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Profit Raising Entry

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Profit Raising Entry

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Abstract: Common wisdom suggests that entry reduces profits of the incumbent firms. On the contrary, we show that if the incumbents differ in marginal costs and the entrants behave like Stackelberg followers, entry may benefit the incumbents who are relatively cost efficient while it always hurts the cost inefficient incumbents. However, the outputs of all incumbents may be higher under entry.

Key Words: Entry; Profit; Stackelberg Competition

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1. Introduction

Since the work of Bain (1956) and Sylos-Labini (1962), the problem of entry has received a great deal of attention. Early attempts to uncover the effects of entry include for instance Frank (1965), Okuguchi (1973) and Ruffin (1971). In an influential paper, Seade (1980) provides a fairly general analysis of entry in an oligopolistic market. He shows that while entry may increase or reduce the outputs of the incumbents, it *always reduces* their profits. These results are based on two important assumptions. First, he assumes that the pre and the post entry product markets are characterized by Cournot competition. However, as shown in Spence (1977), Dixit (1980) and many others, while facing the threat of entry, the incumbents often adopt pre-commitment strategies, which allow them to behave like Stackelberg leaders in the product market. Hence, it is quite reasonable to consider the post-entry market to be characterized by Stackelberg competition between the incumbents and the entrants, as in Spulber (1981) and Basu and Singh (1990). Second, Seade (1980) assumes that all firms are symmetric in terms of production costs. However, cost asymmetry rather than symmetry is perhaps the empirical regularity.

In the present paper we relax the two above-mentioned assumptions and analyze the effects of entry on outputs and profits. More specifically, we show that if the firms differ in production cost, and the pre and post entry product markets are characterized by Cournot and Stackelberg competition respectively, entry always increases the outputs of the cost efficient incumbents, while it may or may not increase the outputs of the cost inefficient incumbents. We also find that entry may increase the profits of the relatively cost efficient incumbents. This happens when the following three factors are 'large': the number of the cost inefficient incumbents relative to the cost efficient incumbents and the entrants, the cost difference between the incumbents, and the costs of the entrants. All these factors help to strengthen the output raising effect of entry under Stackelberg competition while weakening the competition effect. However, entry always reduces the profits of the cost inefficient incumbents. These results suggest that the cost efficient incumbents may actually encourage new entry in the industry.

It is important to note that, unlike Seade (1980), where the output raising effect of entry is due to a sufficiently convex demand function, in our analysis this effect is attributable to Stackelberg competition. Stackelberg leadership induces the incumbents to increase their outputs in order to reduce the market share of the entrants. But the incentive for business stealing is stronger for the cost efficient incumbents relative to the inefficient ones. As a result, entry always increases the outputs of the former firms.

However, the output changes of the cost inefficient firms are ambiguous. On one hand, Stackelberg leadership under entry tends to increase their outputs compared to the situation of Cournot competition under no entry. On the other hand, since the incumbent firms among themselves behave like Cournot oligopolits even under entry, the output expansion of the cost efficient incumbents tends to reduce the outputs of the cost inefficient incumbents. Hence, whether entry increases the outputs of the cost inefficient firms depends on the relative strengths of these opposing effects.

This paper can be related to a recent literature, which shows that entry may increase profits of the incumbents in a vertical structure. Tyagi (1999) and Naylor (2002) respectively find that depending on the market demand curve and the preference of the upstream agents over input price and quantity, entry of a new downstream firm may increase profits of the downstream incumbents. Mukherjee et al. (2007) show that irrespective of the centralized or decentralized upstream market structure, a downstream monopolist has the incentive to create competition through licensing in the downstream market. Higher competition in the downstream market can create a positive effect on the incumbent's profits by reducing the input prices.

Our results do not depend on a vertical structure, and entry does not create any strategic advantage in the input market. The key that drives our results is the cost differences between the firms and the Stackelberg leadership of the incumbents vis-à-vis the entrants.

