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Market structure and the competitive effects of switching costs

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HIGHLIGHTS

- We analyze a continuous-time dynamic model of competition with switching costs.
- In the short-run, switching costs are pro-competitive under weak market dominance.
- However, under strong market dominance, switching costs are anti-competitive.
- In the long-run, switching costs are unambiguously pro-competitive.

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ABSTRACT

We revisit the effects of switching costs on dynamic competition. We consider stationary Markovian strategies, with market shares being the state variable, and characterize a relatively simple Markov Perfect pricing equilibrium at which there is switching by some consumers at all times. For the case of low switching costs and infinitely lived consumers, we show that switching costs are pro-competitive in the long-run (steady state) while the overall effect in the short-run (transient state) depends on market structure. In particular, switching costs are anti-competitive in relatively concentrated markets, and pro-competitive otherwise.

1. Introduction

Switching costs are widespread across a large range of products and services. For instance, customers must bear a cost when gathering information about a new product or service they would like to switch to, or when adopting a new technology that has limited compatibility with the old one. Other switching costs may arise from contractual arrangements (e.g. service contracts with a certain minimum term), or from loyalty programs (e.g. discount coupons or frequent flyer cards), to name just a few.

Switching costs face consumers with a potential lock-in effect which gives rise to dynamic market power. However, since past choices create inertia in consumers' future decisions, market share becomes a valuable asset that firms are willing to fight for. This gives rise to two countervailing incentives: on the one hand, firms want to charge high prices in order to exploit current customers, but on the other hand they also want to charge low prices in order to attract new ones. The conventional wisdom suggests that the former incentive dominates, so that switching costs give rise to anti-competitive effects.[1]

In this paper, we use a continuous-time infinite horizon game formulation to determine the extent to which the conventional wisdom relies on two features: (i) the finite horizon/finitely lived consumers assumptions, and (ii) the absence of switching in equilibrium. We consider stationary Markovian strategies, with

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[1] This conclusion is also supported on a series of models with either a finite horizon (e.g. Klemperer, 1987a) or with finitely lived consumers (e.g. Padilla, 1995), in all of which switching does not occur in equilibrium. Other papers include Klemperer (1987b), Farrell and Shapiro (1988), To (1995) and Villas-Boas (2006), among others. Klemperer (1995) and Farrell and Klemperer (2007) provide a survey of this literature.

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market shares being the state variable, and characterize a relatively simple Markov Perfect pricing equilibrium at which there is switching by some consumers at all times.

For the case of low switching costs and infinitely lived consumers, we show that the conventional wisdom is only partially correct. Indeed, we find that switching costs are pro-competitive in the long-run (steady state) while the overall effect in the short-run (transient state) depends on market structure. These conclusions derive from the interplay of the countervailing incentives mentioned above, together with the presence of switching in equilibrium.

To understand the importance of switching in equilibrium, it is useful to interpret switching costs as a firm-subsidy when consumers are loyal to the firm (i.e., the firm can afford raising its price by the value of the switching cost without losing consumers) or as a firm-tax when consumers are switching to the firm's product (i.e., the firm has to reduce its price by the amount of the switching cost in order to attract new consumers). For a large firm (which has more loyal consumers than consumers willing to switch into its product), the net effect of switching costs is that of a subsidy, whereas for a small firm the net effect of switching costs is that of a tax. Therefore, an increase in switching costs introduces a wedge in the pricing incentives of the two firms: while the large firm becomes less aggressive, the small firm becomes more so, thus inducing market shares to converge over time. In steady state firms become fully symmetric, so that the tax and the subsidy effects induced by an increase in switching costs cancel out for both firms.

However, in a dynamic setting, firms want to attract new consumers not simply as a source of current profits but also to exploit them in the future. Since the value of new customers is greater the higher the switching costs, an increase in switching costs fosters more competitive outcomes in steady state.[2]

In contrast, the short-run effect of an increase in switching costs is ambiguous. While higher switching costs reduce the prices charged by the small firm, the effect on the large firm's pricing incentives depends upon the level of market dominance. With strong market dominance, an increase in switching costs induces higher prices by the dominant firm. This corresponds with the conventional wisdom. However, under weak market dominance, an increase in switching costs induces lower prices by both firms. In this situation, switching costs are pro-competitive also in the short-run.

2. The model

We consider a market in which two firms compete to provide a service which is demanded continuously over time. Firms have identical marginal costs normalized to zero. There is a unit mass of infinitely lived consumers. We assume that all consumers are served. Letting $x_i(t)$ denote the market share of firm $i \in \{1, 2\}$, this implies $x_1(t) + x_2(t) = 1$.

