $\omega_1^d - \omega_2^d$ *are increasing in* w_0, *with* $w_2^d = kw_1^d$ *and* $\omega_1^d = \omega_2^d$ *for* $w_0 = 0$.

To conclude the analysis of the complete decentralized wage setting structure, we substitute (6) into (3) to get the equilibrium outputs, employment levels and firms' profits:

$$y_i^d = \frac{10a - 2(7/k_i - 2/k_j)w_0}{45}; \quad N_i^d = y_i^d/k_i; \quad \pi_i^d = \left[y_i^d\right]^2 \tag{8}$$

It can be checked that $y_i^d > 0,\ i = 1, 2$ for all $1 < k < 5/3$ and $w_0/a < k(5 - 3k)/2(2k-1)$. Finally, using (4), the unions' welfare is given by, $U_i^d = (3/2)(y_i^d)^2$.

4 The strategic role of a sector-level wage deal

In this section we investigate the impact of a minimum wage deal w_m on the firms' profits and the unions' welfare. We are particularly interested in identifying circumstances under which a wage floor, by raising their rivals' relative costs, benefits a group of firms, creating thus strategic incentives for those firms to opt for the activation of the *default MSWI*.

We, nevertheless, start our analysis with the case in which such strategic incentives amongst firms are absent. They are absent when firms are *ex ante* identical, i.e., if $k = 1$. In this case a completely decentralized union wage setting naturally leads to equal firm-specific wage rates. In fact, if $k = 1$, (6) implies that $w_1^d = w_2^d \equiv \widehat{w} = \frac{5a+10w_0}{15}$. Hence, by (5) the equilibrium wage rates are $w_1^* = w_2^* = w_m$ for all $w_m \geq \widehat{w}$ (and $w_1^* = w_2^* = \widehat{w}$ otherwise). That is, a sufficiently high sector-level wage deal becomes binding for both firms' unions. Then it follows from (3) that $\pi_i^* = (a - w_m)^2/9$, which is clearly decreasing with w_m. Obviously, in this case no firm has an incentive to opt for the establishment of a sector-level minimum wage rate.

In contrast, both unions will benefit from a wage floor, provided that w_m is close enough to $\widehat{w}$. This is so, because from (2) $U_i^* = (w_m - w_0)(a - w_m)/3$ and thus,

$$\left.\frac{dU_i^*}{dw_m}\right|_{w_m=\widehat{w}} = \left.\frac{a + w_0 - 2w_m}{3}\right|_{w_m=\widehat{w}} = (a - w_0)/9 > 0\ .$$

Therefore, both unions have an incentive to opt for the establishment of a sector-level wage floor. Proposition 2 summarizes.

Proposition 2. *If there are no technological asymmetries among firms (i.e.,* $k = 1$*), firms and unions have conflicting interests. While both unions would opt for a sector-level wage deal* w_m *that is not too high, no firm has an incentive to establish such a sector-level wage deal.*

