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## ABSTRACT

### Introductory Offers in a Model of Strategic Competition\*

We show how introductory offers emerge endogenously under conditions of competition in markets with switching costs. In a standard Hotelling model we find the combination of switching costs and introductory discounts to reduce industry profits relative to industries without switching costs, in which introductory offers do not emerge. Thus, our analysis offers a formalized argument for the policy conclusion that the strategic use of introductory offers should be promoted, not banned, in environments where firms are able to discriminate across different vintages of customers.

JEL Classification: D43 and L14

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## 1. Introduction

Introductory offers have become important instruments of firms to generate consumer loyalty. For example, academic journals and newspapers sell at largely discounted prices to new customers. Club membership may often be complementary for new members. Banks offer special student accounts and credit cards are offered on very favourable terms for the first year to particular customer segments. Operators of mobile phone services compete in a particularly intense way for new customers by offering, for example, substantial discounts in the fees applied to an early phase of the subscription. It seems that introductory offers do emerge particularly in markets characterized by competition. But why? What are the characteristics of markets in which we can expect to observe discounts to new customers?

This study is the first attempt to analyze introductory offers in a simple oligopoly model. In a two-period version of a Hotelling duopoly<sup>1</sup> we show that introductory offers will emerge in industries characterized by switching costs when firms can price discriminate based on purchase histories. As is well known from the work of von Weizsäcker (1984) and Klemperer (1987, 1995), switching costs drive firms to compete for market shares. Introductory offers are a particular useful instrument in competing for market shares, since they are only granted to new customers. Repeat customers are already attached and, therefore, in the presence of switching costs such customers can be charged higher prices in future trades. Thus, introductory offers serve as a price discrimination device, whereby uncommitted consumers are separated from committed ones. While companies compete aggressively for new clients they profit from charging higher subsequent prices to attached consumers facing switching costs.

In a simple environment with these characteristics we find that introductory offers will only emerge when switching costs are positive. Otherwise, prices remain constant over time. Moreover, in our model with switching costs introductory offers will only occur under conditions of competition. We characterize industry equilibrium in duopoly and find that discounted equilibrium profits are lower with introductory costs than in markets without switching costs (and initial discounts). In this sense, firms would have a collective incentive to ban introductory offers.

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<sup>1</sup> The framework is very similar to the basic set-up of Klemperer (1987) as will be described below.

Our results complement earlier work by Klemperer (1987, 1995) with the case of price discriminating firms. Interestingly, and in contrast to the general trust of Klemperer (1995), we find that switching costs may intensify industry competition under standard assumptions. Our model can be viewed as a simplified version of Klemperer (1987) endowed, however, with the extension of price discrimination. We demonstrate that this ability of firms to price discriminate has dramatic implications for the performance of a Hotelling duopoly, where customers face switching costs. In this case, firms would jointly like to ban introductory offers or reduce switching costs rather than to create them.

Despite their prevalence, this is the first paper to study introductory offers in industry equilibrium. To the best of our knowledge, Gehrig and Stenbacka (2001) offers the most closely related study. These authors analyse repeated loan markets with asymmetric information.<sup>2</sup> Also in their set-up history dependent prices emerges quite naturally in duopoly. Nilssen (2000) provides a similar analyses of the insurance market. However, his emphasis lies on contractual design. Van Ackere and Reyniers (1995) view introductory offers as devices for intertemporal price discrimination. They analyse optimal intertemporal pricing of quasi-durable goods monopolists. Farrell (1985) shows how introductory offers can be used as a signalling device for experience goods. Finally, Caminal and Matutes (1992) study a model where switching costs are endogenously generated by firm commitments to future discounts. Although they also allow for intertemporal price discrimination in a two-period model, their focus is on the endogenous creation of switching costs, which we take for granted. Their results largely conform with the standard literature (e.g. Klemperer, 1995).

The paper is organized as follows. Section 2 presents the basic model. The main results are derived and presented in section 3. Section 4 emphasizes the significance of intertemporal price discrimination, whereas section 5 offers a discussion. Finally, concluding comments are found in section 6.

