Raising Wages to Deter Entry under Unionization

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April 2004

Abstract This paper investigates the strategic effects of new entry into product markets in a unionized oligopoly where entry and wage negotiations are sequential. When both a domestic incumbent and a foreign entrant hire unionized workers, the incumbent has incentives to raise the wage, because a higher wage strengthens the bargaining position of the union relative to the entrant at subsequent negotiations when entry occurs. Such a high wage offer may then discourage the potential entrant to enter the market. We also extend the model to allow the foreign entrant to supply the good to the domestic market either by foreign direct investment (FDI) or exports. Under FDI the entrant must negotiate with the domestic union over wages, while under exports it needs not. We show that surprisingly the incumbent can obtain higher profits when the entrant has both options of FDI and export than when it has only the former option.

JEL Classification Numbers: D43, F12

Keywords: Foreign Direct Investment, Unionized Oligopoly, Wage Contracts, Entry Deterrence

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1. Introduction

It is often argued that labor unions may be an entry barrier in the product market because potential entrants anticipate high wages to be settled at post-entry negotiations. For instance, using data of U.S. industries, Chappell, Kimenyi, and Mayer (1992) find that unionization has a statistically significant entry-deterring effect. Dewatripont (1987, 1988) introduces labor unions in the standard entry-deterrence models of sunk cost and limit pricing (e.g., Dixit 1980; Eaton and Lipsey 1980; Milgrom and Roberts 1982), and studies the relationship between sunk capital and unionization and their different roles in entry deterrence.

This paper takes a step further by demonstrating that the incumbent may welcome relatively strong and wage-oriented labor unions in oligopolistic markets. By taking advantage of the strategic effects of entry deterrence, an incumbent firm may benefit from a union being strong than weak because the former takes away more rents from a new entrant firm in subsequent negotiations. We believe this finding to be novel in the literature.

Consider that a foreign entrant seeks to enter the product market in which a home incumbent already operates and all workers are unionized. The incumbent first bargains with the union over the wage. Then, the entrant decides whether to enter or not, and must also hire unionized workers and negotiate with the union over wages when it enters. Finally the firms choose outputs simultaneously. The bargaining sequence is dictated by the fact that the incumbent already operates in the market and the potential entrant seeks to enter.

Wage bargaining is modeled in a simple way: the firms (incumbent and entrant) make "take-it-or-leave-it" wage offers to the union sequentially. Although the union has no powers to set wages, a high wage may become the negotiation outcome, which arises when the outside-option value of the union is high. In a sense, the "bargaining power" of the union is determined by its outside-option value. Then, by offering high wages, the incumbent can raise the outside-option value of the union relative to the entrant, and subsequently induce the entrant to offer high wages as well, which in turn discourages the entrant to enter the market by anticipating lower post-entry profits.

In fact we will show that when the union has a wage-oriented preference with relatively higher utility weight on wages than employment, the settled wage at post-entry negotiations between the entrant and union is *increasing* in the predetermined wage at the earlier negotiation between the incumbent and union. Thus, in sharp contrast to the standard result, the post-entry profit of the entrant is *decreasing* in the incumbent-union negotiated wage. Such a strategic effect of raising wages may dominate the direct effect that high wages reduce the incumbent's profit, resulting in a high equilibrium wage that can deter entry.

In an extended model, we allow the entrant to have either of two options: one is to build a plant in the domestic market (foreign direct investment, hereafter FDI), and the other is to produce the goods in the foreign country and import them to the domestic country. This extended model may also be viewed as a location choice game in which the entrant chooses where to build the plant. In this structure, entry of the foreign firm cannot be deterred because it enters either by FDI or exports, and thus, in contrast to the previous model, the market structure is always a duopoly.

In this setting we show that the equilibrium wage offered by the incumbent becomes lower when the entrant can choose between both FDI and export options than when it has no options to export/import. This is because the outside-option payoff of the entrant, which is ensured when FDI does not occur, becomes higher when it can export than when it has no such option. Further we provide a set of parameter values under which the above conditions are satisfied and the incumbent can obtain higher equilibrium profits. Thus, in contrast to conventional wisdom, an incumbent firm may benefit from rival firms having multiple production options.

Intuitively, in the absence of labor unions, the incumbent loses if the entrant has more options. Under unionization, the entrant's added option of importing from a foreign country lowers the negotiated wage when the entrant and the union bargain, which enables the incumbent to offer a lower wage in a prior bargain as well. That is, the incumbent successfully passes the burden of the entrant's added option to the labor union by offering a lower wage. This also implies that in unionized oligopolistic markets, if some firms can produce in a foreign country, wages in all firms will be driven down even though labor-management negotiations in different firms are separate and independent.

A few other papers have investigated the roles unions play in deterring entry. In an insider-outsider model of labor unions, Gollier (1991) studies a case where union insiders conspire with management to deter entry to secure high rents. Ishiguro and Shirai (1998) assume that the entrant is not unionized. If it enters, the unionized monopoly's market share is taken away, resulting in lower industry rents. This threat renders the union willing to accept a lower wage. In Haucap, Pauly and Wey (2001), incumbents are assumed to be slightly more efficient (i.e., lower marginal costs) than potential entrants. Raising wages (industry-wide) can raise the rival's cost and deter entry. Naylor (2002) shows profits can be increasing in the number of firms in the industry if wages are determined by bargaining in unionized bilateral oligopoly, because increased product market competition following an increase in the number of firms is mirrored by increased labor market rivalry which induces wage moderation. In Lommerud, Meland and Sorgard (2003), trade liberalization can induce FDI because the firm uses FDI to battle with the union.

The new feature of our paper is to consider the multilateral aspects of wage negotiations, where the union bargains with the entrant firm as well as the incumbent if the former enters the market, and the entrant can choose in which country to locate its production plant.

The remaining sections of the paper are organized as follows: In Section 2 we set up the basic model. In Section 3 we analyze the equilibrium of the game and show that the incumbent has incentives to raise wages to deter entry. In Section 4 we extend the model to allow the foreign firm to have both options of FDI and exports. And Section 5 includes some concluding remarks.