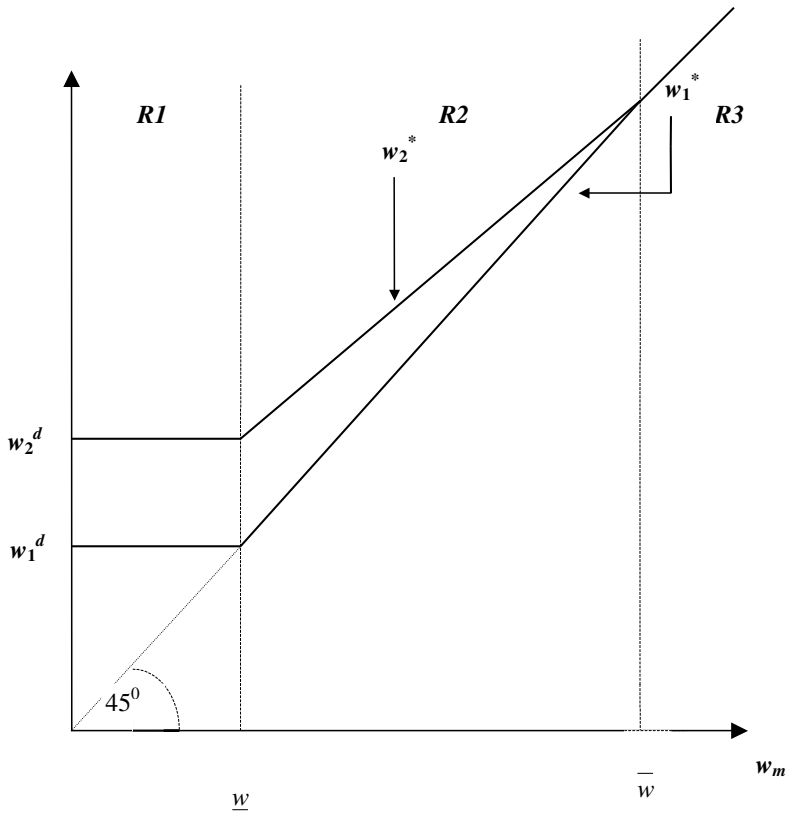

Figure 1

We next turn to the more interesting case where the existence of technological asymmetries among firms (i.e., $k > 1$) implies that, under a complete decentralized wage setting regime, the firm-specific wage rates are *not equal* in equilibrium (i.e., $w_2^d > w_1^d$). Under the presence of a sector-level wage deal w_m, (5) implies that,

$$w_1^* = w_m; \quad w_2^* = \frac{ak + kw_m + 2w_0}{4} \text{ if } \underline{w} \leq w_m \leq \overline{w} \tag{9}$$

and $w_1^* = w_2^* = w_m$ if $w_m \geq \overline{w}$, where $\underline{w} = w_1^d$ and $\overline{w} = \frac{ak+2w_0}{4-k}$ (Obviously, if $w_m < \underline{w}$, then $w_i^* = w_i^d, i = 1, 2$). As w_m increases, it initially becomes binding only for the union of the low wage – under decentralized wage setting – firm, while it eventually becomes binding for both firms' unions. Interestingly, the initial firm-specific wage differential, $w_2^d - w_1^d$, shrinks as w_m increases, vanishing altogether for high enough values of w_m (see Fig. 1). This can be seen from (9), as $0 < dw_2^*/dw_m = k/4 < 5/12$ for all $k < 5/3$ and hence, the positively-sloped straight line $w_2^*(w_m)$, which starts above the 45^0-line at $w_m = \underline{w}$, necessarily intersects with the 45^0-line at a sufficiently high w_m.

A low enough sector-level wage deal w_m has no impact on the unions' wage setting behavior. If, in contrast, the wage deal is sufficiently high, both unions simply

confirm w_m as their employed members' wage rate. For intermediate values of w_m, the sector-level wage deal operates as a wage floor only for the union that would have set the low wage under the decentralized wage setting regime. This union simply confirms w_m, while the rival union optimally sets a higher firm-specific wage rate which is increasing with w_m, but less than one for one (see Fig. 1). Therefore, the gap between the latter union's wage and w_m is decreasing with w_m, which implies that the relative cost disadvantage of the high wage firm (i.e. the efficient firm) decreases as the sector-level wage floor increases. Thus, by means of a high enough wage floor the efficient firm can "steal" market share from its rival, paying however at the same time a higher firm-specific wage. Yet, the positive – business stealing – effect always dominates the negative – rise in own costs – effect. Therefore, the efficient firm has a strategic incentive to opt for a high enough sector-level wage deal. In contrast, as a sector-level wage deal leads not only to a wage increase, but also to a reduction of its market share, the inefficient firm will never opt for the establishment of a (binding) wage floor. Proposition 3 summarizes the firms' preferences over alternative sector-level wage deals.

Proposition 3. *If $k > 1$ (i.e., $w_2^d > w_1^d$), then:*

(i) The efficient firm's profits increase with w_m for all $\underline{w} \leq w_m \leq \overline{w}$ and decrease with w_m for all $w_m > \overline{w}$. Thus, the efficient firm's most-preferred w_m is $m_{F_2} = \overline{w} = (ak + 2w_0)/(4 - k)$.

(ii) The inefficient firm's profits decrease with w_m for all $w_m \geq \underline{w}$. Thus, the inefficient firm's most-preferred w_m is, w.l.o.g., $m_{F1} = \underline{w} = w_1^d$.

Proof. Substituting the equilibrium wage rates (9) into (3), if $\underline{w} \leq w_m \leq \overline{w}$, we get:

$$y_1^* = \frac{5a + 2(w_0/k) - 7w_m}{12}; \qquad (10)$$
$$y_2^* = \frac{a - 2(w_0/k) + w_m}{6}$$

Hence, $d\pi_1^*/dw_m < 0$ and $d\pi_2^*/dw_m > 0$ for all $\underline{w} \leq w_m \leq \overline{w}$. While for $w_m > \overline{w}$, (3) implies that,

$$y_1^* = [a - (2 - 1/k)w_m]/3; \quad y_2^* = [a - (2/k - 1)w_m]/3 \qquad (11)$$

Hence, $d\pi_1^*/dw_m < 0$ and $d\pi_2^*/dw_m < 0$ for all $k < 5/3$. As a result, $m_{F_2} = \overline{w}$, while w.l.o.g. $m_{F1} = \underline{w}$. □

