Switching Costs and Market Competitiveness: De-constructing the Relationship

Article *in* Journal of Marketing Research · December 2008

K. Sudhir
Yale University

Switching Costs and Market Competitiveness: De-constructing the Relationship

Jiwoong Shin and K. Sudhir*
Yale University

November, 2008

*Jiwoong Shin is Assistant Professor of Marketing, Yale School of Management, Yale University, 135 Prospect Street, New Haven, CT 06520 (e-mail: jiwoong.shin@yale.edu). K. Sudhir is Professor of Marketing, Yale School of Management, Yale University, 135 Prospect Street, New Haven, CT 06520 (e-mail: k.sudhir@yale.edu). The authors thank Günter Hitsch and Peter Rossi for their helpful comments.

Abstract

The conventional wisdom is that switching costs raise prices and make markets less competitive. Dube, Hitsch and Rossi (2009, hereafter DHR) demonstrate a U shaped relationship between switching costs and equilibrium average prices; i.e., prices fall at low levels of switching costs and then rise as switching costs become very high. DHR show this result using a numerical solution of an infinite period game modeling stochastic consumer preferences with a logit demand model. The authors replicate the U shaped relationship between switching costs and equilibrium average prices in a two period Hotelling model with changing preferences. This analytically tractable model complements the empirical realism of the DHR model by enabling one to understand which of the features of the DHR model are essential for the U-shaped relationship between switching cost and market competitiveness. The authors conclude that the presence of preference heterogeneity (product differentiation) and changing preferences over time suggested by DHR are critical. Future research on switching cost should incorporate these features to obtain richer insights.

Dube, Hitsch and Rossi (2009 hereafter DHR) question the conventional wisdom that switching costs make markets less competitive. They numerically solve for a Markov-Perfect stationary equilibrium of an infinite period game in which consumer demand is modeled using the empirically realistic logit model. They show that the average equilibrium prices have a U-shaped relationship with switching cost, with prices falling initially as switching costs rise and then rising beyond a threshold level of switching cost. We believe this is an important and novel finding because it provides a more complete description of the relationship between switching cost and prices; challenging the widely prevalent conventional wisdom that switching cost will raise prices and make markets less competitive.[1]

In arriving at this result, DHR expand on the original analytical model used by Klemperer (1987). First, they model demand using a logit model. The logit demand model allows for product differentiation as well as changing preferences over time. Second, they model an infinite period game, which is closer in spirit to Beggs and Klemperer (1992), but relax the assumption of infinite switching cost, that causes perfect lock-in of consumers to firms that they previously purchased from. The infinite horizon model allows us to characterize how firms balance the trade-off between "investing" in customer acquisition and "harvesting" the existing customer base in *every* period of a *steady state* equilibrium. In contrast, two period models artificially separate the investment motive for customer acquisition to be entirely in the first period and the harvesting motive to be entirely in the second period. Therefore, two period games are inadequate to capture steady state equilibrium behavior.

Nevertheless, two period models are often used in analyzing the effect of switching cost on market prices and competition. Hence, it would be interesting to test whether the U shaped switching cost-market competition relationship identified in DHR can be replicated within the two period frame works by incorporating key features of the DHR model. By doing so, we hope to complement DHR by isolating the key drivers for the DHR result, thus providing future researchers guidance on the critical characteristics that are important in obtaining the U shaped relationship between switching cost and market competition.

We note that this paper is different in its focus from Cabral (2008), who shows that in a model where firms *can* discriminate between its current and new customers, switching costs can increase competition. In contrast, our paper stays true to the spirit of DHR model in that firms cannot discriminate between its current and new customers.

MODEL

Consider two firms, indexed by $i \in \{A,B\}$, located on the two ends of a Hotelling line, selling otherwise identical nondurable goods. We denote the firm located at point 0 as firm *A* and the firm at point 1 as firm *B*; the prices charged by firms *A* and *B* at period t are p_{At}, p_{Bt}, respectively.