The remainder of the paper is organized as follows. Section 2 describes the model and shows the results. Section 3 concludes.

2. The model and the results

2.1. The case of no entry

Consider $m+n$ incumbent firms producing a homogenous product. The constant marginal cost of production for each of the m firms is c_m, which is set to be zero for simplicity. The constant marginal cost of each of the n firms is $c_n \geq 0$. Hence, c_n measures the cost difference between the cost efficient and the cost inefficient incumbents. The firms compete in the Cournot fashion.

We assume that the inverse market demand function for the product is

$$P = a - q, \tag{1}$$

where the notations have usual meanings. Each of the m and n firms respectively maximizes the following expression to determine its output:

$$\underset{q_i}{Max}(a-q)q_i, \qquad i = 1,2,...,m, \tag{2a}$$

$$\underset{q_j}{Max}(a-q-c_n)q_j, \qquad j = 1,2,...,n,\ i \neq j, \tag{2b}$$

where $q = \sum_1^m q_i + \sum_1^n q_j$ and $i \neq j$.

The equilibrium outputs can be found as

$$q_i = \frac{a + nc_n}{m+n+1}, \qquad i = 1,2,...,m, \tag{3a}$$

$$q_j = \frac{a-(m+1)c_n}{m+n+1}, \qquad j = 1,2,...,n, \; i \neq j. \tag{3b}$$

For all firms to produce positive outputs, we need

$$c_n < \frac{a}{m+1} \equiv \hat{c}_n, \tag{4}$$

which is assumed to hold.

The equilibrium profit of each firm is respectively,

$$\pi_i = \frac{(a+nc_n)^2}{(m+n+1)^2}, \qquad i = 1,2,...,m, \tag{5a}$$

$$\pi_j = \frac{(a-(m+1)c_n)^2}{(m+n+1)^2}, \qquad j = 1,2,...,n, \; i \neq j. \tag{5b}$$

2.2. The case of entry

Let us now introduce entry. We assume that there are k entrants, each with the constant marginal cost $e(\geq c_n)$. Such entry could arise due to either exogenous knowledge spillover, or patent expiry of an old technology of the incumbents.

Recalling Spence (1977) and Dixit (1980), it may then be reasonable to consider the incumbents as dominant firms and the entrants as Stackelberg followers. We examine the following game. At stage 1, the $m+n$ incumbent firms choose their outputs simultaneously. At stage 2, k entrants determine their outputs simultaneously. Then the profits are realized. We solve the game by backward induction.

Given the outputs of the incumbents, the tth entrant maximizes:

$$\underset{q_t}{Max}(a-q-e)q_t, \tag{6}$$

where $q = \sum_1^m q_i + \sum_1^n q_j + \sum_1^k q_t$ and $i \neq j \neq t$. This gives the optimal output of each entrant as

$$q_t = \frac{a - e - \sum_1^m q_i - \sum_1^n q_j}{k+1}, \quad i \neq j \neq t. \tag{7}$$

Then, each of the m incumbent firms maximizes:

$$\underset{q_i}{Max}\left(a - \sum_1^m q_i - \sum_1^n q_j - \frac{k(a - e - \sum_1^m q_i - \sum_1^n q_j)}{k+1}\right)q_i, \tag{8a}$$

where $i = 1,2,...,m$ and $i \neq j \neq t$, and each of the n incumbent firms maximizes:

$$\underset{q_j}{Max}\left(a - \sum_1^m q_i - \sum_1^n q_j - \frac{k(a - e - \sum_1^m q_i - \sum_1^n q_j)}{k+1} - c_n\right)q_j, \tag{8b}$$

where $j = 1,2,...,n$ and $i \neq j \neq t$.

