“Price-increasing entries in markets with switching costs”

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Price-increasing entries in markets with switching costs

Abstract

While several recent papers have demonstrated that product differentiation can lead to a price-increasing entry, this paper demonstrates that switching costs provide an alternative mechanism through which an entry can increase prices. When switching costs are small, entry occurs and the incumbent's price increases upon entry while the entrant's price may be higher or lower than the initial price of the incumbent. When switching costs are large, entry is blockaded by the incumbent.

Keywords: pricing, entry, switching costs.
JEL Classification: L11.

Introduction

While most conventional oligopoly models would predict that entries will drive market prices down, a number of empirical papers have presented counterfactual evidences that the market price may actually increase with entries in various industries[1]. This has motivated a few recent papers including Perloff et al. (2005) and Chen and Riordan (2006) to provide a theoretical explanation as to how more competition can lead to a higher market price through product differentiation.

In this paper, we provide an alternative mechanism through which an entry can increase prices by looking into models with switching costs where consumers incur some inconvenience costs whenever they change their consumption of products. We demonstrate that the competitive equilibrium price actually increases after a new entry in such markets. This is because the incumbent chooses to charge a higher price to its locked-in consumers rather than to engage in a price competition with the entrant.

As simple as our model is, the result is widely applicable with strong intuition. In a pharmaceutical setting, for example, our model explains that prices of brand-name drugs may increase upon entries of generic pharmaceuticals if the brand-name drug companies find it better to take advantage of its locked-in consumers who are already familiar with usages of their drugs. Note that our explanation differs from the price-discrimination story of Caves et al. (1991) in that we model products to be differentiated and that the extent of brand-consciousness can be explicitly modeled through switching costs. Our model also differs from that of Perloff et al. (2006). While their model predicts that prices are higher upon entry for all firms (i.e., Bertrand price may be above the monopoly price), our model predicts that, while the incumbent's price increases, the entrant's price may be below the original monopoly price and that the gap between the entrant's and the incumbent's prices are larger as the size of the switching costs increases. This is consistent with several empirical observations that brand-name drug prices increase while generic drug prices decrease upon entry of generic drugs[2].

The model is presented in the following section and the equilibrium is specified in Section 2. The last section provides conclusion.

1. The model

We consider a two-period Hotelling model, in which consumers are located uniformly on a unit length. Assume that a monopoly incumbent is located at 0 in period 0 and that an entrant enters at location 1 in period 1[3]. Let p_0 denote the price of the incumbent firm in period 0 and let p^I and p^E denote prices that are simultaneously chosen by the incumbent and the entrant, respectively, in period 1.

Consumers drive a utility $U = b\text{-}S\text{-}dD\text{-}p$, where b is the reservation utility, D is the distance between the consumer and the firm, p is the price paid by the consumer and b, d are both fixed parameters. The switching cost S is incurred in period 1 if the consumer consumes a different product than he did in period 0. We assume that $b/2 < d < b$, so that one firm would not cover the entire market but two firms would.

2. Equilibrium

We solve the model backwards to find subgame-perfect equilibrium. Let x_0 denote the period-0 demand for the incumbent's product. Then there are three discrete cases to consider for period-1 demand due to switching costs. The first case is when the

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[1] See Bresnahan and Reiss (1990), Bresnahan and Reiss (1991), Ward et al. (2002), Perfloff et al. (2005), Goolsbee and Syverson (2006) and Thomadsen (2006).

[2] See Frank and Salkever (1992) and Jones et al. (2001).

