Two at the Top: Quality Differentiation in Markets with Switching Costs*

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We explore the effects of switching costs on the subgame perfect quality decisions of oligopolists with repeated price competition. We establish a strong strategic quality premium. We show that competition for the establishment of customer relationships will eliminate low-quality firms in period 1 and that low-quality firms can survive only based on poaching profits. The equilibrium configuration is characterized by an agglomeration of two providers of top-quality as soon as switching cost heterogeneity is sufficiently significant. We demonstrate a finiteness property, according to which the two top-quality firms dominate the market with a joint market share exceeding 50 %.

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1. Introduction

In existing models of vertical product differentiation firms typically relax price competition by choosing different levels of quality (Shaked and Sutton, 1982). Nevertheless in many industries it appears that several competing firms simultaneously supply products located at the highest available level of the quality spectrum. The rating industry is dominated by the rivals Standard & Poors and Moodys. The auction houses Sotheby's and Christie's are the dominant auction houses for art auctions and these rivals exhibit a roughly similar economic performance. The aircraft industry is characterized by fairly symmetric duopoly competition between Airbus and Boeing and it is indeed hard to find evidence of systematic quality differences between their products. In these examples, rivalry between the two leading firms is intense, but yet no single firm seems to clearly dominate its rival(s) in terms of quality. Similarly, in the micro-processor industry each generation of microprocessors is clearly dominated by two firms, Intel and AMD (American Microprocessor Devices). Finally, the United States General Accounting Office's report to a Senate committee (2003) documents in great detail that the accounting and audit services industry has a structure with two dominant accounting firms when the client firms are classified according to their industrial sector. In fact, for a spectrum of different investigated industrial sectors the two dominant accounting firms have a joint market share in the range between 70 % and 95 %.

These observations are at striking variance with the predictions of the existing literature on vertical product differentiation. Virtually all the existing models of vertical product differentiation, where firms offer quality-differentiated products, have the property that only one firm provides the highest quality product, and all other firms offer products representing distinctly lower qualities. In these models the top-quality firm typically enjoys the highest mark-up, market share and profit.[1] None of these models generates market structures where there could be any agglomeration of competitors offering similar (or even identical) vertical characteristics.

On a more general level, the idea of firms offering identical commodities and competing in prices has virtually no theoretical basis in industrial economics. In equilibrium firms will typically offer differentiated, and hence different products.

In this paper we argue that the traditional vertical differentiation literature has neglected switching costs as a crucial characteristic of those industries, where quality competition is an important dimension. If an airline demands an extra set of jets of a given size class, it might have strong incentives to stay with the incumbent provider in order to economize on the cost of training new crews and mechanics as well as spare parts and maintenance. In other words, switching the aircraft may be quite expensive for an airline. Likewise accountants or rating agencies familiar with a company from previous encounters will cause less of a burden to management time than a new accounting team. Again, switching accountants imposes potentially significant switching costs on management. Sellers of valuable pieces of art might face substantial costs of switching from one auction house to another as the auction house has to convince itself of the authenticity in order to maintain its reputation.[2]

In the presence of switching costs, incumbents have an interest to exploit their monopoly power on those captive clients with an established customer relationship. On the other hand, the very same firm may aggressively poach for new customers, currently loyal to a rival. Hence, switching cost also invite price discrimination between attached and unattached consumers.

In this study we show that switching costs and the possibility to price discriminate generate systematic and interesting interactions with product choice. In particular, switching costs will help to segment the market. Hence, even in a duopoly two high-quality firms are able to share the market and still earn positive profits in the presence of switching costs. While intense ex ante price competition reduces any advantages to incumbency, competition for poaching revenues is limited when the top quality is offered by only two firms.

We focus on vertically differentiated markets where switching cost heterogeneity dominates relative to income heterogeneity. We prove that low-quality producers have a particularly strong incentive to close the quality gap to high-quality producers despite the bite of price competition. Under such circumstances the equilibrium configuration will be characterized by an agglomeration of two firms at the top of the quality spectrum. In this sense our result differs strongly from standard vertical differentiation models, where the degree of differentiation is always strictly positive and no two firms would offer identical qualities. In our model the incentives created by poaching profits dominate relative to the competition-relaxing effects of quality differentiation. This holds true as long as the poaching profits survive, i.e. as long as no more than two firms produce the top quality. However, our results do not invalidate the property

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[1] See, for example, Shaked and Sutton (1982), (1983) or Gehrig (1996).

[2] We should hasten to say that the industries mentioned in this introduction serve illustrative purposes. Of course, empirically many features in addition to switching costs contribute to the industrial structure of these industries. Likewise, it should be emphasized that we make no claim advocating the feature with two top quality providers as a general empirical regularity. However, these industries exhibit regularities that cannot be easily explained by standard models of product differentiation.

of a natural oligopoly found in earlier models of vertical product differentiation (for example, Shaked and Sutton (1982) and (1983)), since entry is limited by the profitability of poaching revenues. In particular, our theory predicts that there will never be more than two firms at the top of the quality spectrum. This generalization of the finiteness property is specific for the combination of switching cost differentiation and vertical product differentiation, and this property does not hold in environments where the vertical product differentiation is combined with a standard type of horizontal product differentiation.

Our analysis is structured as follows. Section 2 presents the basic two-period model of consumers with switching costs. Sections 3 and 4 analyze price and quality competition for duopolistic industries where the consumers have a fixed income level. Section 5 explores some implications of our theory for industrial structure and welfare. Section 6 generalizes the duopoly result to the case of simultaneous income and switching cost heterogeneity and distinguishes switching cost differentiation from other forms of horizontal differentiation. Finally, Section 7 offers concluding comments.

2. A Model of Quality Choice with Switching Costs

We consider a market with repeat purchases of non-durable commodities or services in two periods. In this respect our model can be seen as a dynamic extension of Shaked and Sutton (1982). The commodities can be offered at different quality levels $q \in [\upsilon, \omega]$, where ω (υ) denotes the highest (lowest) available quality ($\upsilon > 0$).

Consumers value quality. Their valuation varies with income *y*. Per-period preferences are quasi-linear in the composite good z_t and can be represented as

$$U_t(q_t, y_t, z_t) \;=\; q_t y_t - z_t \;,\;\; t = 1,2\,. \tag{1}$$

Aggregate inter-temporal utility is separable across time periods. Future consumption is discounted at the rate $0 < \delta \leq 1$ according to

$$U(q_1, y_1, z_1, q_2, y_2, z_2) \;=\; U_1(q_1, y_1, z_1) \;+\; \delta U_2(q_2, y_2, z_2). \tag{2}$$

Consumers are assumed to face consumer-specific switching costs. Extending Chen (1997)[3] we assume that the switching costs s of a consumer with income y are uniformly distributed on $[\underline{s}, \bar{s}]$ with a lower bound $\underline{s}$ such that $0 \le \underline{s} < \bar{s}$.

