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"Customer Poaching with Retention Strategies"

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Customer Poaching with Retention Strategies *

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Abstract

This paper is a first step in investigating the competitive and welfare effects of behaviour-based price discrimination (BBPD) in markets where firms have information to employ retention strategies as an attempt to raise barriers to switching. We focus on retention activity in the form of a discount offered to a consumer expressing an intention to switch. When save activity is allowed forward looking firms anticipate the effect of first period market share on second period profits and so they price more aggressively in the first-period. Thus, first period equilibrium price with BBPD and save activity is below its non-discrimination counterpart. This contrasts with first period price above the non-discrimination level if BBPD is used and save activity is forbidden. Regarding second period prices, retention discounts increase the price offered to those consumers who do not signal am intention to switch. The reverse happens to those consumer who decide to switch after being exposed to retention offers. As in other models where consumers have stable exogenous brand preferences, the instrument of behaviour based price discrimination is bad for profits and welfare but good for consumers. However, BBPD with the additional tool of retention activity boosts consumer surplus and overall welfare but decreases industry profit.

1 Introduction

In markets with repeated purchases firms frequently use the consumers' purchase history to quote different prices to existing and new customers. When trade among consumers is not feasible, firms can try to poach the competitors' current customers, by offering them special inducements to switch. This form of price discrimination, termed behaviour-based price discrimination (BBPD), sometimes also called price discrimination based on purchase history or

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dynamic pricing, is now widely observed in many markets. In the communications markets, for instance, firms frequently offer a lower price to a customer who has been using a competitor's service. Similar pricing strategies are employed in several other markets, especially in those where consumers face a cost to switch to a new supplier (e.g. magazine or newspaper subscriptions, credit cards, banking services, electricity and gas.)[1]

Although this type of behaviour-based price discrimination has received much attention in the economics literature in the recent years,[2] the literature has hitherto focused on the assumption that firms have only the required information to price discriminate between existing and new customers and that firms have no way to react to the rivals' poaching offers.

Interestingly, in some of the markets where firms often discriminate between their own and the rivals' consumers, the switching processes currently in place in many countries have allowed firms to become aware of an existing customer's willingness to switch before the switching takes place. In the UK this kind of switching process is known as Losing Provider Led (LPL). In a LPL process, the consumer must go through a validation process with its existing provider, a proof of which must be provided to his new provider in order to complete a switch. In other words, firms have been increasingly able to recognise different categories of old customers−those showing a desire to leave (*active consumers*) and those showing no intention to switch (*passive consumers*)−and price discriminate accordingly. A recent report by the Ofcom (2010) states that in the UK consumers wishing to switch their mobile telephony services must contact their existing provider and request a porting authorisation code (PAC) which they must communicate to their new provider in order to complete the switching process. The same procedure is applied for switching broadband services, in which case the required code is the migrations authorisation code (MAC).[3]

Thus, in the communications markets, mainly in broadband, mobile telephony and bundles comprising either of these services, apart from being able to know whether or not a consumer purchased from a rival in the past, firms can now have the tool to know as well whether or not a previous customer is willing to switch. Empowered with this additional information firms can have the last word over their competitors poaching offers. The request of a code discloses information about a consumer willingness to switch and allows firms to offer counter-

[1] A recent report by the Office of Gas and Electricity Markets (Ofgem (2008)), the regulator for Britain's gas and electricity industries, has revealed that, in this industry: (*i*) a substantial fraction of consumers are 'switchers' in the sense that they constantly seek out for the best deal in the market; and (*ii*) suppliers are well aware of these consumers' dynamics and do take them into account in their pricing decisions. In particular, "companies charge more to existing ("sticky") customers whilst maintaining competitiveness in more price sensitive segments of the market.

[2] Chen (2005), Fudenberg and Villas-Boas (2007) and Esteves (2009b) present updated literature surveys on BBPD.

[3] It is important to mention that for mobile services, a PAC code is required only where the consumer wants to keep his existing telephone number with the new provider (porting); otherwise, if the consumer is taking a new number, she/he can just deal directly with the new provider without the need for a PAC code.

offers to those customers expressing an intention to leave as an attempt to retain them. Firms can employ save/retention strategies. Theoretically, a firm uses a retention/save activity−e.g. targeted discounting, price matching, loyalty discounts−as a way to make it less attractive for a customer to switch to a competing firm. However, the Ofcom report (2010, p.82) states that save activity is generally in the form of a price discount.

The ability of firms to engage in retention strategies will make it difficult for firms to attract rivals' customers and will potentially raise competitive, welfare and antitrust concerns. Some interesting issues are the following. What is the impact of customer poaching with retention activity on prices and competition? Does BBPD with save activity enhances consumer surplus? Do firms charge "excessive prices" to those consumers who do not signal an intention to switch? Does BBPD with retention strategies enhance the dominance of the firm with a higher customer base? What are the dynamic effects of BBPD with save activity?

Despite the crucial importance of these issues, the answer to these and other related questions is not yet known. This paper aims to contribute to close this gap in the literature on BBPD. It investigates the competitive and welfare effects of customer poaching with retention activity in the form of a price discount[4] offered to a consumer expressing an intention to switch.

The paper considers a two-period model where two horizontally differentiated firms compete for consumers with stable exogenous brand preferences across the two periods. These preferences are specified in the Hotelling-style linear market of unit length with firms positioned at the endpoints. Firms cannot commit to future prices. In period 1 because firms have no information about consumers' brand preferences they quote a uniform price. In period 2 there are two stages. In the first stage, firms use the consumers' first period purchase history to draw inferences about their preferences and price accordingly. They simultaneously choose a price to their old and the rival's previous customers. In the second stage, those customers for whom the rival's offer is more attractive (with a desire to switch) need to contact their current supplier and request an authorization code which they must communicate to the new supplier to complete the switching process. This signal allows each firm to recognise within the group of existing customers those willing to willing to switch (active) and offer them a secret save offer in the form of a fixed discount. Thus, save activity is targeted at consumers expressing an intention to leave and is enabled by a switching process in which a provider is made aware of a customer's intention to switch before the switching takes place (a LPL process).

In order to investigate the static and dynamic effects of BBPD with retention strategies Section 3 presents the benchmark case where firms can only price discriminate between old/new customers. Here we present a simplified version of the Fudenberg-Tirole model. Save activity is not possible either because it is not allowed or because firms have no information to recognise those customers willing to leave.

[4] Retention offers can take other forms apart from a price discount, as for instance, offering the consumer a different package or different features.

