

The Impact of Union Competition on Entry Deterrence

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<Abstract>

This paper analyzes the strategic choice of wage level by the union in the incumbent monopoly firm when workforce in potential entrant is unionized. The incumbent union can play a strategic role by choosing wage level to deter or accomodate the entry of new firm according to the payoffs from each strategy. Especially when workforce in potential entrant is separately unionized, incumbent union's wage is nondecreasing with respect to entering union's wage. Moreover, as technology efficiency of entrant increases, wage response curve shifts to the right and incumbent union's strategic wage level is decreasing. This implies higher productivity of entering firm has effect to deter incumbent union's wage increase and to make entry deterrence more difficult. In addition, in some cases, entry threat and resulting incumbent union's entry deterrence wage policy has positive effect on incumbent firm's profit. Moreover, incumbent firm's profit can be higher even after its monopoly position is collapsed under unionization. This result is quite remarkable since it requires fundamental reformulation of traditional entry deterrence theory.

노동조합간의 경쟁이 진입저지에 미치는 영향

이재기
경제학과

<요 약>

본 논문은 잠재적인 진입기업의 노동력이 조직화된 경우 기존 독점기업 노동조합의 전

략적인 임금수준 선택문제를 분석한다. 기존의 노동조합은 새로운 기업의 진입이 자신의 보수에 미치는 영향을 고려하여 진입을 저지 혹은 허용하는 임금수준을 선택함으로써 전략적 역할을 수행한다. 진입기업의 노동력이 별개의 노동조합으로 조직된 경우, 기존 노동조합의 임금 요구는 진입기업의 노동조합 임금지급의 비증가함수이며, 진입기업의 기술적 효율성이 높을수록 기존 노동조합의 전략적인 임금 요구는 감소한다. 이는 진입기업의 높은 생산성이 기존 기업 노동조합의 임금상승을 억제하는 동시에 진입저지를 어렵게 함을 의미한다. 결과적으로 진입위협에 대해 노동조합이 진입저지 임금정책을 실시할 경우 기존 기업의 이윤이 증가할 수도 있으며, 진입저지가 실패하여 독점적 지위가 붕괴할 경우에도 기존 기업의 이윤이 높아질 수 있다. 이러한 결과는 노동조합의 전략적인 역할을 고려할 경우 전통적인 진입저지이론은 근본적으로 수정되어야 함을 보여준다.

I. Introduction

Labor economics and industrial organization have been separate fields of analysis with very few interactions. Though many researches in the two fields are dealing with complex strategic interactions in the product and labor markets respectively, it is very difficult to find researches considering such interactions simultaneously. Such separated and one-sided approach can be justified since it enables us to treat relatively simple problem. In reality, however, we often need an integration of imperfect competition of product market and that of labor market, especially firm-union relationship. Moreover, since unions are typically concentrated in large firms, they have a relatively high probability of facing imperfect competition on their output side.

It has also been shown that unions are able to reap a substantial portion of excess profits enjoyed by imperfectly competitive firms. Clark(1984) finds that while unions have an insignificant impact on employment, they have a large negative effect on firm profitability. Many previous researches such as Freeman(1983), Karier(1988), Voos and Mishel(1986), Becker and Olson(1990) etc. show that unions decrease firm profit rates considerably in highly concentrated industries, but have no significant impact in unconcentrated industries. These facts suggest that unions can significantly influence the profitability of firm strategies toward rivals. Moreover, as we see in Williamson's(1968) observation in coal mining industry, union's efforts to increase wages could benefit incumbent firms by making entry more difficult.¹⁾ Thus we need to consider the impact of union on entry deterrence.

