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THROUGH HIGH WAGES

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Deterring Entry through High Wages

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Abstract

This paper shows that incumbent firms could use wage rates to deter entry of new firms. Two cases are analyzed. In the first, incumbents determine wages of all firms producing the same good (an extreme case of a wage bargaining at the industry-level -a kind of bargaining which is prevalent in many European countries-). In the second, each firm can choose different wages, knowing that the efficiency of workers depends on their wage relative to a wage that they consider fair. In both cases, there are circumstances in which incumbents choose high wages in order to deter entry.

JEL Classification: D43, E24, J41, J50, L13, L41.

Keywords: entry deterrence, wages, unions, fairness

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1 Introduction

In 1968, Williamson wrote a pioneering paper on the interaction between labor economics and entry deterrence. In that paper, he stresses the importance of studying wage rates as a barrier to entry of new firms.

> "The question of what types of conditions would most effectively support the manipulation of wage rates by one group of firms to bar entry or disadvantage a second group of firms is sufficiently interesting in itself to deserve theoretical analysis." (Williamson (1968, p. 85))

On the basis of a decision by the Supreme Court concerning the United Mine Workers he also argues that industry wage bargaining could be used to deter entry or even to force small incumbent firms to exit.

More recently Dewatripont (1987, 1988) argues for the integration of union-firm relationships and entry deterrence. He advances two reasons for this integration. First unions are mostly present in large firms that usually have some market power; second they are able to extract some rents from this market power. He mainly analyzes the influence of trade unions on entry deterrence through limit pricing under incomplete information, through the influence of sunk costs on wage rates and through the effect of severance pay. He also suggests that bargaining over wages at the industry level could be a mean to deter entry.

This last point is the subject of next section. In many European countries wages are bargained -at least partly- at the industry level. This is the case for example in Austria, Belgium, France, Germany, Italy, Netherlands, Portugal or Spain (see Layard, Nickell and Jackman (1991, pp. 517-524)). In some of these countries the bargained wage automatically applies by law to all workers in the sector even to workers of firms that enter the industry after the wage bargaining (the *entrants*). Therefore raising wage rates increases the costs of the incumbents but it also increases entrants' costs. This can discourage the entrants from entering the market, and thereby, this might increase the incumbents' profit. The net effect of a wage increase on the incumbents' profit is a priori unknown; if it is positive, and if only incumbent firms participate to the industry wage bargaining, then incumbents could use wages to deter entry. This is what I study in Section 2.

In Section 3, I present a similar model in an efficiency wage framework. I assume that each firm determines the wages of its own workers only. The efficiency of the workers depends on the wage that they receive, relative to a wage that they consider fair. That fair wage in turn might depend on the wage that is offered by the other firms. Therefore, increasing the wage in firm i not only increases the efficiency of workers in firm i, but it also increases the fair wage, and therefore, decreases the efficiency of workers in the other firms. Depending on the way the fair wage is defined, the results of Section 2 can apply, that is, incumbents could use wage rates to deter entry. Concluding remarks follow Section 3.

2 The Industry Wage Setting

Could a bargaining over wages at the industry level be used by incumbents to deter entry of new competitors in their market? This is the question that I study in this section.

I use an extreme assumption: incumbent firms determine themselves the wage in the whole industry. This is admittedly not realistic: in practice, even if the wage is set at the industry level in many countries, incumbents do not have the power to determine it alone. The wage is usually bargained over with unions. The assumption that I make is equivalent to giving all the bargaining power to the firms. I discuss this point in more details at the end of the section.

Raising wage rates increases the incumbents' costs but it also increases potential entrants' costs. This reduces the entrants' incentives to enter the market, and thereby, this increases the incumbents' profit. The net effect of a wage increase on the incumbents' profit is studied in this section.

I use the following definitions:

D.1. q_i is the output of the ith firm.

D.2. q_{-i} is the total output of the industry minus the output of the ith firm.

D.3. $Q = q_i + q_{-i}$.

D.4. n is the number of firms.