Section 4 extends the model by allowing firms to offer a discount to a consumer expressing an intention to switch. The second-period static analysis sheds some light on the price effects of BBPD with save activity given an inherit market share. BBPD with save activity can lead to higher prices to passive existing consumers and to higher or lower prices to retained customers. With retention activity firms have more difficulty in attracting the rival's customers. Thus, they need to be more aggressive and so the poaching price under save activity is below its counterpart when this activity is banned. We will also see that firms will only engage in save activity when their customer base is above a threshold (i.e., above 33%).

The second period static analysis sheds also some light on whether or not poaching with retention strategies can help a dominant firm (with a market share above 50%) to maintain its dominant position. We will see that if BBPD is possible but save activity is forbidden, the dominant firm will lose its dominance under BBPD (Corollary 1). A similar result is obtained in Gehrig et al. (2012). In contrast, we will see that if the dominant firm is big enough (with a market share above 75%) BBPD with save activity reduces its dominance but allows the firm to remain the dominant (with a market share above 50%).

While static analysis is a useful tool, a dynamic analysis is the most appropriate to inform competition authorities specially for assessing businesses practices that exhibit intertemporal features. The paper shows that BBPD under retention strategies gives rise to new dynamic effects. In the Fudenberg-Tirole model first-period prices are above the non-discrimination level because consumers anticipate poaching and become less price sensitive. When save activity is introduced, first-period prices are below the non-discrimination levels because forward looking firms play more aggressively to build up first-period market share. In equilibrium, both firms share the first-period market symmetrically. BBPD with save activity leads to all-out competition in period 2. With save activity passive customers pay higher prices than active consumers and these prices will be above the prices they would pay if firms were only allowed to price discriminate between old/new customers. Because the current supplier is always informed of the consumer's intention to switch, it appears to be a relatively costless strategy to charge a high price and lower it only when a switching intention materialises. As in Fudenberg-Tirole model, if retention strategy is not available, BBPD is socially inefficient, since in the second period $\frac{1}{3}$ of consumers buy from the less preferred firm. If save activity is possible, only $\frac{1}{5}$ of the consumer population switch suppliers in equilibrium.

As in other models of BBPD with exogenous brand preferences, the instrument of behavior based price discrimination is bad for profits and welfare but good for consumers. However, conditional on price discrimination being permitted, the use of retention strategies boosts consumer surplus and overall welfare and decreases industry profit (Proposition 5). Save activity is welfare enhancing because it reduces inefficient switching.

This paper is related to the literature on competitive price discrimination,[5] especially the

[5] Comprehensive surveys on competitive price discrimination are presented by Armstrong (2006) and Stole

literature on behaviour-based price discrimination, [6]where firms engage in price discrimination based on information about the consumers' past purchases. Like other forms of price discrimination, BBPD can raise competition and welfare concerns. While in the switching cost approach purchase history discloses information about exogenous switching costs (e.g. Chen (1997) and Taylor (2003)), in the brand preference approach purchase history discloses information about a consumer's exogenous brand preference for a firm (e.g. Villas-Boas (1999), Fudenberg and Tirole (2000)). A common finding in this literature is that BBPD tends to intensify competition and potentially benefit consumers. Behaviour-based pricing tends to intensify competition and reduce profits in duopoly models where the market exhibits best response asymmetry,[7] firms are symmetric and *both* have information to engage in BBPD (e.g. Chen (1997), Villas-Boas (1999), Fudenberg and Tirole (2000), Taylor (2003) and Esteves (2010)). There are, however, some models where firms can benefit from BBPD. This will generally occur when firms are asymmetric (e.g. Shaffer and Zhang (2000)), when firms' targetability is imperfect and asymmetric (Chen et al. (2001)) and when only one of the two firms can recognize customers and price discriminate (Chen and Zhang (2009) and Esteves (2009)). Another relevant paper is Chen (2008) who investigates BBPD in markets with asymmetric firms. He shows that a sufficient condition for dynamic price discrimination to benefit consumers is that it does not result in fewer firms and that consumers have a long time horizon. Finally, the paper is related to Gehrig et al. (2012) who investigate the effects of BBPD in a static asymmetric duopoly, where one of the firms is assumed to have an inherited dominant market position (market share larger than 50%). They show that uniform pricing is a more powerful instrument than BBPD for the dominant firm to defend its market share advantage.[8]

The rest of the paper is organized as follows. Section 2 presents the model. Section 3 presents the benchmark case where firms can only discriminate between old/new customers. Section 4 analysis the model of behaviour-based pricing with retention strategy in the form of a price discount offered to a consumer expressing an intention to switch. Section 5 looks at the welfare effects of customer poaching under retention activity. Section 6 presents some of the extensions to be explored in a more complete version of this paper. Section 7 concludes and the appendix collects the proofs that were omitted from the text.

(2007).

[6]Chen (2005), Fudenberg and Villas-Boas (2007) and Esteves (2009b) present updated literature surveys on BBPD.

[7]Following Corts (1998), the market exhibits best response asymmetry when one firm's "strong" market is the other's "weak" market. In BBPD models there is best-response asymmetry because each firm regards its previous clientele as its strong market and the rival's previous customers as its weak market.

[8]For other recent papers on BBPD and customer recognition see also Chen and Pearcy (2010), Esteves (2010), Esteves and Vasconcelos (2012), Esteves and Regiani (2012), Gehrig, Shy and Stenbacka (2011), (2012), Ghose and Huang (2006), Ouksel and Eruysal (2011), Shy and Stenbacka (2011), (2012).

2 Model

Two firms, A and B, produce at zero marginal cost nondurable goods A and B.[9] There are two periods, 1 and 2. On the demand side, there is population of consumers with mass normalized to 1. In each period, each consumer wishes to buy a single unit either from firm A or B and is willing to pay at most v. The reservation value v is sufficiently high so that nobody stays out of the market. As in Fudenberg and Tirole (2000) consumers have exogenous preferences for brands that are present from the start. Consumer preferences are specified in the Hotelling-style linear market of unit length with firms positioned at the endpoints. A consumer brand preference parameter x is uniformly distributed on $[0, 1]$ and remains fixed for both periods of consumption.[10] As usual a consumer located at x incurs total cost $p_A + tx$ if buys from firm A at the price p_A, and incurs total cost $p_B + t(1 - x)$ if buys the unit from B at the price p_B.

Suppose firms cannot commit to future prices. Consumers reveal information about their brand preferences by their first-period choice. Suppose that standard competition à la Hotelling allows firm A to attract a fraction of θ_1. Firm A's turf is the interval $[0, \theta_1]$, while firm B's turf is the remaining $[\theta_1, 1]$. In period 2 each firm is able to recognise its own previous customers and the rival's ones.