The switching costs s can be justified by, for example an inspection cost, which has to be paid each time a new product is acquired. This inspection cost may, for example, capture a learning cost, e.g. the opportunity cost of getting acquainted with a new piece of software or a new operating system. As another example, the switching cost could capture the initial x-ray a dentist typically takes before starting any operation. It has to be paid each time another dentist is selected. Likewise a tax consultant needs to be familiarized with the personal income situation for each new customer.

We initially assume that income is fixed at $y_t = y$ in order to highlight a configuration where switching cost heterogeneity dominates completely relative to income heterogeneity. This assumption is at variance with Shaked and Sutton (1982), who require positive income dispersion in order to allow for entry of more than one firm.[4] Since in our framework entry is possible even in the absence of income heterogeneity, we concentrate on the simpler case with fixed income.[5] Furthermore, this case allows us to separate the effects of switching cost differentiation from the implications of heterogeneity in income. For simplicity assume that production takes place at constant and identical marginal costs normalized to zero.[6] Only a sunk cost of entry will have to be paid.

The timing of decisions is as follows: With an established industry structure firms select product quality. Then for given and mutually observed qualities the competing firms determine prices in two rounds of competition. In the second round of price competition we allow for history-dependent pricing. In particular, firms can discriminate between their own customers and those consumers with an established customer relationship with a rival. Thus firms are allowed to poach the rivals' customers, while they typically treat their loyal customers differently. Prices to

[3] Chen (1997) focuses on uniform switching costs on intervals of the type $[0, \bar{s}]$.

[4] Strictly speaking, also the quasi-linear specification deviates from Shaked and Sutton's (1982) original specification of preferences. In an earlier version (Gehrig and Stenbacka (2005)) we have analyzed a multiplicative specification of preferences in line with Shaked and Sutton and arrived at qualitatively identical results.

[5] We demonstrate in Section 6 that our main results carry over to the more complex case with simultaneous income and switching cost heterogeneity.

[6] While the assumption of identical costs for commodities of different qualities may not seem realistic, Shaked and Sutton (1982) show that even under this extreme assumption firms may still strategically select the production of different qualities in order to relax price competition.

loyal customers are denoted by p_1^i and p_2^i, while poaching prices in period 2 are denoted by r^i for firms *i=H,L.*

For most of the analysis we are interested in the set of subgame perfect Nash equilibria of this three-stage game. Section 3 analyses the price equilibrium in periods 1 and 2 before section 4 presents the analysis of the quality choice. In section 6 we generalize our model to simultaneously capture income and switching cost heterogeneity.

3. Price Competition with Fixed Qualities

In this section we analyze price competition for fixed quality choices. Further, we assume that the consumers are all endowed with the same income, y. We will here analyze the case of duopoly and subsequently discuss the general case with more than 2 firms in Section 5. Let $q_L \le q_H$.[7]

a) Duopolistic Price Competition in Period 2

In period 2 firms can price discriminate on the basis of customer purchase histories. Firms want to charge particularly attractive prices to rivals' customers in order to poach these, while at the same time exploit locked-in customers up to the limit determined by the customer-specific switching cost. However, the poaching prices of rivals pose a competitive threat to the exploitation of locked-in customers and for that reason incumbent firms may have to charge low enough prices to loyal customers in order to prevent those from being successfully poached by competitors.

Poaching will induce switching only if the poaching offers undercut incumbent prices by more than the switching cost. A former buyer of the high-quality product (q_H) will switch to a low-quality product (q_L) if and only if[8]

$$q_H y - p_2^H \; < \; q_L y - r^H - s \tag{3a}$$

and a former buyer of a low-quality product will switch if and only if

$$q_L y - p_2^L \; < \; q_H y - r^L - s \,. \tag{3b}$$

[7] At this stage it does not matter which firm, 1 or 2, provides the higher quality. We also consider identical qualities.
[8] We have introduced switching costs in the additive way for reasons of simplicity. In an earlier version (Gehrig, Stenbacka, 2005) we focused on a multiplicative specification so as to keep the model as close to Shaked and Sutton (1982). This specification has also been used by, for example, Gabszewicz, Thisse (1979, 1980). Strictly speaking, the multiplicative structure imposes the structure that the effective switching costs increase with the quality of the product one switches to. However, this is not a critical assumption from the point of view of our qualitative results.

Consequently, switching will occur especially for consumers with low switching costs, whereas consumers with higher switching costs tend to be more loyal.

Denote the quality differential by $\Delta = q_H - q_L$. Then the critical level of switching costs, below which the customer finds it optimal to switch to the competitor, is given by

$$\hat{s}_H = \quad p_2^H - r^H - \Delta y \tag{4a}$$

for former customers of the high-quality product, whereas the critical switching cost is

$$\hat{s}_L = \quad p_2^L - r^L + \Delta y \tag{4b}$$

for customers belonging to the inherited market share of the low-quality firm.

Let us consider price competition in period 2 for formerly high quality consumers first. Both the incumbent and the poaching firm maximize expected profits given by

$$\max_{p_2^H} \quad p_2^H \left(\bar{s} - \hat{s}_H \right) \qquad , \tag{5a}$$

$$\max_{r^H} \quad r^H \left(\hat{s}_H - \underline{s} \right) \qquad , \tag{5b}$$

respectively. Likewise the objective functions in the market segment of former customers of the low-quality firm read as:

$$\max_{r^L} \; r^L \left(\hat{s}_L - \underline{s} \right) \tag{6a}$$

$$\max_{p_2^L} \; p_2^L \left(\bar{s} - \hat{s}_L \right) \quad . \tag{6b}$$

Due to price discrimination the period-2 market is separated into segments of former buyers of the high-quality product and former buyers of the low-quality product. Competition for former buyers of the high-quality product involves the high-quality incumbent and the low-quality poacher, while competition for the former buyers of the low-quality product involves the low-quality incumbent and the high-quality poacher. Standard analysis generates equilibrium prices and the corresponding profits from incumbency and from poaching.

