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WAGE BARGAINING AND PARTIAL OWNERSHIP*

NEGOCIACIÓN SALARIAL Y PROPIEDAD CRUZADA

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Abstract

This paper analyzes wage negotiation between firms and unions when cross-participation exists at ownership level. We consider two shareholders and two firms: one firm is jointly owned by the two shareholders and the other is owned by a single shareholder. Labor is unionized and the firms produce substitute products. We show that partial ownership increases the bargaining strength of the firm owned by a single shareholder; although this firm pays lower wages produces less output than the other firm. Compared with the case in which each firm is owned by a single shareholder, partial ownership reduces the wage paid by firms, the output of industry and therefore employment. Whether firms obtain greater or lower profit depends on the degree to which goods are substitutes. In fact, we obtain the surprising result that when the degree to which goods are substitutes is low enough, the firm that is owned by a single shareholder makes more profit than the other firm.

Key words: *Partial Ownership; Wage Bargaining; Heterogeneous Goods.*

Resumen

Este artículo analiza la negociación salarial entre empresas y sindicatos cuando existe propiedad cruzada. Consideramos dos accionistas y dos empresas: una empresa es propiedad conjunta de los dos accionistas y la otra es propiedad de un único accionista. La mano de obra está sindicada y las empresas producen bienes sustitutivos. Mostramos que la propiedad cruzada incrementa la fuerza de negociación de la empresa propiedad de un único accionista; aunque esta empresa paga menores salarios produce menos que la otra. Comparado con el

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caso en que cada empresa es propiedad de un único accionista, la propiedad cruzada reduce el salario pagado por las empresas, el producto de la industria y por lo tanto el empleo. Que las empresas obtengan mayores o menores beneficios depende del grado en que los bienes son sustitutos. De hecho, obtenemos el resultado sorprendente de que cuando el grado en que los bienes son sustitutos es suficientemente bajo, la empresa que es propiedad de un único accionista logra mayores beneficios que la otra empresa.

Palabras clave: *Propiedad parcial; Negociación salarial; Bienes heterogéneos.*

JEL Classification: *L13, L21, J31.*

1. Introduction

The factors that affect wage negotiations between firms and unions have been extensively studied in the literature on wage bargaining.[1] However, theoretical analysis of this issue has not considered how partial ownership of firms influences wage bargaining between firms and unions. In this regard, the literature that analyzes partial ownership of firms usually assumes that production costs are exogenously given (see, for example, Malueg, 1992; Reitman, 1994; Gilo *et. al.*, 2006). However, labor costs are by far the greatest component of costs in most corporations (see Bhagat *et al*., 1990). Therefore, it is important explicitly to assume unionized labor since cross-ownership affects the bargaining position of firms and, thus, their profits.

The literature on wage bargaining has analyzed various factors that increase the bargaining strength of both firms and unions. From the union side, it is well known that centralized bargaining (each firm bargains with an industry-wide union) results in higher wages than decentralized bargaining (firms negotiate with independent unions at firm level) since the bargaining strength of the workers is greater in the first case. Under centralized bargaining, when the union bargains wages with one firm it has the incomes obtained at the other firm as a disagreement payoff, which increases the bargaining strength of the workers (see Horn and Wolinsky, 1988; Davidson, 1988). Dobson (1994) shows that when wage bargaining is centralized at industry level, the union gains by bargaining first with the firm that is in a relatively weak bargaining position or with a firm that has relatively large profits. He points out that in some industries strategic movements come from the union: the industry-wide union targets one firm with which it will negotiate first. The resulting agreement is then used as the basis for future negotiations with other firms in the industry.

On the firm side, Bárcena-Ruiz and Garzón (2000) show that the decision to merge by firms may, together with the reorganization of production decisions,

[1] See, for example, Haucap and Wey (2004), Malcomson (1987), Farber (1986), Oswald (1985) and McDonald and Solow (1981).

allow employers to decrease union incomes.[2] The decision to merge by firms, establishing a multiproduct firm with two divisions, increases their bargaining strength since when the head of the multiproduct firm negotiates wages with the union of one division, its disagreement payoff is the profit of the other division when the first one does not produce.

In this paper we set out to study another factor that influences the bargaining strength of both firms and unions: the existence of cross-participation at ownership level.[3] We believe this analysis to be relevant since in the literature that analyzes wage negotiations it is generally considered that each firm is owned by a different shareholder (see, for example, Dobson, 1994; Davidson, 1988). On the other hand, the literature that studies partial ownership usually assumes exogenous production costs.

The issue that we analyze in this work can be illustrated by taking the automobile industry as an example. In this industry there are examples of partial ownership of rivals, *e.g.* the French firm Renault created an alliance with the Japanese firm Nissan. Renault currently holds a 44.3% equity stake in Nissan Motor and Nissan Motor has a 15% stake in Renault (see www.renault.com). Moreover, in advanced countries firms in the automobile industry negotiate wages with workers' representatives.[4] We set our model in this context.

