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Abstract

In this paper, unlike the conventional wisdom, we demonstrate that the relationship between the size of the market and number of firms would be non-monotonic. While moderate rise in the size would force the local firms to exit and only the foreign firm rules, substantial rise in the size would accommodate all firms. Also, the possibility of survival increases if the local firms could differentiate their product more and then we drift towards the conventional result.

JEL-Codes: L130, D400, F100.

Keywords: product differentiation, free entry, Cournot, output, market size, technology, FDI.

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1. Introduction and Background

According to the conventional wisdom, with free entry and symmetric cost, as market size increases, while entry cost falls, number of firms, outputs will increase in a free entry equilibrium, making the market more competitive in a Cournot framework. Market size effects could be due to demand shifts, income rise, external demand, etc. while entry cost could be incurred due to some barriers such as, IP law or regulations, environmental compliance, licensing fee, set-up costs, R&D costs, etc. Technology and FDI are affected by these factors including trade policies such as tariff or quota. However, recent research questions this hypothesis of monotonic relationship between market size and number of firms (Dastidar and Marjit (2022)). The outcome depends on the curvature of the demand curve although the conventional results would always hold with the standard linear demand and constant marginal cost setup model. Effects of increase in market size or higher entry cost can be different from conventional wisdom depending on the shape of the demand curve (concavity or convexity) and whether the product is strategic substitutes or strategic complements-see Corchon and Fradera (2002), Amir and Lambson (2000), Bulow et al. (1985), Dastidar (2010), etc.

In this paper we show that the number of firms would decline with increase in market size when there are 'n' number of local firms producing homogeneous goods and a foreign firm producing a differentiated good with lower marginal cost than the local firm. The additional feature of our model is the vital role of a parameter representing an index of product differentiation so that higher value of the parameter means lower degree of differentiation. That determines the cut-off point of the market size to determine the number of local firms vis-à-vis that of the foreign firm, or a combination of both. Role of product differentiation and product market competition on technology in different and unrelated context is discussed in Bagchi and Mukherjee (2014), Chang et al. (2013), Han et al. (2020), Mukherjee (2022), to name a few.

As plethora of studies consider the case of foreign firms or multinationals engaging in FDI and technology transfer, the model offers a perspective on entry of foreign multinational firm with access to technology and superior know-how engaging in FDI via arm's length transaction or foreign subsidiaries, etc. Thus, in keeping with the voluminous literature on technology transfer and foreign investment in the developing and emerging economies, another value-addition of the paper is consideration of the foreign firm with a new technology and engaging in FDI (see Pack and Saggi (1997), Glass and Saggi (2002). Marjit and Beladi (1999) considered the role of R&D-cost and aspect of technology adoption in the context of less-developed economies where superior technology is adopted by firms with medium-level of development or the backward ones. A related by different literature analyzes foreign firm with superior technology seeking entry into a new market in a country via FDI, where sets of local firms sell a similar but differentiated products (see Glass and Saggi (2002), Hwang, Marjit and Peng (2016), Kabiraj and Marjit (2003), Bagchi and Mukherjee (2014), Han, Haque and Mukherjee (2020)). Marjit, Beladi and Kabiraj (2007), Saggi (1999), Klein (2022) have considered technology transfer via FDI or licensing and the role of tariffs on brand products or, patents (IPR) and trade secrets on such modes of entry and transfer of technology. In this context, micro-level evidence of how firms' characteristics (heterogeneity) such as efficiency, productivity, innovativeness, or R&D-intensity skill-contents of laborers, etc. influence international location strategy is discussed-see Alguacil et al. (2022). Han et al. (2022) considers cost-asymmetry between foreign and local firms and discusses the aspects of domestic entry of foreign firms and its pro-competitive effects.

As stated earlier, our query is different. We derive conditions by considering a Cournot model with ‘n’ local firms producing homogeneous goods while a foreign firm with superior technology produces a differentiated good and faces a fixed entry cost that becomes sunk while making decision to enter.