Proposition 3.1 (Period-2 Prices): *Let* $2\underline{s} \le \overline{s}$.

i) When $\overline{s} - 2\underline{s} \ge \Delta y$ *both firms engage in poaching in period 2. Equilibrium prices are:*

$$\begin{pmatrix} p_2^H \\ r^H \end{pmatrix} = \frac{1}{3}\begin{pmatrix} 2\overline{s} - \underline{s} + \Delta y \\ \overline{s} - 2\underline{s} - \Delta y \end{pmatrix} \tag{7a}$$

$$\begin{pmatrix} r^L \\ p_2^L \end{pmatrix} = \frac{1}{3}\begin{pmatrix} \overline{s} - 2\underline{s} + \Delta y \\ 2\overline{s} - \underline{s} - \Delta y \end{pmatrix} . \tag{7b}$$

ii) When $\overline{s} - 2\underline{s} < \Delta y$ *firm L abstains from poaching and firm 1 charges the limit price that keeps firm L inactive.*

*Proof***:** The first order conditions of the quadratic objective functions (5a) and (5b.) read

$$\begin{pmatrix} p_2^H \\ r^H \end{pmatrix} = \begin{pmatrix} 2 & -1 \\ -1 & 2 \end{pmatrix}^{-1} \begin{pmatrix} \overline{s} + \Delta y \\ -\underline{s} - \Delta y \end{pmatrix} . \tag{8a}$$

Moreover the first order conditions of (6a) and (6b) read

$$\begin{pmatrix} r^L \\ p_2^L \end{pmatrix} = \begin{pmatrix} 2 & -1 \\ -1 & 2 \end{pmatrix}^{-1} \begin{pmatrix} -\underline{s} + \Delta y \\ \overline{s} - \Delta y \end{pmatrix} . \tag{8b}$$

Straightforward calculations yield the statements of Proposition 3.1.

Q.E.D.

The condition $2\underline{s} \le \overline{s}$ guarantees that the high quality provider always engages in poaching the low quality firm.

In order to interpret these results it is useful to rewrite the bounds on switching costs as $\underline{s} = \tilde{s} - \sigma$ and $\overline{s} = \tilde{s} + \sigma$. With this formulation $\tilde{s}$ can be interpreted as the mean switching cost, and σ as a measure of its dispersion. With this convention we can rewrite Proposition 3.1 as

Corollary 3.2 : *Let* $\tilde{s} \le 3\sigma$.

i) When $3\sigma - \tilde{s} \ge \Delta y$ *both firms engage in poaching in period 2. Equilibrium prices are:*

$$\begin{pmatrix} p_2^H \\ r^H \end{pmatrix} = \frac{1}{3}\begin{pmatrix} \tilde{s} + 3\sigma + \Delta y \\ -\tilde{s} + 3\sigma - \Delta y \end{pmatrix} \tag{9a}$$

$$\begin{pmatrix} r^L \\ p_2^L \end{pmatrix} = \frac{1}{3}\begin{pmatrix} -\tilde{s} + 3\sigma + \Delta y \\ \tilde{s} + 3\sigma - \Delta y \end{pmatrix} \quad . \tag{9b}$$

ii) When $3\sigma - \tilde{s} < \Delta y$ *firm L abstains from poaching and firm 1 charges the limit price that keeps firm L inactive.*

From (9a) and (9b) we can see that the period-2 prices are unambiguously increasing as functions of the dispersion. Essentially increased dispersion of the switching costs σ promotes differentiation and, thus, contributes to relaxing price competition. Higher switching costs per se, as measured by $\tilde{s}$, inhibit poaching, and, thus, endow incumbents with better protection against poaching.

Naturally, in equilibrium the poaching price is always lower than the incumbency price. Incumbents want to exploit the switching costs of their locked-in customers, while poaching the rival's customers at the same time. Active poaching and equilibrium customer switching from high to low quality take place, whenever the heterogeneity in switching costs is sufficiently large, i.e. when $\bar{s} - 2\underline{s} \geq \Delta y$. Otherwise, when this condition does not hold, poaching by the low-quality producer does not take place and the high-quality producer selects prices that just deter poaching from the low-quality producer. Furthermore, the high-quality producer always engages in poaching, and there will always be a positive measure of consumers switching from the low quality to the high quality producer – but not vice versa.

Proposition 3.3: *When* $\bar{s} - 2\underline{s} \geq \Delta y$ *poaching and equilibrium switching take place in both directions. Customers belonging to firm H's market segment switch if* $s < \hat{s}_H = \frac{1}{3}\left[\bar{s} + \underline{s} - \Delta y\right]$*, while customers belonging to firm L's market segment switch if* $s < \hat{s}_L = \frac{1}{3}\left[\bar{s} + \underline{s} + \Delta y\right]$*. In particular, we can conclude that* $\hat{s}_L > \hat{s}_H$.

Proof: Straightforward and omitted.

Proposition 3.3 captures the idea that the lock-in effects of business relationships are quality-contingent within the framework of models with vertical differentiation. In particular, Proposition 3.3 means that the switching cost threshold required to prevent a customer of a low-quality firm from switching is higher than the threshold required to keep a customer of a high-quality firm loyal. Thus, high-quality producers tend to have more loyal customers. In this respect, the production of a high-quality product is associated with a strategic premium as it is structurally more resistant to switching compared with a low-quality product. [9]

We next calculate the profits associated with the equilibrium prices. These profits are reported in

Proposition 3.4 (Period-2 Profits) *Expected profits from incumbency are*

$$\Pi_2(H) = \frac{1}{9}\left(2\overline{s} - \underline{s} + \Delta y\right)^2 \quad \textit{for the high-quality firm,} \tag{10a}$$

$$\Pi_2(L) = \frac{1}{9}\left(2\overline{s} - \underline{s} - \Delta y\right)^2 \quad \textit{for the low-quality firm.} \tag{10b}$$

The expected poaching profits are

$$\tilde{\Pi}_2(H) = \frac{1}{9}\left(\overline{s} - 2\underline{s} + \Delta y\right)^2 \quad \textit{for the high-quality poacher,} \tag{10c}$$

$$\tilde{\Pi}_2(L) = \frac{1}{9}\left(\overline{s} - 2\underline{s} - \Delta y\right)^2 \quad \textit{for the low-quality poacher.} \tag{10d}$$

In line with the standard literature on vertical differentiation (see, Shaked and Sutton (1982), (1983)), the high-quality producer enjoys a competitive advantage and correspondingly higher incumbency and poaching profits. Incumbency profits, however, do not necessarily universally outweigh poaching profits. Poaching profits of the high-quality producer may exceed incumbency revenues of a low quality producer.

It is worth observing already at this stage that the quality differential $\Delta = q_H - q_L$ favors the high-quality producer at the detriment of the low-quality producer, both for incumbency and for poaching revenues. Ultimately, as we will find out later on, this effect induces the low-quality producer to minimize the quality-gap to the high-quality producer.