Consumers make purchase decisions in both time periods. Consumers' preferences (denoted by θ) are uniformly distributed along the Hotelling line $\theta \sim U[0,1]$, and consumers have transportation cost k per unit of length, which represents the importance of product differentiation. A consumer located at θ receives the following utilities from purchasing the product:

$$U_t(p_{At}, p_{Bt} \mid \theta) = \begin{cases} V - p_{At} - k\theta, & \text{if purchase from A} \\ V - p_{Bt} - k(1-\theta), & \text{if purchase from B} \end{cases}$$

For simplicity, we assume that the consumption utility V is greater than $(2k-\gamma)$ so that the market is covered. In the first period, firms *A* and *B* each offer a price p_{A1} and p_{B1}, respectively, to all consumers. Consumers purchase from either firm, depending on which choice is optimal for them.

In the second period, consumers preferences are again re-distributed along the Hotelling line – the preference for the product in the second period is independent of their first period preference. Switching cost is modeled identical to DHR. Consumers who bought the product from the firm *i* receive additional utility $\gamma > 0$ from repeat-purchasing from the same firm in the second period.

Note that DHR introduce stochasticity in consumer preferences across time through the i.i.d. extreme value distribution that leads to the empirically realistic logit model. Instead we allow for consumer preferences to be drawn from an i.i.d. uniform distribution of preferences along a Hotelling line. The assumption of the uniform distribution to accommodate changing consumer preferences, enables us to generate an analytically tractable model, compared to the numerical solution required for the logit demand model. Also, DHR consider a stationary Markov Perfect Equilibrium of an infinite period model, while we consider dynamic equilibrium of a two period model. Both basic models treat consumers as myopic. We solve the proposed game using backward induction.

Second Period

At any given pairs of first period prices from firm *A* and *B*, there always exists a threshold $\underline{\theta}_1$, such that all consumers whose preference θ in the first period is $\theta \le \underline{\theta}_1$ purchase from the firm *A*, and the rest purchase from the firm *B*. Given uniform i.i.d. preferences across time, consumer preferences in the second period are completely independent of their preference in the first period but still uniformly distributed along the Hotelling line. A consumer who bought from *A* in the first period repeat purchases from *A* in the second period if and only if her second period preference is such that $V+ \gamma - p_{A2} - k\theta \ge V - p_{B2} - k(1-\theta) \Leftrightarrow \theta \le (k+\gamma - p_{A2}+p_{B2})/(2k)$. Otherwise, the consumer will switch to firm *B*.

Let us denote the probability of purchasing from *i* in the second period given that a consumer purchase from *j* in the first period as Pr (i|j), where i, j $\in$ {*A,B*}. Hence, the probability of repeat purchase for a consumer who purchased from *A* is $\Pr(A|A) = \mathrm{Min}[(k+\gamma - p_{A2}+p_{B2})/(2k), 1]$, and the probability of switching to the competitor is $\Pr(B|A) = 1 - \Pr(A|A)$. Similarly, a consumer who purchased from *B* in the first period, repeat purchasing from *B* in the second period if and only if $\theta \geq (k-\gamma-p_{A2}+p_{B2})/(2k)$ and, therefore, Pr (B|B) = Min $[(k+\gamma+p_{A2}-p_{B2})/(2k), 1]$. Thus, the firms maximize the following second-period profit functions;

$$\mathrm{Max}_p \Pi_{A2} = p_{A2} \cdot \left(\Pr(A|A) \cdot \underline{\theta}_1 + (1-\Pr(B|B)) \cdot (1-\underline{\theta}_1)\right),$$
$$\mathrm{Max}_p \Pi_{B2} = p_{B2} \cdot \left((1-\Pr(A|A)) \cdot \underline{\theta}_1 + \Pr(B|B) \cdot (1-\underline{\theta}_1)\right).$$

Each firm's second-period demand consists of two parts: (1) from its own previous customers who repeat purchases, and (2) from the competitor's previous customers who switch to it.

First, assuming that $\Pr(A|A)=(k+\gamma-p_{A2}+p_{B2})/(2\alpha)\leq 1$ and $\Pr(B|B)=(k-\gamma+p_{A2}-p_{B2})/(2\alpha)\leq 1$, we can directly take the first-order conditions to get the following prices: $p_{A2} = (3k-\gamma+2s\underline{\theta}_1)/3$, and $p_{B2} = (3k+\gamma-2s\underline{\theta}_1)/3$. Given these prices, the probability satisfy the assumptions about Pr(A|A) and Pr(B|B) if and only if $\gamma \leq \min[(3k)/(1+4\underline{\theta}_1), (3k)/(5-4\underline{\theta}_1)]$.