2. Basic Model Setup

Consider two firms competing in the domestic market. One is a home incumbent firm, already operating in the market. The other is a potential foreign entrant, seeking to enter the domestic market. If the entrant does enter, it must incur a fixed cost $C > 0$. There is also a labor union in the market. Each firm must negotiate with the union over wages, separately. Denote the output of the incumbent (resp. entrant) by $x \geq 0$ (resp. $y \geq 0$). For simplicity, one unit of labor is assumed to produce one unit of output. And the inverse demand function is linear such that, $P(x+y) = a - (x+y)$, where $a > 0$.

We assume that the union has the following utility function

$$U(w,v,x,y) \equiv u_i(w,x) + u_e(v,y), \tag{1}$$

where w and v are wage rates the union receives from the incumbent and the entrant respectively, and u_i and u_e are the utilities coming from the wage and employment obtained by negotiation with the incumbent and entrant respectively. Specifically we assume a symmetric utility function, $u \equiv u_i = u_e$, and it takes the following familiar form which has been extensively used in the literature (see Oswald, 1985 and Pemberton, 1988),

$$u(w,x) = w^{\gamma}x, \quad u(v,y) = v^{\gamma}y, \tag{2}$$

where $\gamma > 0$ is a parameter representing how much the union cares about the wage relative to employment. We say that the union is *wage–oriented* (resp. *employment–oriented*) if $\gamma > 1$ (resp. $\gamma < 1$) (See Mezzetti and Dinopoulos (1991)).

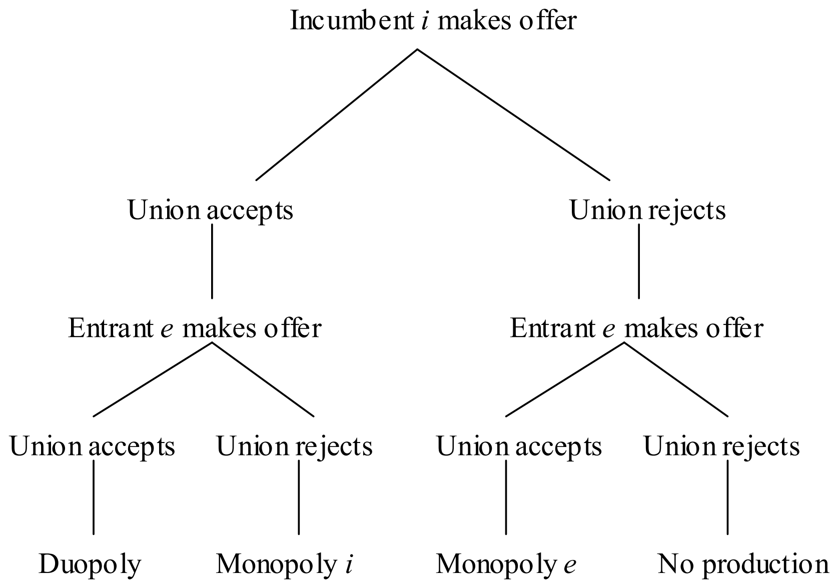
We consider the following 3-stage game:

Stage 1. The incumbent (firm *i*) makes a take-it-or-leave-it wage offer w to the labor union, who then decides whether to accept it or not. If the union rejects it, then the incumbent's profit becomes zero and the game goes to Stage 2.

Stage 2. The entrant (firm *e*) decides whether to enter the product market or not. If it enters, it must incur the fixed cost $C > 0$. The entrant also makes a take-it-or-leave-it wage offer v to the union, who then decides whether to accept it or not. If the union rejects it, then the entrant produces nothing.

Stage 3. Finally, only the firms whose wage offers were accepted by the union can choose the outputs of a homogenous good simultaneously.

A simple game tree can be drawn as follows.



3. Wage Raising Strategy

In this section we solve the game described above by backward induction, and show that the incumbent raises the wage to be offered to the union under the threat of new entry.

3.1. Equilibrium at the Third Stage

First we solve the equilibrium at Stage 3, which has three interesting cases: duopoly by both firms, monopoly by the incumbent and monopoly by the entrant.

Case (i): Duopoly. In this case, both firms succeeded in negotiation with the union at earlier stages. Given a wage vector (w, v), the Cournot–Nash equilibrium outputs x_c and y_c are:

$$x_c(w,v) = \frac{a-2w+v}{3}, \quad y_c(w,v) = \frac{a-2v+w}{3}, \tag{3}$$

provided $a \geq 2w - v$ and $a \geq 2v - w$ are satisfied.

Case (ii): Monopoly by the incumbent. This is the case when only the incumbent succeeded in negotiation with the union at Stage 1. Then, the incumbent chooses the monopoly output x_m, given the wage $w \leq a$:

$$x_m(w) = \frac{a-w}{2}. \tag{4}$$

Case (iii): Monopoly by the entrant. This case arises when only the entrant succeeded in negotiation at Stage 2. Then, given a wage $v \leq a$, the entrant chooses the monopoly output:

$$y_m(v) = \frac{a-v}{2}. \tag{5}$$

3.2. Equilibrium at the Second Stage

Having solved the game in Stage 3, now we consider the equilibrium at Stage 2. First suppose that the incumbent has succeeded in negotiation with the union at Stage 1. Suppose also that the entrant enters the market and makes a wage offer v to the union so as to solve the following problem:

$$\max_{v \geq 0} \quad \Pi_e(v,w) \equiv P(x_c + y_c)y_c - vy_c$$

$$\text{subject to} \quad v^{\gamma} y_c(w,v) + w^{\gamma} x_c(w,v) \geq w^{\gamma} x_m(w), \tag{ACE}$$

where (ACE) is the acceptance constraint for the union, i.e., its left hand side is the total utility of the union when it accepts the entrant's wage offer v, and its right hand side is only the utility $w^{\gamma} x_m$ when it rejects v. Note that by rejecting the wage offer v the union will obtain the following utility:

$$w^{\gamma} x_m(w), \tag{6}$$

because it can now enjoy the wage w and the monopoly output (employment) $x_m(w)$ from the negotiation with the incumbent.