[3] We fix the locations of firms because the focus of the paper is on the effect of entries on market prices and not on the optimal locations of firms. One may interpret this assumption as normalizing the degree of differentiation between the two firms to 1.

incumbent's price compared to that of the entrant's is low enough to capture all its previous consumers and possibly more. That is, when $p^I < d - 2dx_0 + p^E$, the indifferent consumer x is located to the right of x_0 and does not incur switching costs:

$$b - dx - p^I = b - d(1-x) - p^E, \quad (1)$$

$$\therefore x = (d + p^E - p^I)/2d. \quad (2)$$

The second case is when the incumbent's price is too high to capture all its previous consumers, $p^I > d - 2dx_0 + S + p^E$. The indifferent consumer in this case is located to the left of x_0 and is indifferent between:

$$b - dx - p^I = b - S - d(1-x) - p^E, \quad (3)$$

$$\therefore x = (d + S + p^E - p^I)/2d. \quad (4)$$

Lastly, for $d - 2dx_0 + p^E < p^I < d - 2dx_0 + S + p^E$, only those consumers who are locked in will purchase from the incumbent and the demand is $x = x_0$. To summarize, demands for the incumbent and the entrant are:

$$D^I(p^I, p^E, x_0) = \begin{cases} (d + p^E - p^I)/2d, & p^I < d - 2dx_0 + p^E \\ (d + S + p^E - p^I)/2d, & p^I > d - 2dx_0 + S + p^E \\ x_0, & otherwise, \end{cases} \quad (5)$$

$$D^E(p^E, p^I, x_0) = \begin{cases} (d - p^E + p^I)/2d, & p^E > 2dx_0 - d + p^I \\ (d - S - p^E + p^I)/2d, & p^E < 2dx_0 - d - S + p^I \\ 1 - x_0, & otherwise. \end{cases} \quad (6)$$

Given the demands, we can solve for best response functions. The incumbent's second-period profit is:

$$\Pi^I(p^I; p^E, x_0) = D^I(p^I; p^E, x_0)\, p^I. \quad (7)$$

Solving the first-order conditions for each case of $D^I(p^I; p^E, x_0)$, we get:[1]

$$p^I(p^E) = \begin{cases} (d + p^E)/2, & p^E > 4dx_0 - d \\ (d + S + p^E/2, & p^E < 4dx_0 - d - S \\ 2dx_0, & otherwise. \end{cases} \quad (8)$$

The entrant's best response functions are found similarly:

$$p^E(p^I) = \begin{cases} (d + p^I)/2, & p^I < 3d - 4dx_0 \\ (d - S + p^I)/2, & p^I > 3d - 4dx_0 + S \\ 2d - 2dx_0, & otherwise. \end{cases} \quad (9)$$

Graphical demonstrations of the best response functions are represented in Figures 1 and 2 (See Appendix). Both best response functions are weakly upward-sloping since prices are strategic complements. But there are ranges of opponent's price levels over which the best response functions are straight, reflecting the existence of switching costs. Intuitively, a firm does not have incentives to decrease its price over some price ranges of the opposing firm since a portion of consumers are locked in and will not respond to the lower prices of the opponent. As can be seen in the graphs, the larger the magnitude of switching costs is, the wider are the straight regions. Additionally, since the incumbent's best response is flatter than that of the entrant's, we have a stable equilibrium.

The second period equilibria are provided in the following proposition:

Proposition 1: Given the best response functions, there are three possible equilibria, one for each different ranges of x_0:

$$(p^{I*}, p^{E*}) = \begin{cases} (d + S/3, dS/3), & x_0 > 1/2 + S/6d \\ (2dx_0, 2d - 2dx_0), & 1/2 < x_0 \le 1/2 + S/6d \\ (d, d), & x_0 \le 1/2. \end{cases} \quad (10)$$

Proof: The ranges of x_0 in the proposition come from recognizing that the vertical portion in Figure 2, where $p^E = 2d - 2dx_0$, can be in three different regions in Figure 1 ($p^E < 4dx_0 - d - S$, $4dx_0 - d - S \le p^E < 4dx_0 - d$, and $4dx_0 - d \le p^E$). When $4dx_0 - d \le 2d - 2dx_0$, $x_0 \le 1/2$ holds and since $3d - 4dx_0 > 2dx_0$, the two best responses cross where $p^I(p^E) = (d + p^E)/2$ and $p^E(p^I) = (d + p^I)/2$. This results in the equilib-

rium (p^{I*}, p^{E*}) = (d, d). Equilibria in other segments are analyzed in the same manner.

