

Advertising and Entry Deterrence: How the Size of the Market Matters

Khaled Bennour*

Institut des Hautes Etudes Commerciales, University 7 Novembre, Tunisia

Abstract

We analyze the relationship between market size and entry when an incumbent and a potential entrant compete to gain market share and advertising is the only strategic variable. Entry occurs when the relative effectiveness of incumbent's advertising is smaller than a threshold level that depends on the size of the market. This threshold level is monotonically and positively related to market size. Consequently, equilibrium with entry is more likely the greater is the size of the market.

Key words: advertising; entry; market size

JEL classification: D43

1. Introduction

In many cases, competition between firms takes the form of a contest, where firms choose their prices and advertising levels in order to gain market share. In this paper, we consider a standard entry model. Assume that one firm, the incumbent, irreversibly precommits to a certain strategy before a potential entrant considers entry. Firms compete to gain market share, and advertising is the only strategic variable. Schmalensee (1974), who questions whether the presence of a dynamic effect of advertising may lead to a barrier to entry, shows that the incumbent needs to have an advantage for the advertising to deter entry. However, the equilibrium achieved, with or without entry, does not depend on the size of the market. We show that this result is due to the linearity of the advertising cost function. With a more general nonlinear advertising cost, the market size does matter.

We exclude price as a decision variable. This assumption can be justified in many markets where there is little price competition. In the pharmaceutical industries, for example, brands use advertising rather than price to influence the post-patent competition and then the entry decision of generic firms (Hellerstein, 1998; Scott Morton, 2000).

Received February 7, 2007, revised November 21, 2007, accepted January 21, 2008.

*Correspondence to: Institut des Hautes Etudes Commerciales, Carthage Présidence 20016 Tunis, Tunisia.
E-mail: khaled.bennour@ihec.rnu.tn. I would like to thank Khairredine Jebbsi, a referee, and a Board Member of this journal for helpful comments.

The remainder of the paper is organized as follows. In Section 2, we specify the model and notation. Section 3 derives the Stackelberg equilibrium and its properties. Section 4 presents a comparative statics analysis. Section 5 concludes.

2. The Model

Consider an incumbent firm X and a rival Y who considers the possibility of entering into the incumbent's market. Let x and y denote the advertising spending of the incumbent and the entrant, respectively. These quantities measure the number of ads that firms send to consumers. The size V of the market is fixed. We assume that firms have constant marginal production costs equal to c and no fixed costs and that the price is regulated at the level $p > c$. Let $m = p - c$ denote the profit margin. The incumbent makes its advertising decision x and then the potential entrant chooses its advertising effort y under full knowledge of x . Let $c_x(\cdot)$ be the advertising cost of firm X . We assume that c_x is convex and strictly increasing with $c'_x(0) > 0$. The advertising cost of firm Y is described by the convex and strictly increasing function $c_y(\cdot)$ with $c_y(0) = 0$, $c'_y(0) > 0$, $c''_y(y) \geq 0$, and $c'''_y(y) \leq 0$.

We also assume that the market share S of firm X has the following form:

$$S = \left(1 + \frac{y}{\theta x}\right)^{-1}, \quad (1)$$

where θ is a positive parameter that indicates the effectiveness of the incumbent's advertising relative to that of the entrant. This implies that, even if two firms expend the same amount of advertising effort, they may not have the same market share. If the incumbent's advertising effort is twice as effective as that of its competitor (i.e., if $\theta = 2$) and the two firms choose the same advertising spending, then the incumbent will achieve a market share twice as large as the entrant's share.

The relationship given in (1) has been employed in a number of fields, including the economics of advertising (Schmalensee, 1972), rent-seeking (Nitzan, 1994), and the economics of conflict (Hirshleifer, 1995). A large empirical and theoretical literature, published in marketing journals (Cooper and Nakanishi, 1988), has also adopted this relationship, which is referred to as a market share attraction form. The market share received by the incumbent, S , is increasing in its effort x and is decreasing in the effort of its competitor, y , as it obviously should.