We next consider how the unions' rents are affected by the establishment of a sector-level wage floor w_m. The efficient firm's union, who sets the high wage under decentralized wage setting, clearly benefits from a sector-level wage deal that is binding only for its rival union's workers. Due to business-stealing, more jobs are now available for the efficient firm union's members and, moreover, those jobs are better remunerated. In addition, the inefficient firm's union can also benefit from a wage floor, provided that w_m is not too high. A sufficiently low wage floor results in only few job losses for the inefficient union's members, and this negative effect

is more than offset by the positive effect due to the wage increase, leading thus to higher rents for that union. Therefore, even under technological asymmetries among their firms, unions may still have an incentive for the establishment of a (not too high) sector-level wage deal.

In particular, to specify the unions' preferences over alternative sector-level wage floors, we first define the critical values of k, $k_{U2}(.)$, $k_{U1}^{R2}(.)$, $k_{U1}^{R3}(.)$, $k_{U1}(.)$, as the inverse of the following functions, respectively,

$$
\begin{aligned}
[w_{0n}]_{U2}(k) &= k(4k-5)/(2-5k+2k^2) \\
[w_{0n}]_{U1}^{R2}(k) &= k(20-19k)/(7k^2+2k-8); \\
[w_{0n}]_{U1}^{R3} &= (6-5k)/(2k-1) \\
[w_{0n}]_{U1}(k) &= \frac{k\left\{10-7k-6(k-1)\sqrt{7k/(2k-1)}\right\}}{7k^2-4}
\end{aligned}
$$

where w_{0n} represents the worker's (normalized) outside option (w_0/a). Note that all the above functions take the value of 1 for $k=1$ and that are strictly decreasing in k. It can further be checked that $[w_{0n}]_{U1}^{R2} < [w_{0n}]_{U1} < [w_{0n}]_{U1}^{R3} < [w_{0n}]_{U2} < \bar{w}_{0n}$ for all $1 < k < 5/3$; hence, $1 < k_{U1}^{R2} < k_{U1} < k_{U1}^{R3} < k_{U2} < \bar{k}$ for all $0 \leq w_{0n} < 1$. Hence, these functions partition the space of feasible parameters (w_{0n}, k) into five subspaces. The unions' preferences over alternative sector-level wage deals can then be summarized as follows.

Proposition 4. *If $k > 1$ (i.e., $w_2^d > w_1^d$),then:*

(a) The efficient firm union's welfare is always single-peaked and increases with w_m for all $\underline{w} \leq w_m \leq \overline{w}$ (region $R2$). If $k > k_{U2}$, it increases with w_m for all $w_m > \overline{w}$ (region $R3$) too; otherwise, it reaches its peak within $R3$. The efficient firm union's most-preferred w_m is $m_{U2} = ak/(2k-1)$[9] if $k_{U2} \leq k < \bar{k}$ and $m_{U2} = [ak + (2-k)w_0]/(4-2k)$ if $1 < k < k_{U2}$.

(b) If $k \leq k_{U1}^{R2}$, the inefficient firm union's welfare is single-peaked, increasing for all w_m within $R2$ and reaching its peak within $R3$. If $k \geq k_{U1}^{R3}$, its welfare is again single peaked, reaching its peak within R2 and decreasing thereafter. Finally, if $k_{U1}^{R2} < k < k_{U1}^{R3}$, its welfare is double-peaked, reaching one peak within each of the regions $R2$ and $R3$; if $k < k_{U1}$, the highest peak lies within $R3$, while if $k > k_{U1}$, it lies within $R2$. Moreover, the inefficient firm union's most preferred w_m is $m_{U1}^{R3} = [ak - (2k-1)w_0]/(4k-2)$ if $1 < k < k_{U1}$ and $m_{U1}^{R2} = [5ak + (2+7k)w_0]/14k$ if $k_{U1} < k < \bar{k}$.

Proof. (a) Since from (9) and (10) $dw_2^*/dw_m > 0$ and $dy_2^*/dw_m > 0$, $dU_2^*/dw_m > 0$ for all $\underline{w} \leq w_m \leq \overline{w}$ (region $R2$). Further, from (11) we have $U_2^* = (w_m - w_0)[a - (2/k-1)w_m]/3k$ for $w_m > \overline{w}$ (region $R3$). Then $dU_2^*/dw_m = 0$ implies that $m_{U2} = [ak + (2-k)w_0]/(4-2k)$. It can be checked that $m_{U2} > \bar{w}$. However, $m_{U2} < ak/(2k-1)$ (which is the maximum value that w_m can take such that from (11) $y_1^* > 0$), only if $k < k_{U2}$; otherwise, $m_{U2} = ak/(2k-1)$.