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<sup>2</sup> See Sharpe (1997) and Shy (2002) for empirical evidence about the size of switching costs in the banking industry.

## 2. The Model

Consider a repeated Hotelling duopoly operating with a two-period horizon as a model of horizontal product differentiation. The two firms, A and B, are located at the endpoints of the unit interval with addresses 0 and 1, respectively. The production takes place at a constant marginal cost normalized to zero. Consumers are uniformly distributed on the unit interval and incur a constant proportional transportation cost of  $t > 0$  per unit travelled. In each period they purchase at most one unit of the product, for which they will pay at most a price of  $v > 0$ , which is their reservation price.<sup>3</sup> Moreover we assume that each consumer can, in principle, purchase profitably at both locations, i.e.  $v \geq t$ .

The purchase of the product will create some degree of lock-in for later purchases. Hence, an initial purchase in period 1 creates a switching cost of  $s > 0$  if the consumer decides to switch products in period 2.<sup>4</sup> In line with most of the literature we will assume that switching costs are large enough to prevent switching in period 2,<sup>5</sup> an issue we will subsequently elaborate in greater detail.

In principle, we have in mind a stationary market where in each period a proportion  $\mu > 0$  of new consumers is entering the market replacing the same mass of exiting older consumer as in Klemperer (1987). However, in contrast to Klemperer firms can discriminate between new and old customers and charge different prices to each vintage in period 2. We will momentarily therefore neglect  $\mu$ , and only introduce it in section 4, when we discuss the relation to earlier work.

Hence, for a given vintage of consumers, firms independently announce prices  $p_1^A$  and  $p_1^B$  in period 1 as well as  $p_2^A$  and  $p_2^B$  in period 2. We will later on interpret period-1 prices as introductory offers and period-2 prices as the standard reference prices for captive customers. Unlike von Weizsäcker (1984) and like Klemperer (1987), firms

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<sup>3</sup> Examples for such products would be newspapers, deposit accounts, club memberships or mobile phone services.

<sup>4</sup> In the above examples, these costs may be viewed as inconvenience costs of discontinuing a certain series of journals, of getting oriented in a new newspaper, as a penalty for closing a deposit account or of number changes associated with a switch of mobile phone operator.

<sup>5</sup> Otherwise, a pure strategy equilibrium in period-2 prices may not exist (see, for example, Klemperer (1987)).

cannot commit to period-2 prices in period 1, and, hence, will choose profit-maximizing prices in period 2 given their market share of attached consumers.

Both entrepreneurs and consumers discount future profits and consumption at potentially different discount factors  $0 \leq \delta_s \leq 1$  and  $0 \leq \delta_b \leq 1$ , respectively. We assume that both types of agents, sellers and buyers, are rational and correctly anticipate the consequences of current actions on future decisions.

The proper solution concept for this two-stage game is subgame perfect Nash equilibrium.

### 3. Industry Equilibrium with Introductory Offers

We now solve for the subgame perfect Nash equilibria of the game defined in section 2. Hence, we will first determine the period-2 equilibrium prices for given captive clienteles inherited from period 1 and then subsequently we solve for the equilibrium introductory offers, i.e. the period-1 prices.

#### a) *period-2 prices*

We are mainly interested in the case, in which the market is fully covered in period 1, since otherwise we would be describing a configuration with separated repeated monopolies. Hence, assume that in period 1 a proportion  $k_1$  is attached to firm *A*, whereas the remaining proportion of  $1 - k_1$  holds a customer relationship with firm *B*. In this section we also assume that there is no replacement of attached consumers by new and unattached consumers ( $\mu = 0$ ).

If the switching costs are high enough to deter switching in period 2, firms cannot profitably compete for consumers who have formed a customer relationship with the rival firm in period 1. Under such circumstances the switching barriers make the firms local monopolists in period 2 and these firms can charge monopolistic prices, which

maximize period-2 profits  $\pi_2^A = p_2^A \max\left(\frac{1}{t}(v - p_2^A), k_1\right)$  and

$\pi_2^B = p_2^B \max\left(\frac{1}{t}(v - p_2^B), 1 - k_1\right)$ , independently of their rival's prices (and the level of

switching costs  $s$  as long as these are large enough). Initially we characterize the prices set by firms protected by such large switching barriers.