Differently from the standard models of BBPD we assume that in the second-period there is a *two-stage* competition game. In the first stage, each firm simultaneously chooses a price to its old customers p_i^o and a price to the new customers p_i^n, $i = A, B$. Each consumer observes p_i^o and p_j^n. Given a LPL switching process, those customers with an intention to switch (for whom the rival's offer is more attractive) will contact the current supplier and request an authorization code, which they must communicate to the new supplier to complete the switching process. It is important to note that we assume that consumers do not bluff, i.e., only consumers with economic reasons to switch will in fact contact the current supplier. A consumer's request of a code signals his willingness to switch and gives firms an incentive to use retention strategies to tempt them to stay. In other words, firms can employ retention strategies like a price discount in an attempt to make it less attractive for a customer to switch to a competing firm. This paper analyses the case where in the second stage each firm offers each customer showing an intention to leave (i.e., requesting a code) a secret fixed discount d_i.

3 Price discrimination without retention strategies

As a benchmark, suppose first that firms can price discriminate between old/new customers but are not allowed to use save/retention strategies either because in period 2 they cannot distinguish those customers willing to switch or because price discrimination between different types of old

[9] The assumption of zero marginal costs can be relaxed without altering the basic nature of the results derived throughout the model.

[10] For BBPD model with imperfect correlated preferences across periods see Chen and Pearcy (2010).

customers is not permitted. The analysis here is similar to that of Fudenberg and Tirole (2000).

Proposition 1. *When firms can only price discriminate between old/new customers second period equilibrium prices are:*

(i) if $\theta_1 \leq \frac{1}{4}$:

$$p_A^{o,NR} = t(1-2\theta_1);\ p_A^{n,NR} = \frac{1}{3}t(3-4\theta_1)$$

$$p_B^{o,NR} = \frac{1}{3}t(3-2\theta_1);\ p_B^{n,NR} = 0$$

(ii) if $\frac{1}{4} \leq \theta_1 \leq \frac{3}{4}$:

$$p_A^{o,NR} = \frac{1}{3}t(2\theta_1+1);\ p_A^{n,NR} = \frac{1}{3}t(3-4\theta_1)$$

$$p_B^{o,NR} = \frac{1}{3}t(3-2\theta_1);\ p_B^{n,NR} = \frac{1}{3}t(4\theta_1-1)$$

(iii) if $\theta_1 \geq \frac{3}{4}$:

$$p_A^{o,NR} = \frac{1}{3}t(2\theta_1+1);\ p_A^{n,NR} = 0$$

$$p_B^{o,NR} = t(2\theta_1-1);\ p_B^{n,NR} = \frac{1}{3}t(4\theta_1-1)$$

Proof. See the Appendix.

Corollary 1. *When* $\theta_1 = \frac{1}{2}$*, firms will share equally the market in period 2,* $s_A^{2,NR} = s_B^{2,NR} = \frac{1}{2}$*. If* $\theta_1 > \frac{1}{2}$ *then* $s_A^{2,NR} < \frac{1}{2}$ *and* $s_B^{2,NR} > \frac{1}{2}$*. The reverse happens when* $\theta_1 < \frac{1}{2}$*.*

Proof. See the Appendix.

Corollary 1 is useful to evaluate the impact of BBPD when firms depart with an inherited exogenous base of customers. It shows that if firms depart with an equal base of customers, they will share equally the market in period 2. If firms have asymmetric inherited market share, the smaller firm will become the leader in period 2 and the larger firm will become the smaller one. In a static analyses Gehrig et al. (2012) show that uniform pricing is a more powerful instrument than BBPD for the dominant firm to defend its market share advantage.

It is straightforward to obtain that at the interior solution, i.e., if $\frac{1}{4} \leq \theta_1 \leq \frac{3}{4}$ both firms make the same profit in the second period, given by

$$\pi_i^2 = \frac{5}{9}t\left(2\theta_1^2 - 2\theta_1 + 1\right). \tag{1}$$

Thus we can see that each firm's second-period profit is minimized when firms share the first period market equally. The reason is that an equal initial market share generates the most informative outcome in the second period, and, in this setting with best response asymmetry, more information destroys profit. When initial market shares are very asymmetric, on the other hand, little is learned about most consumers' brand preferences, competition is less intense and profits increase. In Esteves (2010) more information leads to more intense competition and to a less favourable competitive outcome. Thus, it shows that firms may be willing to forgo a positive market share in period 1 as an effective way to eschew learning and price discrimination in the subsequent period.

Turn now to first-period competition. Let p_i^1 represent firm i's first-period price, $i = A, B$. Following Fudenberg and Tirole (2000) we obtain the following proposition.

Proposition 2. *There is a symmetric subgame perfect nash equilibrium in which:*
(i) First-period equilibrium prices are $p_A^{1,NR} = p_B^{1,NR} = t\left(1 + \frac{\delta}{3}\right)$ *and the first-period market is split symmetrically with* $\theta^1\left(p_A^1, p_B^1\right) = \frac{1}{2}$.
(ii) Second-period equilibrium prices are $p_A^{o,NR} = p_B^{o,NR} = \frac{2}{3}t$ *and* $p_A^{n,NR} = p_B^{n,NR} = \frac{1}{3}t$.
(iii) Consumers in the intervals $\left[0, \frac{1}{3}\right]$ *and* $\left[\frac{2}{3}, 1\right]$ *do not switch and consumers in the interval* $\left[\frac{1}{3}, \frac{2}{3}\right]$ *do switch in the second-period.*

4 Price discrimination with retention strategies

As usual we solve the game working backwards from the second period.

4.1 Second-period

Suppose that first period prices lead to a cutoff $\theta_1 \in [0,1]$. A consumer located at θ_1 is indifferent between buying from A and B in period 1. Look first at firm A's turf on $[0, \theta_1]$. In the group of firm A's old consumers there is group of consumers who may be willing to switch given the observed second period prices $\{p_A^o, p_B^n\}$. As suggested in the Ofcom report assume that those consumers willing to switch from A to B, need to contact firm A and request a code to complete the switching process. This contact will allow firm A to recognise within the base of old customers those who are willing to leave. Save activity in a form of a secret discount d_A will be used by firm A to tempt these consumers to stay.