[9] This is the maximum value that the wage floor can take such that the inefficient firm still stays in the market.

(b) Since $[U_1^*]^{R2} = (w_m - w_0)[5a + 2(w_0/k) - 7w_m]/12$ in region $R2$, $dU_1^*/dw_m = 0$ implies that $m_{U1}^{R2} = [5ak+(2+7k)w_0]/14k$. It can be checked that $m_{U1}^{R2} > \underline{w}$ in the permissible parameter space, i.e., for all $k < \bar{k}(w_{0n})$. However, $m_{U1}^{R2} \leq \bar{w}$ only if $k > k_{U1}^{R2}$; otherwise, $dU_1^*/dw_m > 0$ for all w_m in R2. Similarly, since $[U_1^*]^{R3} = (w_m - w_0)[a - (2 - 1/k)w_m]/3$ in region $R3$, $dU_1^*/dw_m = 0$ implies that $m_{U1}^{R3} = [ak - (2k - 1)w_0]/(4k - 2)$. It can be checked that $m_{U1}^{R3} < ak/(2k - 1)$. However, $m_{U1}^{R3} > \bar{w}$, only if $k < k_{U1}^{R3}$; otherwise, $dU_1^*/dw_m < 0$ for all w_m in $R3$. As a consequence, if $k_{U1}^{R2} < k < k_{U1}^{R3}$, union 1's welfare has two peaks, one in $R2$ and another one in $R3$. It can then be checked that $[U_1^*]^{R3} > [U_1^*]^{R2}$ if and only if $k < k_{U1}$, and vice versa. Therefore, union 1's most preferred w_m is m_{U1}^{R3} if $k < k_{U1}$, while it is m_{U1}^{R2} if $k \geq k_{U1}$, with $k_{U1}^{R2} < k_{U1} < k_{U1}^{R3}$. □

The intuition behind the above findings is straightforward. If, given w_0, the firms' productivity differential is quite high (i.e., $k > k_{U2}$), the business-stealing effect is so strong that the efficient firm union's losses in terms of jobs are always more than offset by its gains from a higher firm-specific wage, and it would thus opt for the highest possible w_m. For lower productivity differentials, the efficient firm's union, in order to avoid considerable employment losses, would opt for a more moderate – albeit still binding for both firms' unions – wage floor. Turning next to the inefficient firm's union, considerations are reversed. If, given w_0, the firms' productivity differential is sufficiently high (i.e., $k > k_{U1}$) and thus its expected employment losses due to business-stealing from the rival efficient firm are significant, the inefficient firm's union would opt for a low enough w_m, which will ex-post be binding only for its own members. For lower productivity differentials, however, the losses in terms of jobs are not so significant, and the inefficient firm's union would opt for a high enough w_m, that would ex-post be binding for both firms' unions.

It is now clear, as Propositions 3 and 4 dictate, that in the presence of productivity asymmetries among firms, three (out of the four) labor market agents, each acting for its own interest, have an incentive to establish a wage floor in the sector. Hence, while it is not surprising that both unions are better off with the guarantee of a minimum wage, our analysis so far demonstrates that it is the strategic pursuit of the high wage – efficient firm under decentralized wage setting that could enable the establishment of a sector-level wage deal.

5 Endogenous wage-bargaining centralization

We can now proceed to establish the main result of our analysis, that is, to identify the conditions under which the *MSWI* is expected to emerge in equilibrium. Assume for the moment that, in the first stage the government's regulator has decided to activate the *default MSWI* which authorizes a collective settlement of a wage floor in the sector. To simplify the analysis, we have postulated that, in the second stage, the regulator (or a committee of experts under his auspices) proposes a sector-level wage rate and a representative for each firm and each union votes in favor, or against, the proposed minimum wage. Moreover that, the regulator's objective is assumed to take a *lexicographic* form, i.e., the regulator chooses a w_m proposal

to (i) maximize the excess of the "*yes*" over the "*no*" votes and given (i), to (ii) maximize the welfare of the firm, or union, whose representative will be the first to switch his vote from "*yes*" to "*no*" as w_m increases. In this sense, the latter is the *pivotal voter*, and the equilibrium sector-level wage deal w_m^* will be the value of w_m that maximizes the pivotal voter's welfare. Our findings regarding w_m^* are summarized in the following Proposition.