**Lemma 3.1 (period-2 prices):** *With sufficiently large switching costs the period-2 equilibrium prices of firm A are determined as follows:*

- a) if  $k_1 > \frac{v}{2t}$ :  $p_2^A = \frac{v}{2}$
- b) if  $k_1 \leq \frac{v}{2t}$ :  $p_2^A = v - k_1 t$ .

*Equilibrium prices for firm 2 are determined analogously.*

In case a) firm A will essentially find it profitable not to serve the full clientele. This happens (for both firms) when transportation costs are rather large. In this case, the equilibrium configuration in period 2 incorporates separation. Since we are interested in truly strategic interaction, we will assume  $v > 2t$  in the sequel. Under this assumption case a) can be ruled out for both firms.

Next we will characterize the sufficiently large switching barriers which make it possible to sustain monopolistic prices in period 2 as a noncooperative equilibrium. For this reason we have to make sure that firms' undercutting incentives are eliminated through the switching costs. For that purpose we consider a customer located at  $k_1 + x$  ( $0 < x < 1 - k_1$ ), thereby belonging to firm B's market share in period 1. This customer would not switch to A in period 2 if

$$v - p_2^A - (k_1 + x)t - s < v - p_2^B - (1 - (k_1 + x))t$$

meaning that

$$p_2^B - p_2^A < s - (1 - 2(k_1 + x))t.$$

Now substituting  $p_2^B = v - (1 - k_1)t$  into the inequality above we find that a switching cost satisfying



$$s > v - p_2^A - (k_1 + 2x)$$

would deter the arbitrary B-oriented customer located at  $k_1 + x$  from switching. Equivalently, in the presence of the switching cost  $s$  firm A could capture this arbitrary type-B customer in period 2 by charging a price satisfying

$$p_2^A < v - (k_1 + 2x)t - s .$$

Is it worthwhile for firm A to undercut? By undercutting firm A could make a maximal profit of

$$\Gamma(v, s) = \arg \max_x (k_1 + x)(v - (k_1 + 2x)t - s) .$$

In principle, a necessary condition for achieving the maximal profit associated with undercutting would prescribe that the undercutting is made so as to capture customers up until

$$x^* = \frac{v - s}{4t} - \frac{3}{4}k_1 .$$

However, as long as the switching cost is not too close to the reservation value,  $v$ , i.e. as long as  $s < v - (4 - k_1)t$ , the optimal undercutting would call for firm A to reach all of B's period-1 customers.<sup>6</sup> This corresponds to  $x = 1 - k_1$  being the corner solution of the optimization problem above. In this case we find optimal undercutting to generate the profit

$$\Gamma(v, s) = 1 [v - (2 - k_1)t - s] .$$

Consequently, undercutting is unprofitable for firm A if and only if

$$[v - (2 - k_1)t - s] < k_1 [v - k_1 t]$$

Through direct calculation we find that  $s > v(1 - k_1)$  defines a sufficient condition for  $p_2^A = v - k_1 t$  to constitute a best response to  $p_2^B = v - (1 - k_1)t$ . In the presence of this

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<sup>6</sup> Intuitively, at switching costs close to the reservation value it would not be in the interest of firm A to meet the participation constraint of customers located sufficiently far away. Furthermore, switching costs approaching the reservation value  $v$  do not seem to be empirically plausible.

switching cost barrier firm A has no incentive to undercut. Consequently, firm A would not have an incentive to capture any of those consumers, who had a period-1 customer relationship with firm B. Based on completely analogous arguments one can find that  $s > vk_1$  forms a sufficient condition for making B avoid undercutting so as to capture period-1 customers of firm A.

We can summarize our arguments above in the following Proposition.