Limit pricing can be defined as an entry deterrence strategy by which an incumbent firm produces in excess of its pre-entry monopoly optimum in order to scare away potential entrants. In the absence of technological links between pre-entry and post-entry output for the incumbent, the impact of limit pricing on entry is however

1 Williamson, O.(1968), "Wage Rates as Barriers to Entry: The Pennington Case in Perspective", *Quarterly Journal of Economics*, vol. 85, pp. 85-116.

unclear. Once entry has taken place, the intensity of competition will be independent of pre-entry output. Realizing this, the entrant should disregard pre-entry output when deciding about entry. In turn, limit pricing should not occur in equilibrium since it is useless. Milgrom and Roberts(1982) show that this arguments ceases to be true in the presense of incomplete information in which case limit pricing can arise as a signalling device.²⁾ Related with this type of limit pricing as entry deterrence strategy, Dewatripont (1986) showed that the presence of unions lowers the attractiveness and intensity of entry deterrence strategy: what the incumbent would like to do against its rival is the opposite of its objective against the union.³⁾

The use of sunk costs allows the incumbent firm to lower its marginal cost of production. This discourages entry, because other firms realize that they will have to face stiffer post-entry competition from the incumbent. This type of entry deterrence strategy has been studied for a variety of specific, unrecoverable expenditures like physical capital, advertisement, R&D, without ever assuming the existence of strategic interactions on the labor market. The impact of unions on investment in unrecoverable items has been analyzed in the context of perfectly competitive markets by Grout(1984). Using the generalized Nash-bargaining concept, he shows that if unions cannot precommit not to take advantage of the sunkness of previous expenditure, their presence will reduce investment levels whenever capital is at least partly unrecoverable. Dewatripont(1986) also focuses on entry deterrence, and thus on expenditures which are sunk for strategic instead of technological reasons. For the purpose of entry deterrence, the incumbent firm would like to exploit its first mover advantage in order to commit to high output levels. To do so, it would have to sink costs early in the game and for long periods of time. In front of workers however, since sunk costs mean a weaker bargaining position, the incumbent would like to commit for periods of time which are as short as possible.

According to the discussion above, the presence of unions reduces the profitability of various entry deterrence strategies. What the incumbent would like to do against its rival is the opposite of its objective against union. This does not necessarily imply that entry deterrence in general will be less frequent under unionization, because the existence of unions may provide the firm with alternative entry deterrence strategies. One such strategy results from the availability of binding, publicly observable labor contracts. The goal of entry deterrence strategies is to scare away potential entrants through credible threats of intense post-entry competition. One simple way to do so

2 If the entrant can observe output but not true cost of the incumbent before entry is to take place, limit pricing can be a way to credibly signal low cost of production which makes the entrant unprofitable after entry.

3 His main idea is that under asymmetric information about firm profitability, the incumbent has an incentive to overstate its costs in order to cut wages. If the incumbent is the only one to observe its cost, it faces contradictory incentives: it wants to understate its cost in order to deter entry, but to overstate it in order to decrease union rents. This general idea has also been widely studied in optimal contract models [see for example Grossman and Hart(1983), or Hayes(1984) for an explicit reference to unions], without however having been linked to industrial organization.

would be for the incumbent firm to commit, through a contract, to high severance pay for laidoff workers, thereby reducing the incentive to reduce production if entry takes place.⁴⁾

The previous discussion have shown that the presence of unions can strongly affect entry deterrence behavior. Moreover, the explicit integration of strategic interactions on product markets offers insights for the economic analysis of unions. Most previous researches, however, consider unions as secondary factors affecting entry deterrence behavior of firms and assume noncooperative firm-union relationships. As we see in the Pennington case, union has an active role for entry deterrence. Here we can find the possibility of union-firm cooperation about entry deterrence problem. Williamson(1968) analyzes this case and shows another entry deterrence strategy involving incumbent union cooperation. In that case, the union raises wages in the entire industry, making it very costly for small, labor-intensive firms to enter the market. This idea has however not been analyzed in a game-theoretic model. More than union's active role for entry deterrence, the incumbent union has an incentive to play entry deterrence strategy to protect its payoffs as a monopoly union. Thus we need to consider competition between unions as a possible strategy for entry deterrence. The purpose of the paper is to analyze the impact of union competition on entry deterrence.