Note that $\Pi_e(v,w) = (a - 2v + w)^2/9$ and it is decreasing in v. Thus the entrant chooses the smallest wage v satisfying the constraint (ACE). In fact we can verify that the optimal wage v^* that solves the above problem is given by the smallest solution to the inequality (ACE) which holds as equality:

$$v^* = (\frac{1}{2})^{1/\gamma} w. \tag{7}$$

To see this, note that both sides of (ACE) are equalized for all $v \geq (a+w)/2$ because $y_c = 0$ holds. Besides these values, there exists a unique value v at which (ACE) is binding: $v^{\gamma} y_c(w,v) + w^{\gamma} x_c(w,v) = w^{\gamma} x_m(w)$. The explicit solution is given in (7). Finally, since the profit of the entrant $\Pi_e(v,w)$ is strictly decreasing in v, the optimal wage must be v^*, which is the smallest solution to make (ACE) binding.

Let $v^* = v^*(w)$. Note that $v^*(w) < w$ for all w, i.e., the entrant must offer a wage lower than that offered by the incumbent. Also, differentiation of (7) yields

$$\frac{dv^*}{dw} = (\frac{1}{2})^{1/\gamma}. \tag{8}$$

Keeping this in mind, we obtain the following important implication:

$$\frac{d\Pi_e}{dw}(v^*(w), w) = 2y_c\left\{-2\frac{dv^*}{dw}+1\right\} < (>) 0, \quad \text{if } \gamma > (<) 1. \tag{9}$$

Thus the profit of the entrant is *decreasing* in the incumbent wage offer w when the union is wage–oriented. This counterintuitive result comes from the "threat point" effect that a high wage offer w may raise the threat point payoff of the wage–oriented union when it negotiates with the entrant, which in turn induces the latter to offer a high wage v as well.

The net profit of the entrant after subtracting the entry fee $C > 0$ is given by

$$\Pi_e(v^*(w), w) - C. \tag{10}$$

Then two cases arise depending on whether $\Pi_e(v^*(w), w)$ is increasing or not (i.e., $\gamma < 1$ or $\gamma > 1$) as we have seen above. Suppose first that $\gamma > 1$ (wage–oriented union). Then, $\Pi_e(v^*(w), w) - C$ is decreasing in w and there exists a cut off wage, denoted $\hat{w} > 0$, at which

$$\Pi_e(v^*(\hat{w}), \hat{w}) - C = 0,$$

provided $\Pi_e(v^*(0),0)-C>0$, which is equivalent to $a^2/9>C$. If $a^2/9<C$, then the entrant never enters the market. On the other hand, suppose that $\gamma<1$ (employment–oriented union). Then $\Pi_e(v^*(w),w)-C$ is increasing in w and the cut off wage $\hat{w}>0$ exists at which $\Pi_e(v^*(\hat{w}),\hat{w})-C=0$, given $a^2/9<C$. If $a^2/9>C$ then the entrant always enters.

We summarize these results in the following lemma:

Lemma 1. *Consider the sub-game in which the incumbent has succeeded in negotiation with the union at Stage 1. Then, we obtain the following:*

Case (i) $a^2/9>C$*: The entrant enters the market if and only if* $w<\hat{w}$*, when* $\gamma>1$*; while it always enters the market when* $\gamma<1$.

Case (ii) $a^2/9<C$*: The entrant enters the market if and only if* $w>\hat{w}$*, when* $\gamma<1$; *while it never enters the market when* $\gamma>1$.

In fact, when $\gamma>1$ and $a^2/9>C$, we can derive the explicit solution for $\hat{w}$:

$$\Pi_e(v^*(\hat{w}),\hat{w})-C=0, \tag{11}$$

$$\Rightarrow \{a-(2^{1-1/\gamma}-1)w\}^2=9C, \tag{12}$$

$$\Rightarrow \hat{w}=\frac{a-3\sqrt{C}}{2^{1-1/\gamma}-1}. \tag{13}$$

Next suppose that the negotiation between the incumbent and union has broken down at Stage 1. Then the entrant will offer the wage v such that the union accepts it, i.e.,

$$v^{\gamma} y_m \geq \bar{u} , \tag{14}$$

where $\bar{u} > 0$ denotes the reservation payoff of the union obtained from other outside opportunities.[1] Observe that $v^{\gamma} y_m = v^{\gamma}(a - v)/2$ becomes zero at both $v = 0$ and $v = a$, and $d\{v^{\gamma}(a-v)/2\}/dv|_{v=a} = -a^{\gamma}/2 < 0$ and $d\{v^{\gamma}(a-v)/2\}/dv|_{v=0} \geq 0$. Furthermore, $v^{\gamma}(a-v)/2$ is continuous in v. Thus we can find some $v > 0$ at which $v^{\gamma}(a-v)/2 = \bar{u}$. Taking the smallest one, denoted $\underline{w}$, among those values if it is not unique, it is verified that $\underline{w}$ is the optimal wage offer the entrant makes, given that the negotiation between the incumbent and union has broken down at Stage 1. The entrant then obtains the (gross) monopoly profit $\Pi_e^m \equiv P(y_m)y_m - \underline{w}y_m$. It follows that the entrant enters and offers $\underline{w}$ if $\Pi_e^m - C > 0$, and does not enter otherwise. In either case the union obtains the reservation payoff $\bar{u}$.

3.3. Equilibrium at the First Stage

Now consider the wage negotiation game at Stage 1. The incumbent offers a wage w to solve the following:

Problem (IP):

$$\max_{w} \; d(w)\{P(x_c + y_c)x_c - wx_c\} + (1 - d(w))\{P(x_m)x_m - wx_m\} ,$$

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[1] When the union has contracted with the incumbent on the wage w at Stage 1, it cannot run away at Stage 2 to obtain the reservation payoff $\bar{u}$ because the contract agreement is enforceable.

subject to $$d(w)\{w^{\gamma}x_c + v^*(w)^{\gamma}y_c\} + (1-d(w))\{w^{\gamma}x_m\} \geq \bar{u}\,, \tag{ACI}$$

where $d(w)$ is an indicator function which takes one if the entrant enters and zero otherwise. The threat point payoff of the union is given by the outside utility $\bar{u}$, because when negotiation with the incumbent breaks down, it obtains the outside utility $\bar{u}$ if the entrant does not enter, and $\underline{w}^{\gamma}y_m(\underline{w}) = \bar{u}$ if it does enter and negotiates with the union, respectively. In either case the union will obtain the outside utility $\bar{u}$ when it rejects the wage offer made by the incumbent. Then (ACI) says that the union will accept the incumbent's wage offer. Here the left hand side of (ACI) corresponds to the utility of accepting the incumbent's wage offer, in which case the union obtains the utility expressed in the first bracket when the entrant enters at the subsequent stage while it obtains the utility expressed in the second bracket when the entrant does not enter.