**Proposition 3.2 (period-2 prices):** *With sufficiently significant switching costs satisfying  $\max(vk_1, v(1-k_1)) < s < \min(v-(4-k_1)t, v-(4-(1-k_1)t))$  and with sufficiently intense competition, i.e.  $t \leq \frac{v}{2}$ , the Nash equilibrium prices in period 2 are given by*

$$p_2^A = v - k_1 t \tag{1}$$

$$p_2^B = v - (1 - k_1)t . \tag{2}$$

From Proposition 3.2 we can conclude that the switching cost barrier required to sustain the price combination defined by (1) and (2) as an equilibrium in period 2 is higher the higher the degree of asymmetry inherited from period 1. Namely, a firm endowed with a small market share will have a stronger incentive to attract customers attached with the rival firm and, consequently, this increased incentive needs to be counterbalanced by a higher switching cost threshold. In other words, a symmetric market structure in period 1 makes the collusive prices (1) and (2) as well as the customer relationships established in period 1 survive the renewed round of competition at minimal switching costs. In this respect switching costs serve as a more effective device for competition deterrence the more symmetric is the inherited market structure.

We should repeat that the assumption placing an upper limit of the switching costs is made simply for reasons of convenience, but it plays no critical role from the point of view of the validity of Proposition 3.2. In fact, we do not view this limitation to exclude economically interesting cases, in particular not for sufficiently intense competition with “small” transportation costs.

Under the conditions of Proposition 3.2, the period-2 profits  $\pi_2^A = (v - k_1 t) k_1$  and  $\pi_2^B = (v - (1 - k_1) t) (1 - k_1)$  are monotonically increasing in the market shares inherited from period 1. Because of the lock-in effect created by customer relationships established in period 1, firms have incentives to compete aggressively for market shares in period 1. This is precisely what strategies with introductory offers intend to achieve.

b) *introductory offers*

Let us now solve for the equilibrium prices  $p_1^A$  and  $p_1^B$  in period 1. Rational consumers understand that they will be locked-in for repeat business in later periods. Hence, they discount future expected costs when deciding which product to patronize in period 1. A consumer located at  $x$  derives expected utility  $v - p_1^A - xt + \delta_B(v - p_2^A + xt)$  from purchasing product A and  $v - p_1^B - (1 - x)t + \delta_B(v - p_2^B + (1 - x)t)$  from product B. The critical consumer  $k_1$ , indifferent between the two products offered in period 1, is determined by

$$p_1^A + k_1 t + \delta_B(p_2^A + k_1 t) = p_1^B + (1 - k_1)t + \delta_B(p_2^B + (1 - k_1)t). \quad (3)$$

Substituting period-2 prices (1) and (2) into (3) we find that the critical consumer cannot expect any positive future utility. All potential future surplus is extracted by the firms. Accordingly, the address of the indifferent consumer is independent of his discount factor and any other potential period-2 concerns.<sup>7</sup> Solving (3) yields the location

$$k_1 = \frac{1}{2} + \frac{1}{2t}(p_1^B - p_1^A). \quad (4)$$

Provided that the critical consumer defined by (4) decides to buy at all, the period-1 market share of firm A (B) captures all customers with addresses  $k \leq k_1$

( $k \geq k_1$ ). Firms maximize overall profits  $\pi^A = p_1^A k_1 + \delta_s \pi_2^A$  and  $\pi^B = p_1^B (1 - k_1) + \delta_s \pi_2^B$ . Hence firm A and firm B simultaneously choose prices to solve the optimization problems  $\max_{p_1^A} (p_1^A + \delta_s (v - k_1 t)) k_1$  and  $\max_{p_1^B} (p_1^B + \delta_s (v - (1 - k_1) t)) (1 - k_1)$ , respectively. These profit functions are quadratic and concave in period-1 prices. The necessary first-order conditions are

$$\left(1 + \frac{\delta_s}{2}\right) k_1 - \frac{1}{2t} (p_1^A + \delta_s (v - k_1 t)) = 0 \quad \text{and}$$

$$\left(1 + \frac{\delta_s}{2}\right) (1 - k_1) - \frac{1}{2t} (p_1^B + \delta_s (v - (1 - k_1) t)) = 0.$$