D.5. q^n is the output of each firm in a symmetric equilibrium with n firms in the market.

D.6. l_i is the employment of the ith firm.

D.7. w is the wage in the industry.

I also make the following assumptions:

A.1. The inverse demand function $p(Q)$ is twice differentiable; p' is negative.

A.2. All firms have identical cost functions: $F + wl_i = F + wc(q_i)$, where F is a fixed cost and $c(q_i)$ is twice differentiable and monotonically increasing.

A.3. The profit function for the ith firm

$$\pi_i = p\left(Q\right) q_i - wc(q_i) - F, \tag{1}$$

is strictly concave in q_i for any q_{-i}, i.e.,

$$q_i p'' + 2p' - wc'' < 0.$$

A.4. The sequence of decisions is the following. The incumbent firms have already paid the fixed cost at the beginning of the game. *In a first stage*, they determine the industry wage. *In a second stage,* taking this wage as given, the potential entrants decide to enter (and pay the fixed cost) or not. Finally *in a third stage*, firms that are present in the market determine their output (under Cournot competition).

Let us now analyze these stages, in order to derive a condition that determines when it is in the incumbents' interest to deter entry.

- **Third stage.** Each firm maximizes (1) with respect to q_i, taking q_{-i} as given (Cournot setting). Given the wage w, a symmetric equilibrium with n firms yields the following profit per firm:

$$\pi^n \left|_{w \text{ exogenous}} = p\left(nq^n\right) q^n - wc(q^n) - F.\right.$$

  where q^n is such that $p'\left(nq^n\right) q^n + p\left(nq^n\right) = wc'(q^n)$. I define $q^{n'} \equiv \partial q^n / \partial n$. As shown by Seade (1980)

$$\pi^{n'} \equiv \frac{\partial \pi^n \left|_{w \text{ exogenous}}\right.}{\partial n} = p' q^n (q^n + nq^{n'}) + pq^{n'} - wc' q^{n'} < 0; \qquad (2)$$

  for a given wage, the profit decreases with the number of firms in the market.

- **Second stage.** In a market with n firms, profit becomes negative when the wage is slightly higher than $g(n)$ where

$$g(n) = \frac{p\left(nq^n\right) q^n - F}{c(q^n)}.$$

  Suppose that at wage $w1$ there are n firms in the market, each making a positive profit, as shown in Figure 1. Suppose also that $n - 2 > m$ where m is the number of incumbents. Therefore, there are $m - n$ entrants at wage $w1$. If the wage increases, the profit of each of the n firms decreases, as shown in the figures. Once the wage reaches $g(n)$ the profit becomes negative. Hence one of the entrants will avoid entering the market. The number of firms present in the market falls to $n - 1$, increasing therefore the profit of each of the $n - 1$ remaining firms, as shown for example in Figure 1. If the wage continues to increase, the profit of the $n - 1$ firms decreases; at wage $g(n - 1)$ it falls to 0 and one entrant leaves the market, increasing thereby the profit of the remaining $n - 2$ firms, and so on.

Once the wage is equal to $g(m+1)$, only the m incumbents remain in the market. A further increase in the wage decreases their profit which could become negative. However, since all incumbents have already paid the fixed cost, it is not possible to entice them to exit the market even if their profit becomes negative.

Alternatively we could have a figure like Figure 2. If Figure 1 is what is observed, then it is in the interest of the incumbents to choose a wage $g(m+1)$ in order to deter entry because this maximizes their profit. In contrast, if Figure 2 is what is observed, then the incumbents will choose the smallest possible wage, which could allow new firms to enter the market.