In general, an increase in the expected value or in the dispersion of the switching costs, as measured by $\overline{s} - \underline{s}$ (or σ), tends to reduce the intensity of price competition and therefore benefits both firms. A similar effect is characterized in the horizontal differentiation model designed by Gehrig and Stenbacka (2004). In the limiting case of identical quality provision only

[9] This seems to be consistent with observations from, for example, the car industry, where high-quality brands

switching costs matter. In this case the incumbency revenues are double relative to the poaching revenues.

b) Duopolistic Price Competition in Period 1

We next proceed to analyze price competition in period 1. At this stage the competing firms rationally anticipate the period-2 equilibrium and internalize these effects into the decision making in period 1.

In period 1, consumers do not yet know the realization of their switching costs. For that reason consumers with identical incomes will exhibit identical purchasing behavior in period 1. The consumers simply select the product that yields the highest discounted expected utility to them. They are indifferent between the products if

$$q_L y - p_1^L + \delta\left[(q_L y - p_2^L)\frac{\bar{s}-\hat{s}_L}{\bar{s}-\underline{s}} + \int_{\underline{s}}^{\hat{s}_L} (q_H y - r^L - s)\frac{ds}{\bar{s}-\underline{s}} \right] =$$

$$q_H y - p_1^H + \delta\left[(q_H y - p_2^H)\frac{\bar{s}-\hat{s}_H}{\bar{s}-\underline{s}} + \int_{\underline{s}}^{\hat{s}_H} (q_L y - r^H - s)\frac{ds}{\bar{s}-\underline{s}} \right] . \tag{11}$$

Through re-arrangement of the indifference condition (11) we find that

$$p_1^H = p_1^L + \Delta y + \delta\left[(q_H y - p_2^H)\frac{\bar{s}-\hat{s}_H}{\bar{s}-\underline{s}} - (q_L y - p_2^L)\frac{\bar{s}-\hat{s}_L}{\bar{s}-\underline{s}} \right]$$

$$+ \frac{\delta}{\bar{s}-\underline{s}}\left[(q_L y - r^H)\,\hat{s}_H - (q_H y - r^L)\,\hat{s}_L \right] + \frac{\delta}{\bar{s}-\underline{s}}\left[\int_{\underline{s}}^{\hat{s}_L} s\,ds - \int_{\underline{s}}^{\hat{s}_H} s\,ds \right] . \tag{12}$$

From formulation (12) we can conclude that the customer is prepared to pay a premium for the high-quality product in period 1. This premium is higher the larger is the quality differential. This effect, which coincides with the insight from traditional models of vertical product differentiation, is captured by the second term in the right hand side of (12). The third term in the right hand side of (12) denotes the difference between the continuation utility within a customer

typically have a higher degree of customer loyalty.

relationship with the high-quality firm and that associated with the low-quality firm. This difference is positive and it adds to the premium for the high-quality product. The fourth term in the right hand side of (12) is negative. This captures that a period-1 customer of the high-quality firm will face less attractive poaching offers in period 2, and this effect reduces the quality premium in period 1. Finally, the last term in the right hand side of (12) adds to the quality premium, because it denotes the difference of the expected switching costs and from Proposition 3.3 we know that this difference is positive.

It should be emphasized that the quality premium described by (12) approaches the premium familiar from traditional models of vertical differentiation as the discount factor approaches zero, i.e. as the consumers turn completely myopic. Consistent with this observation, the quality premium differs more significantly from the traditional one, the higher is the discount factor.

Firms maximize expected intertemporal profits. Let μ_H denote the period-1 market share of the high-quality firm and μ_L the market share of the low-quality firm. Then intertemporal profits consist of the period-1 profits and the discounted incumbency and poaching profits achieved in period 2. This is expressed formally as follows

$$\Pi^H = \mu_H p_1^H + \delta\big(\mu_H \, \Pi_2(H) + (1-\mu_H)\,\tilde{\Pi}_2(L)\big) \tag{13a}$$

$$\Pi^L = \mu_L p_1^L + \delta\big(\mu_L \, \Pi_2(L) + (1-\mu_L)\,\tilde{\Pi}_2(H)\big), \tag{13b}$$

where, in addition, it holds that $\mu_L = 1 - \mu_H$.

From (13a) and (13b) we can conclude that the intertemporal profits are linear as functions of the market shares acquired in period-1. Therefore, in period 1, the low-quality firm can offer introductory discounts up to a limit determined by the return on a captive period-1 client. At this discount the low-quality firm breaks even. The high-quality firm just needs to match this price using the indifference relation (11) (or equivalently, (12)) and at that price the high-quality firm can still make a positive intertemporal profit on captive clients. Thus, in equilibrium, the high-quality firm will attract all consumers in period 1. The low-quality firm can only hope to poach consumers with low switching costs in period 2.

Proposition 3.5 (Period-1 Prices) *Equilibrium prices in period 1 are given by*

$$p_1^L \quad = \quad -\,\delta\big(\Pi_2(L) - \tilde{\Pi}_2(H)\big)$$

and

$$p_1^H \quad = \quad p_1^L \quad + \quad \Delta y \quad + \quad \delta\left[\;(q_H y - p_2^H)\,\frac{\bar{s} - \hat{s}_H}{\bar{s} - \underline{s}} - (q_L y - p_2^L)\,\frac{\bar{s} - \hat{s}_L}{\bar{s} - \underline{s}}\right]$$

$$+ \quad \frac{\delta}{\bar{s} - \underline{s}}\Big[\,(q_L y - r^H)\,\hat{s}_H \;-(q_H y - r^L)\,\hat{s}_L\Big] \quad + \quad \frac{\delta}{\bar{s} - \underline{s}}\left[\int_{\underline{s}}^{\hat{s}_L} s\,ds \quad - \int_{\underline{s}}^{\hat{s}_H} s\,ds\;\right].$$

At this price equilibrium the high-quality firm captures the whole market in period 1.

Taken together Propositions 3.1 and 3.5 show that the equilibrium prices exhibit a systematic intertemporal structure: a phase of introductory offers with price discounts is succeeded by a phase where the firms exploit locked-in customers, with whom the customer relationship was formed in the first phase. Such an intertemporal pricing structure is typical for models with switching costs (see, for example, the survey models of Klemperer (1995), Varian (2003), Farrell and Klemperer (2004)) or the general analysis of Fudenberg and Tirole (2000) and Taylor (2003)). In our model, the introductory discount of the high-quality firm is just sufficient to deny the low-quality firm any positive market share in period 1. In period 2 the high-quality firm can exploit its incumbency advantage, even though the low-quality firm may successfully poach some of its clients. Based on this line of arguments we can conclude that the intertemporal discounted profit of the low-quality firm is determined by the discounted value of the poaching profits in period 2. We formulate these insights in a more formal way in the next Proposition.