The equilibrium output can be found as

$$q_i = \frac{a + ke + n(k+1)c_n}{m+n+1}, \qquad i = 1,2,...,m, \tag{9a}$$

$$q_j = \frac{a + ke - (k+1)(m+1)c_n}{m+n+1}, \qquad j = 1,2,...,n \text{ and } i \neq j \neq t. \tag{9b}$$

Substituting (9a) and (9b) into (7) to obtain an entrant's equilibrium output

$$q_t = \frac{a - e((k+1)(m+n)+1) + n(k+1)c_n}{m+n+1}, \quad t = 1,2,...,k \text{ and } i \neq j \neq t. \tag{10}$$

We assume that

$$q_t > 0, \text{ i.e., } e < \frac{a + n(k+1)c_n}{(k+1)(m+n)+1} \equiv \bar{e}. \tag{11}$$

Otherwise, entry has no meaning in our analysis. If (11) holds, the outputs of the incumbents are positive since $e \geq c_n \geq 0$ by assumption. Note that, since $e \geq c_n$, we have $\bar{e} \geq c_n$ if $c_n \leq \frac{a}{(k+1)m+1}$. In other words, if $c_n > \frac{a}{(k+1)m+1}$, we obtain $q_t = 0$ for any $e \geq c_n$. Hence, for entry to be meaningful given $e \geq c_n$, we restrict our attention to $c_n < \frac{a}{(k+1)m+1} \equiv \overline{c_n}$.

The equilibrium profit for each of the m and n incumbent firms is respectively

$$\pi_i = \frac{(a + ke + n(k+1)c_n)^2}{(k+1)(m+n+1)^2}, \qquad i = 1,2,...,m, \tag{12a}$$

$$\pi_j = \frac{(a + ke - (k+1)(m+1)c_n)^2}{(k+1)(m+n+1)^2}, \qquad j = 1,2,...,n \text{ and } i \neq j \neq t. \tag{12b}$$

The equilibrium profit of a typical entrant is

$$\pi_t = \frac{(a - e((k+1)(m+n)+1) + n(k+1)c_n)^2}{(k+1)^2(m+n+1)^2}. \tag{13}$$

Proposition 1: *(i) The equilibrium output of each cost efficient incumbent is always higher under entry than under no entry.*

(ii) The equilibrium output of each cost inefficient incumbent is higher under entry than under no entry if $e \in (c_n(m+1), \bar{e})$ *and* $c_n \in [0, \frac{a}{(m+1)((k+1)(m+n)+1) - n(k+1)})$.

Proof: (i) Straightforward from (9a) and (3a).

(ii) We get that (3b) < (9b) if

$$c_n(m+1) < e. \tag{14}$$

Since $e \in [c_n, \bar{e})$, condition (14) holds if $\bar{e} > c_n(m+1)$ or

$$c_n < \frac{a}{(m+1)((k+1)(m+n)+1) - n(k+1)}, \tag{15}$$

where $\frac{a}{(m+1)((k+1)(m+n)+1)-n(k+1)} < \overline{c_n}$. Q.E.D.

Figures 1(a, b) help us to understand Proposition 1.

Figures 1 (a, b)

Given the symmetry within the cost efficient and the cost inefficient incumbents, we draw the reaction functions of a typical cost efficient incumbent, say firm *i*, and a typical cost inefficient incumbent, say firm *j*, under no entry and under entry. *AA* and *BB* represent the reaction functions of firms *i* and *j* under no entry, which are given by $q_i = \frac{a - nq_j}{m+1}$ and $q_j = \frac{a - c_n - mq_i}{n+1}$ respectively. *CC* and *DD* are the reaction functions under entry, and these are given by $q_i = \frac{a + ke - nq_j}{m+1}$ and $q_j = \frac{a + ke - (k+1)c_n - mq_i}{n+1}$ respectively. It is easy to check that the reaction functions of both firms lie outward with entry, which is ensured given our restrictions on c_n and e, leading to $\frac{a+ke}{m+1} < \frac{a-c_n}{m}$.