This paper starts from utility and profit maximization by monopoly union and firm facing potential entrant respectively.

II. The Basic Model

In order to explain the effect of union's strategic wage policy on entry deterrence, we need to make some simplifying assumptions. Consider an industry in which there are two firms producing homogeneous goods. Firm 1 is an incumbent and firm 2 is a potential entrant.⁵⁾ Production technology of incumbent firm is represented by production function of the form (1) and that of entrant is represented by (2);

$$(1) Q_1 = L_1$$

$$(2) Q_2 = cL_2$$

where $c > 0$ is the fixed marginal(average) productivity of labor in the entering firm. Note here that the only difference in production technologies between the firms is

4 This type of strategy is potentially available in nonunion settings too. It is however easier to carry out in the presence of unions because in reality, union contracts are certainly more publicized than nonunion contracts and the existence of unions may make it easier to enforce the execution of the initial contract.

5 For simplicity, we concentrate on models involving only one incumbent and one potential entrant.

marginal(average) productivity of labor or technological efficiency which is measured by the value of c . The inverse market demand for homogeneous good is assumed to be a linear functional of the form:

$$(3) p = a - b(Q_1 + Q_2),$$

where p is the price of the good and Q_1 is the output of the incumbent and Q_2 is that of the entrant when entry is successful. As usually assumed, each firm maximizes her profit.

$$(4) \pi_1 = (a - b(L_1 + cL_2))L_1 - w_1L_1$$

$$(5) \pi_2 = (a - b(L_1 + cL_2))cL_2 - w_2L_2$$

If firm 2's entry is successful, two firms play Cournot-Nash strategies in the product market and resulting demand for labor is derived as follow.

$$(6) L_1(w_1, w_2) = (a - 2w_1 + w_2/c) / 3b$$

$$(7) L_2(w_1, w_2) = (a + w_1 - 2w_2/c) / 3cb$$

where $(w_1, w_2) \in \Phi = \{(w_1, w_2) \in \mathbb{R}^2 \mid \pi_i \geq 0 \text{ for } i=1, 2\}$

Assume union in firm i maximizes its wagebill. Then its optimization problem is to maximize $V_i = w_i L_i$, $i=1,2$, subject to (6) and (7) respectively. Wage level is set non-cooperatively by the union and employment level is determined by the firm on its labor demand curve.⁶⁾ The reason for this assumption is that even if a firm and union choose wages and employment level on the contract curve through efficient bargaining, the former has an incentive to abrogate the agreement and to decrease employment level to a point on the demand curve.⁷⁾

For the purpose to compare with the other results we need to calculate monopoly case and duopoly case with unions' playing Cournot-Nash strategies. If firm 1 and union in the firm is monopolistic, then the union maximizes $w_1 L_1$ subject to $L_1 = (a - w_1)/2b$. In this case, the results of collective bargaining are as follows.

$$w_1^* = a/2, L_1^* = a/4b, V_1^* = a^2/8b, \pi_1^* = a^2/16b, p^* = 3a/4.$$

6 The equilibrium on labor demand curve satisfies the condition for Nash equilibrium.

7 There are two different approaches - monopoly union model and efficient contract model - on the determination of wage and employment in the unionized labor market. Monopoly union model is adopted in this paper since most of collective bargaining in the United States and other advanced countries seem to grant firms considerable discretion over the level of employment. Empirical works done in this area such as MaCurdy and Pencavel(1986) and Brown and Ashenfelter(1986) do not give us a decisive conclusion about the validity of two models.

If union 1 and union 2 in duopoly simply play Cournot-Nash strategies, their objective functions and resulting wage levels are as follow.

$$\begin{aligned} V_1 &= w_1 L_1 = (w_1/3b)(a-2w_1+w_2/c) \\ V_2 &= w_2 L_2 = (w_2/3cb)(a+w_1-2w_2/c) \\ w_1^* &= a/3, w_2^* = ac/3 \end{aligned}$$

III. Entry Deterrence When Unions are Organized Separately

In this section we analyze the strategic choice of wage level by the union in the incumbent monopoly firm when workforce in potential entrant is also separately unionized. In this case the union can play a strategic role by choosing wage level to deter or accomodate entry of firm 2 according to the payoffs from each strategy. Of course, the important factor which affects union's strategic behavior is the difference in the efficiency of production technology.

