Markets with Consumer Switching Costs and Non-Linear Pricing.[*]

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Abstract

In a non-cooperative oligopoly model where firms use simple linear prices, Klemperer (1987) has shown that the existence of consumers' switching costs may generate monopoly like prices, and thereby create substantial loss in welfare. We show that when allowing firms to use two-part tariffs, social optimal prices are always set and the size and distribution of switching costs only affect the distribution of surplus between firms and consumers.

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1 Introduction

Ex ante homogeneous products may be ex post differentiated by switching costs. In a model with linear prices Klemperer (1987a) shows that a non-cooperative equilibrium in an oligopoly with switching costs may be the same as the collusive outcome in an otherwise identical market without switching costs. In general, the

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non-cooperative equilibrium with switching costs depends on the size and distribution of consumer switching costs. In particular, in a model with simple linear prices Klemperer (1987a) shows that if all consumers have different but positive switching costs the equilibrium price will vary between marginal cost pricing and monopoly pricing depending on the density of consumers with zero switching costs.[1] When all consumers have identical and strictly positive switching costs the only candidate for equilibrium involves collusive pricing. The analysis suggests that the existence of consumers' switching costs can potentially be very detrimental to welfare.

In many markets more general pricing schemes are observed. In most Telecom markets for instance, the use of non-linear tariffs seems to be the rule. In this paper we adopt a similar setting as in Klemperer (1987a), but we allow firms to use non-linear prices (two-part tariffs). In a very simple model we show that when a pure strategy equilibrium exists, this equilibrium always entails socially efficient marginal prices, and that competition between firms will take place in the fixed fees. Higher switching costs tend to switch surplus from consumers to firms and vice versa with lower switching costs. We show that the late-period inefficiencies often claimed to be an inherent feature in switching cost models are not due to switching costs per se, but rather to the lack of appropriate contractual instruments. This suggests that the welfare reducing effects of switching costs may be overstated by the earlier literature.

2 Analysis

It is well-known that a profit-maximizing monopolist with access to two-part tariffs will offer a contract that maximizes social surplus, and by charging an appropriate fixed payment he can convert social surplus into profits. Let $q^* \in \arg\max_q \{u(q) - C(q)\}$ denote the individual quantity that maximizes social surplus, where $u(\cdot)$ is individual utility (gross of payment) from consuming q units and $C(\cdot)$ is the associated

[1] See also Klemperer's (1995) survey and Farell and Klemperer (2001). In fact, 'bargains followed by ripoffs' is one of the main themes of the switching-costs literature, see also Klemperer (1987b), Basu and Bell (1991), Padilla (1992), and Basu (1993) among others.

cost function. Suppose preferences are such that each individual consumer has a downward sloping demand curve: $u''(q) < 0$. Then the socially optimal allocation can be implemented by an appropriately chosen two-part tariff: the marginal price z should be set equal to equal to marginal cost $c^* \equiv C'(q^*)$: Moreover, if we let $V(z) \equiv \max_q \{u(q) - zq\}$ denote the gross surplus (or indirect utility) for this pricing rule, then the optimal fixed fee is given by $p = V \equiv V(c^*)$.[2]

Next consider a situation with two firms, each with a unit mass of consumers from earlier periods. Consumers have identical preferences, but they are split between the two firms, and their switching costs also vary. Consumers have switching costs s distributed according to a CDF $G(s)$ with support $[0; \bar{s}]$. Let $g(s)$ denote the corresponding density. The distribution of switching costs are the same across firms.

Each firm offers his customers a two-part tariff. The firms cannot discriminate between new and old customers. Then, whatever the opponent does, it never pays to charge inefficient marginal prices. Whether or not a customer stays with his original supplier or switches to the supplier depends on differences in his net consumer surplus. Hence, both firms have an incentive to maximize gross consumer surplus by offering efficient marginal prices, and then regulate net consumer surplus with the fixed fee. Any interaction between the firms therefore goes through the fixed fee p. (Clearly, this hinges on consumers having identical preferences.)

Suppose the two firms set fixed fees p and q, respectively. Without loss of generality assume that $q \leq p$. Then the profit of the two firms are given by

$$\begin{aligned} \pi_1(p; q) &= (1 - G(p - q))p \\ \pi_2(q; p) &= (1 + G(p - q))q \end{aligned}$$

For these prices to be locally optimal, the following first order conditions must hold:

$$\frac{\partial \pi_1(p; q)}{\partial p} = 1 - G(p - q) - pg(p - q) = 0$$

[2] Intuitively, this result can be generalized to any conceivable cost and demand structure (even non-differentiable utility and cost functions): as long as a socially optimal individual demand q^* exists, the monopolist should impose this optimum (for instance by offering the consumers a take-it-or-leave-it quantity of q^* at a total price $C(q^*) + p$, with p set such that the consumer is indifferent between accepting and rejecting.

$$\frac{\partial \pi_2(q;p)}{\partial q} = 1 + G(p - q) - qg(p - q) = 0$$

In any symmetric equilibrium $p = q$ and the two first order conditions collapse into one single one (using that $G(0) = 0$):

$$1 - pg(0) = 0 \iff p = \frac{1}{g(0)}$$

Clearly, it might be the case that the fixed fee is limited by the consumer's willingness to pay, that is, by V, instead of by competition. Then we have:

Proposition 1 If $g(0) \in (0; \infty)$, the only candidate for equilibrium in pure strategies involves

$$\pi = p = \min\{\frac{1}{g(0)}; V\}$$

When two-part tariffs can be used, efficient marginal prices are always used, and all interaction is in the fixed fees charged by the firms. As in Klemperer (1987a), in a symmetric pure-strategy equilibrium, the only information about the distribution of switching costs that matters is the density of consumers with zero switching costs, $g(0)$. Of course, the first order conditions may not be sufficient, as inframarginal price increases or cuts may be tempting. The rest of the distribution of s is crucial in determining whether the fixed fees satisfying the first order conditions are global best responses for the firms. The higher the density of consumers with zero switching costs, the lower the fixed fees will be charged by the firms.