We find from the reaction functions of firm *i* that, for a given q_j, the increase in q_i under entry compared to no entry is $\Delta q_i(q_j / R_i) = \frac{ke}{m+1}$, where R_i stands for the reaction functions of firm i. The reaction functions of firm j show that to maintain the same amount of q_j under both entry and no entry, we need to increase the amount of q_i by $\Delta q_i(q_j / R_j) = \frac{k(e - c_n)}{m}$, where R_j stands for the reaction functions of firm *j*. It is easy to show that $\Delta q_i(q_j / R_i) \underset{<}{\geq} \Delta q_i(q_j / R_j)$ for

$c_n(m+1) \stackrel{\geq}{<} e$. Hence, for a given q_j, entry shifts firm *i*'s reaction function more (less) than firm *j*'s reaction function if $c_n(m+1) > (<) e$. Therefore, if $c_n(m+1) > e$, entry increases the output of firm *i* but reduces that of firm *j*, which is depicted in Figure 1(a).

On the other hand, if $c_n(m+1) < e$, entry increases the output of firm *j*. But, given the negatively sloped reaction functions, it is not immediate whether the output of firm *i* increases. We can show that for a given q_i, the increase in q_j under entry compared to no entry is higher in reaction function R_i than in R_j, i.e., $\Delta q_j(q_i / R_j) < \Delta q_j(q_i / R_i)$. Hence, entry increases the output of firm *i* even for $c_n(m+1) < e$. Figure 1(b) represents this situation.

Intuitively, entry creates two effects on the output behavior of the incumbents. First, it encourages all the incumbents to increase their outputs in order to steal market shares from the entrants, which is reflected by the outward shifts of the incumbents' reaction functions. Second, since the incumbents compete like Cournot oligopolists, an output change of one incumbent affects the output decision of other incumbents due to strategic interactions, which determines the final equilibrium outputs on the new reaction functions. Since the marginal gains are higher for the cost efficient incumbents than the cost inefficient ones, the incentives for increasing outputs are higher to the former firms than the latter, and we find that entry always increases the outputs of the cost efficient incumbents.

Therefore, there are two opposing effects of entry on the cost inefficient incumbents. On one hand, the Stackelberg leadership effect tends to increase the outputs of all incumbents, but on the other hand, the output expansion of the cost efficient incumbents tends to reduce the outputs of the cost inefficient incumbents. If the costs of the entrants are sufficiently high, which help to strengthen the former effect, and the cost difference between the incumbents is sufficiently small, which helps to weaken the latter effect, entry increases the outputs of the cost inefficient incumbents compared to no entry.

Proposition 2: *(i) Only if* $n > m\sqrt{k+1}-1$, *the profit of each of the* m *incumbents (which are cost efficient) is higher under entry than under no entry for* $c_n > \frac{a(\sqrt{k+1}-1)-k\bar{e}}{n\sqrt{k+1}(\sqrt{k+1}-1)}$ *and* $e > \frac{(\sqrt{k+1}-1)(a-nc_n\sqrt{k+1})}{k} \equiv e^c(c_n)$.

(ii) The profit of each of the n *incumbents (which are cost inefficient) is lower under entry than under no entry.*

Proof: (i) We get that (12a) > (5a) if

$$e > \frac{(\sqrt{k+1}-1)(a-nc_n\sqrt{k+1})}{k} \equiv e^c(c_n)\,. \tag{16}$$

Since $e \in [c_n, \bar{e})$, $c_n \in [0, \frac{a}{(k+1)m+1})$ and $e^c(c_n)$ is negatively related to c_n, the necessary condition for (16) to hold is

$$\bar{e} > e^c(c_n = \frac{a}{(k+1)m+1}),$$

or $\quad (k+1-\sqrt{k+1})(n+1-m\sqrt{k+1}) > 0$,

or $\quad n > m\sqrt{k+1}-1. \qquad (17)$

Therefore, (17) is a necessary condition for (16) to hold, but not sufficient, since $e^c(c_n)$ can be in the feasible range of $e \in [c_n, \bar{e})$ if

$$c_n > \frac{a(\sqrt{k+1}-1)-k\bar{e}}{n\sqrt{k+1}(\sqrt{k+1}-1)}\,. \tag{18}$$

Hence, entry increases the profits of the cost efficient incumbents if (16), (17) and (18) all hold.