Firstly, assume that the union in incumbent firm choose to deter entry of firm 2. Then it behaves as monopoly union and demand for union labor is $L_1 - (a-w_1)/2b$. The necessary condition for this strategy to be optimal is that firm 2's demand for labor is zero at the union 1's entry deterrence wage level and firm 2 has no incentive to enter, that is, its profit is not increasing with respect to its labor when $L_2=0$. From these two necessary conditions, we can derive entry deterrence wage level and resulting payoffs(wagebill) to the entry deterring union.⁸⁾

$$\begin{aligned} (8) \quad w_1^D &= -a+2w_2/c \\ (9) \quad V^D - w_1^D L_1 &= (1/b)\{-a^2 + 3a(w_2/c) - 2(w_2/c)^2\} \end{aligned}$$

On the other hand, if union 1 accomodates firm 2 and its union, its optimization problem is to solve;

$$\text{Max}_{w_1} V^A = w_1 L_1 = (w_1/3b)(a-2w_1+w_2/c)$$

In this case, resulting wage level and payoffs are as follow.

$$\begin{aligned} (10) \quad w_1^A &= (1/4)(a+w_2/c) \\ (11) \quad V_1^A(w_1^A) &= (1/24b)[a^2+2a(w_2/c)+(w_2/c)^2] \end{aligned}$$

8 From the condition $L_2=0$, $w_1 = -a+2w_2/c$ and from the condition $\partial\pi_2/\partial L_2|_{L_2=0} = a-bL_1 w_2/c - a-(a-w_1)/2-w_2/c \leq 0$, $w_1 \leq -a+2w_2/c$. Hence the highest entry deterrence wage level is derived as the equation (8) and it should be positive.

In order to determine which strategy is optimal to the union in the incumbent firm, we need to compare the payoffs from each strategy. By subtracting (11) from (9), we can find a critical wage level of entering firm's union which makes incumbent union's payoff indifferent regardless of its strategic choice.

$$(12) \Delta V = V^D - V^A = (-1/24b)[7(w_2/c) - 5a]^2 \leq 0$$

$$(13) (w_2/c)^* = 5a/7$$

Proposition 1: (1) If entering firm's wage level $w_2 \geq 3ac/4$, incumbent union sets $w_1^D = a/2$ and entry deterrence strategy will be successful.

(2) If $5ac/7 \leq w_2 \leq 3ac/4$, incumbent union can deter entry of firm 2 by setting wage level according to equation (8). In this case $w_1^D \in [3a/7, a/2]$.

(3) If $0 \leq w_2 \leq 5ac/7$, the best strategy for the incumbent union is to accommodate entry and sets wage level according to the equation (9). In this case, wage level $w_1^A \in [a/4, 3a/7]$.

proof: (1) If $w_2 \geq 3ac/4$ and the incumbent union sets wage level $w_1 = a/2$ which is monopoly union wage, entrant's demand for labor, L_2 is nonpositive by the equation (7).

(2) If $5ac/7 \leq w_2 \leq 3ac/4$ and the incumbent union sets wage level according to (8), similarly with the above case, $L_2 \leq 0$.⁹

(3) If $0 \leq w_2 \leq 5ac/7$, $V^A \geq V^D$. Thus the incumbent union will choose accommodation wage according to the equation (10). ■

The above analysis can be represented by Figure 1 and 2. In Figure 1 we can easily figure out that incumbent union's wage is nondecreasing with respect to entering union's wage. Moreover, as technology efficiency of entrant, c , increases, wage response curve shifts to the right and incumbent union's strategic wage level is decreasing. This implies higher productivity of entering firm has effect to deter incumbent union's wage increase and to make entry deterrence more difficult. In Figure 2, we can find that incumbent union's payoff (wagebill) is less than $a^2/8b$ when entering firm's wage level, $w_2 \in (5ac/7, 3ac/4)$. This fact implies incumbent union loses some portion of its payoff in spite of successful entry deterrence.