We consider in our paper that there are two firms that produce substitute products. There are two shareholders: one firm is jointly owned by the two shareholders while the other is owned by only one of them. The only factor of production is labor and all workers are unionized. There is an independent union at each firm. To determine the wage set at each firm, we consider the "right-to-manage" model of Nickell and Andrews (1983) where union and firms bargain over a uniform wage rate while employment is set unilaterally by the firms.

We show in the paper that three effects arise, two at the wage setting stage and one at the production stage. The first effect is the disagreement payoff effect: the shareholder that owns shares in both firms has a positive disagreement payoff when negotiating wages with the union of the firm in which he is the single owner (disagreement payoff effect), and it is well known that the higher the disagreement payoff of a firm the stronger its bargaining position is and the lower the wage paid. The second effect is the cross-ownership effect at the wage setting stage: the shareholder that owns shares in both firms takes into account how the wage paid by the firm in which he is the single owner affects the profits of the other

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[2] It is usually argued that if a multiplant firm centralizes wage bargaining its bargaining power increases, since when its head bargains wages with the workers of one plant, it has the profits obtained in the firm's other plants as a disagreement payoff (see, Heywood and Peoples, 1994 or Mezzetti and Dinopoulos, 1991).

[3] An explanation of why partial ownership arrangements are formed can be seen in Alley (1997). One of the reasons is that it alters the degree of competition in the industry (see, for example, Reynolds and Snapp, 1986; Farrell and Shapiro, 1990; Malueg, 1992; Reitman, 1994).

[4] Bargaining structures in developed countries differ. In E.U. countries, in general, collective agreements are concluded between the relevant union and the employers' association of an industry on a regional basis (see Layard *et al*., 1991; Addison and Siebert, 1993). In Japan, wages are negotiated simultaneously in the 'Spring offensive' and the basic structure of the Japanese labor union is mostly enterprise-based (see Sasajima, 1993).

firm; this effect raises the wage paid by this firm to reduce market competition. The third and final effect is the cross-ownership effect at the production stage: the shareholder that owns shares in both firms reduces the output of the firm in which he is the single owner to reduce market competition.[5]

We show in the paper that when wages are negotiated the first effect dominates the second one and thus, compared with the case in which each firm is owned by a single shareholder, partial ownership increases the bargaining strength of the shareholder who has an investment in both firms. Therefore, the firm owned by a single shareholder pays lower wages than the other firm. As wages are strategic complements, if one firm decreases wages so does the other. As a result, under cross-ownership both firms pay lower wages than when each firm is owned by a single shareholder.

The output of the firms depends on all three effects. At the production stage the cross-ownership effect leads the firm owned by a single shareholder to reduce its output level to reduce market competition. Thus, although the first and second effects imply that this firm pays the lower wage, the third effect leads this firm to produce the lower output. The other firm obtains a greater market share and hires more workers at the expense of this firm.

Cross-ownership increases the utility of the union that bargains with the firm owned by the two shareholders but reduces the utility of the other union and the aggregate utility of the two unions. Under partial ownership, the firm that is jointly owned by the two shareholders makes more profit than if each firm is owned by a single shareholder. The other firm may obtain more or less profit depending on the degree to which goods are substitutes.

We find in the paper that the cross-ownership effect depends on the degree to which goods are substitutes. Specifically, the lower this degree is the lower the competition in the product market and the lower the incentive to reduce market competition and therefore the weaker the cross-ownership effect is.

When goods are substitutes to a high degree, the cross-ownership effect is strong enough. Thus, the firm owned by a single shareholder obtains lower profits and the other firm obtains greater profits than when each firm is owned by a single shareholder. When the degree to which goods are substitutes takes an intermediate value, the cross-ownership effect is weaker and thus both firms obtain greater profits than when firms are owned by different shareholders, but the firm owned by the two shareholders still obtains more profit than the other firm. Finally, when the degree to which goods are substitutes is low enough, the cross-ownership effect is weaker than in the preceding case, so both firms obtain greater profits than when firms are owned by different shareholders, but the firm owned by a single shareholder obtains more profits than the other firm.

The rest of the paper is organized as follows. Section 2 describes the general features of the model and Section 3 presents the results. Finally, Section 4 draws some conclusions.

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[5] Papers analyzing partial ownership (see, for example, Malueg, 1992; Reitman, 1994; Gilo *et. al*, 2006), consider only the third effect.

2. The Model

We consider a market consisting of two firms denoted by 1 and 2, which produce substitute goods. They have identical technology and face a linear demand:

$$p_i = a - q_i - b\, q_j,\ 0 \le b \le 1,\ i \ne j;\ i, j = 1, 2,$$

where p_i is the price of firm i and q_i, is the output level of firm i. As usual, parameter b measures the degree to which their goods are substitutes.