By definition of $v^*(w)$, $w^{\gamma}x_c(w,v^*(w)) + v^*(w)y_c(w,v^*(w)) = w^{\gamma}x_m(w)$ holds for any w. Thus (ACI) can be reduced to

$$w^{\gamma}x_m(w) \geq \bar{u}\,, \tag{15}$$

where $x_m(w) = (a-w)/2$.

Since $w^{\gamma}x_m(w) = 0$ at both $w = 0$ and $w = a$ and is continuous in w,[2] we can find some value $w > 0$ at which $w^{\gamma}x_m(w) = \bar{u}$. By definition, this minimum wage equals to $\underline{w}$. Note that $\underline{w}$ also corresponds to the equilibrium wage offered by the incumbent when entry

[2] $d\{w^{\gamma}(a-w)/2\}/dw\,|_{w=0} \geq 0$ and $d\{w^{\gamma}(a-w)/2\}/dw\,|_{w=a} < 0$ also hold.

is impossible at the outset (for example, $C = +\infty$). Therefore the union's utility is simply its reservation payoff $\overline{u}$ if no new entry arises at all.

Next we examine how equilibrium changes in the presence of entry. Let us define the profit functions of the incumbent, respectively in the cases of monopoly and Cournot duopoly,

$$\Pi_i^m(w) \equiv P(x_m)x_m - wx_m, \qquad (16)$$

$$\Pi_i^c(w) \equiv P(x_c + y_c)x_c - wx_c, \qquad (17)$$

where $x_c = (a - 2w + v^*(w))/3$ and $y_c = (a - 2v^*(w) + w)/3$. Under the linear demand assumption, we have

$$\Pi_i^m(w) = x_m^2 = \frac{(a-w)^2}{4}, \qquad (16')$$

$$\Pi_i^c(w) = x_c^2 = \frac{(a-2w+v^*(w))^2}{9} \qquad (17')$$

which then give rise to respectively

$$\frac{d\Pi_i^m}{dw} < 0, \qquad (18)$$

$$\frac{d\Pi_i^c}{dw} = 2x_c(1/3)\left\{-2+\frac{dv^*}{dw}\right\} = (2/3)x_c\{-2+(1/2)^{1/\gamma}\} < 0. \qquad (19)$$

We now concentrate on the case that the wage offer is not trivial, i.e., $\hat{w} > \underline{w}$. Otherwise, it becomes always optimal for the incumbent to offer the minimum wage $\underline{w}$, regardless of entry possibility. Then, the optimal wage w^* which solves the above problem (IP) is given as follows:

Proposition 1. *Suppose that $\hat{w} > \underline{w}$. Then the equilibrium wage offer of the incumbent is characterized as follows:*

(i). Wage-oriented union ($\gamma > 1$):

$$w^* = \begin{cases} \hat{w} & \text{if } \Pi_i^m(\hat{w}) \geq \Pi_i^c(\underline{w}) \\ \underline{w} & \text{otherwise} \end{cases},$$

(ii). Employment-oriented union ($\gamma < 1$): $w^* = \underline{w}$.

Proof. Suppose that $\hat{w} > \underline{w}$. This means that $\hat{w} > 0$ and hence $a^2/9 > C$ (resp. $a^2/9 < C$) must hold when $\gamma > 1$ (resp. $\gamma < 1$).

Consider first the case of $\gamma > 1$. Then the entrant enters the market if and only if $w < \hat{w}$ by Lemma 1. Moreover, both $\Pi_i^m(w)$ and $\Pi_i^c(w)$ are decreasing in w. Thus the incumbent's profit becomes $\Pi_i^m(w)$ and $\Pi_i^c(w)$ if it offers wages $w > \hat{w}$ and $w < \hat{w}$ respectively. Since $\Pi_i^m(w) > \Pi_i^c(w)$ for all $w \geq 0$ and $\underline{w}$ is the minimum wage, the incumbent respectively offers the wage $\hat{w}$ (and hence deters entry) if $\Pi_i^m(\hat{w}) \geq \Pi_i^c(\underline{w})$, and the wage $\underline{w}$ (and hence allows entry) otherwise.

Next suppose that $\gamma < 1$. Then, by Lemma 1 the entrant enters the market if and only if $w > \hat{w}$. Thus, since $\Pi_i^m(w) > \Pi_i^c(w)$ for all $w \geq \underline{w}$, and both Π_i^m and Π_i^c are decreasing in w, the incumbent offers the minimum wage $\underline{w}$ and deters entry. Q.E.D.

Note that when the union is wage–oriented ($\gamma > 1$) the "high wage" $\hat{w} > \underline{w}$ may be the optimal wage offer to deter entry. This is in sharp contrast to the case that no entry is allowed at the outset ($C = +\infty$). The intuition is as follows: First, the outside option value of the union, $w^\gamma x_m(w)$, when it rejects the wage offer by the entrant, is increased by raising the wage w slightly from the minimum wage $\underline{w}$. Therefore, the entrant must offer a high wage when the incumbent and union have already settled at a high wage w earlier. Indeed we have shown this is the case: The increase of the incumbent-union negotiated wage w raises the negotiated wage v in the bargain between the entrant and union when the union is wage-oriented (See equation (8)). Thus the post-entry profit of the entrant is decreasing in the incumbent-union negotiated wage w, in contrast to the standard result.

Some parametric restrictions are needed to ensure that the first case of Proposition 1 actually occurs. Note that, since $\hat{w}$ is decreasing in C and continuously varies from 0 to $a/(2^{1-1/\gamma} - 1)$, we can find some $\overline{C}$ such that $\hat{w} > \underline{w}$ for all $C \in (0, \overline{C})$ (here we use the inequality $a/(2^{1-1/\gamma} - 1) > a > \underline{w}$). Moreover, $\Pi_i^m(\underline{w}) > \Pi_i^c(\underline{w})$. Thus, there exists some $\underline{C} > 0$ such that for all $C \in (\underline{C}, \overline{C})$, we have $\hat{w} > \underline{w}$ and $\Pi_i^m(\hat{w}) > \Pi_i^c(\underline{w})$.

We also establish the following, which shows that the possibility of new entry benefits the union.