Hereafter, we only look for the pure strategy symmetric equilibrium. As the first period analysis will show below, the symmetric outcome will be that both firms charge the same price in the first period and obtain equal market share. Therefore, $\underline{\theta}_1 = ½$ is the symmetric equilibrium solution. Under symmetry, the condition $\gamma \leq \min[(3k)/(1+4\underline{\theta}_1), (3k)/(5-4\underline{\theta}_1)]$ simplifies to $(\gamma/k) \leq 1$.

When switching cost is relatively low such that $(\gamma/k) \leq 1$, there always exist some portion of consumers who switch firms in the second period. The equilibrium prices are $p_{A2} = (3k-\gamma+2s\underline{\theta}_1)/3$ and $p_{B2} = (3k+\gamma-2s\underline{\theta}_1)/3$, and the corresponding second period profits are $\Pi_{A2}= (3k-\gamma+2\gamma\underline{\theta}_1)^2/(18k)$, $\Pi_{A2}= (3k+\gamma-2\gamma\underline{\theta}_1)/^2/(18k)$. In particular, when $\underline{\theta}_1 = ½$, $p_{A2}= p_{B2} = (3k-\gamma+2\gamma\underline{\theta}_1)/3 = k$ and $\Pi_{A2}= \Pi_{B2}=k/2$. What is particularly interesting here is that switching costs have no impact on the second period prices and profits. Here the changing preference across periods is critical. Neither firm is able to harvest any benefit in the second period from switching cost because there exist some marginal customers who had purchased from the competing firm in the previous period.

However, when the switching cost is sufficiently high such that $(\gamma/k)>1$, Pr(A|A)=1 and Pr(B|B)=1, which imply that consumers *never* switch firms in period 2. With such "perfect lock-in", each firm acts as a monopolist for its own previous consumers. Given our market coverage assumption $(V+\gamma)/2>k$, firms can extract the entire surplus from their marginal customer (θ=1 for *A* and θ=0 for *B*). Therefore, firms charge $p_{A2} = p_{B2} = V+\gamma-k$. The second period profits for firms are therefore $\Pi_{A2}= (V+\gamma-k)\cdot\underline{\theta}_1$, $\Pi_{A2}= (V+\gamma-k)\cdot(1-\underline{\theta}_1)$. In particular, when $\underline{\theta}_1 = ½$, $\Pi_{A2}= \Pi_{B2}= (V+\gamma-k)/2$.[2]

First period

We consider two cases of (1) imperfect lock-in when $(\gamma/k)\leq 1$ where firms can attract the competitor's customers in the second period, and (2) perfect lock-in when $(\gamma/k)>1$ where firms can cannot attract competitor's customers in the second period. The incentives to invest in customers in the first period differ in these two different cases.

(1) When the switching cost is relatively small ($\gamma/k \leq 1$), firms maximize the following total profit functions: $\Pi_A = p_{A1}\cdot\underline{\theta}_1 + \delta\cdot\Pi_{A2} = p_{A1}\cdot\underline{\theta}_1 + \delta\cdot\{(3k-\gamma+2\gamma\underline{\theta}_1)^2/(18k)\}$, $\Pi_B = p_{B1}\cdot(1-\underline{\theta}_1) + \delta\cdot\Pi_{B2} = p_{B1}\cdot(1-\underline{\theta}_1) + \delta\cdot\{(3k+\gamma-2\gamma\underline{\theta}_1)/^2/(18k)\}$, where $\underline{\theta}_1 = (k-p_{A1} + p_{B1})/(2k)$.[3] This leads to the equilibrium first period price and the total profit directly from the first order condition: $p_{A1} = p_{B1} = k-(2\gamma\delta/3)$, and $\Pi_A= \Pi_B= (3k+(3k-2\gamma)\delta)/6$.

(2) When the switching cost is sufficiently large ($\gamma/k > 1$), we can calculate the optimal first period prices using the same logic. The only difference is that the second period profit functions are now $\Pi_{A2}= (V+\gamma-k)\cdot\underline{\theta}_1$, $\Pi_{A2}= (V+\gamma-k)\cdot(1-\underline{\theta}_1)$, which leads to the equilibrium first period price and the total profits $p_{A1} = p_{B1} = k-\delta(V+\gamma-k)$, and $\Pi_A= \Pi_B= k/2$.