The only factor used in the production process is labor. Technology exhibits constant returns to scale such that $q_i = L_i$. Each firm hires L_i workers with a uniform wage w_i. All workers are unionized and there is an independent union at each firm. The unions seek to maximize the wage bill and the utility function of the union of firm i (union i) is: $U_i(w_i, L_i) = w_i L_i$, $i = 1, 2$. We consider a variant of the right-to-manage model of Nickell and Andrews (1983) where union and firms bargain over a uniform wage rate while employment is set unilaterally by firms.

There are two shareholders, denoted by A and B. Firm 1 is owned by shareholder A while firm 2 is jointly owned by both shareholders, though shareholder B owns the majority of shares in firm 2. We denote by α, $\alpha < 1/2$, the percentage of shares that shareholder A owns in firm 2. Therefore, the objective functions of shareholders A and B, respectively, are: $\pi_A = \pi_1 + \alpha\pi_2$ and $\pi_B = (1-\alpha)\ \pi_2$. The profit of firm i is given by $\pi_i = (p_i - w_i)\ q_i$, where w_i is the wage paid to the workers of firm i.

The timing of the game is the following. In the first stage, shareholder A bargains wages with union 1 and simultaneously shareholder B negotiates wages with union 2. In the second stage, shareholder A decides the output level of firm 1 and simultaneously shareholder B chooses the output level of firm 2. We solve the game by backward induction to get a subgame perfect Nash equilibrium.

3. Results

In the second stage, shareholders simultaneously choose the output level that maximize their objective functions. Solving this, we obtain the Cournot-Nash equilibrium output (and therefore, employment) levels and firms' and shareholders' profits, as a function of wage rates:

$$q_1 = \frac{2(a - w_1) - b(1+\alpha)(a - w_2)}{4 - b^2(1+\alpha)},$$

(1)

$$q_2 = \frac{2(a - w_2) - b(a - w_1)}{4 - b^2(1+\alpha)}.$$

Substituting (1) in the profits of the firms, we obtain:

$$\pi_1 = \frac{(2(a-w_1)-b(1+\alpha)(a-w_2))((a-w_1)(2-b^2\alpha)-b(1-\alpha)(a-w_2))}{(4-b^2(1+\alpha))^2},$$

(2)

$$\pi_2 = \frac{(2(a-w_2)-b(a-w_1))^2}{(4-b^2(1+\alpha))^2}.$$

In the first stage, unions bargain wages simultaneously with firms' owners. The disagreement payoff of shareholder *A* when wage bargaining with union 1 is positive since this shareholder owns a positive percentage of the shares in firm 2. If union 1 goes on strike shareholder *A* gets α percent of firm 2's profits since union 2 does not go on strike. If we denote as D_A firm 2's profits when this firm operates as a monopolist, the disagreement payoff of shareholder *A* is αD_A, where $D_A = (a - w_2)^2/4$.[6] The disagreement payoff of each union is zero since we consider independent unions at firm level. The solution to the bargaining problem between shareholder *A* and union 1 is then given by:

(3) $$w_1(w_2) = \underset{w_1}{arg\ max}\ [\pi_1 + \alpha\pi_2 - \alpha D_A]\ [w_1\, q_1],$$

where π_1, π_2 and q_1 are given by (2) and (1), respectively. The disagreement payoff of shareholder *B* is zero since he only owns shares in firm 2. The bargaining problem for shareholder *B* is:

(4) $$w_2(w_1) = \underset{w_2}{arg\ max}\ [(1 - \alpha)\,\pi_2]\ [w_2\, q_2],$$

where π_2 and q_2 are given by (2) and (1), respectively. Solving (3) and (4) we get the reaction function in wages:

$$w_1 = \frac{a(2-b(1+\alpha))+b(1+\alpha)w_2}{8},$$

(5)

$$w_2 = \frac{a(2-b)+bw_1}{8}.$$

As usual, reaction functions in wages are upward sloping and thus wages are strategic complements; this means that if one firm pays a higher (lower) wage the other firm reacts by also paying a higher (lower) wage. From (5) we obtain the following result.

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[6] It is easy to see that when firm 2 behaves as a monopolist, its output level is $q_2 = (a-w_2)/2$, and thus its profit is $\pi_2 = (a-w_2)^2/4$.