⁹ Note here that although the incumbent union chooses accommodation wage policy, entrant's demand for labor is non positive.

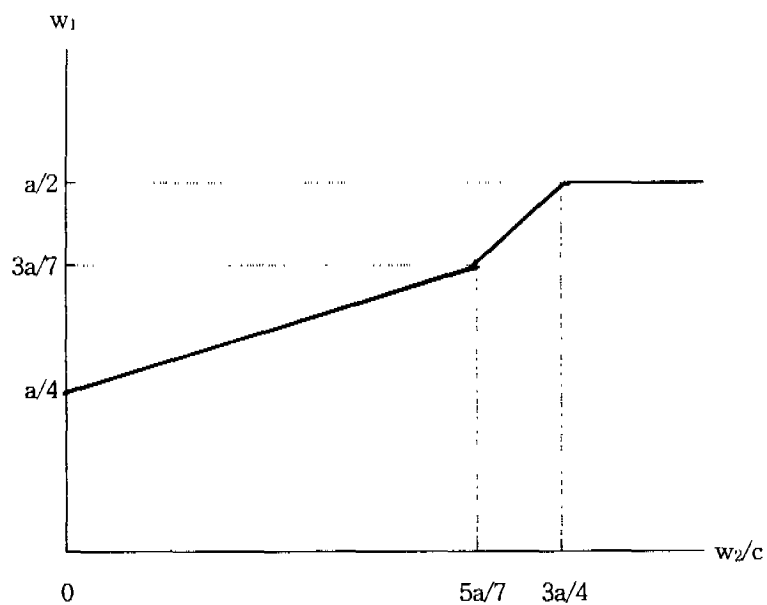


Figure 1: Wage Response Curve

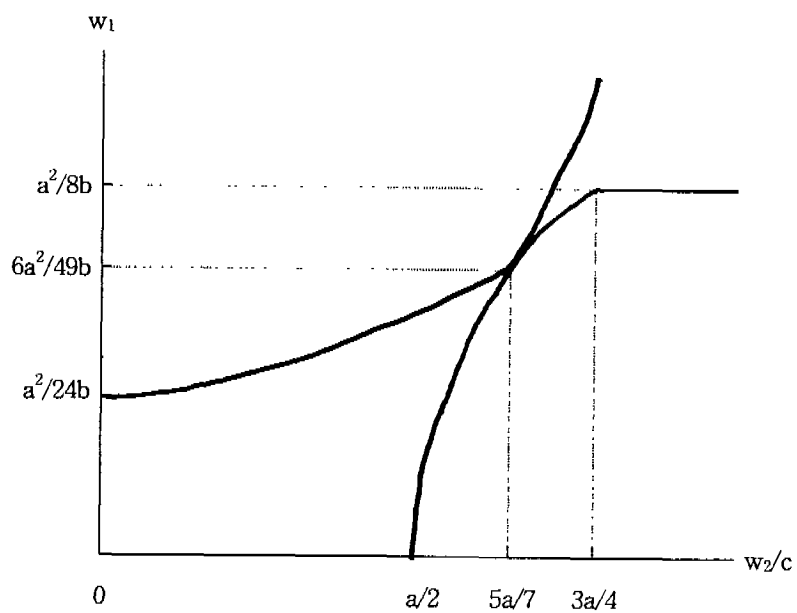


Figure 2 : Incumbent Union's Payoff

Incumbent firm's profit as a function of entering firm's labor cost per output is calculated as following equation (14) and this relation is showed in Figure 3. We can easily find that in accomodation area, incumbent firm's profit is increasing as entering firm's labor cost per output is increasing, but it is non-increasing in entry deterrence area. Especially, it is remarkable that entry threat and resulting incumbent union's entry deterrence wage policy has positive effect on incumbent firm's profit when $w_2 \in [5ac/7, 3ac/4]$. This is because the union lowers wage request but incumbent firm maintains its monopoly position. Moreover, incumbent firm's profit can be higher even after its monopoly position is collapsed under unionization. This result is quite remarkable since it requires fundamental reformulation of traditional entry deterrence theory.