Proposition 2. *Suppose that the union is wage–oriented* ($\gamma > 1$), $\hat{w} > \underline{w}$ *and* $\Pi_i^m(\hat{w}) > \Pi_c(\underline{w})$. *Then in the presence of entry the union can obtain some positive "rent",* $w^* x_m > \overline{u}$, *even when it has no bargaining powers when negotiating the wage.*

The intuition is, without the threat of entry, the union is always offered the minimum wage by the incumbent; while with the threat of entry, the incumbent offers a high wage to deter entry strategically, yielding positive rents to the union.

4. An Extension to International Duopoly with Imports

Now we extend the model to the case that the incumbent is located in the home country, and the foreign entrant either produces directly in the home country (FDI) as in previous sections, or it produces in a foreign country and imports back to the home country for sales (export option). That is, the foreign firm always enters either way, and there is always a duopoly in the market. The new timing of the game has 4 stages as follows.

Stage 1. The incumbent offers a wage w to the labor union. Then the union decides whether to accept this offer or not.

Stage 2. The foreign entrant chooses either exports or FDI. Here the entrant is assumed to build only one plant either in the home country (i.e., the case of FDI) or the foreign country (i.e., the case of exports). The set up cost of building the plant in the home country (resp. foreign country) is denoted by $C_h > 0$ (resp. $C_f > 0$). We hereafter assume that $C_h > C_f$. This is a realistic assumption because the entrant faces more costs of setting up the plant in a foreign country than it does in its home country.

Stage 3. If the entrant has decided to build the plant in the home country (FDI), it offers a wage v to the labor union. Then the union decides whether to accept it or not.

Stage 4. There are two possible cases. **(i)**. *The Case of FDI*: If both wage offers w and v are accepted by the union, then the incumbent and the entrant simultaneously choose their outputs x and y in the Cournot fashion. If only wage offer w (resp. v) is accepted, the incumbent (resp. entrant) chooses the monopoly output. **(ii)**. *The Case of Exports*: If the incumbent's wage offer w is accepted by the union at Stage 1, then both firms (the incumbent and the entrant) simultaneously choose their outputs x and y. If the union rejects the offer w, then only the entrant chooses the monopoly output y. In the case of export the entrant incurs the competitive wage $\underline{v}$ per unit of output, which is determined in the labor market of the foreign country and exogenously given in this model.

We will first solve the equilibrium in Stage 4. As before, the equilibrium profits of the incumbent and entrant, given wages w and v, are defined as follows:

$$\Pi_i(w,v) \equiv \frac{(a-2w+v)^2}{9}, \tag{20}$$

$$\Pi_e(w,v) \equiv \frac{(a-2v+w)^2}{9}. \tag{21}$$

Here the definitions of $\Pi_i(w,v)$ and $\Pi_e(w,v)$ also cover the case that one firm becomes a monopolist because the other firm fails to negotiate with the union. For example, we obtain

$\Pi_i(\overline{w},v)=0$ and $\Pi_e(\overline{w},v)=(a-v)^2/4$, by defining the wage $\overline{w}\equiv(a+v)/2$, when the incumbent's wage offer w was rejected but the entrant's offer v was accepted by the union earlier. Furthermore, $\Pi_i(w,\underline{v})$ and $\Pi_e(w,\underline{v})$ represent the equilibrium profits of the incumbent and the entrant respectively when the incumbent's wage offer w was accepted by the union and the entrant decided to import the product to the home country.

Next we consider the wage offer v by the entrant when it chooses FDI. This problem is equivalent to the previous analysis without the export option. The entrant will offer the wage v as the smallest solution to make the constraint (ACE) binding:

$$v^{\gamma}y_c(w,v)+w^{\gamma}x_c(w,v)=w^{\gamma}x_m(w). \tag{22}$$

Note here that when the union rejects the entrant's wage offer v, it obtains utility $w^{\gamma}x_m(w)$ from bargaining only with the incumbent, who then becomes the monopolist in the market. This is because the entrant keeps only one plant either in the home country or in the foreign country, and hence it cannot produce any outputs when it has the plant in the former country but negotiations with the union break down. Then, as before, the optimal wage offer v^* is given by (7). Thus, provided v^* is accepted by the union, the entrant chooses FDI if and only if

$$\Pi_e(w,v^*(w))-C_h>\Pi_e(w,\underline{v})-C_f. \tag{23}$$

In the following analysis we focus on the case of wage–oriented union ($\gamma>1$). As we have already known, the left hand side of (23) is decreasing in w if $\gamma>1$. Its right hand side is however increasing in w. Thus there exists a unique value of w, denoted $\widetilde{w}\geq 0$, such that inequality (23) holds as equality, given $\Pi_e(0,v^*(0))-C_h \geq \Pi_e(0,\underline{v})-C_f$ (otherwise, the left hand side of (23) is always greater than its right hand side for all $w \geq 0$ [3]). Of course, $\Pi_e(w,v^*(w))-C_h >(<)\Pi_e(w,\underline{v})-C_f$ if and only if $w<(>)\tilde{w}$. It follows that the entrant chooses FDI if and only if $w<\tilde{w}$, when the union is wage–oriented ($\gamma>1$). This is illustrated in Figure 1 where the upward (resp. downward) sloping curve represents the function $\Pi_e(w,\underline{v})-C_f$ (resp. $\Pi_e(w,v^*(w))-C_h$) with respect to w.

At Stage 1, when the wage offer w is accepted by the union and the entrant chooses FDI (i.e., $w<\tilde{w}$), the incumbent's profit becomes

$$\Pi_i(w,v^*(w)). \tag{24a}$$

On the other hand, it becomes

$$\Pi_i(w,\underline{v}), \tag{24b}$$

when the wage offer w is accepted by the union and the entrant chooses export (i.e., $w \geq \tilde{w}$).