The optimization problem for firm X is:

$$\max \{\pi_x\} = \max \{SmV - c_x(x)\}, \quad x \geq 0, \quad (2)$$

and the problem for firm Y is:

$$\max \{\pi_y\} = \max \{(1 - S)mV - c_y(y)\}, \quad y \geq 0. \quad (3)$$

3. Equilibrium

To analyze the allocation of the advertising spending in this scenario, we begin by considering the second-stage choice of firm Y . At this second stage, firm Y takes x as given and chooses the solution y to the program (3). We are interested in deriving the conditions under which Y chooses not to enter, that is, when $y = 0$.

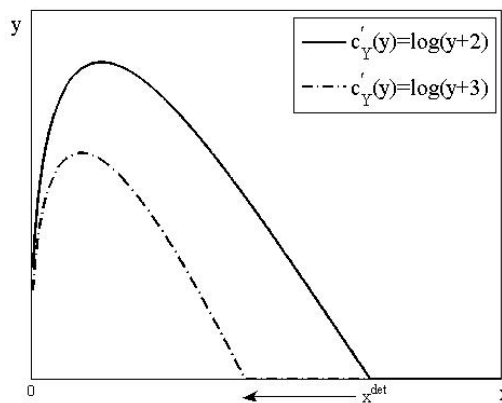
Since π_y is strictly concave in the strategy y , the maximizer is unique. The solution is given in the following proposition.

Proposition 1: Let $x^{\text{det}} = mV/\theta c'_y(0)$. Given the advertising spending x of the incumbent, the potential entrant's optimal reaction y is null for $x \geq x^{\text{det}}$ and strictly positive for $0 < x < x^{\text{det}}$ with x and y satisfying:

$$\theta mVx = (\theta x + y)^2 c'_y(y). \tag{4}$$

In (4), x^{det} is the minimum spending of firm X to advertising necessary to prevent entry. x^{det} depends positively on the size V of the market and the profit margin m and depends negatively on the relative effectiveness θ of the incumbent's advertising. The threshold x^{det} depends negatively on the value of $c'_y(0)$, which approximates the entrant's average cost of small levels of advertising spending. Figure 1 depicts the best-reply y of the potential entrant to the advertising spending of the incumbent, x , for two different marginal cost functions $c'_y(\cdot)$. For $x < x^{\text{det}}$, there is an inverted-U shaped relationship between y and x . Otherwise, y equals 0.

Figure 1. The Best-Reply Function of Y



When entry is allowed and the incumbent choice is fixed, there is a positive relationship between the advertising spending of the entrant and the attractiveness of the market, measured by mV , but the effect of an increase in the relative

effectiveness of the incumbent's advertising on the advertising spending of the entrant is ambiguous.

We consider now the choice of the first stage of the incumbent. At this first stage, the incumbent chooses its advertising spending x to solve program (2). When choosing x , the incumbent firm takes into account the reaction of the potential entrant.

If $x \geq x^{\text{det}}$, then $y = 0$ and $S = 1$. Equation (2) implies that the profit of the incumbent, for $x \geq x^{\text{det}}$, is a decreasing function of x . Consequently, the optimal choice of the incumbent is obtained at x not greater than x^{det} .

We begin by showing that the constraint $x \geq 0$ is not binding. Proofs are provided in the Appendix.

Lemma 1: When $x \rightarrow 0$ then $y \rightarrow 0$ and $y/x \rightarrow +\infty$.

Lemma 2: When $x \rightarrow 0$, then $d\pi_x/dx \rightarrow +\infty$.

It follows from Lemma 2 that the incumbent's optimal advertising spending is positive. We show next that the type of equilibrium, with or without entry, depends on the sign of the (left-hand) derivative of π_x at $x = x^{\text{det}}$.