Given the first and second period equilibrium results, we can now calculate the per-period average price for the bundle consisting of the first and second period prices. Average price is calculated as

$$p_i^{Avg} = \frac{\left(\Pr(i\,|\,i)\cdot p_{i2} + \Pr(j\,|\,i)\cdot p_{j2}\right) + \left(\Pr(i)p_{i1} + \Pr(j)p_{j1}\right)}{2}$$

Note that $\Pr(j|i)=1-\Pr(i|i)$ and $\Pr(j)=1-\Pr(i)$ for all i, j $\in\{A,B\}$. Under symmetry, this formula simplifies to $p_{avg} = (p_1 + p_2)/2$.

First, when $\gamma/k \leq 1$, the average price $p_{avg} = (p_1 + p_2)/2 = k-(\gamma\,\delta/3)$, which is decreasing in the switching cost γ. In contrast, when $\gamma/k > 1$, the overall average price is $p_{avg} = (p_1 + p_2)_{/2} = ((V+\gamma)(1-\delta)+\delta k)/2$, which is increasing in the switching cost γ when $\delta < 1$. We plot the average prices along the ratio of γ/k in Figure 1 when V=4, $\delta= .9$, k=1. Thus, we replicate the U shaped relationship between switching cost and competition in DHR in two period setting.

*** Figure 1 ***

The stark change in the slope of the relationship between the switching costs and prices is due to the different nature of customer lock-in in each region. When $\gamma/k < 1$, consumers' choices are more influenced by their current preference and not by their previous choice (through switching costs) and, therefore, we are in an imperfect lock-in regime. Hence, firms compete aggressively for attracting consumers in the first period. But this competition only drives down overall aggregate prices and profits, because as discussed earlier second period price and profit is constant irrespective of the level of switching costs due to the changing consumer preferences across periods.[4]

When $\gamma/k > 1$, no consumer switches firms even if preferences change (which implies a perfect lock-in). Under perfect lock-in, firms can enjoy the monopoly profits in the second period, and the second period price increases monotonically in the switching cost. As a consequence, firms compete hard to attract more customers in the first period expecting the second period profit. However, firms value the future potential gain less due to the discount factor ($\delta<1$). Hence, the discount factor reduces the incentive to invest in the first period and, therefore, the first period becomes less competitive. But when $\delta = 1$, the first period competition indeed wipes away any potential gain in the second period and average price will be constant at $p_{avg} = (p_1 + p_2)/2=1/2$.

In sum, both switching costs and preference heterogeneity (the importance of which is represented through consumer transportation cost k) affect the nature of customer lock-in, which in turn determine the nature of market competition. Hence, we see the dramatic change in the pricing regime at the critical point $\gamma/k = 1$. However, it is important to recognize that that the downward sloping price curve when $\gamma/k < 1$ is driven by changing consumer preferences, while the upward sloping when $\gamma/k > 1$ is driven by the discount factor δ.

DISCUSSION

By incorporating features of DHR into the original Klemperer model, we replicate the U shaped relationship between switching cost and average prices even within finite period game. Given that we analyze a two-period model, we should be cautious in comparing the result with that of DHR who analyze the steady state outcome of an infinite horizon model. First, as discussed in the introduction, in the infinite horizon model is more realistic in that firms have both investment and harvesting motives in every period, while the two-period model does not. Second, the definition of competition characterized by average prices is different across the two models. The average price in the two period model is an average price across the investment and harvesting periods while the average price in DHR is the steady state price within a given period.

Given the above analysis, we can now shed light on what aspects of the DHR model are essential for the U-shaped relationship in a finite model. It is clear that the ratio γ/k plays an important role in the nature of the pricing regimes through its effect on customer lock-in. Apart from switching costs, two key factors interact in the level of lock-in. They are: (1) preference heterogeneity (related to product differentiation), captured by the extreme value distribution in DHR and the uniform distribution in our model captured (through k) respectively; (2) change in preferences across time as captured by the i.i.d. assumption on preferences across time. In addition, the discount factor δ also plays a critical role in the upward slope of the price curve at high switching cost.