Lemma 1. *When there is cross-participation at ownership level, the wage paid to workers, the output and employment levels of firms, the profit of firms and the utility of the unions are:*

$$w_1 = \frac{a(16 - b(6+b)(1+\alpha))}{64 - b^2(1+\alpha)}, \qquad w_2 = \frac{a(16 - 6b - b^2(1+\alpha))}{64 - b^2(1+\alpha)},$$

$$q_1 = L_1 = \frac{6a(16 - b(6+b)(1+\alpha))}{(64 - b^2(1+\alpha))(4 - b^2(1+\alpha))}, \qquad q_2 = L_2 = \frac{6a(16 - 6b - b^2(1+\alpha))}{(64 - b^2(1+\alpha))(4 - b^2(1+\alpha))},$$

$$\pi_1 = \frac{36a^2(16 - b(6+b)(1+\alpha))(16 + 2b(5\alpha - 3) - b^2(1+7\alpha) - b^3\alpha(1+\alpha))}{(64 - b^2(1+\alpha))^2(4 - b^2(1+\alpha))^2}$$

$$\pi_2 = \frac{36a^2(16 - 6b - b^2(1+\alpha))^2}{(64 - b^2(1+\alpha))^2(4 - b^2(1+\alpha))^2}$$

$$U_1 = \frac{6a^2(16 - b(6+b)(1+\alpha))^2}{(64 - b^2(1+\alpha))^2(4 - b^2(1+\alpha))}, \qquad U_2 = \frac{6a^2(16 - 6b - b^2(1+\alpha))^2}{(64 - b^2(1+\alpha))^2(4 - b^2(1+\alpha))}.$$

We consider as a benchmark the case in which there is no cross-ownership ($\alpha = 0$). In that case, each firm is owned by a single shareholder. The results obtained in that case, denoted without subscripts, are that of Lemma 1 with α being replaced by zero.

Lemma 2. *When each firm is owned by a single shareholder, the wage paid to the workers of each firm, the output and employment levels of each firm, the profit of each firm and the utility of each union are:*

$$w = \frac{(2-b)a}{8-b}, \quad q = L = \frac{6a}{(2+b)(8-b)}, \quad \pi = \frac{36a^2}{(2+b)^2(8-b)^2}, \quad U = \frac{6(2-b)a^2}{(2+b)(8-b)^2}$$

From Lemmas 1 and 2 it is easy to obtain the following result.

Proposition 1. *In equilibrium:*

i) $w > w_2 > w_1$;
ii) $q_2 = L_2 > q = L > q_1 = L_1$, $2L = 2q > q_1 + q_2 = L_1 + L_2$;
iii) $U_2 > U > U_1$, $2U > U_1 + U_2$.

Proposition 1 shows that firms pay a lower wage under cross-ownership than when each firm is owned by a single shareholder: $w > w_2 > w_1$. There are two

effects at the wage setting stage that explain this result.[7] First, only shareholder *A* has a positive disagreement payoff when he negotiates the wage with his union (disagreement payoff effect). Thus, when negotiating wages the bargaining position of shareholder *A* is stronger than that of shareholder *B*. And it is well known that the higher the disagreement payoff of a firm the stronger its bargaining position is and the lower the wage paid. The second effect arises due to partial ownership: shareholder *A* takes into account how the wage paid by firm 1 affects the profits of firm 2 (cross-ownership effect). This effect weakens the bargaining position of shareholder *A* when negotiating the wage with union 1 since the higher the wage paid by firm 1 is, the lower the market share of this firm is and thus the greater the market share and profits of the other firm.

The objective function of shareholder *A*, taking into account the disagreement payoff, when bargaining the wage of firm 1 is: $\pi_1 + \alpha\pi_2 - \alpha D_A$. This can be rewritten as: $\pi_1 - \alpha(D_A - \pi_2)$. Therefore, if we interpret $\alpha(D_A - \pi_2)$ as the disagreement payoff of shareholder *A* when bargaining wages with union 1, it is easy to see which of the two effects dominates.[8] As seen above, D_A is the profit of firm 2 when this firm is a monopolist in the product market while π_2 is the profit of firm 2 as a duopolist. Thus, D_A is greater than π_2, and therefore $(D_A - \pi_2)$ is positive. This means that, at the wage setting stage, the disagreement payoff effect dominates the cross-ownership effect, and thus firm 1 pays a lower wage under cross-ownership than when each firm is owned by a single shareholder (*i.e.*, when $\alpha = 0$). Given that wages are strategic complements firm 2 also pays a lower wage. Finally, firm 1 pays a lower wage than firm 2 ($w > w_2 > w_1$) since shareholder *A* has greater bargaining strength than shareholder *B*. It should be noted that when each firm is owned by a single shareholder neither of these two effects is found.

It is easy to see from Lemma 1 that the higher the value of parameter α is, the lower the wages paid by firms is.[9] Moreover, the gap between the wages paid by the two firms increases with α.[10] The greater the stake held by shareholder *A* in firm 2 is, the lower the wages paid by the two firms and the wider the gap between the wages paid by the two firms.