Hence, the system of equations

$$\begin{pmatrix} 2 + \delta_s & -(1 + \delta_s) \\ -(1 + \delta_s) & 2 + \delta_s \end{pmatrix} \begin{pmatrix} p_1^A \\ p_1^B \end{pmatrix} = ((1 + \delta_s)t - \delta_s v) \begin{pmatrix} 1 \\ 1 \end{pmatrix}$$

determines the unique subgame perfect equilibrium.<sup>8</sup>

**Proposition 3.3 (Subgame perfect Nash equilibrium)** *With sufficiently significant switching costs and with sufficiently intense competition, i.e. under the conditions of Proposition 3.2, there is a unique subgame perfect Nash equilibrium. The period-1 equilibrium prices are given by  $p_1^A = p_1^B = (1 + \delta_s)t - \delta_s v$ , whereas the period-2 prices are determined in Proposition 3.2.*

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<sup>7</sup> Basically, the critical consumer's address coincides with the address a myopic consumer disregarding any future purchases would have selected.

<sup>8</sup> It should be recalled that marginal costs were normalized to zero. Thus, formally negative prices should be interpreted as period-1 prices below marginal costs.

In the absence of firm heterogeneity, the equilibrium is symmetric. Moreover, in equilibrium no switching takes place in period 2, since the lock-in effects are sufficiently strong. Firms understand the profitability of period-2 sales to locked-in consumers and, hence, in equilibrium compete aggressively for new customers in period 1 as long as future period-2 profits are taken into account, i.e. as long as they base their calculations on a positive discount rate  $\delta_s > 0$ . In the limiting case of complete discounting (or myopic firms), i.e.  $\delta_s = 0$ , firms charge the standard Hotelling equilibrium prices in period 1. Otherwise, when  $\delta_s > 0$ , we can infer from Proposition 1 that firms discount period-1 prices by  $\delta_s(v-t) > 0$ . Hence, our terminology and the interpretation of period-1 prices as introductory offers. Note also that the introductory discount is larger than the discounted period-2 equilibrium prices.

Finally observe that the presence of switching costs is necessary for the emergence of introductory offers. In the absence of switching costs, i.e. when  $s=0$ , the unique subgame perfect Nash equilibrium of the two-period game predicts a repetition of the one-shot equilibrium of the standard Hotelling model. Accordingly, prices are identical across periods and introductory discounts do not emerge in that case.

On the basis of Propositions 3.2 and 3.3 the overall dynamic equilibrium profits can now easily be determined. Since equilibrium prices are symmetric firms will split the market evenly.

**Corollary 3.4 (Overall equilibrium profits):** *When switching costs are significant and when competition is sufficiently intense firms (as characterized in detail in Proposition*

*3.2) equilibrium profits are  $\pi^A = \pi^B = \frac{t}{2} (1 + \delta_s) - \delta_s \frac{t}{4}$ .*

It is interesting and important to note that the discounted value of the profits generated through the equilibrium characterized in Proposition 3.3 is actually lower than that associated with repeated Hotelling competition in the static sense. In the latter case, there is no strategic intertemporal link, and thereby no switching cost barriers are created. Thus, in that case the Nash equilibrium of the repeated Hotelling game constitutes the unique subgame perfect equilibrium generating the intertemporal profit

$\hat{\pi}^A = \hat{\pi}^B = \frac{t}{2}(1 + \delta_s)$ . In other words, in the absence of switching costs introductory offers do not arise in industry equilibrium. At the same time and for precisely that reason, industry profitability is higher when switching costs are absent.

Thus, when the switching costs are sufficiently significant, when competition is sufficiently intense (as characterized in detail in Proposition 3.2) and when firms are not completely myopic, i.e.  $\delta_s > 0$ , the following proposition holds.

**Proposition 3.5 (Switching costs and market profitability):** *Endogenously determined discriminatory prices will generate market outcomes which are more competitive in the presence of switching costs than in their absence, i.e. industry profitability is higher in the absence of switching costs meaning that  $\pi^A = \pi^B < \hat{\pi}^A = \hat{\pi}^B$ .*

Contrary to most switching cost models (see Klemperer (1995)), our model suggests that firms would like to eliminate switching costs. If significant switching costs exist and introductory discounts are feasible, firms by necessity compete aggressively for market share in period 1. Hence equilibrium discounts exceed period-2 prices, and thus reduce overall industry profitability.