Now consider the acceptance decision of the union at Stage 1. First suppose that the union accepts the wage offer w by the incumbent. If $w<\tilde{w}$, the entrant chooses FDI and offers the wage $v^*(w)$ at Stage 3. In this case the union obtains utility $w^\gamma x_m(w)$ by (22). If $w>\tilde{w}$, then the entrant decides to export and the union obtains utility $w^\gamma x_c(w,\underline{v})$. Hence the union will finally obtain the following utility by accepting the incumbent's wage offer w:

[3] Without loss of generality we define $\tilde{w}=0$ when this case is applied.

$$U^*(w) \equiv \begin{cases} w^\gamma x_m(w) & \text{if } w < \tilde{w}, \\ w^\gamma x_c(w, \underline{v}) & \text{if } w \geq \tilde{w}. \end{cases} \quad (25)$$

Next note that when the union rejects the wage offer w proposed by the incumbent at Stage 1 it obtains the reservation utility $\bar{u}$ irrespective of the subsequent choice of the entrant: In the case of export there exist no wage bargains; and in the case of FDI the entrant offers the minimum wage $\underline{w}$ to the union. In either case the union will obtain $\bar{u}$. Thus the union accepts the wage offer w if and only if $U^*(w) \geq \bar{u}$. Let $\underline{w}^*$ denote the minimum wage w such that $U^*(w) \geq \bar{u}$ holds.

Since the entrant has the export option, the incumbent obtains the Cournot–Nash equilibrium profit $\Pi_i(w, \underline{v})$ even when the entrant does not build the plant in the home country by FDI. As $v^*(w)$ is increasing in w, we find a unique wage level of w, denoted w^0, such that $v^*(w) > (<) \underline{v}$ if and only if $w > (<) w^0$. Moreover, since $C_h > C_f$, when $\tilde{w} > 0$, by (23) we derive

$$\Pi_e(\tilde{w}, v^*(\tilde{w})) = \Pi_e(\tilde{w}, \underline{v}) + C_h - C_f > \Pi_e(\tilde{w}, \underline{v}), \quad (26)$$

which shows $v^*(\tilde{w}) < \underline{v}$. Since v^* is increasing, we have $\tilde{w} < w^0$.

Furthermore, both $\Pi_i(w, v^*(w))$ and $\Pi_i(w, \underline{v})$ are decreasing in w. Also, we obtain $\Pi_i(w, \underline{v}) \geq (<) \Pi_i(w, v^*(w))$ if and only if $w \leq (>) w^0$, because $v^*(w) \geq (<) \underline{v}$ if and only if $w \geq (<) w^0$, and $\Pi_i(w, v)$ is increasing in the second argument. Since the entrant decides to enter the market by FDI if and only if $w \leq (>) \tilde{w}$, the incumbent's profits become

$\Pi_i(w, v^*(w))$ for $w < \tilde{w}$ and $\Pi_i(w, \underline{v})$ for $w \geq \tilde{w}$ respectively. Together with the condition that $\tilde{w} < w^0$, the incumbent chooses either the minimum wage $\underline{w}^*$ or high wage $\tilde{w}$. This is illustrated in Figure 2: the two curves $\Pi_i(w, \underline{v})$ and $\Pi_i(w, v^*(w))$ are downward sloping and cross only once at w^0. Since $\tilde{w}$ is the cut-off wage to change the entry decision of the foreign entrant, the bold parts of these curves represent the profit function of the incumbent. It is clear from the figure that it will offer either the minimum wage $\underline{w}^*$ or the high wage $\tilde{w}$ depending on whether $\tilde{w} > \underline{w}^*$ or not. Thus we establish:

Proposition 3. *Suppose that the foreign entrant has both options of FDI and exports, and that the union is wage-oriented ($\gamma > 1$). Then, when $\tilde{w} > \underline{w}^*$ is satisfied, the domestic incumbent offers the minimum wage $\underline{w}^*$ to induce the entrant to choose FDI if $\Pi_i(\underline{w}^*, v^*(\underline{w}^*)) > \Pi_i(\tilde{w}, \underline{v})$ and the high wage $\tilde{w}$ to induce the entrant to export otherwise respectively. When $\tilde{w} \leq \underline{w}^*$ is satisfied, the incumbent always offers the minimum wage $\underline{w}^*$ to induce the entrant to export.*

Since $\tilde{w} < \hat{w}$, the incumbent may offer a lower wage to deter FDI when the entrant has both FDI and export options than when it has only FDI option. This result implies that in unionized oligopolistic markets, if some firms can produce in a foreign country, wages in all firms will be driven down even though labor-management negotiations in different firms are separate and independent.

Note also that the minimum wage $\underline{w}^*$ defined in the extended model is not less than the one defined in the previous model without export option, $\underline{w}$. This is because the utility of the union defined by $U^*(w)$ is not greater than $w^\gamma x_m(w)$, which is the utility of the union obtained when no export option exists.

Now we show a set of parameter values under which the incumbent can obtain a higher equilibrium profit when the entrant has the export option than when it has no such option. Thus, in contrast to the standard argument, there exists a case that the incumbent can become better off when the entrant has more production options. To see this, it will be helpful to consider separately two distinct cases in equilibrium, one is that entry arises and the other is that entry is blocked (see Section 3).

First, consider the model without export option and suppose that the incumbent offers the minimum wage $\underline{w}$ to allow the entrant to enter the market. Then the incumbent's equilibrium profit becomes $\Pi_i(\underline{w}, v^*(\underline{w})) = (a - 2\underline{w} + v^*(\underline{w}))^2 / 9$ by Proposition 1. Next consider when the entrant has both options of FDI and export, as analyzed in this section. Suppose that $\tilde{w} \leq \underline{w}^*$ is satisfied so that the incumbent offers the minimum wage $\underline{w}^*$ and the entrant chooses to export (Proposition 3). In this case, the incumbent's equilibrium profit becomes $\Pi_i(\underline{w}^*, \underline{v}) = (a - 2\underline{w}^* + \underline{v})^2 / 9$. Now assume that the reservation utility $\overline{u}$ is set equal to zero. Then we have $\underline{w} = \underline{w}^* = 0$,[4] and

$$\Pi_i(0, \underline{v}) = (a + \underline{v})^2 / 9 > \Pi_i(0, v^*(0)) = a^2 / 9,$$

[4] The case of $\tilde{w} \leq \underline{w}^*$ here is consistent with the assumption $\overline{u} = 0$. For example, when the entrant always enters the market by export for all $w \geq 0$, because in such a case we have $\tilde{w} = \underline{w}^* = 0$.

i.e., the incumbent can obtain a higher equilibrium profit when the entrant has both options of FDI and export than when it has only the FDI option.