$$(14) \pi_1^* = \begin{cases} (1/36b)(a+w_2/c)^2, & \text{if } 5ac/7 \leq w_2 \\ (1/b)(a-w_2/c)^2, & \text{if } 5ac/7 \leq w_2 \leq 3ac/4 \\ a^2/16b, & \text{if } w_2 \geq 3ac/4 \end{cases}$$

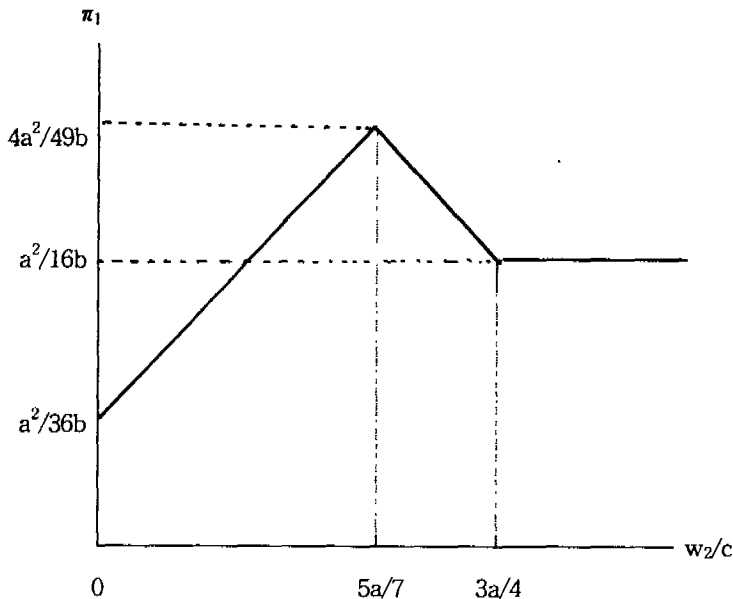


Figure 3 : Profit Schedule

The above results also has some policy implications. By the entry deterring wage policy, union has some loss of its payoffs in contrast with the increase of profits of the incumbent firms. Thus we can find the possibility of implicit union-firm cooperation. The incumbent firm has an incentive to transfer some portion of her increased profit to the union as a reward to the successful entry deterrence. The other

possibility is that the incumbent firm has an incentive to transfer her advanced technology to the potential entrant to depress union's bargaining power and consequently its wage request. This can be a kind of backdoor policy to discipline military union.¹⁰ In addition, the effect of tariffs or subsidy policy by the government must be reconsidered by incorporating their effects on union and industry structures.

IV. Entry Deterrence When One Union Organizes Both Firms

When one union organizes both firm we can consider two different union wage policies. Firstly, the union can use price(wage) discrimination policy. Since the union is a monopolist, it can use its monopoly power and act as a price discriminator. We can find some firms in the United States using two-tier wage system and it looks like a kind of price discrimination, but it is quite different from the concept used here since it is initiated by the firm and low-waged workers are usually non-union members. In actual, it is difficult to find the case where union applies wage discrimination policy.¹¹ Therefore, more practical wage policy for unions is to use equal wage for equal work policy. Thus, as we see in the Pennington case, it is more plausible that union can threaten against entry by committing incorporation of all new members of entering firm and imposition of a kind of limiting prices.