Switching opportunities for consumers take place over time according to independent Poisson processes with unit rate,[3] i.e., in the interval $(t, t + dt)$, the expected fraction of consumers considering switching or not between firms is dt. We assume that consumers cannot anticipate infinite equilibrium price trajectories and thus can only react to current prices.[4] Conditional on having the opportunity to switch, $q_{ji} \in (0, 1)$ denotes the probability with which a customer currently served by firm j switches to firm i. Accordingly, $q_{jj} = 1 - q_{ji}$ is the probability that a customer already served by firm j maintains this relationship. Firm i's net (expected) change in market share in the infinitesimal time interval $(t, t + dt]$ can be expressed as

$$x_i(t + dt) - x_i(t) = q_{ji}x_j(t)dt - (1 - q_{ii})x_i(t)dt, \quad (1)$$

i.e., the net (expected) change in market share is equal to the expected number of customers that firm i steals from firm j, minus the customers that firm j steals from firm i. The revenue accrued in the infinitesimal time interval $(t, t + dt]$ is the sum of $p_i x_i(t)dt$ (i.e., revenue from current customers) and $p_i[q_{ji}x_j(t) - (1 - q_{ii})x_i(t)]dt$ (i.e., revenue gain/loss from new/old customers). Hence, the rate at which revenue is accrued by firm i, say $\pi_i(t)$, can be written as

$$\pi_i(t) = p_i x_i(t) + p_i[q_{ji}x_j(t) - (1 - q_{ii})x_i(t)]. \quad (2)$$

In order to characterize the switching probabilities, we assume a discrete choice model in which the net surplus from product $i \in \{1, 2\}$ at time $t > 0$ is of the form

$$u_i(t) = v_i(t) - p_i(t)$$

wherein we make the following standing assumption[5]:

Assumption. The collection $\{v_i(t) : t > 0\}$ is *i.i.d.* and $v_i(t) - v_j(t)$ is uniformly distributed in $\left[-\frac{1}{2}, \frac{1}{2}\right]$.

When an opportunity to switch arises for a given customer, he would opt for firm i (if currently served by firm j) provided that

$$u_i - \frac{s}{2} = v_i - p_i - \frac{s}{2} > u_j = v_j - p_j$$

where $\frac{s}{2}$ is the switching cost incurred ($s < 1$). Hence, the probability that such a customer served by firm j switches to firm i, q_{ji}, is given by

$$q_{ji} = \Pr\left(v_j - v_i < -\frac{s}{2} + p_j - p_i\right) = \frac{1}{2}(1 - s) - p_i + p_j$$

where we assume $p_i - p_j \in \left[-\frac{1}{2}(1 - s), \frac{1}{2}(1 + s)\right]$. Conversely, if firm i serves the selected consumer, he will maintain this relationship if

$$u_i = v_i - p_i > u_j = v_j - p_j - \frac{s}{2}.$$

Hence, the probability q_{ii} that a customer already served by firm i maintains this relationship is[6]

$$q_{ii} = \Pr\left(v_j - v_i < \frac{s}{2} - p_i + p_j\right) = \frac{1}{2}(1 + s) - p_i + p_j.$$

Substituting q_{ji} and q_{ii} into (1) and taking the limit, as $dt \to 0$, we obtain

$$\dot{x}_i(t) = -x_i(t)(1 - s) + \frac{1 - s}{2} - p_i + p_j.$$

[2] There are other recent papers showing the potential pro-competitive effect of switching costs. See Viard (2007), Cabral (2011, 2012), Dubé et al. (2009), Shi et al. (2006), Doganoglu (2010), Arie and Grieco (2013), and Rhodes (2013). Our paper differs from this literature, which features overlapping generation models for finitely lived consumers and discrete time models of dynamic price competition.

[3] The analysis is robust to arrival rates different from one. However, this would add an additional parameter in the model, with only a scaling effect. One could instead envisage a model in which the arrival rate is a function of firms' prices. However, this would further complicate the analysis, and it is out of the scope of the current paper.

[4] The main conclusions of the paper are preserved if we allowed for more sophisticated consumers. See Section 3 for further comments on this issue. See Fabra and García (2013).

[5] Note this assumption is consistent with Hotelling's model of product differentiation with product varieties at the extremes of a linear city uniformly distributed in $[0, \frac{1}{2}]$. Results are robust to allowing for more general distributions.

[6] Note that $q_{ii} \geq q_{ji}$ reflects the fact that, for given prices, firm i is more likely to retain a randomly chosen current customer than to "steal" one from firm j.