Proposition 5. *Whenever a MSWI, authorizing a sector-level wage deal, is in effect, the regulator proposes a minimum wage w_m^* such that:*

(i) $w_m^* = m_{F2} = \bar{w} = (ak + 2w_0)/(4 - k)$ *for all* $k \leq \hat{k}$*, as in this case it is the efficient firm's representative that will switch first his vote from "yes" to "no" as w_m increases.*

(ii) $w_m^* = m_{U1}^{R2} = [5ak + (2 + 7k)w_0]/14k$ *for all* $k > \hat{k}$*, as in this case it is the inefficient firm union's representative that will switch first his vote from "yes" to "no" as w_m increases,*
where $\hat{k}(.)$ is the inverse function of $\hat{w}_{on}(k) = \frac{5k(29k-32)}{49k^2+30k-64}$ and $1 < k_{U1}^{R2} < \hat{k} < k_{U1} < \bar{k}$.

Moreover, the proposed w_m^* receives three (out of the four) votes and is established as the sector-level wage floor.

Proof. Propositions 3 and 4 imply that if the regulator chooses a $w_m > \underline{w}$ that is not too high, his proposal will receive three votes in favor (from the representatives of the efficient firm and the two unions) and one vote against (from the representative of the inefficient firm). The reverse is true for any proposal $w_m \leq \underline{w}$. Hence, the regulator can maximize votes by properly selecting a *binding* wage floor. Now in order to find the optimal w_m for the regulator, we need to identify the representative who will be the first to switch his vote from "*yes*" to "*no*" as w_m increases.

First, since the efficient firm's profits increase with w_m within $R2$, and decrease within $R3$, its representative's switching w_m, η_{F2}, is obtained by equating its profits under a non-binding w_m (i.e., under decentralized wage setting) with those under a binding for both firms w_m, i.e., $\pi_2^d = \pi_2^*(w_m > \bar{w}) = (w_m - w_0)[a - (2/k - 1)w_m]/3$. From (8) $\eta_{F2} = (5ak + 14w_0 - 4kw_0)/5(6 - 3k)$. It can be checked that $\bar{w} < \eta_{F2}$ in the permissible range of parameters.

Similarly, by solving $U_1^d = [U_1^*]^{R2} = (w_m - w_0)[5a + 2(w_0/k) - 7w_m]/12$, we obtain the switching w_m for the representative of the inefficient firm's union in $R2$, $\eta_{U1}^{R2} = (40ak + 49kw_0 + 16w_0)/105k$. Of course, this lies in $R2$ only if $\eta_{U1}^{R2} \leq \bar{w}$. It can be checked that the latter inequality holds only if k is large enough and, in particular, if $k \geq \hat{k}$. On the other hand, the U_1's representative switching w_m in $R3$, η_{U1}^{R3}, is obtained by solving $U_1^d = [U_1^*]^{R3} = (w_m - w_0)[a - (2 - 1/k)w_m]/3$, and is given by

$$\eta_{U1}^{R3} = \frac{15(ak + 2w_0k - w_0) + \sqrt{(160a - 63w_0)\, w_0 + 32\,(w_0^2/k) - 10kF + k^2G}}{30(2k - 1)}$$

where $F = (-20a^2 + 43aw_0 + 6w_0^2)$ and $G = (-175a^2 + 220aw_0 + 116w_0^2)$. It can be checked that $\eta_{U1}^{R3} > \bar{w}$ in the relevant range of parameters and moreover,

that it is always smaller than the switching w_m, η_{U2}, of the efficient firm union's representative (which, by Proposition 4, lies in R_3). Finally, it can be checked that for all $k < k_{U1}$, $\eta_{U1}^{R3} > \eta_{F2}$, i.e., if k is small enough, the representative of the efficient firm will switch his vote from "*yes*" to "*no*" at a smaller w_m than the representative of the inefficient firm's union (provided that the latter has not switched his vote already within R_2).