In the second-stage of period 2, the indifferent consumer between staying with A after a receiving a save offer and pay price $p_A^o - d_A$ and switching to B paying p_B^n is located at x_A, given by:

$$p_A^o - d_A + tx_A = p_B^n + t(1 - x_A).$$

It follows that

$$x_A = \frac{1}{2} + \frac{p_B^n - p_A^o + d_A}{2t} \tag{2}$$

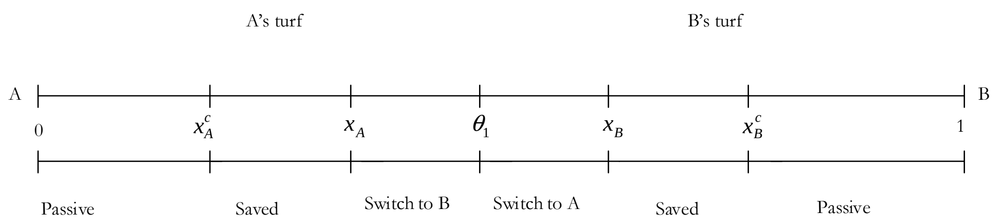

Figure 1: Behaviour-based price discrimination with retention strategies

The indifferent consumer between acting as a passive (i.e., showing no intention to switch) and as an active (i.e., showing an intention to switch) is located at x_A^c such that $U(p_A^o, d_A = 0) = U(p_B^n)$. From this condition we obtain:

$$x_A^c = \frac{1}{2} + \frac{p_B^n - p_A^o}{2t}. \tag{3}$$

Similar derivations allow us to obtain x_B^c. In the second stage firms A and B solve, respectively, the following problem:

$$\underset{d_A}{Max}\,(p_A^o - d_A)\,(x_A - x_A^c)$$

$$\underset{d_B}{Max}\,(p_B^o - d_B)\,(x_B^c - x_B)$$

from which it is straightforward to obtain that the secret discount offered by firm A is $d_A = \frac{p_A^o}{2}$ and by firm B is $d_B = \frac{p_B^o}{2}$.

With no loss of generality look on firm A's turf. In the first-stage of period 2 firm A and B solve respectively:

$$\underset{p_A^o}{Max}\pi_A^o = p_A^o x_A^c + (p_A^o - d_A)(x_A - x_A^c) \text{ s.t } d_A = \frac{p_A^o}{2}$$

$$\underset{p_B^n}{Max}\pi_B^n = p_B^n\,(\theta_1 - x_A) \text{ s.t. } d_A = \frac{p_A^o}{2}$$

A similar reasoning is applied to firm B's turf. Simple computations allow us to obtain Proposition 3.

Figure 1 illustrates the different segments of consumers.

Proposition 3. *When firms can employ poaching and retention strategies second period equilibrium prices are:*

(i) if $\theta_1 \leq \frac{1}{3}$:

$$p_A^o = t\,(1 - 2\theta_1)\,;\; p_A^n = \frac{2}{5}t\,(2 - 3\theta_1)$$

$$p_B^o = \frac{2}{5}t\,(3 - 2\theta_1)\,;\; d_B = \frac{1}{5}t\,(3 - 2\theta_1)\,;\; p_B^n = 0$$

(ii) if $\frac{1}{3} \leq \theta_1 \leq \frac{2}{3}$:

$$p_A^o = \frac{2}{5}t\,(2\theta_1 + 1)\,;\; d_A = \frac{1}{5}t\,(2\theta_1 + 1)\,;\; p_A^n = \frac{2}{5}t\,(2 - 3\theta_1)$$

$$p_B^o = \frac{2}{5}t\,(3 - 2\theta_1)\,;\; d_B = \frac{1}{5}t\,(3 - 2\theta_1)\,;\; p_B^n = \frac{2}{5}t\,(3\theta_1 - 1)\,.$$

(iii) if $\theta_1 \geq \frac{2}{3}$:

$$p_A^o = \frac{2}{5}t\,(2\theta_1 + 1)\,;\; d_A = \frac{1}{5}t\,(2\theta_1 + 1)\,;\; p_A^n = 0$$

$$p_B^o = t(2\theta_1 - 1);\; p_B^n = \frac{2}{5}t\,(3\theta_1 - 1)$$

Proof. See the Appendix.

Note first that firms only engage in save activity when their customer base is above a threshold. Firm A, for instance, will only employ save activity if $\theta_1 > \frac{1}{3}$. Additionally, the retention discount obtained is equal to 50% of the second period current price to old customers. The Ofcom report (2010, p.82) shows that retention discounts varied between 32% and 60% of the current price in mobile telephony and between 25% and 44% of the current price in broadband services.

The next corollaries shed some light on the effects of BBPD with retention strategies when the firms in the industry have inherited market shares.

Corollary 3. *Moving from uniform pricing to BBPD with save activity:*

(i) increases the price for firm A passive consumers, i.e., $p_A^o > p^u$ *as long as* $\theta_1 > \frac{3}{4}$, *otherwise* $p_A^o < p^u$.

(ii) decreases the price for active and new consumers, regardless of firm A's inherited market share.

Given the second period nash equilibrium prices defined in proposition 1 and 3 it is straightforward to prove the corollary 4.

Corollary 4. *From the comparison of BBPD with and with no save activity:*

(i) firm A's passive consumers pay higher prices with save activity when $\theta_1 > \frac{1}{3}$.

(ii) firm A's active saved customers pay higher prices when $\theta_1 < \frac{4}{7}$, *while they pay a lower price when* $\theta_1 > \frac{4}{7}$.

(iii) firm A's price to new customer under save activity is always below its counterpart when this activity is banned.

Figure 2 illustrates the behaviour of second-period equilibrium prices given an inherited market share with and without retention strategies in firm A's turf A assuming that $t = 1$.

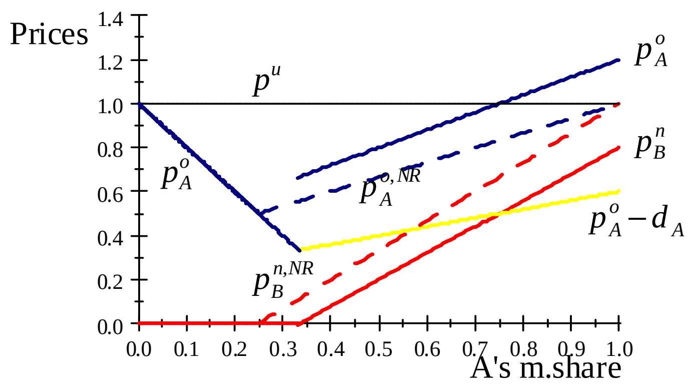

Figure 2: Second-period prices with and without retention strategies

Like in BBPD with no retention strategies, when firms employ retention strategies all prices, for active and passive consumers, may end up being higher than if save activity was not allowed/feasible (one uniform price for all existing consumers). Note however that if we have for instance a big enough firm in the market (say A, $\theta_1 > \frac{3}{4}$) some of its passive customers may be exploited and pay a higher price with BBPD with save activity than with no discrimination.