Consider first the case in which the (left-hand) derivative $d\pi_x/dx$ is negative for $x = x^{\text{det}}$. The profit function of the incumbent has an interior maximum at a value of x that satisfies:

$$\left(\frac{\partial S}{\partial x} + \frac{dy}{dx} \frac{\partial S}{\partial Y} \right) mV = c'_x(x) \quad \text{with } 0 < x < x^{\text{det}}. \quad (5)$$

The first term on the left-hand side of (5) captures the direct effect of greater advertising effort x by the incumbent on its profit. The second term represents the strategic effect of x on the choice of the potential entrant. In this case, the incumbent maximizes its profit by choosing its advertising spending such that the marginal revenue equals the marginal cost. Given that this advertising level is smaller than x^{det} , the entry is allowed.

Consider now the case in which the (left-hand) derivative $d\pi_x/dx$ is not negative at $x = x^{\text{det}}$. We need the following lemma.

Lemma 3: The marginal revenue of the incumbent for all x such that $0 < x < x^{\text{det}}$ is greater than its marginal revenue at $x = x^{\text{det}}$.

Let $R = \partial S/\partial x + (dy/dx)(\partial S/\partial Y)$. By Lemma 3 we find that $R(x)mV > R(x^{\text{det}})mV \geq c'_x(x^{\text{det}}) \geq c'_x(x)$ for all $0 < x < x^{\text{det}}$. Hence, $d\pi_x/dx$ is positive for $0 < x < x^{\text{det}}$ and the profit function of the incumbent is strictly increasing. Consequently, the incumbent chooses an advertising spending equal to x^{det} and entry is prevented. We summarize this as follows.

Lemma 4: The type of equilibrium, with or without entry, depends on the sign of the (left-hand) derivative of π_x at $x = x^{\text{det}}$. Entry is prevented if and only if this derivative is not negative.

4. Comparative Statics

Depending on the parameters θ and V , the incumbent may or may not seek to deter entry. If the relative effectiveness of the incumbent’s advertising, θ , is less than or equal to a critical level, then entry will be allowed for all values of the market size. Otherwise, the incumbent finds it profitable to deter entry provided that the market size is not large.

We show easily that the (left-hand) derivative of π_x at $x = x^{\text{det}}$ is given by:

$$\frac{d}{dx} \pi_x \Big|_{x=x^{\text{det}}} = \frac{\theta c'_y(0)}{2 + mV c''_y(0)/[c'_y(0)]^2} - c'_x \left(\frac{mV}{\theta c'_y(0)} \right). \tag{6}$$

Let’s consider the special case in which $c_x(x) = x$ and $c_y(y) = y$. In this case, an explicit solution for (4) and a well-behaved reduced-form profit function are obtained. Equation (6) becomes:

$$\frac{d}{dx} \pi_x \Big|_{x=x^{\text{det}}} = \frac{\theta}{2} - 1,$$

and we obtain the result derived by Schmalensee (1974), which we state as a proposition.

Proposition 2: When marginal advertising costs are constant, with $c'_x = c'_y = 1$, the type of equilibrium does not depend on the market size. Furthermore, entry is prevented only when the incumbent has an advantage in terms of the effectiveness of its advertising, with $\theta \geq 2$.

When considering changing its advertising spending, the incumbent compares its marginal revenue with its constant marginal cost. One can show easily that the marginal revenue, for $0 < x < x^{\text{det}}$, is positive and decreasing. The equilibrium does not depend on the market size since marginal revenue at $x = x^{\text{det}}$ depends only on the relative effectiveness θ of the incumbent’s advertising.

In contrast, when advertising costs are nonlinear, the market size does matter. Figures 2, 3, and 4 illustrate the following results.

Proposition 3: For a given value of θ , there are two cases: (i) if $\theta \leq 2c'_x(0)/c'_y(0)$, then entry is allowed for all values of V and (2) if $\theta > 2c'_x(0)/c'_y(0)$, there exists a threshold level V^* such that entry is prevented when the market size V is not larger than V^* and entry is allowed when V is larger than V^* . Furthermore, θ and V^* are monotonically and positively related.