From Proposition 4, if $k > k_{U1} > \hat{k}$, U_1's representative will switch first his vote from "*yes*" to "*no*" at $w_m = \eta_{U1}^{R2} < \bar{w}$; hence, $w_m^* = m_{U1}^{R2} = [5ak + (2 + 7k)w_0]/14k$, because the regulator's proposal coincides with U_1's most-preferred w_m. On the other hand, if $k < \hat{k}$, we saw above that the efficient firm's representative will switch first his vote from "*yes*" to "*no*" at $w_m = \eta_{F2} > \bar{w}$; hence, $w_m^* = m_{F2} = \bar{w} = (ak + 2w_0)/(4 - k)$, because the regulator's proposal coincides with F_2's most-preferred w_m. It remains to see what happens when $\hat{k} < k < k_{U1}$. In this case, U_1's representative will defer switching his vote from "*yes*" to "*no*" at $w_m = \eta_{U1}^{R2} < \bar{w}$, and instead switch his vote at $w_m = \eta_{U1}^{R3} > \bar{w}$, only if $\eta_{U1}^{R3} < \eta_{F2}$. This is so, because in that case the regulator's proposal will be $w_m^* = m_{U1}^{R3}$ and U_1 could thus achieve its (global) maximum welfare. If, in contrast, $\eta_{U1}^{R3} > \eta_{F2}$, the regulator's proposal will be $w_m^* = \bar{w}$, in which case U_1's welfare would be lower than under $w_m^* = m_{U1}^{R2}$, a level that the representative of U_1 can achieve by switching his vote at $w_m = \eta_{U1}^{R2} < \bar{w}$. But as we saw above, for all $k < k_{U1}$, $\eta_{U1}^{R3} > \eta_{F2}$ and hence U_1's representative will switch first his vote from "*yes*" to "*no*" at $w_m = \eta_{U1}^{R2} < \bar{w}$. Hence, $w_m^* = m_{U1}^{R2} = [5ak + (2 + 7k)w_0]/14k$, for $\hat{k} < k < k_{U1}$ too. □

The intuition behind these results is quite simple. For small productivity differences ($k < k_{U1}$), both unions' rents are maximized for $w_m > \bar{w}$, i.e., within region $R3$. There, however, the efficient firm's profits decrease with w_m. Hence, if the proposed w_m happens to be greater than $\overline{w}$, the representative of the efficient firm will switch his vote from "*yes*" to "*no*" at a smaller w_m than the representatives of the unions and in particular of the inefficient firm's union. The regulator's proposal will then be equal to the pivotal voter's – efficient firm's most-preferred wage floor, i.e., $w_m^* = \bar{w}$. On the other hand, if productivity differences are large ($k > k_{U1}$), the inefficient firm union's welfare attains its (global) maximum for some $\underline{w} < w_m < \bar{w}$, i.e., within region $R2$. Since $\eta_{U1}^{R2} < \bar{w}$ for all those values of k, its representative will switch first his vote from "*yes*" to "*no*" within $R2$, and thus before the representative of the efficient firm (who switches within $R3$), inducing the regulator to choose its most-preferred wage floor, i.e. $w_m^* = m_{U1}^{R2}$.

An interesting implication of Proposition 5 is that the established wage floor does not behave monotonously with productivity asymmetries. For small k,i.e. $k \leq \hat{k}$, w_m^* increases with k, while the opposite is true for $k > \hat{k}$. Since for small k, the pivotal voter is the efficient firm, an increase in productivity asymmetries leads this firm to opt for a higher wage floor in order to eliminate its relative labor cost disadvantage. In contrast, since for a large k, the pivotal voter is the inefficient firm's union, an increase in productivity asymmetries makes this union more reluctant to accept a high wage floor that would lead to significant job losses.

Finally, turning to the first stage of the game, the government's regulator will decide to *activate* the *default MSWI* (or equivalently, to establish it in case that it is absent) for the particular sector, only if he expects some supra-normal benefits from such a decision. Obviously, the more (explicit or implicit) support from the involved parties the regulator receives for his adopted policies, the more successful his career is likely to be and the higher will be his expected future benefits. In particular, we assume that the regulator is a public sector manager and his objective function is of a managerial-type, $U_R = P(\nu^+)V - \varepsilon$, where V is the discounted sum of the regulator's benefits (above a standard salary) from being a successful public manager, $P(\nu^+)$ is the probability of being successful and $\varepsilon > 0$ (with $\varepsilon << V$) are the "managerial" costs of implementation of a specific policy. Moreover, $P$is an increasing function of the degree of social consensus ν^+ that a policy receives, which is measured by the support, i.e. the excess of the "*yes*" over the "*no*" votes, that an adopted policy, explicitly or implicitly, obtains by the involved parties.

In our setup, the government's regulator will *activate* the *default MSWI* for the particular sector, if he expects that this "institutional resolution" will *implicitly* receive the support of the majority of the firms' and unions' representatives. As those representatives do not actually vote in favor or against any institutional resolution in the first stage, this is done implicitly through their vote in the second stage, where a vote in favor or against a proposed sector-level wage floor is essentially a positive or negative vote for the authorization of the *MSWI* per se. Therefore, the regulator will not activate the *MSWI*, unless he is confident that his w_m proposal in the following stage will receive the majority of votes and will thus be established as a sector-level wage floor.