Compare next BBPD with and with no save activity. Firm A's existing consumers pay the same price with and without save activity when firm A's market share is too low, specifically when $\theta_1 \leq \frac{1}{4}$. At the interior solution (not too strong asymmetry between firms), as firms are able to segment their existing customer base between "active" and "passive" they can charge a much higher price to passive consumers than if retention activity was banned ($p_A^o > p_A^{o,NR}$). Note also that firms only engage in save activity when their customer base is above a threshold. Firm A, for instance, will only employ save activity if $\theta_1 > \frac{1}{3}$. When we move from BBPD with no save activity to BBPD with save activity we find that saved customers pay higher prices when $\theta_1 < \frac{4}{7}$, while they pay a lower price under save activity when $\theta_1 > \frac{4}{7}$. The reason is that when $\theta_1 > \frac{1}{2}$ some consumers in firm A's turf A are B-oriented consumers, thus firm A needs to price more aggressively if it wants to avoid switching. Additionally, with retention activity firms have more difficulty in attracting the rival's customers, thus firm A's poaching price to new customers (p_i^n) under save activity is always below its counterpart when this retention activity is banned.

Corollary 5. *When firms have symmetric initial market shares they split equally the market in the second-period. When $\theta_1 \in \left[\frac{1}{3}, \frac{2}{3}\right]$ BBPD with retention strategies leads the dominant firm to lose its dominance, that is $s_A^2 \leq \frac{1}{2}$ $\left(s_B^2 \geq \frac{1}{2}\right)$ if $\theta_1 \geq \frac{1}{2}$ $\left(\theta_1 \leq \frac{1}{2}\right)$. In contrast, the bigger firm is able to maintain its dominance when the asymmetry in the market is strong enough. Particularly, it follows that $s_A^2 \geq \frac{1}{2}$ $\left(s_B^2 \leq \frac{1}{2}\right)$ if $\theta_1 \in \left[\frac{3}{4}, 1\right]$ and $s_A^2 \leq \frac{1}{2}$ $\left(s_B^2 \geq \frac{1}{2}\right)$ if $\theta_1 \in \left[0, \frac{1}{4}\right]$.*

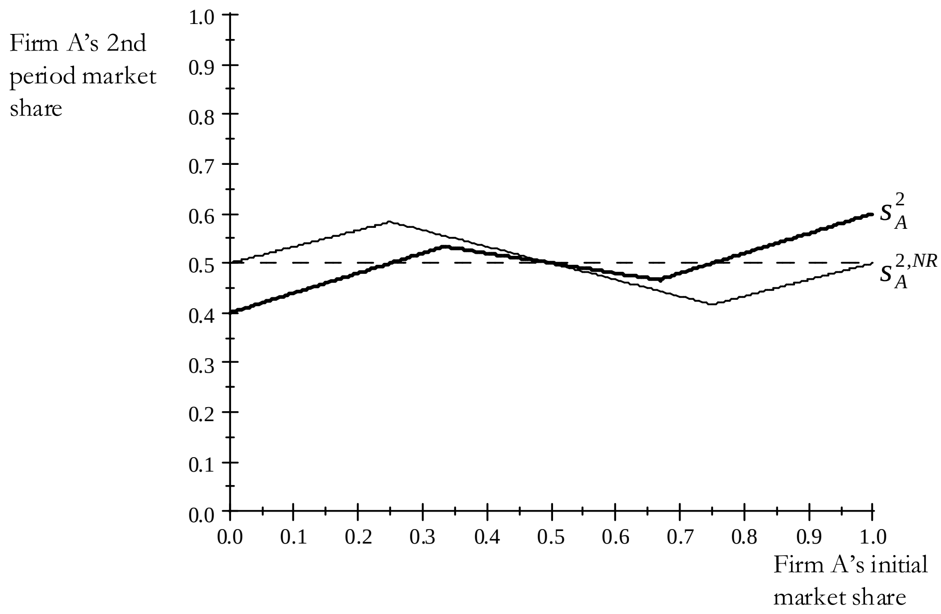

Figure 3: Firm A's second-period market share

Proof. See the Appendix.

Figure 3 plots firm A's second period market share when firms have an exogenous initial customer base and can engage in BBPD with and without save activity, respectively given s_A^2 and $s_A^{2,NR}$. It confirms the findings in Corollaries 1 and 5. We can see that when firms can only discriminate between old/new customer the bigger firm (initial market share higher than 50% of the market) always loses its dominance with this form of BBPD. It is interesting to note for any $\theta_1 \geq 0.5$, $s_A^2 \geq s_A^{2,NR}$. Thus, in fact BBPD with save activity helps the bigger to maintain their previous clientele. Note also that, when firms can price discriminate between old/new customers and between different categories of old customers, BBPD may not destroy the dominance of the bigger firm. This happens when the initial market share of the bigger firm is sufficiently high (i.e., higher than 75% of the market). If firm A has an initial market share of 90%, BBPD with save activity will reduce its second-period market share to 56%. Although this form of price discrimination makes the market more competitive it does not destroy firm A's dominance (which still remains above 50%).

Corollary 6 summarizes second period equilibrium profits.

Corollary 6. *Second-period equilibrium profits with BBPD and retention strategies are:*

(ii) when $\theta_1 < \frac{1}{3}$:

$$\pi_A^2 = t\,(1-2\theta_1)\,\theta_1 + \frac{2}{25}t\,(3\theta_1 - 2)^2 \tag{4}$$

$$\pi_B^2 = \frac{3}{50}t\,(2\theta_1 - 3)^2 \tag{5}$$

(ii) when $\frac{1}{3} < \theta_1 < \frac{2}{3}$:

$$\pi_A^2 = \frac{3}{50}t\,(2\theta_1 + 1)^2 + \frac{2}{25}t\,(3\theta_1 - 2)^2 = \frac{1}{50}t\left(48\theta_1^2 - 36\theta_1 + 19\right) \tag{6}$$

$$\pi_B^2 = \frac{3}{50}t\,(2\theta_1 - 3)^2 + \frac{2}{25}t\,(3\theta_1 - 1)^2 = \frac{1}{50}t\left(48\theta_1^2 - 60\theta_1 + 31\right) \tag{7}$$

(iii) when $\theta_1 > \frac{2}{3}$:

$$\pi_A^2 = \frac{3}{50}t\,(2\theta_1 + 1)^2 \tag{8}$$

$$\pi_B^2 = (1-\theta_1)\,t(2\theta_1 - 1) + \frac{2}{25}t\,(3\theta_1 - 1)^2 \tag{9}$$