Proposition 3.6 (Intertemporal Profits)

(a) *If* $\bar{s} - 2\underline{s} \geq \Delta y$ *and* $q_H > q_L$ *the intertemporal discounted profit of the low-quality firm is*

$$\Pi^L \quad = \quad \delta\,\tilde{\Pi}_2(H) \quad = \quad \frac{\delta}{9}\big(\bar{s} - 2\underline{s} - \Delta y\big)^2 .$$

(b) *If* $\bar{s} - 2\underline{s} < \Delta y$ *and* $q_H > q_L$ *the low-quality firm is not active and its intertemporal discounted profit is* $\Pi^L \;=\; 0$.

(c) *The intertemporal discounted profit of the high-quality firm is always positive and it exceeds that of the low-quality firm.*

(d) *If* $\Delta = 0$, *i.e. if the duopolists offer identical qualities, the intertemporal profit for both firms is* $\Pi^i = \delta\, \widetilde{\Pi}_2(j) = \frac{\delta}{9}(\bar{s} - 2\underline{s})^2$, for $i, j \in \{H, L\}$, $i \neq j$.

Proposition 3.6 (d) reports a particularly striking finding as it highlights the divergence of our results from the standard literature on product differentiation. In the presence of differentiated switching costs the equilibrium profits are positive even when the competing firms offer identical product characteristics. In our setting with competing duopolists each firm is a monopolist on the poaching revenues associated with those consumers who have a customer relationship with the rival. For that reason it is profitable to poach the competitor in period 2 even when there is so harsh ex-ante competition for market shares that all profits, which are related to market shares acquired in period 1, are effectively eliminated through the introductory discount at the stage when the firms compete for the formation of customer relationships. Hence, the intertemporal discounted profits are strictly positive despite identical product choices by the firms. This result, however, will not survive the entry of additional equal quality competitors, as Section 5 demonstrates.

With identical qualities Proposition 3.6 (d) implies that the equilibrium profits can be rewritten as $\Pi^i = \frac{\delta}{9}(3\sigma - \widetilde{s})^2$. Thus, equilibrium profits increase (decrease) as a function of the dispersion (mean) of the switching costs.

On the basis of the present analysis one might also be tempted to enquire about the dynamics of the poaching process in a more general structure with several rounds of competition. What would be the ultimate distribution of prices? On the basis of our analysis we would conjecture that the answer should depend on the type of information about the history of purchases available to the competitors. If firms can only observe current consumer attachment, and if they have no records about past purchasing behavior, the steady state actually coincides with our period-2 prices. If firms keep more detailed records about past purchasing behavior, further possibilities to segment the market will be exploited in equilibrium.

4. Quality Competition

We continue to focus on a duopolistic industry where the competing firms can produce differentiated qualities. The quality decision serves as a long-run commitment relative to the subsequent stage of price competition. We assume the available range of qualities to be given by the interval $[\upsilon, \omega]$, where $\omega\,(\upsilon)$ denotes the highest (lowest) available quality ($\upsilon > 0$). Suppose, for the purpose of analyzing the strategic incentives for quality provision as opposed to quality decisions determined by cost considerations, that the establishment of a production line of quality q imposes "low" costs, which are independent of the quality.

Suppose that the duopolistic firms operate with different quality levels so that the high-quality firm produces q_H, whereas the low-quality firm produces q_L. As we have shown in the previous section, in period 1 the high-quality firm captures all the market and the intertemporal discounted equilibrium profits of the low-quality firm are given by its discounted poaching profits in period 2, $\delta\,\widetilde{\Pi}_2(H) = \frac{\delta}{9}\left(\bar{s} - 2\underline{s} - \Delta y\right)^2$ (see (10.d)). These poaching profits are strictly decreasing as a function of the quality produced by the high-quality producer, q_H, and strictly increasing as a function of the firm's own quality, q_L. Thus, the low-quality firm always has an incentive to increase its quality q_L until it approaches the high quality level q_H. Likewise, the profit of the high-quality firm is increasing in q_H. Consequently, we can characterize the equilibrium configuration with respect to the quality commitments according to the next proposition.

Proposition 4.1 (Agglomeration at the Top)
In the absence of costs of quality provision the subgame perfect equilibrium in duopoly is characterized by quality agglomeration whereby both firms offer the highest available quality $q_L = q_H = \omega$.

This result is in stark contrast to the literature on vertical product differentiation (e.g. Shaked and Sutton (1982), (1983) and Andersen, de Palma and Thisse (1992)). While that literature predicts local monopolies, in our theory more than one firm can profitably operate with identical qualities. In our theory, when markets are sufficiently large, or alternatively when sunk costs of entry are sufficiently small, at least two firms will enter at the top. As we will subsequently see, there will be exactly two providers of top quality.

We have seen that higher dispersion of the switching costs will stimulate poaching profits, whereas a higher mean of the switching costs has the opposite effect. Within the framework of our model increased poaching profits will make entry more attractive even at identical qualities. This, in turn, will promote competition in the vertically differentiated industry. In this respect more dispersed switching costs tend to make the industry more competitive from the point of view of a long-term perspective with free entry. This prediction seems to modulate the common view according to which higher switching costs would increase the market power of incumbent firms. Clearly, this popular view is restricted to a short-term perspective with already established customer relationships and with a given market structure. Moreover this view is restricted to the average level of switching costs but not to their dispersion.

5. Endogenous Market Structure

Switching costs open up the possibility of poaching. As the previous section has demonstrated, in duopoly this allows clustering of firms at the top quality. Can even more firms enter at the top, once we allow for endogenous entry with sufficiently small entry costs *F*?

The answer is no. When three firms offer identical quality, competition for poaching revenues eliminates any poaching rents. Since ex-ante competition eliminates any incumbency rents, overall revenues will not cover any positive sunk cost of entry (see Taylor, 2003). This is stated in Lemma 5.1

Lemma 5.1 (Competition for poaching revenues)
Consider a market with at least three (or more) firms, i=1,2,3 offering the same highest quality, $q_i = \omega$. *(There may be further firms offering the same or lower quality.) In any subgame perfect equilibrium period-2 prices are then characterized by the poaching prices* $r^i = 0$ *and incumbency prices* $p_2^i = \frac{1}{2}(\bar{s} + \Delta y)$. *Intertemporal profits are then* $\Pi^i = 0$ *for all firms and these cannot cover any positive entry costs.*

Proof: Since $i=1,2,3$ are identical competitors, the argument developed by Taylor (2003) applies. Accordingly, in equilibrium Bertrand competition eliminates any poaching profits. Further, ex-ante competition eliminates any incumbency profits. In this setting firms with lower quality cannot even attract positive market shares.

Q.E.D.

Accordingly, in any industry equilibrium with costly entry no more than two firms can offer the highest quality and still earn positive revenues. This argument is essentially true also for any quality level below top quality. Each quality level can be offered by at most two firms.