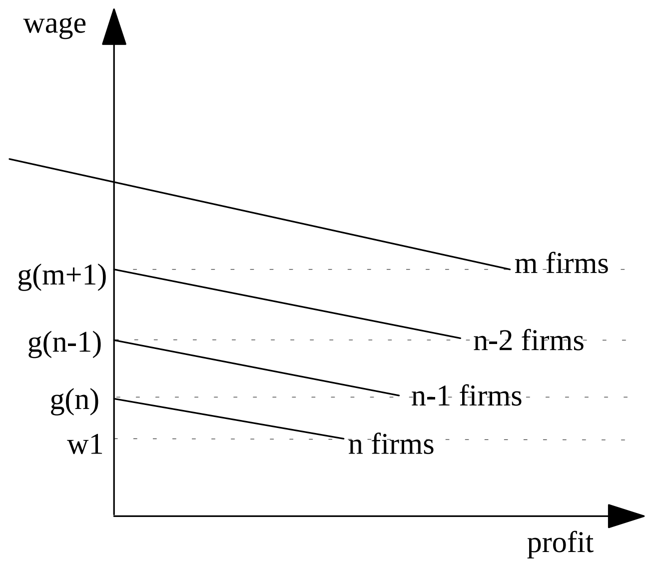

Figure 1: Evolution of profit - a first case

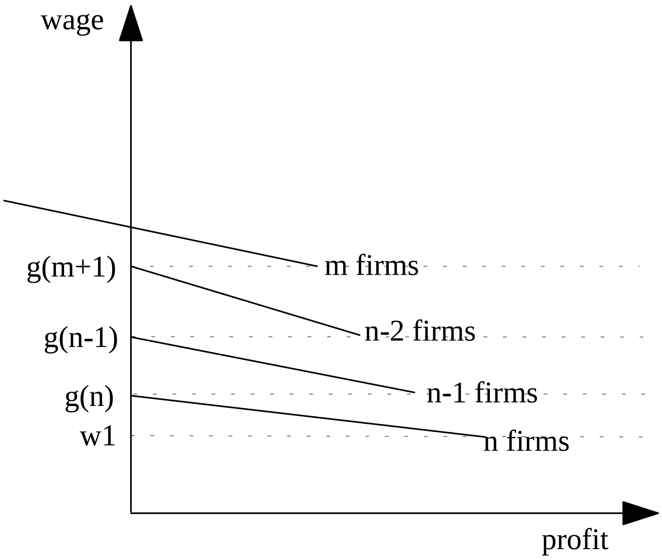

Figure 2: Evolution of profit - a second case

- **First stage.** The wage $g(n)$ determines the number of firms in the market: to have $n-1$ firms in the market, the wage must be equal to $g(n)$. If the m incumbents set a wage that allows the entry of $n-1-m$ firms, their profit becomes:

$$\pi^{n-1}\Big|_{w=g(n)} = p\left((n-1)\,q^{n-1}\right)q^{n-1} - \frac{p\,(nq^n)\,q^n - F}{c(q^n)}c(q^{n-1}) - F,$$

$$\text{or } \pi^{n-1}\Big|_{w=g(n)} = c(q^{n-1})\left[g(n-1) - g(n)\right].$$

On one hand an increase in the number of firms (n) increases competition and therefore reduces profit; but on the other hand it reduces $g(n)$, the wage that determines the number of firms that will enter the market. It is possible to derive a condition that determines the overall effect of an increase in n on profit.

What is of interest is the evolution of profit when the wage is given by

$g(n)$:

$$\begin{aligned}\frac{\partial \pi^n \left|_{w=g(n)}\right.}{\partial n} &= \left[g'(n-1) - g'(n)\right] c(q^{n-1}) + c'(q^{n-1}) q^{n-1'} \left[g(n-1) - g(n)\right] \\ &= A - B + C,\end{aligned}$$

where

$$\begin{aligned}A &= p'\left[(n-1)q^{n-1})\right] q^{n-1}\left[q^{n-1} + (n-1)q^{n-1'}\right] + \\ &\quad p\left[(n-1)q^{n-1})\right] q^{n-1'} - c'\left(q^{n-1}\right) q^{n-1'} g(n-1), \\ B &= \left[p'(nq^n)q^n\left(q^n + nq^{n'}\right) + p(nq^n)q^{n'} - c'\left(q^n\right) q^{n'} g(n)\right] \frac{c\left(q^{n-1}\right)}{c\left(q^n\right)}, \\ C &= c'\left(q^{n-1}\right) q^{n-1'} \left[g(n-1) - g(n)\right].\end{aligned}$$