If (17) does not hold, we obtain $\bar{e} < e^c (c_n = \frac{a}{(k+1)m+1})$, and the profits of the cost efficient incumbents are always lower under entry than under no entry.

(ii) We have (5b) > (12b) if

$$\frac{(\sqrt{k+1}-1)(a+c_n(m+1)\sqrt{k+1})}{k} > e\,, \tag{19}$$

which holds for any $e \in [c_n, \bar{e})$. Q.E.D.

The intuition for the above result is as follows. While entry creates higher competition, it also induces the cost efficient incumbent firms to increase their outputs compared to no entry. When the number of cost inefficient incumbents relative to the cost inefficient ones and the entrants, the cost difference between the incumbents and the costs of the entrants are all sufficiently large, the output raising effect of entry outweighs the competition effect, resulting in higher profits of the cost efficient incumbents under entry than under no entry.

Figures 2 (a, b) portray the effects of entry on the profits of the cost efficient incumbents.

Figures 2(a, b) here

The lines *EE*, *0F* and *GG* depict the relationship $e = \frac{(\sqrt{k+1}-1)(a-nc_n\sqrt{k+1})}{k}$ (see (16)), $e = c_n$ and $e = \frac{a+nc_n(k+1)}{(k+1)(m+n)+1} (\equiv \bar{e})$ (see (11)). Figure 2(a) is based on $n > m\sqrt{k+1}-1$, and the shaded area in Figure 2(a) satisfies $e > \frac{(\sqrt{k+1}-1)(a-nc_n\sqrt{k+1})}{k}$, $e \geq c_n$ and $e < \bar{e}$. Hence, entry increases the profits of the cost efficient incumbents in the shaded area. Figure 2(b) considers the case of $n < m\sqrt{k+1} - 1$, and shows that $e > \frac{(\sqrt{k+1}-1)(a - nc_n\sqrt{k+1})}{k}$ is not satisfied in $e \in [c_n, \bar{e})$. In this situation, entry always reduces the profits of the incumbents.

However, entry always reduces the profits of the cost inefficient firms, even if their output might rise, because the negative effects of higher competition and output expansion by the cost efficient incumbents always dominate the output effects for the cost inefficient incumbents.

3. Conclusion

It is generally believed that entry of new firms reduces profits of the incumbent firms. We show that this may not be the case if the incumbents differ in marginal costs of production, and the incumbents and the entrants behave like Stackelberg leaders and followers.

We show that when the relative number of cost inefficient incumbents is large enough, the cost efficient incumbents earn higher profits under entry than under no entry if the cost difference between the incumbents and the costs of the entrants are above certain levels. However, the cost inefficient incumbents always earn lower profits under entry than under no entry. While entry always increases the outputs of the cost efficient incumbents, its effect on the outputs of the cost inefficient incumbents is ambiguous.

Though we assume an exogenously given Stackelberg leader-follower structure under entry, as already mentioned, it may arise endogenously if the incumbent firms have the option to pre-commit to their capacity levels (Spence, 1979 and Dixit, 1980). Obviously, the purpose of this paper is to show the effects of entry in the simplest way, rather than explaining the evolution of the Stackelberg structure.