Proposition 5.2 (No more than two at the Top)

In any equilibrium each quality level is provided by at most two firms. In particular, at most two firms offer the highest quality.

In contrast to the standard literature on vertical product differentiation, in equilibrium each quality level can be provided by more than one firm in the presence of consumer switching costs. However, there cannot be more than two firms active on each quality level, because otherwise any poaching revenues would be eliminated. So what are the implications for the overall industrial structure in markets with consumer switching costs? Will the finiteness property survive the introduction of switching costs? Will the industry with switching costs remain a natural oligopoly?

In order to answer this question we have to introduce a sunk cost of entry. Since we are particularly interested in large mature markets, we might as well assume that the sunk cost is relatively small (but positive).

Proposition 5.2 implies that in any free entry equilibrium of a large market there will be exactly two firms offering top quality. Moreover, based on the analysis of section 3 we realize that due to the introductory offers in period 1 the top qualities are sold at such attractive discounts that in period 1 only the two top quality providers will attract positive market shares. All other firms that might potentially enter necessarily have to specialize on poaching activities. But even in period 2 the top quality providers enjoy a significant competitive advantage.

Proposition 5.3 (Natural Oligopoly):

In equilibrium, the joint market share of the two top quality incumbents exceeds 50% of the captive clients for any number of active firms. Hence, in equilibrium the two top quality providers always control more than half of the market, for any number of (lower quality) competitors.

Proof: Consider the artificial case of a cartel agreement between the two top quality providers first. Consider price competition against the second highest quality provider and ignore the influence of further firms for the moment. In this case, the number of loyal customers is determined by $\bar{s} - \hat{s}_H$ for given period-2 prices. The incumbents' (joint) reaction function reads as $p_2^H = \frac{1}{2}\left(\bar{s} + r^H + \Delta y\right)$. Substituting this into $\bar{s} - \hat{s}_H$ we find that for any constellation of prices and poacher quality the market share of customers loyal to the high-quality firms is at least 50%, since

$$\left[\bar{s} - \frac{1}{2}\left[\bar{s} + r^H + \Delta y\right] + r^H + \Delta y\right] = \frac{1}{2}\left[\bar{s} + r^H + \Delta y\right] > \frac{1}{2}\left(\bar{s} - \underline{s}\right).$$

Returning back to the general setting, whatever poaching rates and quality differentials are, it holds true that even under the most competitive conditions, $r^H = 0$ and $\Delta = 0$, the poaching sector cannot acquire more than 50% market share. The reasons for this to hold true are even stronger when competition among the high-quality producers reduce the incumbency rates below the potential cartel rate discussed above.

Q.E.D.

Our model presents a very specific version of the finiteness property. In any equilibrium industrial structure the two top firms dominate the market and secure more than half of the sales. While in general, we cannot rule out the entry of an increasing number of poachers as sunk costs of entry diminish, the degree of competitiveness as well as industry profits are largely determined by the two top quality providers. Consequently, our industry exhibits all the essential properties of a natural oligopoly in the sense of Shaked and Sutton (1983). Hence, switching costs change the qualitative nature of markets with quality differentiation, since they invite a race to the top. On the other hand, the central prediction that endogenous sunk costs tend to generate natural oligopolies remains valid even in the presence of switching costs.

The equilibrium configuration characterized above seems to be consistent with the empirically observed industrial structure of the public accounting firms in the US. As the United States General Accounting Office's report to a Senate committee (2003) makes clear, the accounting and audit services industry has a structure with two dominant accounting firms when the client firms are classified according to their industrial sector. In fact, for the different industrial sectors scrutinized by the report the two dominant accounting firms have a joint market share in the range between 70 % and 95 %.

From Proposition 3.3 we can directly conclude that the welfare loss induced by switching costs is independent of the quality level in all symmetric equilibria where firms supply identical qualities, because under such circumstances the proportion $\frac{\frac{1}{3}(\bar{s}+\underline{s})-\underline{s}}{(\bar{s}-\underline{s})}=\frac{\sigma-\frac{1}{3}\tilde{s}}{2\sigma}$ of the customers switch. Interestingly, the ratio of switching consumers is increasing (decreasing) as a function of the variance (mean) of the switching costs. Thus, the welfare loss from switching is increasing (decreasing) as a function of the variance (mean) of the switching costs. Furthermore, as observed in Corollary 3.1, the poaching prices are increasing (decreasing) as functions of the variance (mean) of the switching costs in equilibria with identical qualities.[10]

Our model implies that industries with switching costs will provide higher average quality than industries without. Furthermore, the equilibrium quality is an increasing (decreasing) function of the variance (mean) of the switching costs. However, if (positive) sunk investment are required for quality production, obviously several welfare concerns arise. First, equilibrium switching always entails a welfare cost to consumers. Second, agglomeration implies excessive investments at the same quality level.

6. Duopoly Competition with Multidimensional Differentiation

We will first demonstrate the robustness of our theory with respect to income differentiation, since this case underlies the theory of Shaked and Sutton (1982, 1983). We will then demonstrate that our theory differs fundamentally from an environment where switching costs are absent.

[10] Of course, in our model where each consumer purchases precisely one unit of the product the price effect represents nothing but a transfer between the consumers and the producers with no impact on total welfare.

Thus a standard model with multidimensional horizontal product differentiation cannot replicate our results.

a) Income and Switching Cost Differentiation

In order to render our results comparable to the literature on quality differentiation based on income heterogeneity alone we generalize the basic model and introduce income differentiation in addition to the differentiation in switching costs. Will agglomeration at the top quality also hold if the seminal analysis of Shaked and Sutton (1982) is extended to incorporate switching cost differentiation in addition to income differentiation?

Assume that in period 2 consumers are represented by their combination of switching cost and income *(s,y)*. Consumers *(s,y)* are now assumed to be uniformly distributed on $\left[\underline{s},\bar{s}\right]\times\left[\underline{y},\bar{y}\right]$.[11] As a starting point we also assume that the duopolistic firms operate with different quality levels so that the high-quality firm produces q_H, whereas the low-quality firm produces q_L.

In light of our findings in Section 3 (in particular Proposition 3.5) we can start the analysis with the case in which the high-quality firms succeeds in attracting all customers in period 1. Thus, the low-quality firm can only engage in poaching in period 2. This situation is illustrated graphically in Figure 1.The critical consumers are just indifferent between staying with the high-quality firm and paying price p_2^H, and switching to the lower-quality product and paying the poaching price r^H. Formally, these indifferent consumers are captured by the line

$$s \quad = \quad p_2^H \quad - \quad r^H \quad - \quad \Delta y \ . \qquad (14)$$

As indicated in Figure 1, consumers located below this line switch, whereas consumers above this line remain within the established customer relationship. Formally, Figure 1 captures the configuration with $\bar{s}-2\underline{s} \quad > \quad \Delta\,(\,\bar{y}-\underline{y})$.[12]

[11] The literature reports fairly few attemtps to analyze multi-dimensional product differentiation. Important exceptions are Irmen and Thisse (1998) for an analysis of competition in general multi-characteristics spaces, Ireland (1987) (Chapter 7) for a combination of horizonal and vertical product differentiation and Dos Santos Ferreira and Thisse (1996) for an analysis of the Launhardt model.