In Klemperer's (1987a) analysis with linear prices, $g(0)$ affects marginal prices, so that when $g(0) \to \infty$ prices satisfying the first order conditions approach marginal costs, and when $g(0) = 0$; prices equal the monopoly price. Consequently, with linear prices, the lower the density of consumers without switching costs the higher the welfare loss. In contrast, with two-part tariffs the welfare optimum is always attained and the density of consumers without switching costs only affects the division of surplus between the firms and the consumers. When $g(0) = 0$ all surplus goes to the firms, and when $g(0) \to \infty$ consumers get all the surplus. Inbetween the two extreme cases, firms and consumers split the first-best welfare surplus.

The global condition for the existence of the pure-strategy equilibrium in Proposition 1 is:

$$(1 + G(p - p_u))\, p_u \leq p \quad \forall p_u$$

The left-hand side is a firm's profit when undercutting by charging a fixed fee $p_u < p$ and attracting a share $G(p - p_u)$ of the rival firm's customers, and the right-hand side is the fee p from Proposition 1. When this condition holds no profitable infra-marginal price cuts can be made. It is straightforward to verify that the global condition for instance holds for any uniform distribution $G(s)$.[3]

Finally consider the special case where all consumers have identical switching costs $s > 0$:

Proposition 2 When all consumers have a common $s > 0$ and $s \geq \frac{1}{2}V$ there exist a pure strategy equilibrium in which $p = q = V$.

Proof: When all consumers have $s > 0$, $g(0) = 0$ and from Proposition 1 the only candidate for a pure strategy equilibrium is $p = V$. Optimal undercutting entails lowering the fixed fee with exactly s and get all the customers and profit $\pi = 2(V - s)$. This is profitable when $2(V - s) > V \iff s < \frac{1}{2}V$. Thus, for a sufficiently high switching cost $p = V$ constitute an equilibrium in pure strategies. QED.

For $s < \frac{1}{2}V$ there exist no pure strategy equilibria, any equilibrium is in mixed strategies. These equilibria are difficult to compute. However, as shown by Shilony (1977) with linear prices, when switching costs are less than those supporting the joint profit maximizing outcome, the expected market price and the firms' expected profits increase continuously and monotonically from the competitive equilibrium to the collusive outcome as the switching costs increase.

[3] In fact, since the global condition holds for any uniform distribution $G(s)$ it must also hold for any arbitrary distribution $H(s)$ such that $H(s) \leq G(s)\ \forall s$. The reason is that any infra-marginal price cuts with H will attract fewer of competitor's customers than with the uniform distribution, and therefore be less profitable.

3 Concluding remarks

Earlier models with switching costs has focused on late period inefficiencies due to firms' abuse of market power created by consumer lock-in. In this paper we have shown that the inefficiencies are not related to the fact that consumers have substantial switching costs per se, but rather to the limitations in contractual instruments. In the simple model presented in this paper, the inefficiencies in the lock-in phase inherent in models with switching costs and linear prices evaporate when allowing for more general contracts. With two-part tariffs, the firms will always have an incentive to charge efficient marginal prices, and the competition between firms will be in the fixed fees. As such our results suggest that the welfare reducing effects of switching costs may be overstated by the earlier literature.

Finally, it is interesting to observe that our model behaves just like a rectangular (unit) demand model where consumers would buy a fixed amount as long as the price is below a certain choke level. Note, however, that in our model this feature is not driven by assuming peculiar consumer preferences, but rather emerges as an equilibrium result when allowing for two-part tariffs and quite general preferences.

References

[1] Basu, K. (1993): "Switching costs and rural credit," Lectures in Industrial Organization Theory, 15.3.

[2] Basu, K. and C. Bell (1991): "Fragmente duopoly: Theory and applications to backward agriculture," Journal of Development Economics 36, 145-165.

[3] Farrel, J. and P. Klemperer (2001): "Coordination and Lock-In: Competition with Switching Costs and Network Effects," Forthcoming in Armstrong, M. and R. Porter (eds): Handbook of Industrial Organization vol. 3.

[4] Klemperer, P. D. (1987a): "Markets with consumer switching costs," Quarterly Journal of Economics 102, 375-94.

[5] Klemperer, P. D. (1987b): "The competitiveness of markets with switching costs," RAND Journal of Economics 18, 138-150.

[6] Klemperer, P. D. (1995): "Competition when consumers have switching costs: An overview with applications to Industrial Organization, macroeconomics, and international trade," Review of Economic Studies 62, 515-39.

[7] Padilla, A. J. (1992): "Mixed pricing in oligopoly with consumer switching costs," International Journal of Industrial Organization 10, 393-412.

[8] Shilony,Y. (1977): "Mixed Pricing in Oligopoly," Journal of Economic Theory 14, 373-88.