After some manipulations, I find the following condition:

$$\frac{\partial \pi^n \left|_{w=g(n)}\right.}{\partial n} < 0 \Longleftrightarrow \frac{\pi^{n-1'}}{c\left(q^{n-1}\right)} < \frac{\pi^{n'}}{c\left(q^n\right)}. \tag{3}$$

This is equivalent to the condition that $\pi^{n'}/c\left(q^n\right)$ is increasing in n, that is, equivalent to

$$\pi^{n''} c\left(q^n\right) - c'\left(q^n\right) q^{n'} \pi^{n'} > 0. \tag{4}$$

As shown in (2), $\pi^{n'}$ depends on $q^{n'}$; therefore $\pi^{n''}$ depends on $q^{n''}$ which itself depends on p''' and c'''. Hence, it becomes difficult to have a simple interpretation of this condition. Since the second term is generally positive ($\pi^{n'} < 0$ and $q^{n'}$ is generally negative[1]), a necessary condition for (4) to hold is that $\pi^{n''}$ be positive, which seems to be realistic: it can be expected that the profit per firm decreases more when the market expands from 1 to 2 firms than when it expands from 1000 to 1001 firms (but a formal proof would need the use of p''' and c''').

If (4) is fulfilled then Figure 1 is what is observed: the incumbents would increase their profit by reducing the number of their competitors

[1] See however Seade (1980) or Novshek (1985) who show that $q^{n'}$ could be positive.

even if this needs to set a high wage in the industry. Therefore they set a wage that deters entry but that also leaves their own profit (and that of all other incumbent firms) positive. If there are m incumbents, that wage is equal to

$$g(m+1) = \frac{p\left((m+1)q^{m+1}\right)q^{m+1} - F}{c(q^{m+1})}.$$

It is the wage that would received the agreement of all incumbent firms: any higher wage would reduce their profit (increasing the costs without changing the receipts) and any lower wage would also reduce their profit (reducing the costs but mainly increasing competition).

This establishes the following proposition.

Proposition 1 *Under assumptions A.1. to A.4. incumbent firms determine an industry wage that deters entry if* $\pi^{n''}c\left(q^n\right) - c'\left(q^n\right)q^{n'}\pi^{n'} > 0$.

Example

As an illustration, assume $P(Q) = a - bQ$ and $c(q_i) = dq_i$. With n firms in the market, $q^n = (a - wd)/b(n+1)$ and

$$\pi^n\left|_{w \text{ exogenous}}\right. = \left[\frac{a - wd}{n+1}\right]^2 \frac{1}{b} - F.$$

- We can check if $\pi^{n''}c\left(q^n\right) - c'\left(q^n\right)q^{n'}\pi^{n'} > 0$ is fulfilled:

$$\begin{aligned} q^{n'} &= -\frac{(a - wd)}{b(n+1)^2}, \\ c'\left(q^n\right) &= d \\ \pi^{n'} &= -\frac{2}{n+1}\left[\pi^n\left|_{w \text{ exogenous}}\right. + F\right] \\ \pi^{n''} &= \frac{2}{n+1}\frac{3}{n+1}\left[\pi^n\left|_{w \text{ exogenous}}\right. + F\right] \end{aligned}$$

Therefore $\pi^{n''}c\left(q^n\right) - c'\left(q^n\right)q^{n'}\pi^{n'} = 1/(n+1) > 0$. The condition (4) is fulfilled: *under a linear demand curve and constant marginal costs, incumbent firms will always manage to deter entry.*

- Another way to check the result is to directly compute the profit at wage $g(n)$. The wage that would set $\pi^{n+1} = 0$ is $g(n) = \left[a - (n+2)\sqrt{bF}\right]/d$. At wage $g(n)$, profit becomes

$$\pi^n \big|_{w=g(n)} = \left[\left(\frac{n+2}{n+1}\right)^2 - 1\right] F$$

which is clearly decreasing in n.