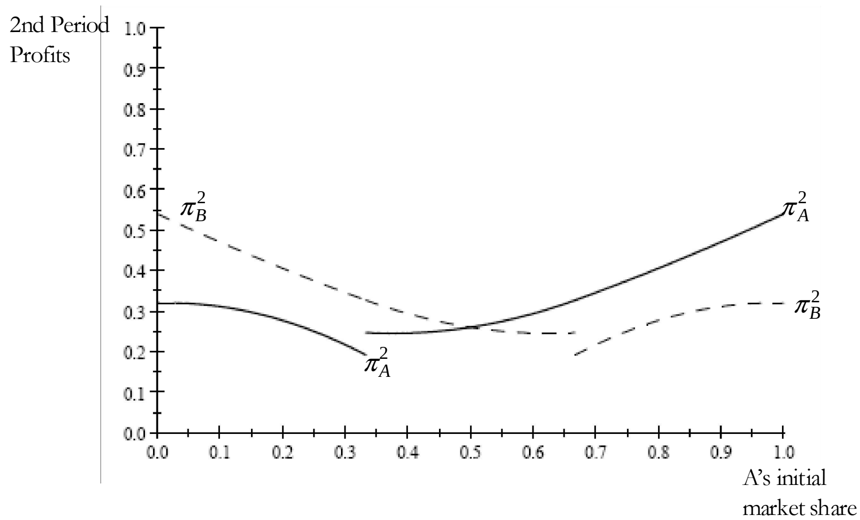

Figure 4: Second-period profits

Figure 4 plots both firms' second-period profits as a function of θ_1 (firm A's initial customer base). It allows us to assess the effects of BBPD with save activity when firms have initial asymmetric customer bases. From a static point of view, as expected, we observe that the dominant firm earns higher profits than the smaller firm. We have seen that with no retention activity, at the interior solution ($\frac{1}{4} \le \theta_1 \le \frac{3}{4}$) both firms make the same profit in the second period. With save activity this is no longer the case. At the interior solution ($\frac{1}{3} \le \theta_1 \le \frac{2}{3}$) both firms earn the same profit only when they are initially symmetric and each firm's profit increases with its own initial market share. Taking now into account the intertemporal effects of BBPD with save activity, we should expect that each firm has a strategic incentive to build up its first-period market share. This reasoning will be useful to understand the price behavior of forward looking firms in period 1.

4.2 First-period

Next we look at the choice of first-period prices. Consumers and firms are forward looking and both use the same discount factor δ. Because firms are forward looking they take today's price decisions rationally anticipating *how* they will affect their subsequent profit. Consumers are sophisticated in the sense that they anticipate the effect of initial market share on future prices.

Let firm A's first-period price be p_A^1 and B's first-period price be p_B^1. The marginal consumer in the first period will surely switch in the second period to take advantage of the poaching price. If first-period prices lead to a cutoff θ_1 the consumer located at θ_1 is indifferent between buying from firm A in period 1 at price p_A^1 and then buying from B in period 2 at the poaching price p_B^n, or buying from B in period 1 at price p_B^1 and then buying from A at the poaching price p_A^n. At an interior solution we must observe:

$$p_A^1 + t\theta_1 + \delta\left(p_B^n + t\left(1-\theta_1\right)\right) = p_B^1 + \left(1-\theta_1\right)t + \delta\left(p_A^n + t\theta_1\right)$$

from which we obtain:

$$\theta_1 = \frac{t + p_B^1 - p_A^1 + \delta\left[p_A^n\left(\theta_1\right) - p_B^n\left(\theta_1\right)\right]}{2t\left(1-\delta\right)}$$

Using the expressions obtained for p_A^n and p_B^n in Proposition 3 it follows that:

$$\theta_1 = \frac{5\left(t - p_A^1 + p_B^1\right) + t\delta}{2t\left(\delta+5\right)} = \frac{1}{2} + \frac{5\left(p_B^1 - p_A^1\right)}{2t\left(\delta+5\right)} \tag{10}$$

Note that when price discrimination is not permitted or when the discount factor is zero $\theta_1 = \frac{t-p_A^1+p_B^1}{2t}$.With no discrimination $\frac{\partial\theta_1}{\partial p_A^1} = -\frac{1}{2t}$. With save activity in period 2 we find that:

$$\frac{\partial\theta_1}{\partial p_A^1} = -\frac{1}{2t\left(\frac{\delta}{5}+1\right)}$$

Thus, as long as $\delta > 0$, consumers react less sensitively to price reductions in the first period than they would in a static model of this kind. Additionally under poaching with no save activity we have that $\theta_1 = \frac{1}{2} + \frac{3\left(p_B^1 - p_A^1\right)}{2t(\delta+3)}$ and $\frac{\partial\theta_1}{\partial p_A^1} = -\frac{1}{2t\left(\frac{\delta}{3}+1\right)}$. It is straightforward to see that sophisticated consumers react less sensitively to price reductions in the first period if save/retention activity is possible in period 2.

Now consider the equilibrium choices of p_A^1 and p_B^1. At an interior solution, firm A and B's overall objective function is, respectively given by:

$$p_A^1\left(\frac{1}{2} + \frac{5\left(p_B^1 - p_A^1\right)}{2t\left(\delta+5\right)}\right) + \delta\left(\frac{1}{50}t\left(48\left(\theta_1\left(p_A^1, p_B^1\right)\right)^2 - 36\theta_1\left(p_A^1, p_B^1\right) + 19\right)\right), \tag{11}$$

$$p_B^1\left(\frac{1}{2}+\frac{5\left(p_A^1-p_B^1\right)}{2t\left(\delta+5\right)}\right)+\delta\left(\frac{1}{50}t\left(48\left(\theta_1\left(p_A^1,p_B^1\right)\right)^2-60\left(\theta_1\left(p_A^1,p_B^1\right)\right)+31\right)\right). \tag{12}$$

Substituting (10) in (11) and (12) it is straightforward to obtain the following proposition:

Proposition 4. *There is a symmetric subgame perfect nash equilibrium in which:*
(i) *first-period equilibrium prices are* $p_A^1 = p_B^1 = t\left(1-\frac{\delta}{25}\right)$ *and both firms share equally the market in period 1, thus* $\theta^1\left(p_A^1, p_B^1\right) = \frac{1}{2}$.
(ii) second-period equilibrium prices are $p_A^o = p_B^o = \frac{4}{5}t$, $d_A = d_B = \frac{2}{5}t$ *and* $p_A^n = p_B^n = \frac{1}{5}t$.
(iii) Consumers in the intervals $\left[0, \frac{1}{5}\right]$ *and* $\left[\frac{4}{5}, 1\right]$ *behave as passive, consumers in the intervals* $\left[\frac{1}{5}, \frac{2}{5}\right]$ *and* $\left[\frac{3}{5}, \frac{4}{5}\right]$ *show an intention to switch in period 2 and are retained, consumers in the intervals* $\left[\frac{2}{5}, \frac{3}{5}\right]$ *show an intention to leave and do in fact switch to a different supplier in period 2.*

Proof. See the Appendix.