Consider first the case where there are no asymmetries in productivity amongst firms in the sector, i.e., $k = 1$. In this case, due to the conflicting interests of firms and unions, there is no w_m proposal that could receive the majority of their representatives' votes. In fact, Proposition 2 implies that any (binding) w_m proposal will receive equal votes in favor (from the unions' representatives) and against (from the firms' representatives) and thus cannot be established as a wage floor in the sector. Moreover, since the regulator expects a zero excess of the "*yes*" over the "*no*" votes ($\nu^+ = 0$) in the following stage, and thus zero gross benefits, i.e., $P(0)V = 0$, he prefers to keep the *MSWI* idle in order to save on the policy implementation costs ε.

In contrast, under productivity asymmetries ($k > 1$), Propositions 3 and 4 imply that there will be sufficient social consensus for the activation of the *MSWI*. In fact, the regulator's optimal proposal w_m^* (as described in Proposition 5) will receive three votes in favor (from the representatives of the two unions and the efficient firm) and only one vote against (from the representative of the inefficient firm). Since the regulator expects that the adoption of a *MSWI* will *implicitly* receive the support of the majority of the sector's agents, and in particular it will obtain an excess of two votes in favor ($\nu^+ = 2$), he has an incentive to activate it in the first stage. This is so, because for an ε sufficiently small, $P(2)V - \varepsilon > 0$. The above results are summarized in the following Proposition.

Proposition 6.

(i) If there are no productivity asymmetries among firms, i.e., $k = 1$, the regulator does not have any incentive to activate the default MSWI. The prevailing institution in this case will be completely decentralized union- wage setting.

(ii) If there are productivity asymmetries among firms, i.e., $k > 1$, the regulator has always an incentive to activate the MSWI (or establish it in case it is absent). The prevailing institution will be completely centralized wage setting, if k is sufficiently small, while for larger k there will be partially decentralized wage setting, where the efficient firm's union will set a firm-specific wage above the sector-level wage floor.

The reasoning behind the second part of Proposition 6 and in particular, on the institution that prevails in equilibrium, stems from Proposition 5. If productivity asymmetries are small enough, the regulator, after activating the *MSWI*, will propose and establish a sector-level wage floor $w_m^* = m_{F2} = \bar{w}$ that will *ex post* be binding for both firms' unions. Therefore, during the firm-level wage setting, both unions will simply confirm the sector-level minimum wage, and the prevailing institution will thus resemble to a completely centralized wage bargaining. On the other hand, if productivity asymmetries are sufficiently large, the regulator, after activating the *MSWI*, will establish a sector-level wage floor $w_m^* = m_{U1}^{R2} < \bar{w}$ that will *ex post* be binding only the inefficient firm's union. Therefore, during the firm-level wage setting, the inefficient firm's union will simply confirm the sector-level minimum wage, while the efficient firm's union will set a higher than the wage floor firm-specific wage. As a result, the prevailing institution is of a hybrid form, i.e., partially decentralized bargaining over wages.

It should be noticed that Proposition 6 dictates that, even under small productivity asymmetries (i.e., k close enough to 1), the *MSWI* will be established in the sector despite its implementation costs. This is due to our assumption that the regulator is the only agent who bears the institution's implementation costs (explicitly captured by ε), while no other agent (firm or union) faces any fixed costs, e.g., lobbying costs during the activation stage of the institution or those arising from the agents' participation in the centralized wage negotiations stage induced by the *MSWI*. In particular, when k is too close to 1, the pivotal agent's – the efficient firm's – gains from the activation/establishment of the *MSWI* are infinitesimal. Those gains would, most likely, not cover the efficient firm's costs from sending its representatives to the sector-level wage negotiations, in which case the regulator would be unable to guarantee an ex-post approval for its decision to activate the *MSWI*. While our analysis does not explicitly consider this type of "frictions" that exist in real life, it is clear that under these circumstances, the regulator will not be willing to authorize sector-level wage negotiations by activating the institution in the first stage. Therefore, if the productivity asymmetries are rather insignificant, the *MSWI* will not be established and decentralized wage setting is expected to prevail in equilibrium. Nevertheless, since lobbying and participation costs are fixed costs, they would not affect the equilibrium outcome once the *MSWI* is established.