Proposition 1 states that $q_2 = L_2 > q = L > q_1 = L_1$. To explain this result it must be noted that the cross-ownership effect affects shareholder *A* also at the production stage. When shareholder *A* chooses q_1 he takes into account how q_1 affects the profit of the other firm (since its objective function is $\pi_1 + \alpha\pi_2$); thus, firm 1 reduces its output level compared with the case in which each firm is owned by a single owner. Therefore, to explain this result all three effects

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7 As we are considering independent unions, these effects come from the firms' side only, and not from the unions' side.

8 If the disagreement payoff of firm 1 is zero (*i.e.* if $\alpha D_A = 0$), only the cross-ownership effect is present. In this case, the objective function of firm 1 can be rewritten as $\pi_1 - (-\alpha\pi_2)$; therefore this effect can be interpreted as a negative disagreement payoff. This means that, in this case, firm 1 should pay a higher wage than when each firm is owned by a single shareholder.

9 $\dfrac{\partial w_2}{\partial \alpha} = -\dfrac{6ab^2(8+b)}{(64-b^2(1+\alpha))^2} < 0$, $\dfrac{\partial w_1}{\partial \alpha} = -\dfrac{48ab(b+8)}{(64-b^2(1+\alpha))^2} < 0$.

10 $\dfrac{\partial(w_2 - w_1)}{\partial \alpha} = \dfrac{6ab(64-b^2)}{(64-b^2(1+\alpha))^2} > 0$.

have to be considered. The disagreement payoff effect leads shareholder A to pay lower wages to the workers of firm 1 and, thus, the output level of that firm rises. However, the cross-ownership effect goes in the opposite direction. On the one hand, at the wage setting stage it leads firm 1 to pay higher wages and thus indirectly to reduce market competition. On the other hand, at the production stage it leads firm 1 to reduce its output level, directly reducing market competition. The cross-ownership effect is stronger than the disagreement payoff effect which means than firm 1 produces less than firm 2. Thus, firm 2 obtains a greater market share and hires more workers at the expense of firm 1. When there is no cross-ownership the output and employment levels of the firms are between those obtained under partial ownership (although the wages paid by firms are higher). We also obtain that the output of firm 1 decreases with α while the output of firm 2 increases with α.[11] Therefore, the higher parameter α is, the higher the gap between outputs is. Moreover, cross-ownership decreases the output of the industry, and therefore employment: $2L = 2q > L_1 + L_2 = q_1 + q_2$.[12]

We find that the utility obtained by unions is $U_2 > U > U_1$. Therefore, partial ownership increases the utility of the union at the firm owned by the two shareholders but reduces the utility of the union at the other firm. The firm owned by a single shareholder pays the lower wage ($w > w_2 > w_1$) and hires less workers ($L_2 > L > L_1$) and thus the utility obtained by its union is the lowest possible. The rival firm pays an intermediate wage and hires more workers, which implies that its union obtains the greater utility. Moreover, it can be shown that $2U > U_1 + U_2$; therefore, cross-ownership reduces the aggregate utility obtained by the two unions. This is because under cross-ownership both firms pay lower wages (due to the disagreement payoff effect) and total employment is lower (due to the cross-ownership effect).

Let b^* be the value of parameter b such that $\pi_1 = \pi_2$, and b^{**} the value of parameter b such that $\pi_1 = \pi$. It should be noted that both b^* and b^{**} depend on parameter α (see Appendix). By comparing the profits of the firms with and without cross-ownership we obtain the following result, which is illustrated in Figure 1.

Proposition 2. *In equilibrium:*

i) $p_2q_2 > pq > p_1q_1$, $\pi_1 + \pi_2 > 2\pi$,
ii) $\pi_1 \geq \pi_2 > \pi$ *if and only if* $b \leq b^*$,
iii) $\pi_2 > \pi_1 \geq \pi$ *if and only if* $b^* < b \leq b^{**}$,
iv) $\pi_2 > \pi > \pi_1$ *if and only if* $b^{**} < b$.

Proof. See Appendix

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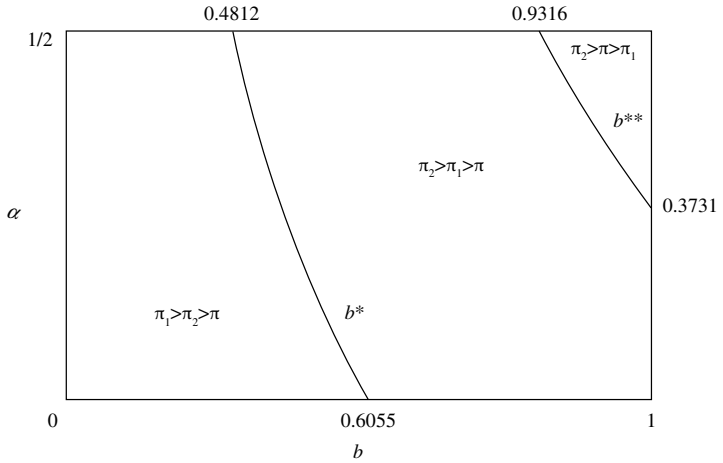
[11] $$\frac{\partial q_1}{\partial \alpha} = -\frac{6ab(1536 - 832b + 32b^3(1+\alpha) - (6b^4 + b^5)(1+\alpha)^2)}{(256 - 68b^2(1+\alpha) + b^4(1+\alpha)^2)^2} < 0;$$