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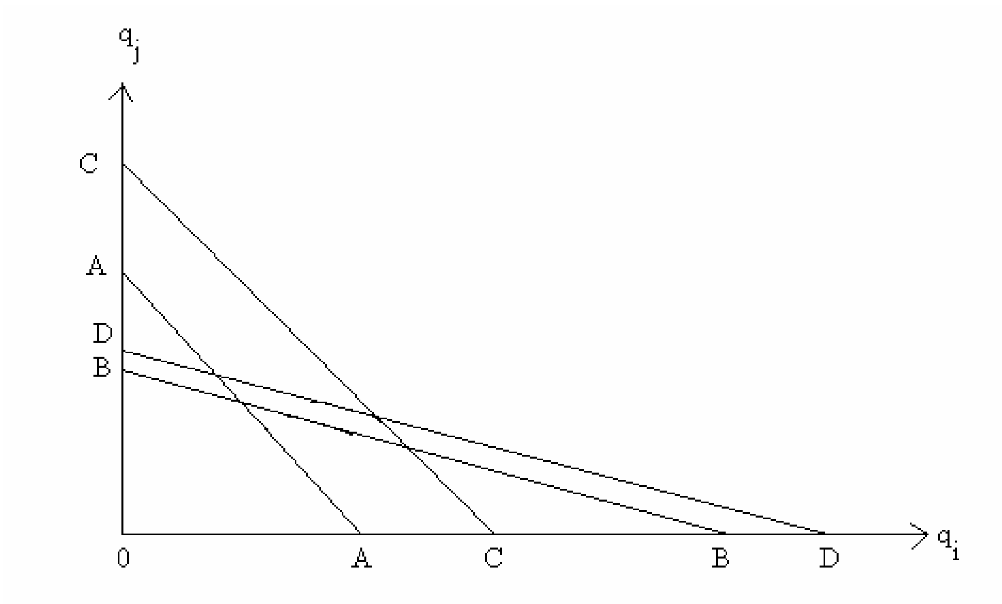