6 Employment and welfare effects

Our analysis entails a number of interesting implications for the wage structure and employment, as well as production patterns and consumers' welfare, in sectors with market power. First, if wage bargaining centralization emerges endogenously, wage differentials between employees of efficient and inefficient firms are expected to decrease substantially or even to be eliminated. In this narrow sense therefore, distribution of income is improved. Second, wages are always higher than under the completely decentralized wage bargaining institution. As a result, aggregate production is lower,[10] product price is higher, and hence consumers' welfare is lower. Despite that some of their members will be left unemployed under wage bargaining centralization unions' total rents are always higher than under the decentralized regime. Further, the (efficient) firm that has the initiative to establish wage bargaining centralization will benefit from this institution, while the rival firm will always be hurt. Third, since the efficient firm pays a higher wage under the completely decentralized regime, the equilibrium wage bargaining institution induces a production shift to the "right direction", i.e., the efficient firm's market share increases and thus wage bargaining centralization is an efficiency-enhancing institution. Finally, aggregate employment is always lower under wage bargaining centralization. The reason is that aggregate production decreases and the market share of the firm possessing the labor-saving technology increases.

These results are not entirely novel in the literature. A minimum wage always acts as a redistribution tool (see, e.g., Freeman [12]). In particular, a sector-level minimum wage acts as a "sword of justice", shifting the earnings distribution in favor of the low-paid workers and, since some of those workers will be left unemployed, there may be adverse employment effects (see Dolado et al. [10]). Our theory further suggests that distribution among high-paid and low-paid employees will be improved, at the cost of inefficient employers. Moreover, we provide a clear explanation for the predicted negative employment effects of wage bargaining centralization. The latter implies higher unit labor costs for all the firms in the sector. This, in conjunction with a labor-saving production shift, leads naturally to lower aggregate employment.

7 Concluding remarks

In this paper we have developed a theoretical framework for the endogenous determination of alternative wage bargaining structures that are actually observed in unionized sectors. We have shown that economic factors, such as technological asymmetries among firms, may effectively be the driving force behind the establishment of various degrees of wage bargaining centralization. It is due to those asymmetries that a coalition, consisting of all unions and efficient firms, may provide a regulator with the right incentives to activate/establish a Minimum Sectoral Wage Institution.Moreover, if firms' productivity differences are *ceteris paribus*

[10] This is so, because in a constant-returns-to-scale Cournot market, aggregate output depends only on the sum of marginal costs.

small enough, negotiations over wages will be conducted at the sector-level alone and hence a completely centralized wage setting structure will emerge in equilibrium. Otherwise, bargaining over wages will also be conducted at the firm-level and thus a partially centralized wage setting structure will emerge. In contrast, if those asymmetries are negligible, the completely decentralized wage bargaining regime will be sustained in equilibrium.

Our model, though stylized, turns out to be robust along a number of dimensions. First, similar results can be obtained if our assumption that each firm/union has one vote during sector-level negotiations is replaced with the postulate that the regulator will activate the *MSWI* whenever the workers' association (e.g., the unions' federation) is expected to vote in favor of the proposed minimum wage, while the employers' association's vote is expected to be deadlocked. Second, qualitatively similar results could be obtained under a broader regulator's objective in which the minimum wage proposal is specified as an increasing function of the pivotal agent's most-preferred wage floor. If, for instance, the regulator cares about the implications of the activation of the *MSWI* on consumer surplus, the proposed w_m could be smaller than the pivotal voter's (i.e., the efficient firm's or the inefficient firm union's) most-preferred wage floor, provided that it does not fall below, or exceeds, the wage floor that the other agents prefer.

Productivity asymmetries have been shown to determine the extent of bargaining centralization also in a different context. Jun [16] analyzes union formation decisions when a firm employs two groups of workers, a high- and a low-productivity group. Before entering in wage negotiations with the firm, workers decide to form a joint union or two separate unions. If productivity differences are small enough, a joint union is established, which then negotiates with the firm about wage(s). Otherwise, two separate unions are formed, which then simultaneously negotiate with the firm, each over its own wage.

There has also been growing interest in studying the macroeconomic implications of various labor market institutions (see, e.g., Calmfors and Driffil [4]; Jackman et al. [14]; Jimeno [15]). This literature shows that the degree of wage bargaining centralization significantly affects long-run unemployment and inflation rates. It thus becomes all the more important to understand and analyze, as our framework attempts, the circumstances under which a certain degree of wage bargaining centralization may endogenously emerge, as well as to study its consequences at the aggregate level. Our analysis predicts that productivity asymmetries across firms could lead to the establishment of some degree of centralization. The latter always leads to a lower aggregate employment, due to the higher labor costs and the induced shift of production towards efficient firms. Policy measures could then be carefully designed, targeted towards a group of labor market agents, who acting for their own interest, could promote the establishment of socially desirable institutions.

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