Section 2 develops such model and derives some results with discussion, and Section 3 concludes.

2. Model and Results

We consider symmetric local firms with identical products and a foreign firm producing a good differentiated from them. Consider a Cournot Oligopoly with product differentiation. There are ‘n’ number of symmetric local firms producing a homogeneous good. Also, there is a foreign firm producing a different (heterogeneous) good. They face the following *local* demand functions as below:

$$P = a - q_1 - q_2 - \dots \dots \dots q_n - \theta q^* \qquad (1)$$

$$P^* = a - \theta q_1 - \theta q_2 \dots \dots - \theta q_n - q^* \qquad (2)$$

Here ‘a’ is a parameter representing market size and q’s are outputs of ‘n’ firms in local market. “q*” is output of foreign firm seeking entry locally. $0 < \theta < 1$ denotes the degree of product differentiation. Effectively, there are two goods (one homogeneous types and another is differentiated one).

For local firms, the technology is defined as a constant marginal cost (MC) denoted by ‘α’, whereas for the foreign it is ‘β’ with $0<\beta<\alpha$.

However, it faces a fixed cost (F). This can also be an entry cost into the local market such as the per period discounted cost of foreign direct investment (FDI) to be covered by the gross profit. Local firms have no fixed cost to be incurred.

We first look at the Cournot Equilibrium of the game, noting that all local firms are the same. First-order-condition of profit-maximization would imply for the local firm:

$$\frac{\partial \pi_i}{\partial q_i} = 0 \Rightarrow a - 2q_i - \sum_{j \neq i} q_j - \theta q^* = \alpha \qquad (3)$$

Symmetry would imply $q_i = q \forall i$. Thus, (3) boils down to

$$(n+1)q + \theta q^* = a - \alpha \qquad (4)$$

Similarly, $\frac{\partial \pi^*}{\partial q^*} = 0 \Rightarrow a - \theta n q - 2q^* = \beta$. This yields,

$$\theta n q + 2q^* = a - \beta \qquad (5)$$

Solving (4) and (5), $q = \frac{2(a-\alpha) - \theta(a-\beta)}{\Delta}$, where $\Delta = 2(n+1) - n\theta^2 > 0$ as $0 < \theta < 1$

Rearranging terms, $q = \frac{(2-\theta)a - 2\alpha + \theta\beta}{\Delta}$ (6)

From (6), numerator <0, $q \leq 0 \Rightarrow$

$$\alpha > a - \frac{\theta}{2}(a-\beta) \quad (7)$$

We are interested specifically in two net payoffs, π^* when the local firms cease to exist and π when foreign firm does not enter.

If only local firms are there, $q^* = 0 \Rightarrow (n+1)q = a - \alpha \Rightarrow q = \frac{a-\alpha}{(n+1)}$, so that for each of the n-firms

$$\pi = \left(\frac{a-\alpha}{n+1}\right)^2 .$$

Therefore, local firms will operate when there is no foreign firm i.e., $q \geq 0,\ \alpha < a - \frac{\theta}{2}(a-\beta)$. (i.e., when $a > \alpha + e > \alpha$)

But if the foreign firm enters, the local firms cannot stay in the market. This is captured by (8).

$$a > \alpha > a - \frac{\theta}{2}(a-\beta) \quad (8)$$

Or $\alpha < a < \alpha + e$ where $e = \frac{\theta}{2}(a-\beta)$, 0<β<α (9)

When local firms are not there, from (5), $q = 0 \Rightarrow 2q^* = a - \beta$.

Therefore, $\pi^* = \frac{(a-\beta)^2}{4} - F$ yielding

$$\pi^* = \frac{(a-\beta)^2}{4} \text{ and for entry, } (\pi^* - F) > 0 \text{ iff } a > 2\sqrt{F} + \beta \quad (10)$$

To start with n local firms operate i.e. (8) holds and the foreign firm does not enter, (9) holds. As foreign firms enter, 'n' declines when (10) holds. To prove the case for a decline in number of firms (n) with an increase in market size ("a"), we focus on the case that

$$a < [\alpha + \frac{\theta}{2}(a-\beta)] = \alpha + e \quad (9a)$$

Condition (9a) states that if foreign firm decides to enter, the local firms do not survive if "a" satisfies (9a).