$$\frac{\partial q_2}{\partial \alpha} = \frac{6ab^2(832 - 408b - (32b^2 - 12b^3)(1+\alpha) + b^4(1+\alpha)^2)}{(256 - 68b^2(1+\alpha) + b^4(1+\alpha)^2)^2} > 0.$$

[12] The fact that cross-ownership reduces market competition and thus the output of industry is a well known result (see, for example, Malueg, 1992).

FIGURE 1
ILLUSTRATION OF PROPOSITION 2



Proposition 1 shows that $q_2 > q > q_1$, which implies that $p_2q_2 > pq > p_1q_1$. It is shown in the Appendix that $p_1 > p_2 > p$; therefore, the preceding result depends mainly on the market share obtained by firms.

It is easy to see that if there is no wage bargaining and thus production costs are exogenous: $\pi_2 > \pi > \pi_1$ and $\pi_2 + \pi_1 > 2\pi$. In this case only the cross-ownership effect at the production stage exists. Shareholder *A* reduces market competition by reducing the output level of firm 1 because he takes into account how the output level of firm 1 affects the profit of firm 2. Thus, under cross-ownership firm 2 obtains more profit at the expense of firm 1 and the profit of the industry is greater under cross-ownership. Proposition 2 also shows that when production costs are endogenously determined the profit of the industry is greater under cross-ownership since the cross-ownership effects dominate the disagreement payoff effect.

Proposition 2 shows that firm 2 obtains more profit under partial ownership ($\pi_2 > \pi$ for all b). As when production costs are exogenously given, this result is due to the reduction in competition in the product market caused by partial ownership of firms. As seen above, this benefits firm 2, which is jointly owned by both shareholders.

Firm 1 can obtain more profit than firm 2, which depends on the degree to which goods are substitutes. In order to explain this result, it has to be analyzed how parameter b affects the three effects arising in the model. First, the disagreement payoff effect is not affected by parameter b since D_A is firm 2's profit when that firm operates as a monopolist. Second, the cross-ownership effect is weakened as b decreases since the lower the degree to which goods are substitutes, the lower the competition in the product market and the less incentive shareholder *A* has to reduce market competition. When wages are endogenously determined the cross-ownership effect influences both the pro-

duction stage and the wage setting stage; however, when wages are exogenous the cross-ownership effect influences only the production stage. Therefore in the former case the cross-ownership effect varies more strongly with parameter b than in the latter case.

When goods are substitutes to a high degree ($b > b^{**}$) it is obtained as when production costs are exogenous: $\pi_2 > \pi > \pi_1$. In both cases, the result is due to the cross-ownership effect. When wages are exogenous, there is no disagreement payoff effect and when wages are endogenously determined, the cross-ownership effects are strong enough since goods are substitutes to a high degree. In this case, as parameter b is great enough competition in the product market is strong and the result is due to the market share obtained by firms: the firm that obtains the greater market share obtains greater profits.

When parameter b is not high enough ($b \leq b^{**}$), the result obtained differs from that obtained when production costs are exogenous; in this case, the lower production costs of firm 1 under partial ownership result in its obtaining greater profits than when firms are owned by different shareholders ($\pi_1 > \pi$).

When the degree to which goods are substitutes takes an intermediate value ($b^* < b \leq b^{**}$), the cross-ownership effect is weakened and thus both firms obtain greater profit than when firms are owned by different shareholders, but firm 2 still obtains a greater profit than firm 1 ($\pi_2 > \pi_1 \geq \pi$).

Finally, when the degree to which goods are substitutes is low enough ($b \leq b^*$), the cross-ownership effect is weaker than in the preceding case and thus both firms obtain greater profits than when they are owned by different shareholders, but firm 1 obtains more profit than firm 2 ($\pi_1 \geq \pi_2 > \pi$). In this case, as parameter b is low enough competition in the product market is weak and firm 1 obtains more profit than firm 2 due to its lower production costs. When $b > b^*$, firm 2 obtains more profit ($\pi_2 > \pi_1$) due to its greater market share.