Our result suggests that the implications of switching costs for industry profitability, and industry structure, may crucially depend on the ability of firms to price discriminate based on consumer histories. We will discuss this issue in more detail in the next section where we compare our result to a version of the model of Klemperer (1987), which does not allow for introductory offers or other forms of (intertemporal) price discrimination.

#### 4. Industry Equilibrium with No Intertemporal Discrimination

In order to highlight the significant role of intertemporal price discrimination, we formulate a version of Klemperer's (1987) switching cost model, which does not allow introductory offers. For that purpose we consider the two-period Hotelling model, but modify it by assuming that in period 2 a proportion  $\mu > 0$  of new consumers enters the market replacing the same mass of exiting older consumers. The complementary

proportion,  $1 - \mu$ , of the customers faces sufficiently high switching costs. Thus, in period 2 the duopolist faces the tradeoff between exploiting incumbent customers and competing for new customers emerging in period 2. In contrast to the previous section we now assume that firms are unable to distinguish new customers from old ones.

As long as switching costs are sufficiently large to deter the customer base inherited from period 1 from changing supplier, firm A decides on its period-2 price,  $p_2^A$ , in order to maximize<sup>9</sup>

$$p_2^A [(1-\mu)k_1 + \mu k_2] ,$$

where  $k_t$  denotes the location of the indifferent customer in period  $t$  ( $t = 1,2$ ). Of course,  $k_2$  is determined by the period-2 prices, whereas  $k_1$  characterizes the market shares inherited from period 1. Straightforward optimization shows that the equilibrium prices in period 2 can be expressed conditional on  $k_1$  according to

$$\begin{pmatrix} p_2^A \\ p_2^B \end{pmatrix} = \begin{pmatrix} t + \frac{2(1-\mu)}{3\mu} (1+k_1)t \\ t + \frac{2(1-\mu)}{3\mu} (2-k_1)t \end{pmatrix}. \quad (5)$$

Thus, the location of the customer indifferent between the two products in period 2 must be given by

$$k_2 = \frac{1}{2} + \frac{1-\mu}{3\mu} (1-2k_1). \quad (6)$$

In period 1 rational consumers understand that they will be locked-in for repeat business in later periods. Also such consumers take into account the probability of exit prior to period 2. Hence, they discount future expected costs when deciding which product to patronize in period 1. The critical consumer  $k_1$ , indifferent between the two products offered in period 1, is now determined by

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<sup>9</sup> Analogously, firm B sets its period-2 price  $p_2^B$  in order to maximize  $p_2^B [(1-\mu)(1-k_1) + \mu(1-k_2)]$ .

$$p_1^A + k_1 t + \delta_B (1 - \mu) (p_2^A + k_1 t) = p_2^B + (1 - k_1)t + \delta_B (1 - \mu) (p_2^B + (1 - k_1)t). \quad (7)$$

Solving (5) with respect to  $k_1$  yields

$$k_1 = \frac{1}{2} + \frac{p_1^B - p_1^A}{2t \Delta}, \quad (8)$$

where  $\Delta$  is defined by

$$\Delta = 1 + \delta_B (1 - \mu) \left(1 + \frac{2(1 - \mu)}{3\mu}\right). \quad (9)$$

Substituting (9) back into (6) we find that

$$k_2 = \frac{1}{2} + \frac{1 - \mu}{\mu} \frac{p_1^B - p_1^A}{3t \Delta}. \quad (10)$$

Consequently, from (10) we can observe that firm A's period-2 market share is an increasing function of its period-1 price. Namely, by substituting (8) into (5) we find that

$$p_2^A = \frac{1}{2} + \frac{(1 - \mu) (p_1^B - p_1^A)}{6t \Delta}. \quad (11)$$

Thus, a higher price in period 1 tends to make firm A more aggressive in period 2, because in that case firm 1 will have a lower installed base of period-1 customers, which will increase the incentives to capture new customers in period 2.