Another example is given in the Appendix: *if the demand and the cost functions have a constant elasticity then condition (4) is fulfilled and entry will be deterred.*

Comments

The analysis made so far is admittedly not realistic since it assumes that the incumbent firms determine the wage in the industry. In practice, even if the wage is set at the industry level in many countries, firms do not have the power to determine it; the wage is usually bargained over with unions that have some bargaining power. Including that dimension in the model would however introduce complexities of its own[2] (see Gollier (1991) for a model of this kind) without adding much flavor to the analysis.

For example if (4) is fulfilled and if the union cares only about wages (this is well known to be the case if the union is governed by the median worker who is largely protected against layoffs by seniority rules) it would be in its interest and in the incumbent firms' interest to set a wage at least equal to the wage that deters entry (w_m). Hence Proposition 1 also applies to a wage bargaining in which the union cares only about wages.

If the union cares a lot about employment, it might be that it is willing to allow entry in order to increase employment while incumbent firms would be willing to deter entry. This case is theoretically possible but does not

[2] If the Nash solution is chosen to determine the wage, then the Nash product is discontinuous: a change in the wage could modify the number of firms in the market; this in turn would *discontinuously* change the employment level and therefore also the profit and the union utility if the union cares about employment.

seem very realistic: it implies that the union seeks to reduce the wage in order to increase the industry employment while the incumbent firms want to increase the wage in order to deter entry.

Therefore, for a realistic union utility, the union and the incumbent firms probably determine an industry wage that is at least high enough to deter entry if (4) is fulfilled. Even if (4) is not (but nearly) fulfilled, the incumbents will be less eager to refuse high wages to the unions because they know that these wages will deter the entry of competitors, attenuating therefore the negative impact of wages on profit (but the net impact of wages on profit would stay negative in this case).

3 The Fair Wage - Effort Hypothesis

In many countries the wage chosen by one firm can be different from that chosen by other firms. However, as we shall see in this section, this does not guarantee that incumbent firms are unable to use wage rates as a mean to deter entry of new firms.

In this section I keep the main assumptions of the previous section. I just change the cost function slightly and replace assumption A.4. by:

A.4.' The sequence of decisions is the following. The incumbent firms have already paid the fixed cost at the beginning of the game. *In a first stage*, they determine the wages of their workers. *In a second stage,* taking these wages as given, the potential entrants decide to enter (and pay the fixed cost) or not. If they enter they determine the wages of their own workers. Finally *in a third stage*, firms that are present in the market determine their output (under Cournot competition).

As argued for example by Agell (1999), fairness is a concept that becomes more and more used in labor economics because it is well documented in empirical researches based on surveys or experiments and because it is now formalized in game theory (see for example Rabin (1993)). Akerlof and

Yellen (1990) develops a simple model that formalizes fairness in the relationships between a firm and its workers. According to them, insofar as the actual wage is less than what workers consider as a fair wage, workers supply a corresponding fraction of normal effort. Normalizing normal effort to 1, workers of firm i provide the following effort

$$e_i = \min\left(w_i/w^*, 1\right),$$

where w^* is the fair wage. The effort is linked to the production by the following relation: $e_i l_i = c(q_i)$. The profit function for the ith firm becomes therefore

$$\pi_i = p\left(Q\right) q_i - \frac{w_i c(q_i)}{\min\left(w_i/w^*, 1\right)} - F,$$

$$\text{or } \pi_i = p\left(Q\right) q_i - \max\left(w^*, w_i\right) c(q_i) - F. \tag{5}$$

In assumptions A.2. and A.3., w should now be replaced by $\max\left(w^*, w_i\right)$.