4. Conclusions

The literature on wage bargaining between firms and unions has studied various factors that affect the bargaining strength of both negotiators, but it has not considered how partial ownership of firms affects wage negotiation. In this paper we analyze wage bargaining when one firm is jointly owned by two shareholders and the other is owned by only one of them. We compare this with the case in which each firm is owned by a single shareholder.

The results show that partial ownership reduces the wages paid by both firms, the output of the industry and, therefore, employment. Moreover, it increases the utility of the union that bargains with the firm owned by both shareholders but reduces the utility of the other union because the firm owned by a single shareholder pays the lower wage and hires fewer workers. We show that cross-ownership affects the bargaining position of firms and, thus, their profits. The firm that is jointly owned by both shareholders obtains more profit than when each firm is owned by a single shareholder. The profit of the other firm depends on the degree to which goods are substitutes.

One possible extension of the paper is to consider that firms and unions may have different bargaining powers. It can be proved that the main results of the paper hold since these results are due to the bargaining payoff effect and

to the cross-ownership effects, which effects are still present when we assume bargaining powers. The same happens when we consider non linear demand functions. Another possible extension of the paper is to consider industry-wide unions. We leave this issue for future work.

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APPENDIX

Proof of Proposition 2

We prove first that $p_1 > p_2 > p$.

i) $p_1 - p_2 = \dfrac{36a(1-b)b\alpha}{256-68b^2(1+\alpha)+b^4(1+\alpha)^2} > 0,$ since $b \in [0, 1]$ and $\alpha < 1/2$.

ii) $p_2 - p = \dfrac{6ab^2\alpha(44-10b+b^2(1+\alpha)+b^3(1+\alpha))}{(16+6b-b^2)(256-68b^2(1+\alpha)+b^4(1+\alpha)^2)} > 0,$ since $b \in [0,1]$ and $\alpha < 1/2$.

Next we prove that $\pi_1 \geq \pi_2$ if $b \leq b^*$. It can be proved that:

$$\pi_1 - \pi_2 = \frac{36a^2b\alpha(64+16b^2(1+\alpha)+b^4(1+\alpha)^2-60b(2+\alpha)+6b^3(2+3\alpha+\alpha^2))}{(256-68b^2(1+\alpha)+b^4(1+\alpha)^2)^2}.$$

The denominator of the above expression is positive. We must analyze the sign of the numerator. Let us denote H_1 as follows:

$H_1 = (64+16b^2(1+\alpha)+b^4(1+\alpha)^2-60b(2+\alpha)+6b^3(2+3\alpha+\alpha^2))$. Then:

$$\frac{\partial H_1}{\partial b} = 32b(1+\alpha)+4b^3(1+\alpha)^2-60(2+\alpha)+18b^2(2+3\alpha+\alpha^2),$$

$$\frac{\partial^2 H_1}{\partial b^2} = 4(8(1+\alpha)+3b^2(1+\alpha)^2+9b(2+3\alpha+\alpha^2)) > 0.$$

Therefore, H_1 is strictly concave in b. On the other hand, if $b = 0$ we obtain that $H_1 = 64 > 0$, while if $b = 1$ we obtain that $H_1 = -27 - 24\alpha + 7\alpha^2 < 0$. So there is a value of parameter b, denoted by b^* $(0 < b^* < 1)$, such that if $b < b^*$ we obtain that $H_1 > 0$, while if $b > b^*$ we obtain that $H_1 < 0$. As a result, $\pi_1 \geq \pi_2$ if and only if $b \leq b^*$.

It is easy to see that if $\alpha = 0$ we get that $\pi_1 = \pi_2$ for $b^* = 0.6055$, while if $\alpha = 1/2$ we get that $\pi_1 = \pi_2$ for $b^* = 0.4812$. As a result, $0.4812 < b^* < 0.6055$.

Next, we prove that $\pi_2 \geq \pi$, $\forall$ *b:*

$$\pi_2 - \pi = (36a^2b^2\alpha(52-6b-b^2-b^2\alpha)(512-136b^2+2b^4-$$

$$84b^2\alpha-6b^3\alpha+3b^4\alpha+b^4\alpha^2)) / ((8-b)^2(2+b)^2(64-b^2-b^2\alpha)^2(4-b^2-b^2\alpha)^2).$$

Both the denominator and the numerator of the above expression are positive since $(52-6b-b^2-b^2\alpha)>0$ and $(512-136b^2+2b^4-84b^2\alpha-6b^3\alpha+3b^4\alpha+b^4\alpha^2)>0,\ \forall b\in [0, 1]$ and $\alpha \in (0, 1/2)$.