This result stems from the fact that even though the market structures are duopoly in both models, the incumbent gains a cost advantage against the entrant when the latter obtains the export option. Specifically, it arises because both wages of the incumbent and entrant are set to zero in the former case, $\underline{w} = v^*(\underline{w}) = 0$, leading to a lower market price, while in the latter case the entrant faces an exogenously fixed wage at $\underline{v} > 0$ but the wage set by the incumbent is zero, $\underline{w}^* = 0$, leading to a cost advantage of the incumbent relative to the entrant. In other words, the added export option of the entrant induces the incumbent to offer the minimum wage in earlier, resulting in a cost advantage for the incumbent.

The second, and more interesting, case is that in the model without export option the incumbent offers a high wage $\hat{w}$ to deter entry. In this case, since entry by FDI is blocked, the market structure becomes a monopoly by the incumbent (i.e., the first case of Proposition 1). However, if the entrant has the export option, the market structure becomes a duopoly because the entrant can produce the goods in the foreign country and export to the domestic market. Thus, since the market structures are different in the two models, comparison between the incumbent's equilibrium profits is not straightforward. However, in the following proposition, we provide a parametric example which gives the sufficient conditions for the incumbent's profit to be increased by the entrant having both FDI and export options.

Proposition 4. *There exists a non-empty set of parameter values for which the following is true: (i) The incumbent offers the equilibrium wage $\hat{w}$ to deter entry when the entrant has* *only the FDI option. (ii) The incumbent's equilibrium profit becomes higher when the entrant has both FDI and export options than when it has only the FDI option.*

Proof. We maintain the assumption that the union is wage-oriented, $\gamma > 1$.

First we set C_h to satisfy

$$\Pi_e(0, \underline{v}) - C_f \geq \Pi_e(0, v^*(0)) - C_h, \tag{27}$$

which, since $v^*(0) = 0$, gives

$$C_h \geq C_f + \frac{4\underline{v}(a - \underline{v})}{9}. \tag{28}$$

In this case, since $\Pi_e(w, \underline{v})$ is increasing in w and $\Pi_e(w, v^*(w))$ is decreasing in w if $\gamma > 1$, we obtain $\Pi_e(w, \underline{v}) - C_f \geq \Pi_e(w, v^*(w)) - C_h$ for all $w \geq 0$. It follows that the entrant always decides to export for all $w \geq 0$ (we can define $\tilde{w} = 0$ in this case and, hence, $\tilde{w} \leq \underline{w}^*$ trivially holds). By the last statement of Proposition 3, the incumbent offers the minimum wage $\underline{w}^*$ at Stage 1. Then if the entrant can export, the incumbent obtains the equilibrium profit:

$$\Pi_i^o \equiv \Pi_i(\underline{w}^*, \underline{v}) = x_c(\underline{w}^*, \underline{v})^2 = \frac{(a - 2\underline{w}^* + \underline{v})^2}{9}. \tag{29}$$

In the following we will assume that $\overline{u} = 0$. In this case $\underline{w}^* = 0$ and $\Pi_i^o = (a + \underline{v})^2 / 9$.

Next suppose that the entrant has no export option. It decides whether to enter the home country by FDI or not and in the latter case it produces nothing. As our previous analysis has shown, the incumbent offers the wage $\hat{w}$ to deter entry when $\Pi_i^m(\hat{w}) \geq \Pi_i^c(\underline{w})$

and $\hat{w} > \underline{w}$. Since we are assuming $\overline{u} = 0$, implying $\underline{w}^* = 0$, the above condition reduces to $\Pi_i^m(\hat{w}) > \Pi_i^c(0)$. This can be rewritten as

$$\frac{a-\hat{w}}{2} > \frac{a+v^*(0)}{3} = \frac{a}{3} \;\Rightarrow\; 3\hat{w} < a. \tag{30}$$

Since $\hat{w}$ is given by (13), this inequality holds if and only if

$$\sqrt{C} > \frac{a(4-2^{1-\frac{1}{\gamma}})}{9}. \tag{31}$$

When the above condition is satisfied, the incumbent offers $\hat{w}$ and obtains the equilibrium profit when the entrant has no export option as follows:

$$\Pi_i^{no} \equiv \Pi_i^m(\hat{w}) = x_m(\hat{w})^2 = \frac{(a-\hat{w})^2}{4}. \tag{32}$$

Finally we compare the equilibrium profits Π_i^o and Π_i^{no}. To this end, let us set $C \equiv C_h$ for the comparison to be based on the same entry fee.

Then $\Pi_i^o > \Pi_i^{no}$ if and only if $(a-\hat{w})/2 < (a+\underline{v})/3$. Using (13), this becomes

$$\sqrt{C} < \frac{a(4-2^{1-\frac{1}{\gamma}}) + 2\underline{v}(2^{1-\frac{1}{\gamma}}-1)}{9}. \tag{33}$$

By combining (31) and (33), we must have

$$\frac{a(4-2^{1-\frac{1}{\gamma}})+2\underline{v}(2^{1-\frac{1}{\gamma}}-1)}{9} > \sqrt{C} > \frac{a(4-2^{1-\frac{1}{\gamma}})}{9}. \tag{34}$$

Furthermore, since $y_c = (a - 2\underline{v} + \underline{w}^*) > 0$ must hold, we need $a > 2\underline{v}$ (note that we are considering the case of $\underline{w}^* = 0$). Then, inequalities (28) and (34) together with $a > 2\underline{v}$ become sufficient conditions for $\Pi_i^o > \Pi_i^{no}$.

Inequality (28) can be satisfied by taking a small C_f and $\underline{v} > 0$. Also, letting $RHS(a)$ and $LHS(a)$ denote the right hand and left hand sides of (34) as the functions of a, we obtain $dRHS/da = dLHS/da$ and $LHS(0) = (2\underline{v}/9)(2^{1-1/\gamma} - 1) > 0 = RHS(0)$ (note here that $\gamma > 1$). Thus $LHS(a) > RHS(a)$ for all $a > 2\underline{v}$. Then we can take $C > 0$ to satisfy inequality (34) as well as $a > 2\underline{v}$. Q.E.D.

The intuition behind Proposition 4 can be explained as follows. First, consider when FDI is the only option to the foreign entrant. As we have shown in Proposition 1, the incumbent offers a high wage to keep the market structure monopoly instead of offering the minimum wage $\underline{w}$, which results in a "more competitive" duopoly because the entrant enters and offers a low wage $v^*(\underline{w})$ as well at post-entry negotiations. For instance, in the parametric example given in Proposition 4, both the incumbent and the entrant face zero marginal cost, $\underline{w} = v(\underline{w}) = 0$.