[12] This condition guarantees that the line (13) intersects below $\bar{s}$ at $y=\underline{y}$ and above $\underline{s}$ at $y=\bar{y}$.

Let us proceed by determining the price equilibrium for this configuration. As can be seen from Figure 1, the area of switching consumers is given by $(\frac{1}{2}(s_1 + s_2) - \underline{s})(\bar{y} - \underline{y})$, where s_1 and s_2 are determined by

$$s_1 = p_2^H - r^H - \Delta \bar{y} \tag{15a}$$

and

$$s_2 = p_2^H - r^H - \Delta \underline{y} . \tag{15b}$$

Thus, the number of switching consumers is given by

$$\left[p_2^H - r^H - \Delta \frac{\bar{y} + \underline{y}}{2} - \underline{s} \right] (\bar{y} - \underline{y}) , \tag{16}$$

whereas the number of loyal consumers is

$$\left[\bar{s} - p_2^H + r^H + \Delta \frac{\bar{y} + \underline{y}}{2} \right] (\bar{y} - \underline{y}) . \tag{17}$$

In light of (16) and (17) the period-2 price charged to existing clients and the period-2 poaching price are determined by the firms' optimization problems

$$\max_{p_2^H} \quad p_2^H \left[\bar{s} - \frac{q_H}{q_L} p_2^H + r^H + \frac{q_H - q_L}{q_L} \frac{\bar{y} + \underline{y}}{2} \right] (\bar{y} - \underline{y}) \tag{18a}$$

and

$$\max_{r^H} \quad r^H \left[p_2^H - r^H - \Delta \frac{\bar{y} + \underline{y}}{2} - \underline{s} \right] (\bar{y} - \underline{y}) . \tag{18b}$$

When $\bar{s} - 2\underline{s} > \Delta (\bar{y} - \underline{y})$ both optimization problems generate interior solutions with the following incumbency and poaching prices:

$$p_2^H \quad = \quad \frac{1}{3} \quad \left(2\bar{s} - \underline{s} \quad + \quad \frac{\Delta}{2} \; (\bar{y} + \underline{y}) \right) \tag{19a}$$

and

$$r^H \quad = \quad \frac{1}{3} \left(\; \bar{s} - 2\underline{s} \quad - \quad \frac{\Delta}{2} \; (\bar{y} + \underline{y}) \right) \quad . \tag{19b}$$

Comparing these equilibrium prices with those characterized by (7a) we can observe that the given income is substituted by average income. Furthermore, one verifies readily that

$$\frac{\partial p_2^H}{\partial q_H} \quad > \quad 0 \;\; \text{and} \qquad \frac{\partial r^H}{\partial q_L} \quad > \quad 0 \, .$$

Consequently, the incumbency price of the high-quality firm and the poaching price of the low-quality firm are always increasing functions of the qualities.

Substituting the equilibrium prices (19a) and (19b) back into the profit functions (18a) and (18b) establishes incumbency profits as

$$\Pi_2(H) \quad = \quad p_2^H \left[\bar{s} \quad - \quad r^H \; \right] \; (\bar{y} - \underline{y}) \tag{20a}$$

and

$$\widetilde{\Pi}_2(H) \quad = \quad \left(r^H \right)^2 \; (\bar{y} - \underline{y}) \qquad\qquad , \tag{20b}$$

respectively. In particular, as the poaching price r^H is strictly increasing as a function of q_L we can conclude that the poaching profit (20b) is a strictly increasing function of q_L. This implies that each competitor has an incentive to provide the highest quality. Since, due to switching costs and poaching, both competitors can earn positive revenues even when they offer identical products, in equilibrium they will both offer top quality. In addition, the poaching profit (20b) is a strictly increasing function of $\bar{s}$.

Proposition 6.1 (Minimal Quality Differentiation)

Let $\bar{s} - 2\underline{s} \; > \; (\varpi - v)(\bar{y} - \underline{y})$ and $2\underline{y} \geq \bar{y}$. *Then in duopoly the subgame perfect equilibrium exhibits agglomeration at the highest quality level.*

It should be emphasized that the sufficient condition in Proposition 6.1 can be rewritten according to $3\sigma - \tilde{s} > (\varpi - \nu)(\bar{y} - \underline{y})$. This reformulation shows that a sufficiently large dispersion of the switching costs is the crucial feature behind the emergence of agglomeration at the top quality. Furthermore, the poaching price (20b) can also be rewritten according to

$$r^H \quad = \quad \frac{1}{3}\left(3\sigma - \tilde{s} \quad - \quad \frac{\Delta}{2}\ (\bar{y} + \underline{y})\right),$$

from which we can conclude that the poaching price and profit is increasing (decreasing) as a function of the dispersion (mean) of the switching costs.

Proposition 6.1 confirms that our central theme "two at the top" also applies to an economic environment that closely resembles Shaked and Sutton (1982) with the added feature of switching cost differentiation. The equilibrium property, however, is in stark contrast to the traditional literature on vertical product differentiation, which – in the absence of switching costs - predicts configurations, where the oligopolists always engage in quality differentiation as a strategic device to relax competition (see, Shaked and Sutton (1982) or Chapter 8 in Anderson, de Palma and Thisse (1992)). Within the framework of our model the incentive to relax competition is outperformed by the incentive to profit from poaching. In equilibrium, the low-quality producer always tries to minimise the distance to the high quality producer[13], thereby generating an equilibrium configuration with minimum quality differentiation.

Our agglomeration result qualitatively reminds of the principle of minimum differentiation established by de Palma, Ginsburgh, Papageorgiou and Thisse (1985) and Gehrig (1998). These authors consider an environment of a traditional Hotelling model equipped with an added dimension of taste heterogeneity such that firms cannot determine the purchasing behavior of an individual consumer. By applying a probabilistic discrete choice model or a search characteristic they establish product clustering as the subgame perfect product choice as long as the unobservable taste heterogeneity of consumers or the agglomeration economy is sufficiently strong. In our model sufficiently differentiated switching costs generate the agglomeration of qualities. Thus, contrary to these static contributions, here we focus on vertical product differentiation in a dynamic context, not horizontal product differentiation. Accordingly, the underlying economic mechanism is very different. Within the framework of our model the incentive to relax competition is dominated by the incentive to profit from poaching. In contrast,

[13] Obviously the high-quality producer always prefers to maintain differentiation relative to the low-quality producer.

in de Palma, Ginsburgh, Papageorgiou and Thisse (1985) the price reduction induced by product agglomeration is dominated by the advantage of a higher market share associated with a location in the center of the Hotelling line when the non-spatial dimension associated with taste heterogeneity is sufficiently strong.