As usual the first period equilibrium price under BBPD with save activity is below the non-discrimination level. An interesting finding of the paper is that the first-period price with retention strategies is *below* the uniform price and its counterpart when BBPD is used alone. We have seen before that in Fudenberg-Tirole model with a uniform distribution of preferences a change of first-period prices has no effect on second-period profit because a firm's marginal gains in one second-period market are exactly offset by losses in the other. Thus, in the uniform case the result of first period equilibrium prices above the non-discrimination levels is only explained by the decrease in price sensitivity of forward-looking consumers in period 1.

In contrast, when we allow firms to offer a retention discount to those customers showing an intention to switch, we observe that firms do take into account that a change in first-period prices changes the first-period cut-off θ_1 and therefore affects second-period competition. With retention strategies consumers are more price sensitive and forward looking firms have strategic incentives to decrease first period prices as a way to build up first period market share.[11] As a result of these two forces first period prices fall.

Additional results emerge from Propositions 3 and 5. With BBPD and no retention strategies the consumers in the interval $\left[0, \frac{1}{3}\right]$ and $\left[\frac{2}{3}, 1\right]$ do not switch in equilibrium and their present value payment for the two periods of consumption is $(1+\delta)\,t$, which is equal to its counterpart with no discrimination. In other word, in the Fudenberg-Tirole model for these groups of consumers price discrimination has no effect on consumer welfare and profits. In contrast the consumers in the interval $\left[\frac{1}{3}, \frac{2}{3}\right]$ switch from one firm to another and the present value of their payment is equal to $(1+\delta)\,t - \frac{\delta}{3}t$. This group of consumers is strictly better off under BBPD with no retention strategies than under no discrimination.

[11] If we look at the effect of first-period prices on second-period profit given by $\frac{\partial \pi^2}{\partial p_A^1}$ we observe that in the symmetric equilibrium it is equal to $-\frac{3}{5}\frac{\delta}{\delta+5} < 0$.

Look next at BBPD with retention offers. The consumers in the intervals $\left[0, \frac{1}{5}\right]$ and $\left[\frac{2}{5}, 1\right]$ do not signal an intention to switch and the present value payment for the two periods of consumption is $(\delta+1)\,t - \frac{6\delta t}{25}$, lower than $(1+\delta)\,t$. Thus, even thought passive consumers face a higher second-period price, the decrease in first-period price more than compensates the second period loss. The existing active consumers in the intervals $\left[\frac{1}{5}, \frac{2}{5}\right]$ and $\left[\frac{3}{5}, \frac{4}{5}\right]$ are retained. The present value of the price paid by these consumers in both periods of consumption is $(\delta+1)\,t - \frac{16\delta t}{25}$. Thus, these consumers are clearly better off when firms employ BBPD with retention discounts. Consumers in the intervals $\left[\frac{1}{3}, \frac{2}{5}\right]$ and $\left[\frac{3}{5}, \frac{2}{3}\right]$ decide not to switch when we move from BBPD alone to BBPD with save offers. The present value of their payment is equal to $(\delta+1)\,t - \frac{6\delta t}{25}$ with retention discounts, while it is equal to $(1+\delta)\,t - \frac{\delta}{3}t$ with no save offers. These group of consumers also benefit from save activity. Finally, the poached consumers in the interval $\left[\frac{2}{5}, \frac{3}{5}\right]$ switch from one firm to another under retention strategies. The present value of the price paid by them for the two periods of consumption is equal to $(\delta+1)\,t - \frac{21\delta t}{25}$. Summing up, BBPD with retention strategies reduces the present value of the price paid by consumer in all segments, suggesting that retention offers boost overall consumer surplus.

The previous discussion is important to explain the intuition behind the profit effects of save offers presented in corollary 6.

Corollary 6. *(iii) Each firm second-period equilibrium profit is equal to* $\frac{13}{50}t$ *and first period equilibrium profit equals* $\frac{t}{2}\left(1 - \frac{\delta}{25}\right)$.

(iii) For any $\delta > 0$ *overall equilibrium profit under BBPD with save activity is equal to* $\frac{1}{50}\,(12\delta + 25)$, *lower than overall equilibrium profit under BBPD with no save activity which is equal to* $\frac{1}{18}t\,(8\delta + 9)$.

5 Welfare Analysis

This section looks at the welfare effects of poaching with retention strategies. With no discrimination consumers buy from the closer firm which is efficient. The first-period equilibrium outcome is also efficient with and without retention strategies. However, the second-period switching lowers welfare. If we let ETC denote the expected transport cost incurred by consumers overall welfare can be written as $W = v - ETC$.

Look first at welfare in period 2. With no discrimination all consumers buy from the closer firm in period 2. Thus second-period welfare with no discrimination, w_{nd}^2 is

$$w_{nd}^2 = v - \int_0^{\frac{1}{2}} tx dx - \int_{\frac{1}{2}}^1 t(1-x)dx = v - \frac{1}{4}t.$$

When firms can poach the rival's previous customers and use simultaneously retention strategies second-period welfare is w^2 :

$$w^2 = v - \int_0^{x_A} txdx - \int_{x_A}^{\theta_1} t(1-x)dx - \int_{\theta_1}^{x_B} txdx - \int_{x_B}^{1} t(1-x)dx,$$

which in equilibrium is equal to:

$$w^2 = v - \frac{27}{100}t.$$

When firms can only price discriminate between old/new customers (no retention strategies are used) second period welfare is $w^{2,NR}$ given by:

$$\begin{aligned} w^{2,NR} &= v - \int_0^{\frac{1}{3}\theta_1+\frac{1}{6}} txdx - \int_{\frac{1}{3}\theta_1+\frac{1}{6}}^{\theta_1} t(1-x)dx - \int_{\theta_1}^{\frac{5}{6}-\frac{1}{3}\theta_1} txdx - \int_{\frac{5}{6}-\frac{1}{3}\theta_1}^{1} t(1-x)dx \\ &= v - \frac{11}{36}t. \end{aligned}$$

Look next at consumer surplus with retention strategies in period 2, denoted $ECS^2 = w^2-$Industry Profits. At the interior solution equilibrium solution we have:

$$ECS^2 = v - \frac{1}{50}t\left(62\theta_1^2 - 62\theta_1 + 55\right).$$

Similarly, consumer surplus with no retention strategies in period 2, denoted $ECS^{2,NR}$ equals:

$$ECS^{2,NR} = v - \frac{1}{9}t\left(13\theta_1^2 - 15\theta_1 + 12\right).$$

Next we investigate the effect of poaching with retention strategies on overall industry profit, consumer surplus and welfare. Overall welfare is given by $W = w^1 + \delta w^2$. Overall welfare with no discrimination is:

$$W^{nd} = v\left(1+\delta\right) - \frac{t}{4} - \frac{t\delta}{4}.$$

With retention strategies overall welfare is given by

$$W = v\left(1+\delta\right) - \frac{1}{4}t - \frac{27}{100}t,$$

while with no retention strategies it equals:

$$W^{NR} = v\left(1+\delta\right) - \frac{1}{4}t - \frac{11\delta}{36}t.$$

From corollary 6, equilibrium industry profit under BBPD with save activity is $\pi_{ind} = 2\left(\frac{1}{50}t\left(12\delta+25\right)\right)$ while with no retention strategies it is equal to $\pi_{ind}^{NR} = \frac{2}{18}t\left(8\delta+9\right)$. We can now compute overall consumer surplus with and without retention strategies, respectively given by

$$CS = v - \frac{5}{4}t - \frac{3}{4}t\delta + v\delta$$

and

$$CS^{NR} = v - \frac{5}{4}t - \frac{43}{36}t\delta + v\delta$$

It is straightforward to obtain the following proposition.