Proposition 4: For a given value V , there exists a threshold level θ^* such that for θ not smaller than θ^* entry is prevented and for θ smaller than θ^* entry is allowed. Furthermore, V and θ^* are monotonically and positively related.

Proposition 4 shows that a larger market size implies a higher probability of the entry accommodating equilibrium. The intuition is as follows. When the market size is high, strong incentives exist for the potential entrant to advertise in order to gain market share. It follows that the incumbent needs to spend heavily on advertising to deter the entry of its competitor. But in this situation, since the advertising exhibits increasing marginal cost, marginal revenue will be smaller than the marginal cost. Consequently, the incumbent prefers to moderate its spending in advertising and thus entry occurs.

Figure 2. Entry or No Entry

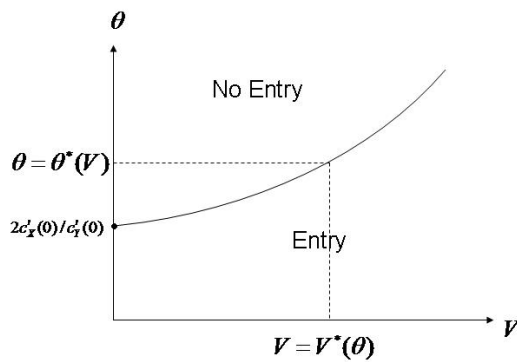


Figure 3. θ^* Increases as V Increases

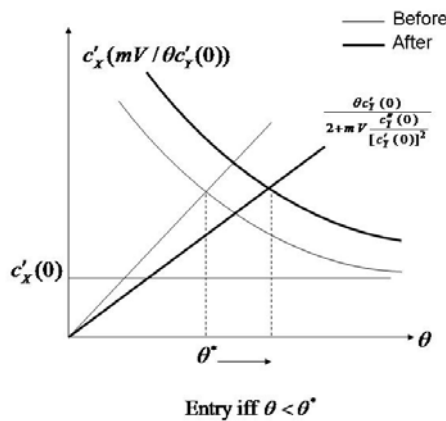
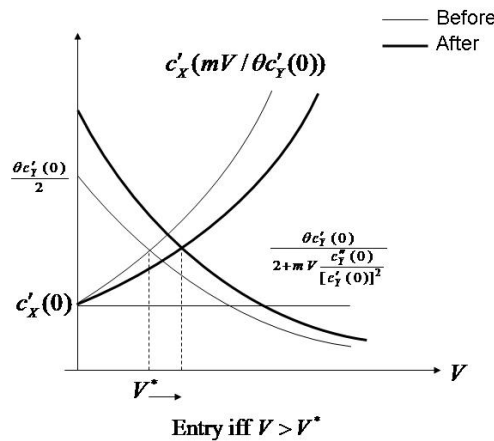


Figure 4. V^* Increases as θ Increases



Considering more general specifications for advertising costs yields another striking result which contrasts with the result obtained in Proposition 2. The incumbent may have an incentive to deter entry even though it does not have an advantage in terms of the effectiveness of its advertising. For example, the entry deterring equilibrium may hold for θ not larger than one. In this case, $2c'_x(0)/c'_y(0)$ is smaller than θ and the market size is small enough (i.e., $V < V^*$); see Figure 2.

5. Conclusion

We show that market size matters when analyzing a Stackelberg model in which an incumbent and a potential entrant compete to gain market share and advertising is the only strategic variable. Ellison and Ellison (2000) report evidence that drugs with higher revenues are most likely to attract generic entry. Scott Morton (2000) analyzes the US pharmaceutical industry and questions whether pre-expiration brand advertising deters generic entry. She shows that market attractiveness, measured by pre-expiration brand revenue, is the most important factor determining the number of entrants.

Appendix

Proof of Lemma 1: Equation (4) yields $\theta mVx \geq y^2 c'_y(y) \geq y^2 c'_y(0)$. Then $0 < y^2 \leq \theta mVx / c'_y(0)$. It follows that $y \rightarrow 0$ for $x \rightarrow 0$. Also, from (4) $y / \theta x = \sqrt{mV / (\theta x c'_y(y))} - 1$. Since $x c'_y(y) \rightarrow 0$ for $x \rightarrow 0$, $y/x \rightarrow +\infty$ for $x \rightarrow 0$.