Figure 1(a): Entry increases outputs of the cost efficient incumbents firms

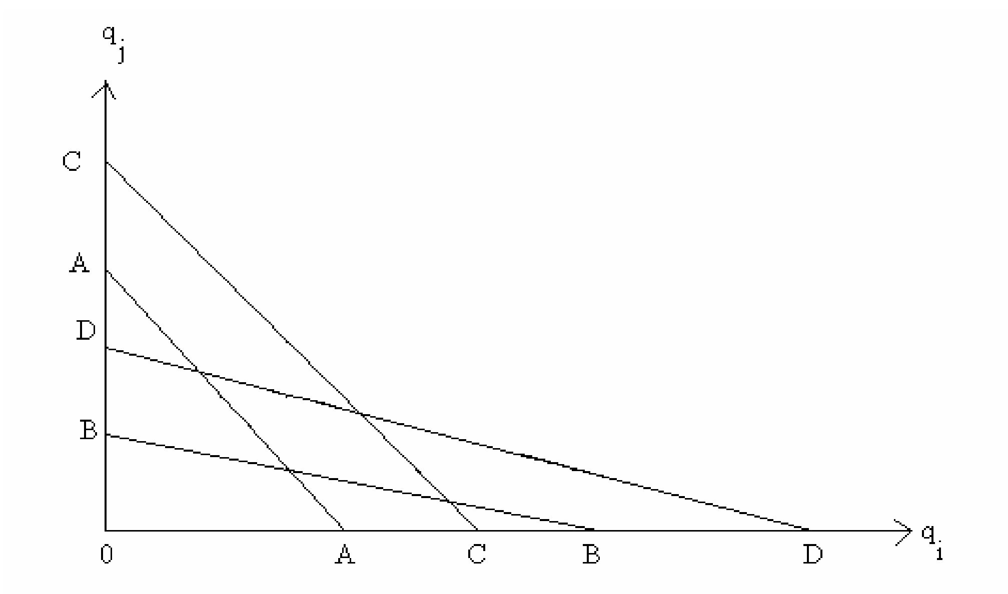

Figure 1(b): Entry increases outputs of all incumbents

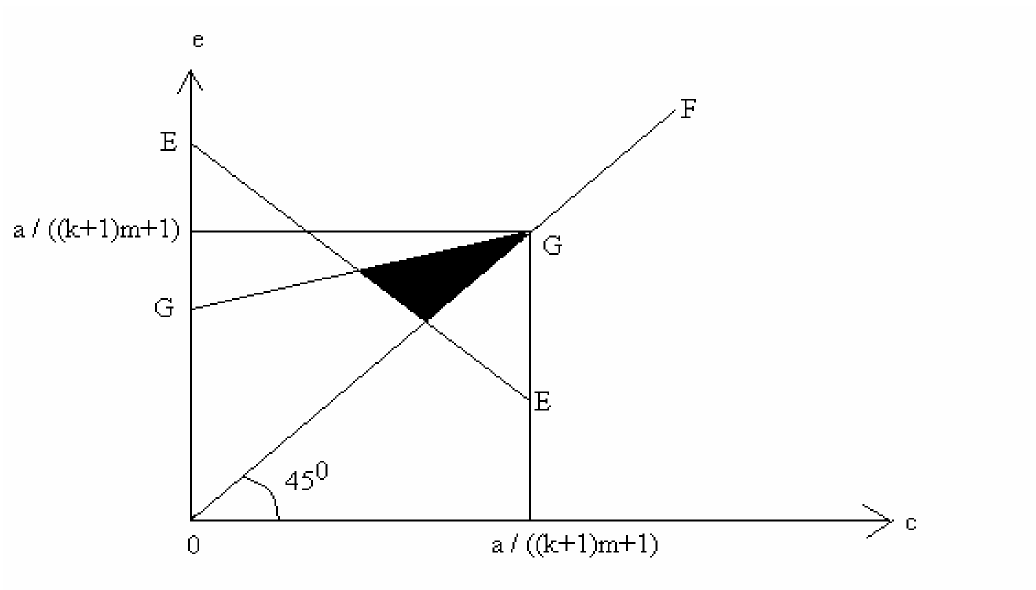

Figure 2(a): Entry increases the profits of the cost efficient incumbents when $n > m\sqrt{k+1} - 1$.

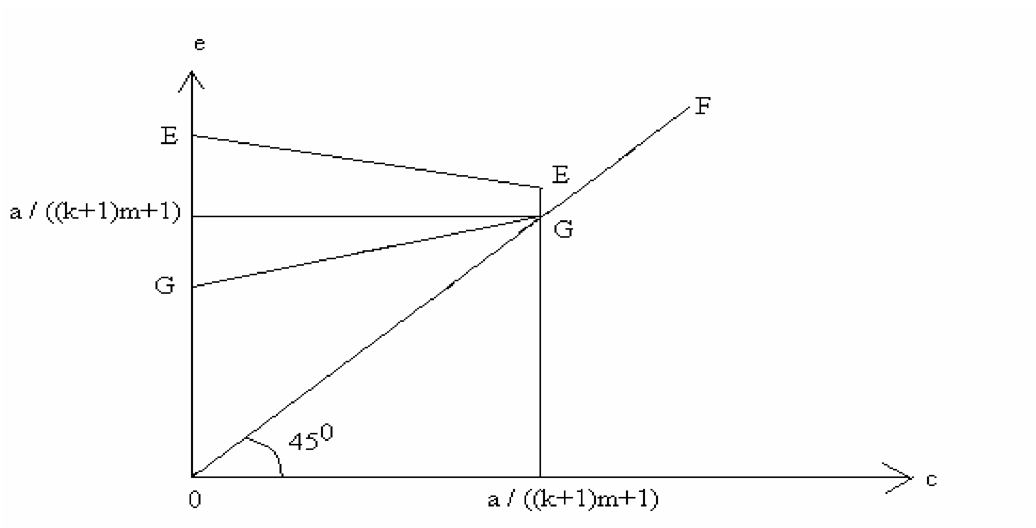

Figure 2(b): Entry always reduces the profits of the incumbents when $n < m\sqrt{k+1} - 1$.

AWPE **DATA SHEET**

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TI: Profit Raising Entry

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