Rewriting (9a), with algebraic manipulation, $a < [\frac{2\alpha - \theta\beta}{2-\theta}]$ (11)

We now proceed to increase the size of " a " monotonically and explore the number of firms (*"n"*) that can operate in the market. Following proposition is immediate.

Proposition:

(i) If $\alpha < a < 2\sqrt{F} + \beta$ only 'n' local firms operate.

(ii) If $\alpha + e > a > 2\sqrt{F} + \beta$ only foreign firms will operate.

(iii) If $a > \alpha + e$, all firms operate.

Proof: For case (i), foreign firm cannot operate because of high F, even if $\beta < \alpha$ and for $a > \alpha$ only local firms can operate. If " a " increases to exceed $2\sqrt{F} + \beta$ but still lies below $\alpha + e$, only foreign firm is there and (iii) implies that for quite large " a ", all firms are there. (QED).

Initially when the market size is very small no firm finds it viable to operate. As market size expands but still is not too large to accommodate the foreign firm because "F" is high ($F > \pi^*$) but high enough to tolerate the MC of the local firm, n local forms would be there. As soon as the market size is good enough to accommodate the foreign firm with a far superior technology (*F<β<α<a,* $F < \pi^*$), n firms exit the market, and the number of firms falls from n to 1 (i.e., only the foreign firm with better technology and low fixed entry cost). Then for a substantially bigger market size all firms can coexist (if $a > \frac{2\alpha - \theta\beta}{2-\theta}$).

Pivotal role is played by $"e"$ via $"\theta"$ (see Equation 9). If $"\theta"$ is higher i.e., the degree of product differentiation is less, the cut off market size which can accommodate local firms has to be higher. Therefore, differentiating the product from the foreign entrant makes it easier for the local firms to compete with the foreign firm. Hence, the possibility of a drop in number of firms becomes less. Hence, in a more differentiated market number of firms and market size may go hand in hand.

Our example can easily work with a more general demand function since the results depend only on the interplay between fixed cost ("F") of the entrant and the marginal cost of both type of firms ($\beta < \alpha$). Any standard reduced from profit function would preserve the basic non-monotonicity relationship between market size and number of firms. Only a shift parameter in the demand function would do. The fact that a moderate market size cannot accommodate the less efficient local firms along with the foreign firm would continue to hold. That for very small and very large markets the outcome would be symmetric such that no firm and all firms would be there, is straight forward.

One can also show that from consumers' perspective having only the entrant with a better technology is more lucrative as price would drop even if 'n' firms exit the market. This happens because the marginal cost of the exiting firms must be greater than the monopoly price charged by the entrant.

3. Conclusion

Recent literature questions the hypothesis that larger market always accommodates greater number of firms and hence makes the market more competitive in a Cournot framework. However, the outcome depends on the curvature of the demand curve and in the standard linear demand constant marginal cost models the conventional result would always hold. Our contribution is to show that larger market size might reduce number of firms even in the simple linear structure. Although our result does not necessarily depend on product differentiation, we add that feature to the model to focus on the degree of product differentiation as an interesting causal element.

Another contribution of the paper is to place the model with a realistic perspective where appealing to the literature on foreign firm contemplating to enter a new market in a country with a superior technology via FDI where there is a set of local firms selling a similar but differentiated product. This relates our paper to the voluminous literature on technology transfer and foreign investment in developing countries. We demonstrate that here the relationship between the size of the market and number of firms would be non-monotonic. While moderate rise in the size would force the local firms to exit and only the foreign firm rules, substantial rise in the size would accommodate all firms. Also the possibility of survival increases if the local firms could differentiate their product more and then we drift towards the conventional result.

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