Q.E.D.

Note that (p^{I*}, p^{E*}) = (d, d) is the symmetric equilibrium in the case without switching costs. For the other two cases, dependent on the period-0 demand (i.e., the number of locked-in consumers) and the magnitude of switching cost, the incumbent firm charges a strictly higher price than the entrant, taking advantage of its locked-in consumers. Thus, equation (10) demonstrates that the incumbent can influence the period-1 equilibrium through different choices of x_0 which, in turn, is determined by p_0. Additionally, from Figures 1 and 2, one can see that larger x_0 (in other words, lower p_0) pushes both best response functions outwards towards the right, thereby increasing the chances of implementing a more favorable (i.e., asymmetric) equilibrium in period 1.

Given the period-1 equilibria, the choice of the incumbent in period 0 is analyzed below. Consider the period-0 equilibrium price charged by the incumbent, taking the first-period equilibria in equation (10) as given. The maximization problem is:

$$\max_{p_0} x_0 p_0 + D^I(p^{I*}; p^{E*}, x_0) \cdot p^{I*}, \tag{11}$$

where the period-0 demand is determined by period-0 price, i.e., $x_0 = (b - p_0)/d$.

Substituting $x_0 = (b - p_0)/d$ and (p^{I*}, p^{E*}) into equation (11), the maximization problem can be re-stated as:

$$\max_{x_0} x_0(b - dx_0) + \begin{cases} \left(\frac{1}{2} - \frac{S}{6d}\right)\left(d + \frac{S}{3}\right), & \text{if } x_0 > \frac{1}{2} + \frac{S}{6d} \\ x_0 2dx_0, & \text{if } \frac{1}{2} < x_0 \le \frac{1}{2} + \frac{S}{6d} \\ \frac{d}{2}, & \text{if } x_0 \le \frac{1}{2}. \end{cases} \tag{12}$$

Proposition 2: Given the initial assumption on the parameters, $b/2 < d < b$, the solution to equation (12) is ($p_0^* = b/2$, ($p^{I*} = d + S/3$, $p^{E*} = d - S/3$)) for small S and entry is blockaded with ($p_0^* = b - d$, $p^{I*} = 2d$) for large S.

Proof: In the first and the third cases, the maximization leads to $x_0^* = b/2d$. Substitute this to $x_0 = (b\text{-}p_0)/d$, we get $p_0^* = b/2$. Since $x_0^* = b/2d > 1/2$, the period-1 equilibrium is ($p^{I*} = d + S/3$, $p^{E*} = d - S/3$) from equation (10) as long as $S < 3(b - d) < 3d$. In the second case, the first-order condition is positive meaning we have a boundary solution at $x_0^* = 1$. Thus, entry is blockaded. Substituting $x_0^* = 1$ to equation (10), we get the period-1 equilibrium at $p^{I*} = 2d$ and $p^{E*} = 0$. Also substituting $x_0^* = 1$ into the condition provided in equation (12), this equilibrium holds as long as $S \ge 3d$.

Q.E.D.

In both equilibria, price of the incumbent is higher in period 1 than in period 0. For the case of small switching costs, $p_0^* = b/2 < d < d + S/3 = p^{I*}$ under the given assumption. Thus, upon entry, the incumbent firm charges a higher price than in period 0 while the entrant charges a lower price than the incumbent. Additionally, if $3b/2 < S < 3d$, the entrant's price is lower than the incumbent's period 0 monopoly price. As shown in Frank and Salkever (1992) and Jones et al. (2001), if the entrant's market share is large enough, such low prices of the entrant will drive the average market price down upon entry. Finally, the larger the switching cost is, the bigger is the gap between the prices between the entrant and the incumbent.