Assume that the union pursues equal wage policy for its members and both firm 1 (incumbent) and firm 2 (entrant) maximize their profits. Then, profit functions are derived as follow.

$$(4') \pi_1 = \{a - b(L_1 + cL_2)\}L_1 - wL_1$$

$$(5') \pi_2 = \{a - b(L_1 + cL_2)\}cL_2 - wL_2$$

In addition, assume that both firm play Cournot strategy in the product market. Then their demand for unionized labor are as following:

$$(6') L_1(w_1, w_2) = \{a - (2c-1)w/c\} / 3b,$$

$$(7') L_2(w_1, w_2) = \{a - (2-c)w/c\} / 3cb,$$

where $(w_1, w_2) \in \phi = \{(w_1, w_2) \in \mathbb{R}^2 \mid \pi_i \geq 0 \text{ for } i=1, 2\}$

10 This type of intentional international technology transfer will be more likely to occur in international settings. If a domestic firm is an worldwide monopolist and it is struggling with military union, it might have a strong incentive to transfer its technology to the potential entrant.

11 Peter Kuhn, "A Nonuniform Pricing Model of Union Wages and Employment", *Journal of Political Economy*, 1988, pp.473-508.

1. Entry Deterrence

If union 1 in the incumbent firm chooses a strategy to deter entry, it must set the wage level w^D which satisfies $L_2 \leq 0$. By the condition that the numerator in the right hand side of equation (7') is nonpositive, entry deterring wage level is

$$(10) \quad w^D \geq ac/(2-c)$$

Note here that $c < 2$ for w^D to be positive. If the deterrence strategy will be successful, then the incumbent firm and union can exercise their monopoly power in the product market and labor market respectively. Monopoly firm's demand for labor is

$$(11). \quad L_1(w) = (a-w)/2b.$$

Lemma 1: Entry deterrence strategy works only for less efficient firm.

proof: Substitute $w^D = ac/(2-c)$, the lowest deterrence wage level, into the equation (11) Then, $L_1(w^D) = a(1-c)/b(2-c)$. To get positive demand for labor, c must be less than 1. Q.E.D.

If union 1 exercises entry deterrence strategy, its utility level(wagebill) is

$$(12) \quad V^D = w^D L_1(w^D) = a^2 c(1-c) / b(2-c)^2.$$

2. Accomodation

If the union in the incmbent firm accomodates the entry of firm 2, it will maximizes its wagebill subject to the firm 1's demand for labor. That is,

$$\text{Max } V_1^A = w^A L_1(w^A) = \{aw^A - (2c-1)w^{A2}/c\} / 3b$$

$$(13) \quad w^A = ac / 2(2c-1), \quad c > 1/2^{12}$$

$$(14) \quad L_1(w^A) = a / 6b$$

$$(15) \quad V^A = w^A L_1(w^A) = a^2 c / 12b(2c-1)$$

$$(16) \quad V^D - V^A = -a^2 c(5c-4)^2 / 12(2c-1)(2-c)^2$$

From (16), the critical level of c is $4/5$. That is, if $c=4/5$ deterrence and accomodation strategies are indifferent to the union in the incumbent firm.

¹² Actually c must be greater than $2/3$ since $w_A < a$ from the equation (1).

Proposition 2: The union in the incumbent firm will choose deterrence(acomodation) strategy if c is less(greater) than $4/5$.

proof: Since monopoly union wage is $a/2$ and entry deterrence wage level is $ac/(2-c)$, their equality holds when $c=2/3$. On the other hand, deterrence wage level is increasing with respect to $c \in (2/3, 4/5)$ and accomodation wage level is decreasing with respect to $c > 4/5$.¹³⁾ ■

Figure 4 clarifies the arument mentioned above.