CONCLUSION

We demonstrate the usefulness of adopting the key features suggested by DHR in modeling switching costs in a finite setting to obtain a more complete characterization of the relationship between switching costs and market competitiveness. We conclude that the presence of preference heterogeneity (product differentiation) and changing preferences over time suggested by DHR are critical. Though the underlying mechanism driving the relationship identified here may not be applicable in the infinite horizon case, we suggest that the key insight from the infinite horizon model of DHR carries over to the finite model. Without these features, one may get a partial and perhaps misleading message: that switching cost makes the market, either less or more competitive. Future research on switching cost should therefore incorporate these features to obtain richer insights.[5]

The U shaped relationship between switching cost and average prices has implications for how we interpret existing empirical work and design new tests on how switching costs affect competition. For example, Viard (forthcoming) finds that allowing number portability (reduced switching cost) in mobile telephony lowered prices. This result may appear to be superficially inconsistent with the DHR finding. However, once we recognize the U shaped relationship, the result can be consistent with the DHR result if the switching cost before number portability was in the high switching cost range. Given the typical long-term contracts signed by customers, the mobile telephony market is consistent with being a high switching cost market. Other recent studies have estimated switching costs to be greater than the cost of the product in frequently purchased product categories (e.g., Shum 2004).

As DHR show in their Figure 1, if firms act myopically (or discount the future heavily), prices rise with switching cost; if they are forward looking and dynamically optimal, prices fall in a wide range of switching cost. This suggests a possible line of empirical work to study the extent to which firms act in a dynamically optimal manner in setting prices (for example, Che et al. 2007).

We believe that the DHR result will spawn both theoretical and empirical work that expands our insights on the effect of switching costs on prices and competition.

References

Beggs, Alan, and Paul Klemperer (1992), "Multi-period Competition With Switching Costs," *Econometrica*, 60 (3), 651-666.

Cabral, Lous M. B. (2008), "Switching Costs and Equilibrium Prices," *working paper,* NYU.

Cabral, Lous M. B., and Miguel Villas-Boas (2005), "Bertrand Supertraps," *Management Science*, 51 (4), 599-613.

Che, Hai, K. Sudhir, and P.B. Seetharaman (2007), " Bounded Rationality in Pricing under State Dependent Demand: Do Firms Look Ahead? How Far Ahead?," *Journal of Marketing Research*, 44 (August), 434-49.

Dube, Jean-Pierre, Gunter J. Hitsch, and Peter E. Rossi (2008), "Do Switching Costs Make Markets Less Competitive?" *Journal of Marketing Research*, forthcoming.

Farrell, Joseph, and Paul Klemperer (2007), "Coordination and Lock-In: Competition with Switching Costs and Network Effects," *Handbook of Industrial Organization*, Vol 3, Chapter 31, M. Armstrong and R. Porter, eds., Amsterdam: North Holland.

Klemperer, Paul (1987), "The Competitiveness of Markets with Switching Costs," *RAND Journal of Economics*, 18 (1), 138-150.

Shin, Jiwoong, and K. Sudhir (2008), "A Customer Management Dilemma: When to Punish or Reward Own Customers," *working paper*, Yale University.

Shum, Matthew (2004), "Does Advertising Overcome Brand Loyalty? Evidence from the Breakfast-Cereals Market," *Journal of Economics & Management Strategy*, 13 (2), 241-272.

Footnotes

1. There are a few exceptions which show that switching costs can lower the market prices and make the market more competitive under certain conditions (for example, Klemperer 1987). Cabral and Villas-Boas (2005) show a sufficient condition for this to occur in a two period model. However, no paper shows the U-shaped relationship between switching cost and prices. See Farrell and Klemperer (2007) for an excellent review on the literature of switching costs.
2. Any empirical operationalization of the logit model normalizes the scale of the extreme value distribution to 1. Thus, the estimated switching cost and price coefficients are scaled by the true scaling factor. The range is the scaling factor of the uniform distribution and based on the argument in footnote 3, the transportation cost k can be considered the scaling factor. Then it is easy to see why the threshold for imperfect or perfect lock-in is based on γ / k.
3. In this model, we assume myopic consumers as in DHR (2008) for direct comparison.
4. The same result that the strategic competition effect in the first period outweighs the direct effect of the switching cost in the second period and, therefore, reduces the profit and average prices is found in Cabral and Villas-Boas (2005), which they call *Bertrand Supertrap*.
5. This result has some similarities with the recent paper by Shin and Sudhir (2008) which shows that the decision whether to reward one's own customers is crucially dependent on the changing preferences over time.

Figure 1: Average Price (V=4, δ=0.9,k=1)