For the case of large switching costs, the incumbent finds it in its best interest to block entries, and thus charges a lower price in period 0 than it would have if it was to accommodate entry (as in the case of small switching costs). That is, $p_0^* = b - d < b/2$. Upon successfully blocking entries, the incumbent increases its price $p_0^* = b - d < d < 2d = p^{I*}$ so as to take advantage of its captured consumers.

Conclusion

This paper provides a theoretical explanation as to how entries can cause market prices to increase through a model with switching costs. In markets with switching costs, the incumbent firm wants to take advantage of its locked-in consumers by charging a higher price rather than engaging in a price competition with a new entrant. As simple as the model is, the result potentially has many applications including those observed in pharmaceutical industries.

Appendix A

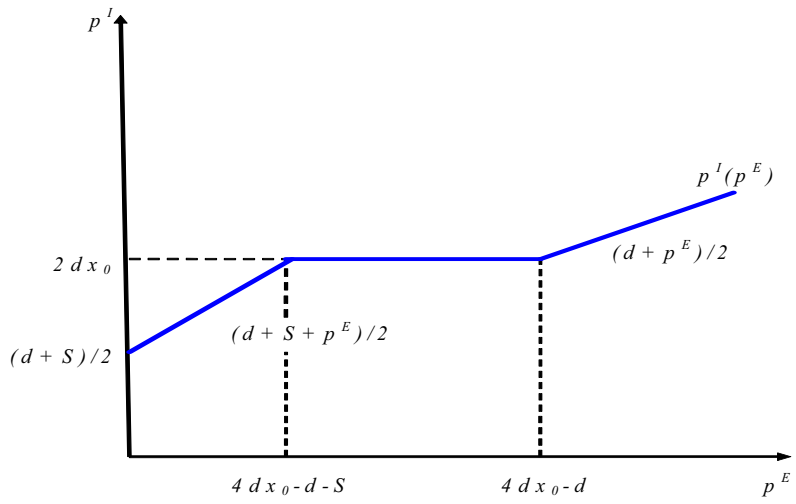

Fig. 1. Incumbent's best response function

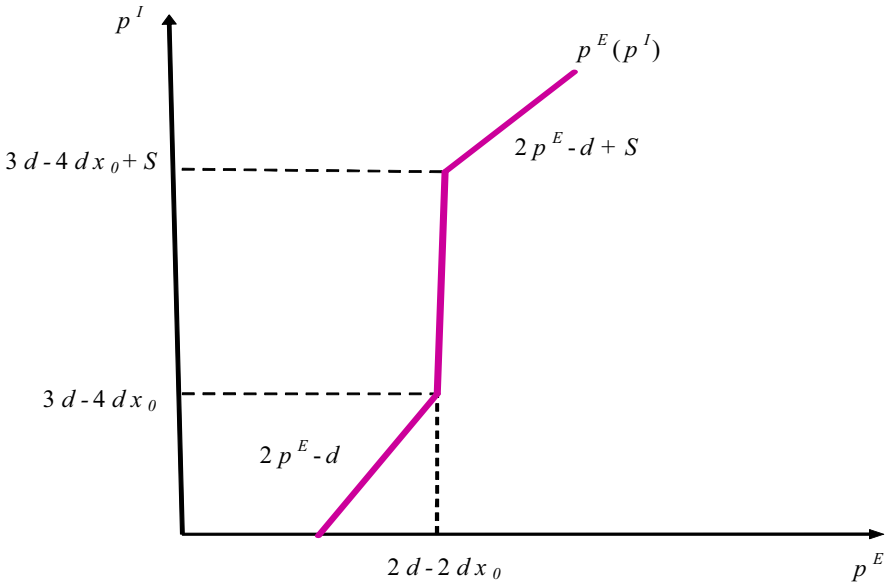

Fig. 2. Entrant's best response function

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