It is important to emphasize that the established generalization of the finiteness property is specific for the combination of switching cost differentiation and vertical product differentiation. Next we will demonstrate that this property does not hold in environments where the vertical product differentiation is combined with a general type of horizontal product differentiation.

b) Vertical and Horizontal Differentiation

Consider a static model with vertical and horizontal differentiation such that the utility function is given by $U(q, d, y, z) = q y - td^2 - z$, where d measures distance traveled and t proportional transportation costs. As fixed costs of entry F become sufficiently small it is for this specification impossible that market shares of the dominant firm remain bounded from below. Even if the dominant firm were to sell at marginal cost prices (*=0*), profitable entry of competitors within the market covered by the dominant firm is possible at the highest quality, when sunk costs of entry are sufficiently small. Hence, ultimately any market share will converge to zero as sunk costs fall, and the number of firms providing top quality grows without limit.

Proposition 6.2: *For t>0 the industrial structure is fragmented, i.e. the maximal market share converges to zero as F declines to zero.*

This result is not surprising in the light of Shaked and Sutton (1983), since in the presence of horizontal differentiation, i.e. positive transportation costs, the property of a common ranking of the commodities by all consumers is lost. Hence, the two-dimensional model essentially has the same fragmentation properties as the basic Hotelling model.

In our model the differentiated switching costs eliminate this fragmentation property, because there will never be more than two firms at the top quality. For any market size, or any sunk cost of entry, at most two firms will offer top quality. To the best of our knowledge no existing model has theoretically predicted clustering at the highest quality. Nevertheless this result seems to be interestingly related to the analysis of the Launhardt model by Dos Santos

Ferreira and Thisse (1996). These authors establish that duopolists have an incentive to agglomerate (deglomerate) at maximum (different) transportation costs if the there is maximum (minimum) differentiation along the geographical characteristic. Furthermore, in certain types of multidimensional models of horizontal product differentiation without quality dimension the literature has established that clustering along one dimension may emerge as an equilibrium phenomenon.[14]

7. Conclusion

In this study we have established that quality choice is importantly affected by switching costs. In particular, in vertically differentiated markets where switching cost heterogeneity is sufficiently significant, we have demonstrated that low-quality producers have a particularly strong incentive to close the quality gap to high quality producers despite the bite of price competition. Under such circumstances the equilibrium configuration will be characterized by an agglomeration of two firms at the top of the quality spectrum. In this sense our result differs strongly from standard vertical differentiation models, where the degree of differentiation is always strictly positive. In our model the incentives created by poaching profits dominate relative to the competition-relaxing effects of quality differentiation. This holds true as long as the poaching profits survive in equilibrium, i.e. as long as no more than two firms produce the top quality. Our results do not invalidate the finiteness property found in models of vertical product differentiation, since entry is limited by the profitability of poaching revenues. In particular, our theory predicts that there will never be more than two firms at the top of the quality spectrum. Furthermore, we found that the two top quality providers always control more than half of the market, for any number of (lower quality) competitors.

Our results differ from the standard literature in three major aspects. First, and most importantly, our model shows that quality choice in models of vertical product differentiation typically also depends on aspects of the market environment other than income, such as switching costs. Abstracting from such features is not innocuous for the analysis of the degree of differentiation. However, the central result of the finiteness property is robust with respect to the introduction of switching costs. Our theory clearly predicts very concentrated market structures in

[14] For examples, see Gehrig (1998) or Irmen and Thisse (1998).

large markets with two dominant firms and potentially a competitive fringe, which survives based on poaching profits.

Secondly, our theory contributes to the literature on switching costs. In our model minimum quality differentiation occurs if switching cost heterogeneity is sufficiently significant. Strictly speaking this is a consequence of our assumption that the quality choices do not affect the magnitude of the switching costs. If switching costs are affected by product distance, Gehrig and Stenbacka (2004) show that an additional effect on location has to be taken into account. Firms prefer distance because it is a means of increasing switching costs, and hence poaching profits.

Thirdly, we have demonstrated that our model can be generalized to an environment where the consumers are differentiated in two dimensions: switching costs and incomes. Consequently, the quality agglomeration and the associated predictions regarding industry structure seem to be relevant for industries where the dimension of switching cost heterogeneity is sufficiently important. Many of the industries described in the introduction, perhaps, in particular, the accounting and audit industry, seem to fit this picture to a reasonable extent.

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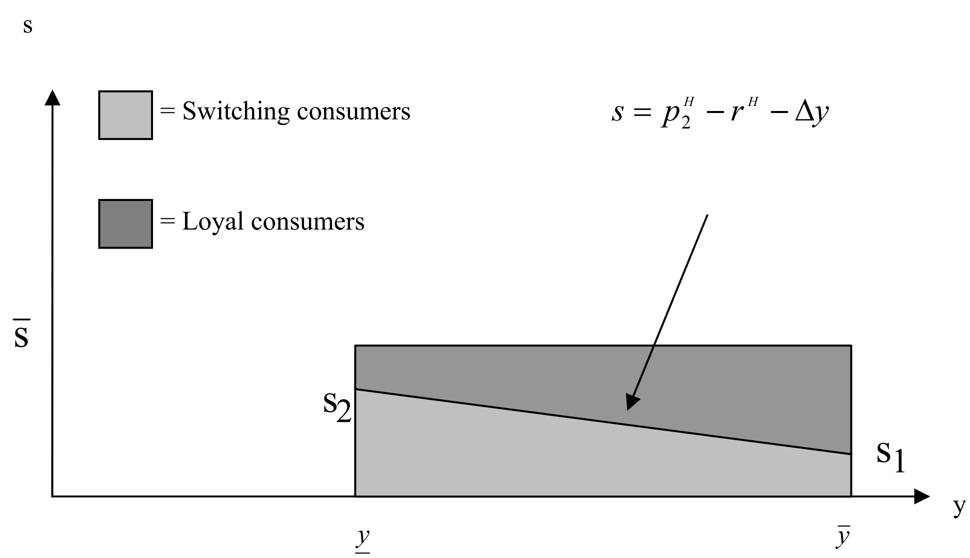

Figure 1: Poaching of consumers belonging to the market segment of the high-quality firm in period 1 with income and switching cost differentiation: the case with $\overline{s} - 2\underline{s} > \Delta(\overline{y} - \underline{y})$.