As stressed by Akerlof and Yellen (1990), there are many candidates for playing the role of the fair wage. One "natural" candidate is the highest wage that is offered in similar firms. The reasoning of workers would be of the following kind: "if one firm is able to give a high wage to its workers, there is no reason that the firm in which I am working (which is similar to the high-wage firm) be unable to give me the same high wage. If my wage is lower than that wage, it is because the firm is treating me unfairly, seeking to increase its profit at my expenses (and at least one firm does not do that); therefore, I will retaliate by lowering my effort." Under this interpretation, profit of firm i becomes

$$\pi_i = p\left(Q\right) q_i - \max\left(w_1, ..., w_j\right)\, c(q_i) - F.$$

It is the highest wage in the industry (and not necessarily w_i) that influences the profit of firm i. Therefore, choosing a low wage does not decrease the costs; these are determined by the firm that chooses the highest wage. Under assumption A.4.', incumbents are first to choose their wages. Hence, each incumbent is in the same kind of position as in Section 2: by increasing its wage above the wages of the other firms, it increases its own costs, but it also increases proportionally the costs of all other firms, including the entrants. It is as if each incumbent were able to determine the wage in the whole industry. Hence, the analysis of previous section can be repeated and Proposition 1 also applies here. Therefore, when (4) is fulfilled, it is in the interest of each incumbent to deter entry, even if it needs to give high wages to the workers to do so: by increasing its wage, the incumbent also proportionally increases the costs of the entrants which will hence avoid entering the market.

Of course this equivalence result applies for a particular efficiency wage model. Still, if there exists a link between the wage in one firm and the efficiency of workers in other firms, it might be possible to reach a proposition that is close to Proposition 1. In the efficiency wage literature, many models assume that the workers' effort positively depends on their actual wage relative to some "reference wage" (see e.g. Summers (1988), Akerlof and Yellen (1990), Layard, Nickell and Jackman (1991), or de la Croix (1994)). Generally, the "reference wage" includes the wages paid by similar firms. For example, the "reference wage" could be the mean wage in the industry.

As an illustration, assume that (5) still applies but with $w^* = \sum_{i=1}^{n} w_i/n$. Also assume that the incumbents act in concert to set their wages. Then Proposition 1 still applies: incumbents collude to determine a "reference wage" w^* that deters entry if (4) is fulfilled. If each incumbent agree to increase its wage by 1, w^* increases by 1, and so some entrants may be forced to avoid entering the market. It is as if incumbents were together determining the costs of the entrants: provided that (4) is fulfilled, they set w^* in order to deter entry of new firms. Note that in contrast with the model of Section 2, entrants can in principle set a wage that is lower than that in incumbent firms; however, if they do so, they do not increase their profit.

In the absence of collusion between incumbents, the analysis becomes quite complex but the incentive to set a wage that deters entry decreases because to increase w^* by 1, an incumbent must increase its wage by n, while in the collusion case, each incumbent firm has to increase its wage by 1 only. The complete analysis of this case is however beyond the scope of this paper.

4 Conclusion

In this paper I show how the wage determination could be used by incumbent firms to deter entry. If incumbents can choose the wage for all firms in the same industry, then it could be in their interest to set a high wage that deters entry; this is Proposition 1. Two examples suggest that for plausible cost and demand functions, incumbents are able to deter entry.

This result is important because it shows that bargaining over wages at the industry-level (a kind of bargaining which is prevalent in many European countries) can be used by incumbent firms to deter entry, reducing therefore the employment level. This could explain the result obtained by Calmfors and Driffill (1988) who show that for employment purposes, the industry level is the worse level of wage bargaining.

By choosing an appropriate way of modelling efficiency wage, it is also possible to reach Proposition 1. Of course this equivalence result applies for a particular efficiency wage model. Still, if there is a collusion between incumbent firms and if there exists a link between the wage in one firm and the efficiency of workers in other firms, it might be possible to reach a proposition that is close to Proposition 1.

There is now a lot of papers that relate entry deterrence and the inputs markets (e.g. Salop and Scheffman (1983), Salinger (1988) or Ordover et al. (1990)). The basic idea is that incumbents are able to increase the costs of their competitors. For example when an upstream and a downstream firm integrate, the unintegrated downstream rivals could be foreclosed from the input supplies controlled by the integrated firm. Market foreclosure could also be reached by contracts between the buyer and the seller of the input (see Aghion and Bolton (1987)). In general integrated and unintegrated firms will face different input prices because of the market foreclosure. Therefore some high costs firms could decide not to enter the market.