Next, we prove that $\pi_1 \geq \pi$ if and only if $b \leq b^{**}$. It is easy to determine that:

$$\pi_1-\pi=(36a^2b\alpha(16384+8192b-21760b^2-2688b^3+4944b^4+168b^5-$$
$$136b^6-2b^7+b^8-15360b\alpha-7424b^2\alpha+2560b^3\alpha+4944b^4\alpha+616b^5\alpha-$$
$$204b^6\alpha-11b^7\alpha+2b^8\alpha+1536b^3\alpha^2+1408b^4\alpha^2+352b^5\alpha^2-68b^6\alpha^2-10b^7\alpha^2+$$
$$b^8\alpha^2-b^7\alpha^3))/((8-b)^2(2+b)^2(64-b^2-b^2\alpha)^2(4-b^2-b^2\alpha)^2).$$

The denominator of the above expression is positive. We must now analyze the sign of the numerator. Let us denote H_2 as follows:

$$H_2=(16384+8192b-21760b^2-2688b^3+4944b^4+168b^5-136b^6-2b^7+b^8-$$
$$15360b\alpha-7424b^2\alpha+2560b^3\alpha+4944b^4\alpha+616b^5\alpha-204b^6\alpha-11b^7\alpha+2b^8\alpha+$$
$$1536b^3\alpha^2+1408b^4\alpha^2+352b^5\alpha^2-68b^6\alpha^2-10b^7\alpha^2+b^8\alpha^2-b^7\alpha^3).$$

This expression can be rewritten as:

$$H_2=(16384+8192b-21760b^2-2688b^3+4944b^4+168b^5-136b^6-2b^7+b^8)-$$
$$b(15360+7424b-2560b^2-4944b^3-616b^4+204b^5+11b^6-2b^7)\alpha+$$
$$b^3(1536+1408b+352b^2-68b^3-10b^4+b^5)\alpha^2-b^7\alpha^3.$$

The first and third terms are positive while the second and fourth are negative (since $0 \leq b \leq 1$). It can be proved that if $b \leq 0.9$ the first term is higher than the second one, and the third term is higher than the fourth. Therefore, $H_2 > 0$ if $b \leq 0.9$. It remains to be seen what happens if $b > 0.9$. To analyze this, we check whether H_2 increases or decreases with b:

$$\frac{\partial H_2}{\partial b}=2(4096-21760b-4032b^2+9888b^3+420b^4-408b^5-7b^6+4b^7)-$$
$$(15360+14848b-7680b^2-19776b^3-3080b^4+1224b^5+77b^6-16b^7)\alpha+$$
$$2b^2(2304+2816b+880b^2-204b^3-35b^4+4b^5)\alpha^2-7b^6\alpha^3.$$

If $b > 0.9$, the first, second and fourth terms of the above expression are negative, and the third term is positive (since $0 \leq b \leq 1$). It easy to see that the

first term is higher than the second one if $b > 0.9$. As a result, H_2 decreases with b. When $b = 0.9$ we obtain that:

$$H_2 = \frac{744180661741 - 1447651405548\alpha + 221089479021\alpha^2 - 47829690\alpha^3}{10^8} > 0.$$

If $b = 1$, we obtain that: $H_2 = 5103 - 14877\alpha + 3219\alpha^2 - \alpha^3$, and this expression can be positive or negative depending on the value of parameter α. It can be proved that it is positive if and only if $\alpha < 0.3731$. Therefore, there is a value of parameter b denoted by b^{**} ($0.9 < b^{**} < 1$), such that if $b < b^{**}$ then $H_2 > 0$, while if $b > b^{**}$ then $H_2 < 0$. Therefore, $\pi_2 \geq \pi$ if and only if $b \leq b^{**}$.

It is easy to see that if $\alpha = 1/2$, then $H_2 = 0$ for $b = 0.9316$; as a result, $0 < b^{**} < 1$. As b^* is such that $0.4812 < b^* < 0.6055$, then $b^* < b^{**}$.

It remains to prove that $\pi_1 + \pi_2 > 2\pi$. By comparing $\pi_1 + \pi_2$ with 2π, we get the following result:

$$\pi_1 + \pi_2 - 2\pi = 36a^2b\alpha((16384 + 34816b - 24832b^2 - 10272b^3 + 5760b^4 + 408b^5 -$$

$$148b^6 - 4b^7 + b^8) - 2b(7680 + 3712b + 1160b^2 - 2568b^3 - 514b^4 +$$

$$108b^5 + 8b^6 - b^7)\alpha + b^3(1536 + 1408b + 488b^2 - 68b^3 - 14b^4 + b^5)$$

$$\alpha^2 - 2b^7\alpha^3) / ((16 + 6b - b^2)^2(256 - 68b^2(1+\alpha) + b^4(1+\alpha)^2)^2).$$

The denominator of the above expression is positive. To obtain the sign of the numerator, it can be proved that the first and third terms are positive while the second and fourth terms are negative (since $0 \leq b \leq 1$). Moreover, the first term is higher than the second and the third term is higher than the fourth. Therefore, $\pi_1 + \pi_2 - 2\pi > 0$.