By making use of (8), (10) and (11) we find firm A's equilibrium profit in period 2 to be given by

$$\pi_2^A(p_1^A, p_1^B) = \frac{t}{2\mu} \left[ 1 + \frac{(1 - \mu) (p_1^B - p_1^A)}{3t \Delta} \right]^2. \quad (12)$$



The indirect profit function (12) characterizes the period-2 consequences of the pricing decisions in period 1. In period 1 firm A decides on its period-1 price in order to maximize the discounted two-period objective function<sup>10</sup>

$$\Gamma(p_1^A, p_1^B) = p_1^A \left[ \frac{1}{2} + \frac{p_1^B - p_1^A}{2t\Delta} \right] + \delta_s \pi_2^A(p_1^A, p_1^B). \quad (13)$$

Of course, the analogous optimization problem can be formulated for firm B. The period-1 reaction functions of firms A and B can be expressed according to

$$\begin{pmatrix} 2 - 2\delta_s \frac{(1-\mu)^2}{9\mu\Delta} & -(1 - 2\delta_s \frac{(1-\mu)^2}{9\mu\Delta}) \\ -(1 - 2\delta_s \frac{(1-\mu)^2}{9\mu\Delta}) & 2 - 2\delta_s \frac{(1-\mu)^2}{9\mu\Delta} \end{pmatrix} \begin{pmatrix} p_1^A \\ p_1^B \end{pmatrix} = t \begin{pmatrix} \Delta - 2\delta_s \frac{1-\mu}{3\mu} \\ \Delta - 2\delta_s \frac{1-\mu}{3\mu} \end{pmatrix}.$$

Solving the system of equations determined by these reaction functions we find the equilibrium prices in period 1 to be given by

$$\begin{pmatrix} p_1^A \\ p_1^B \end{pmatrix} = t \begin{pmatrix} \Delta - \delta_s \frac{2(1-\mu)}{3\mu} \\ \Delta - \delta_s \frac{2(1-\mu)}{3\mu} \end{pmatrix} \begin{pmatrix} 1 \\ 1 \end{pmatrix}$$

or equivalently

$$\begin{pmatrix} p_1^A \\ p_1^B \end{pmatrix} = t \left( 1 + \delta_B (1-\mu) + \frac{2(1-\mu)}{3\mu} [(1-\mu)\delta_B - \delta_s] \right) \begin{pmatrix} 1 \\ 1 \end{pmatrix}. \quad (14)$$

From (14) we can conclude that the equilibrium prices in period 1 are decreasing as a function of  $\mu$ . This means that higher switching costs will induce higher equilibrium prices in period 1 in the precise sense that the period-1 equilibrium prices are higher, the larger the proportion of customers affected by switching costs.

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<sup>10</sup> We assume the sufficient second-order conditions to hold. Explicitly, concavity of the objective function requires that  $\delta_s < \frac{9\mu\Delta}{(1-\mu)^2}$ .

Substituting the equilibrium prices (14) into the discounted two-period objective function (13) we find the equilibrium profit to be given by

$$\Gamma^* = \Gamma(p_1^A, p_1^B) = \frac{t}{2} \left[ 1 + \delta_B (1 - \mu) \left[ 1 + \frac{2(1 - \mu)}{3\mu} \right] + \delta_s \frac{1 + 2\mu}{3\mu} \right] . \quad (15)$$

It can immediately be seen that the equilibrium profit (15) is strictly decreasing as a function of  $\mu$ . Thus, in line with our interpretation regarding the equilibrium prices, higher switching costs will induce higher equilibrium profits.

In particular, in order to evaluate the profit implications of switching costs, the equilibrium profit (15) can be compared with the equilibrium profit without switching costs. In the absence of switching costs the intertemporal equilibrium configuration involves a repetition of the static equilibrium associated with the Hotelling model. More precisely, in the absence of switching costs the equilibrium profits are

$$\Gamma^{NS} = \frac{t}{2} [1 + \delta_s] . \quad (16)$$

By straightforward comparison of (15) and (16) we find the inequality

$$\Gamma^* > \Gamma^{NS} \quad (17)$$

to always hold.

We can summarize our findings regarding the impact of switching costs on the performance of a duopoly industry with in the absence of intertemporal price discrimination.