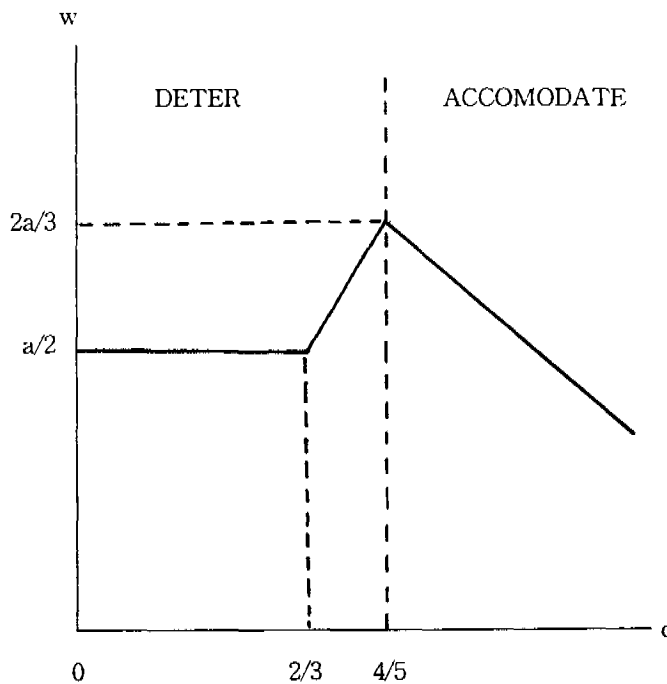


Figure 4: Wage and Technology Efficiency

VI. Conclusion

The presence of unions can strongly affect entry deterrence behavior. Moreover, the explicit integration of strategic interactions on product markets offers insights for the economic analysis of unions. Most previous researches, however, consider unions as secondary factors which affect entry deterrence behavior of firms and assume noncooperative firm-union relationships. This paper finds the possibility of union-firm cooperation about entry deterrence problem.

¹³ Note that $\partial w^D / \partial c = 2a/(2-c)^2 > 0$ and $\partial w^A / \partial c = 2a/(4c-2)^2 < 0$.

In this paper, we first analyze the strategic choice of wage level by the union in the incumbent monopoly firm when workforce in potential entrant is unionized. In this case the union can play a strategic role by choosing wage level to deter or accommodate entry of firm 2 according to the payoffs from each strategy. Especially when workforce in potential entrant is separately unionized, we figure out that incumbent union's wage is nondecreasing with respect to entering union's wage. Moreover, as technology efficiency of entrant increases, wage response curve shifts to the right and incumbent union's strategic wage level is decreasing. This implies higher productivity of entering firm has effect to deter incumbent union's wage increase and to make entry deterrence more difficult. An interesting result is that in some cases, entry threat and resulting incumbent union's entry deterrence wage policy has positive effect on incumbent firm's profit. This is because the union lowers wage request but incumbent firm maintains its monopoly position. Moreover, incumbent firm's profit can be higher even after its monopoly position is collapsed under unionization. This result is quite remarkable since it requires fundamental reformulation of traditional entry deterrence theory.

The policy implications are as follow. By the entry deterring wage policy, union has some loss of its payoffs in contrast with the increase of profits of the incumbent firms. Thus we can find the possibility of implicit union-firm cooperation. The incumbent firm has an incentive to transfer some portion of her increased profit to the union as a reward to the successful entry deterrence. The other possibility is that the incumbent firm has an incentive to transfer her advanced technology to the potential entrant to depress union's bargaining power and consequently its wage request. This can be a kind of backdoor policy to discipline military union.

The framework work of this paper can be used to analyze the effect of differences in union militancy. Assume that the objective function of incumbent union is $V_1 - w_1L_1$ and that of enterant union is $V_2 - w_2L_2^{2r}$ ($0 \leq r \leq 2$), where r implies union militancy. From the first-order condition, $\partial V_1 / \partial w_1 - a - 4w_1 + w_2 = 0$ and $\partial V_2 / \partial w_2 = a + w_1 - 4w_2/r = 0$, we find $w_1 = (4a + ra)/(16 - r)$ and $w_2 = 5ar/(16 - r)$. The results imply that wage level of union 1 is increasing with respect to the militancy of union 2. The other possibility of extentions is to incorporate insider and outsider problem and uncertainty in the types of enterant.

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