On the other hand, when the foreign entrant has both options of FDI and export, the incumbent does not need to care about the effect that its wage offer may change the market structure: the domestic market always remains a duopoly whether the entrant enters the market by FDI or exports. In particular, as shown Proposition 4, if the foreign entrant always chooses to export regardless of whatever wage the incumbent offers at the first stage, the incumbent has no choice but to offer the minimum wage $\underline{w}^*$ (this can be zero in the given example) at the first stage. Furthermore, in contrast to the case without export option, the marginal cost of the entrant is *exogenously fixed* at $\underline{v} > 0$.

Thus the following trade-off arises: on the one hand, when the entrant has both FDI and export options the incumbent always faces duopolistic competition (implying lower market prices), but can offer the minimum wage (implying lower cost); on the other hand, when the entrant has only the FDI option, the incumbent raises the wage offer to deter entry in equilibrium, resulting in a combination of higher cost and higher market price. In other words, there is a wage raising effect (to deter entry) and a competition effect (a consequence of the export option). When the former effect dominates the latter one, as shown in Proposition 4, the incumbent can obtain higher profits when the entrant has both FDI and export options than when it has only the FDI option. Thus the incumbent may welcome the entrant to have multiple production options.

5. Concluding Remarks

We analyzed an entry deterrence model in which both the incumbent and the entrant face a labor union and hire unionized workers, and have shown that in equilibrium the incumbent offers a high wage to the union in order to deter entry of the entrant. Such a wage raising strategy is effective because it increases the outside-option value of the union at post-entry negotiations with the entrant, which makes entry unattractive to the entrant, since now it anticipates that a high wage must be settled after entry. In contrast to the existing literature, the incumbent succeeds in deterring entry by offering a high wage. Our results further explain the phenomenon that multinationals seek out non-unionized industries and regions to undertake FDI. For instance, the Toyota branch in Kentucky, USA, did not hire unionized workers in its early days; Wal-mart has about 28 independent branches and 26 joint ventures with more than 10,000 employees in China, but none is unionized (2003 figures).

Even though wage offers are sequential in the present model, the mechanism that drives our results should remain the same in a simultaneous bargaining setup. The reason is that raising wages hurts the entrant more than the incumbent under certain conditions. As a consequence the potential entrant chooses not to enter, regardless if bargaining is sequential or simultaneous.

We also extended the basic model to include international trade, where a foreign firm considers entering the domestic market by choosing either FDI or exports. The presence of multiple production options of the entrant may depress the equilibrium wage offered by the incumbent. This implies that in unionized oligopolistic markets, if some firms can produce in a foreign country, wages in all firms will be driven down even though labor-management negotiations in different firms are separate and independent. Furthermore, the incumbent may become better off by the entrant having both FDI and export options as compared to the case when it has only the FDI option.

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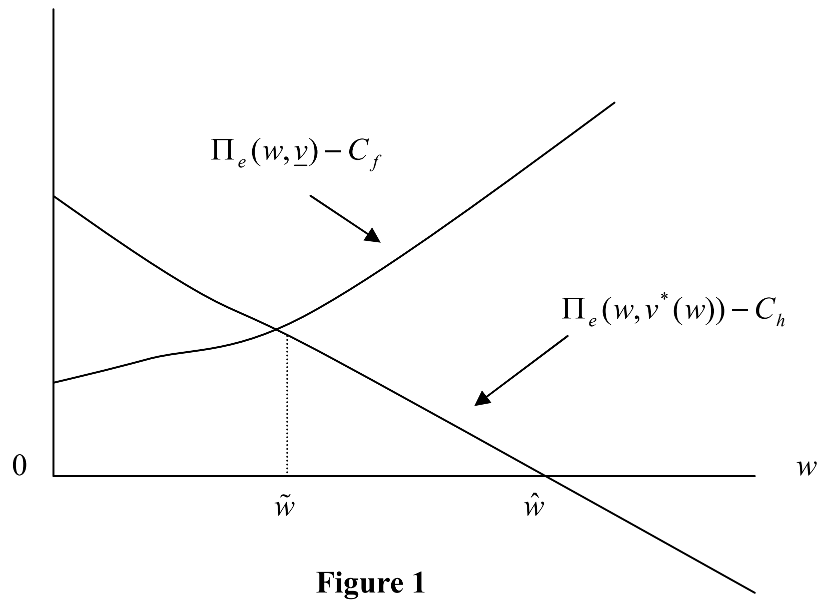

Figure 1

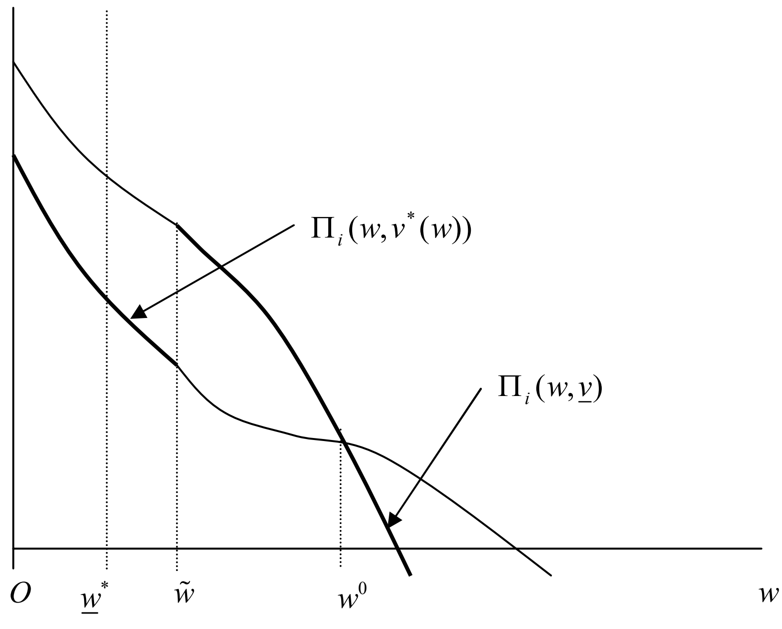

Figure 2