Proof of Lemma 2: Using (4) and by applying the envelope theorem, we obtain the derivative dy/dx and obtain:

$$\begin{aligned}
R &= \frac{\theta y}{(\theta x + y)^2} - \frac{c'_y(y)}{mV} \frac{\theta mV - 2\theta(\theta x + y)c'_y(y)}{2(\theta x + y)c'_y(y) + (\theta x + y)^2 c''_y(y)} \\
&= \frac{y}{x} \frac{c'_y(y)}{mV} - \frac{c'_y(y)}{mV} \frac{mV(\theta x + y) - 2\theta mVx}{2mVx + mVx(\theta x + y)c''_y(y)/c'_y(y)} \\
&= \frac{y}{x} \frac{c'_y(y)}{mV} - \frac{c'_y(y)}{mV} \frac{mV(y/x - \theta)}{2mV + mV(\theta x + y)c''_y(y)/c'_y(y)}.
\end{aligned}$$

Hence, $R = A + B$, with $A = (y/x)[c'_y(y)/mV]\{1 - [1/2 + (\theta x + y)c''_y(y)/c'_y(y)]\}$ and $B = [c'_y(y)/mV][\theta/2 + (\theta x + y)c''_y(y)/c'_y(y)]$. By Lemma 1, we find that $B \rightarrow \theta c'_y(0)/2mV$ and $A \rightarrow +\infty$ as $x \rightarrow 0$.

Proof of Lemma 3: For $x = x^{\det}$, $A = 0$ and $B = [c'_y(0)/mV]|\theta/2 + \theta x^{\det} c''_y(0)/c'_y(0)|$. For $0 < x < x^{\det}$, $A > 0$. We then need to show that:

$$\frac{c'_y(y)}{mV} \frac{\theta}{2 + (\theta x + y)c''_y(y)/c'_y(y)} \geq \frac{c'_y(0)}{mV} \frac{\theta}{2 + \theta x^{\det} c''_y(0)/c'_y(0)}.$$

Since $c'_y(y) \geq c'_y(0)$ and $c''_y(y) \leq c''_y(0)$, we need to show that $(\theta x + y) \leq \theta x^{\det}$ for every (x, y) satisfying (4). But (4) yields $\theta mVx = (\theta x + y)^2 c'_y(y)$. Consequently, for every x such that $0 < x < x^{\det}$ we have:

$$(\theta x + y)^2 c'_y(y) \leq \theta mVx^{\det} = \theta^2 (x^{\det})^2 c'_y(0) \leq \theta^2 (x^{\det})^2 c'_y(y).$$

References

- Cooper, L. G. and M. Nakanishi, (1988), *Market-Share Analysis*, Boston: Kluwer.
- Ellison, G. and S. F. Ellison, (2000), "Strategic Entry Deterrence and the Behavior of Pharmaceutical Incumbents Prior to Patent Expiration," *MIT Working Paper*.
- Hellerstein, J., (1998), "The Importance of the Physician in the Generic versus Trade-Name Prescription Decision," *The Rand Journal of Economics*, 29, 108-136.
- Hirshleifer, J., (1995), "Anarchy and Its Breakdown," *Journal of Political Economy*, 103, 26-52.
- Nitzan, S., (1994), "Modeling Rent-Seeking Contests," *European Journal of Political Economy*, 10, 41-60.
- Schmalensee, R., (1972), *The Economics of Advertising*, Amsterdam: North Holland.
- Schmalensee, R., (1974), "Brand Loyalty and Barriers to Entry," *Southern Economic Journal*, 40, 579-588.
- Scott Morton, F. M., (2000), "Barriers to Entry, Brand Advertising, and Generic Entry in the U. S. Pharmaceutical Industry," *International Journal of Industrial Organization*, 18, 1085-1104.