As in this literature, in the model of this paper, the objective of the incumbents is to increase rival costs in order to induce them to stay out of the market. However, in contrast with most of the literature, I assume that it is not possible to foreclose rivals from the input supplies and, more importantly, the costs of the inputs are identical for all firms: to increase rival costs the incumbents must increase their own costs proportionally. Still, even in that case, incumbents could have an incentive to deter entry by increasing their costs. This is highly relevant in unionized industries where the bargained wage automatically applies by law to all workers in the sector, even to workers of firms that enter the market after the wage bargaining. A similar result would apply to cases in which the incumbents are able to increase the costs of all firms in the industry (including their own costs). For example, they could lobby the government to strengthen (costly) mandatory product standards.

Of course these are a stylized models. Reality is more complex; incumbent firms are not all alike: some are large, other are small, they use different techniques and they produce goods that are not homogeneous. Moreover they are often stuck with a technology that is older than that of potential entrants. Some of these features could weaken Proposition 1. However it remains that incumbent firms will be less eager to refuse high wages when they know that this could deter entry of potential competitors.

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5 Appendix: Another Example

As another illustration, assume $P(Q) = Q^{-1/\alpha}$ $(\alpha \geq 1)$ and $c(q_i) = q_i^{\beta}$ $(\beta > 1)$. With n firms in the market, the output of each firm is

$$\begin{aligned} q^n &= \left[\frac{\alpha w \beta}{\alpha n - 1}\right]^{\frac{\alpha}{\alpha - \alpha\beta - 1}} n^{\frac{(1+\alpha)}{\alpha - \alpha\beta - 1}} \\ \text{and } \pi^n\left|_{w \text{ exogenous}}\right. &= (q^n)^{\beta} w \left[\frac{\alpha n(\beta - 1) + 1}{\alpha n - 1}\right] - F. \end{aligned}$$

We can check if $\pi^{n''} c(q^n) - c'(q^n) q^{n'} \pi^{n'} > 0$ is fulfilled:

$$\begin{aligned} q^{n'} &= q^n \frac{\alpha n - 1 - \alpha}{n(\alpha n - 1)(\alpha - \alpha\beta - 1)}, \\ c'(q^n) &= \beta (q^n)^{\beta - 1}, \\ \pi^{n'} &= (q^n)^{\beta} \frac{w\beta}{n(\alpha n - 1)^2 (\alpha - \alpha\beta - 1)} X, \\ \text{where } X &= 3\alpha n + \alpha^2 n^2 \beta - \alpha n \beta - \alpha^2 n^2 - 1 - \alpha, \\ \pi^{n''} &= (q^n)^{\beta} \frac{w\beta}{n^2 (\alpha n - 1)^3 (\alpha - \alpha\beta - 1)^2} Y, \\ \text{where } Y &= [\beta(\alpha n - 1 - \alpha) - (\alpha - \alpha\beta - 1)(3\alpha n - 1)] X + \\ & \quad (\alpha n - 1) n (\alpha - \alpha\beta - 1)\left(3\alpha + 2\alpha^2 n\beta - \alpha\beta - 2\alpha^2 n\right). \end{aligned}$$

Therefore $\pi^{n''} c(q^n) - c'(q^n) q^{n'} \pi^{n'} > 0$ if and only if

$$\Longleftrightarrow 1 + \alpha - 3\alpha n - 3\alpha^2 n + 5\alpha^2 n^2 - \alpha^2 n^2 \beta - \alpha^3 n^3 + \alpha^3 n^3 \beta > 0$$

which is always fulfilled when $\alpha \geq 1$, $\beta \geq 1$ and $n \geq 1$. *Under a constant elasticity demand curve and a constant elasticity cost function, incumbent firms will always manage to deter entry.*

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