**Proposition 4.1 (Equilibrium prices and profits as functions of the switching costs):**  
*In the absence of intertemporal price discrimination higher switching costs will induce higher equilibrium prices and higher industry profits in the sense that both period-1*

*equilibrium prices and industry profits are higher, the larger the proportion of customers affected by switching costs.*

In particular, we can conclude that firms have a collective incentive to design business strategies generating barriers of switching costs in industries where intertemporal price discrimination does not belong to the viable set of strategic instruments.

## 5. Discussion

Switching costs constitute a theoretical rationale commonly used to explain introductory offers. Most prominently, Klemperer ((1987), (1995)) argues that in the presence of switching costs, introductory offers may be an effective instrument to lock-in customers and, thus, to establish valuable customer relationships. Since the locked-in consumers will find it costly to switch, captured customers are open for exploitation by incumbents charging higher prices in the future. Hence, according to Klemperer ((1987), (1995)) both individual firms and industries will generally profit from the existence of switching costs. Moreover, antitrust authorities should try to prevent the strategic creation of switching costs.

However, in Klemperer's models firms are not able to engage in intertemporal price discrimination. Thus, he actually uses the terminology of introductory offers to simply refer to the fact that the presence of "high" switching costs induces equilibrium prices to exhibit a particular systematic time structure: an initial stage with low prices followed by a mature stage of high prices when firms exploit the switching cost barriers.

We show that the negative antitrust implications of introductory offers do not apply to markets, where firms can price discriminate between different vintages of consumers. While the time pattern of prices conforms precisely with the standard view, we show that the discounted sum of industry profits are lower in the presence of switching costs, when firms can charge different prices to different vintages of consumers. These results emerge in precisely those variants of the Hotelling model, on which much of the earlier literature (v. Weizsäcker, 1984, Klemperer, 1987) is based. In such a model we show that when firms can target new consumers, and discriminate against repeat consumers, they will compete aggressively for new customers by charging

low prices and exploit captive customers on repeat business through protection offered by switching costs. This is precisely what introductory offers aim to achieve. In our model, competition for market share is so intense in period 1 that the gains from relaxed competition in future period cannot compensate. In this sense, introductory offers have favorable welfare implications in the presence of switching costs. Consequently, our analysis offers a formalized argument for the policy conclusion that the strategic use of introductory offers should be promoted, not banned, in environments where firms are able to discriminate across different vintages of customers.<sup>11</sup>

## **6. Concluding Comments**

This analysis has focused on a two-period version of a Hotelling duopoly. We have shown that introductory offers will emerge endogenously in industries characterized by switching costs when firms can price discriminate based on purchase histories. In such an environment firms can target new consumers, and discriminate against repeat consumers. In the presence of switching costs firms will under such circumstances compete aggressively for new customers by charging low prices and exploit captive customers on repeat business. We show that the price-reducing effect valid for the initial stage of introductory offers will dominate relative to subsequent price-increasing effect associated with the exploitation of locked-in customers. In this respect endogenously determined competition based on discriminatory introductory offers between symmetric oligopolists for the exploitation of profitable future lock-in configurations will lead to outcomes which are unambiguously more competitive in the presence of switching costs than in their absence. Thus, our analysis offers a formalized argument for the policy conclusion that the strategic use of introductory offers should be promoted, not banned, in environments where firms are able to discriminate across different vintages of customers.

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<sup>11</sup> In the context of the banking industry the terms of new loans are typically made conditional on the client's repayment history. To the extent that banks learn private information about the quality of their clients during their customer relationship, switching costs arise endogenously in this industry. Interestingly, and in line with our present argument, information sharing among banks may serve as a commitment mechanism to reduce competitive pressure (Gehrig, Stenbacka, 2001).

The welfare implications of introductory offers in presence of substantial switching costs do not, however, mean that introductory offers are of no concern from a more general antitrust perspective. The welfare conclusions reached for symmetric oligopolies rather imply that introductory offers in the presence of substantial switching costs are anti-competitive only insofar as they serve as a strategic device to make market dominance persistent. In other words, in asymmetric oligopolies the strategic creation of switching costs through introductory offers may very well serve as a device to increase concentration even further. Our model could very well be used to study this issue more closely by shifting attention to an asymmetric duopoly where the firms have different costs.

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