Proposition 5. *For any $\delta > 0$ price discrimination based on customer recognition is bad for profits and welfare but good for consumers. However, conditional on price discrimination being permitted, the use of retention strategies boosts consumer surplus and overall welfare and decreases industry profit.*

Our analysis of BBPD with save activity predicts that industry profits are lower and consumers' surplus is higher under save activity than without save activity because overall the lower prices for those consumers that switch more than compensate the higher prices for those consumers that do not switch. Because in the present model there is no role for price discrimination to increase aggregate output, variations in welfare are uniquely explained by the "disutility" supported by those consumers who do not buy the most preferred brand.[12] As save activity reduces the inefficient switching welfare increases when firms use retention strategies.

6 Conclusions

The economics literature on price discrimination by purchase history has hitherto focused on the assumption that (i) firms have only the required information to price discriminate between old and new customers and (ii) firms have no way to react to the rivals' poaching offers. Interestingly, in some of the markets where firms often price discriminate between their own and the rivals' consumers, the switching processes currently in place in many countries have allowed firms to become aware of an existing customer's willingness to leave before the switching takes place. Consequently, firms have been increasingly able to recognise different categories of old customers−those willing to stay and those willing to switch−and try to raise switching barriers by engaging in retention/save activities.

This paper has taken a first step in investigating the impact of behaviour-based price discrimination in markets where firms are allowed to engage in save activity, in the form of a discount, as an attempt to retain their previous customers.

The static second-period analysis highlights that firms will only engage in save activity when their customer base is above a threshold (i.e., above 33%). It also sheds some light on whether or not poaching with retention strategies helps a dominant firm (with a market share above 50%) to maintain its dominant position. If BBPD is possible but save activity is forbidden, the dominant firm will lose its dominance under BBPD. In contrast, if the dominant firm is big enough (with market share above 75%), BBPD with save activity makes the market more competitive but allows the bigger firm to maintain its dominance.

While static analysis is a useful tool, the dynamic analysis is the most appropriate to inform competition authorities specifically for assessing businesses practices that exhibit intertemporal features. Take into account the intertemporal effects of BBPD with save activity the paper shows that first period equilibrium price with retention strategies is below its non-discrimination

[12] For a model with BBPD with elastic demands see Esteves and Regiani (2012).

counterpart, which contrasts with first period price above the non-discrimination level when these business strategies are forbidden. Regarding second period prices, we find that save activity leads to higher prices for those consumers who do not signal an intention to switch. The reverse happens to those consumers who decide to switch after being exposed to retention strategies. However, the present value of the price paid by passive consumers is lower under save activity than when it is banned, suggesting that even thought passive consumers face a higher second-period price, the decrease in first-period price more than compensates the second period loss. In sum the paper shows that BBPD with retention strategies reduces the present value of the price paid by consumer in all segments.

Therefore, a relevant contribution of the paper is to shed some light on the welfare and antitrust concerns of poaching and retention strategies. As in other models where consumers have stable exogenous brand preferences, in comparison to uniform pricing the instrument of behavior based price discrimination is bad for profits and welfare and good for consumers. However, when BBPD is employed the additional tool of save activity further decreases profits and boosts overall consumer surplus and welfare. Particularly, welfare increases due to a lower degree of inefficient switching.

Like other models of BBPD, the model presented in this paper has some limitations which are left for further research. The unit demand assumption may be one limitation.[13] It implies that, in these models, output is constant whatever the pricing policy (discriminatory or uniform) and the price levels. Prices only affect how the total surplus available in the economy is shared between consumers and firms. In these models, a pricing policy that generates more switching will yield a lower welfare. Even thought the unit-demand assumption may not be a limitation on the welfare predictions when all prices are unambiguously higher or lower under one scenario compared to another, it does put some limits on the predictions when this is not the case. As the present model predicts that the present value of the price paid by all consumer segments decreases with save activity, extending the model to elastic demands would produce the same qualitative welfare results. Secondly, it was assumed that consumer preferences were distributed uniformly. It would be important to understand what changes if there is a large tail of consumers with preferences for one firm and a small tail of consumers with preferences for the other. Finally, in this model it was assumed that firms offer the same discount to all consumers expressing an intention to leave. In practice, firms offer different discounts to consumers and these may be the outcome of a “bargaining process” which may be influenced by the consumer’s level of brand loyalty.

Notwithstanding the model addressed in this paper has is far from covering all complex aspects of real markets, it has tried to offer a closer approximation of reality where firms have increasingly more consumer information to react to the rivals’ poaching offers. Although any

[13] For a paper on BBPD with elastic demands see Esteves and Regiani (2012).

advice to a regulatory authority should take into account the features of each market, in those markets that could be reasonably well represented by the features of the current model, restrictions on the ability of firms to employ retention offers would benefit industry profits at the expense of consumer welfare.

A Proofs

Some of the proofs in this technical appendix need to be improved.

Proof of Proposition 1. Consider second-period competition in firm A's first period customer base $[0, \theta_1]$. Let p_A^o represent firm A's price to its previous customers and p_B^n firm B's poaching price.

The indifferent consumer between buying again from A at price p_A^o and switching to B and pay p_B^n is located at θ_A such that

$$\begin{aligned} p_A^o + t\theta_A &= p_B^n + t(1-\theta_A) \\ \theta_A &= \frac{1}{2} + \frac{p_B^n - p_A^o}{2t} \end{aligned}$$

This implies that at prices p_A^o, p_B^n, consumers in the interval $[0, \theta_A]$ have a strong preference from A and buy again product A. Differently, consumers in the interval $[\theta_A, \theta_1]$ switch from A to B. Using similar arguments it is straightforward to show that in B's turf the indifferent consumer between staying with B and switching to A is located at

$$\theta_B = \frac{1}{2} + \frac{p_B^o - p_A^n}{2t}.$$

Thus, consumers in the interval $[\theta_1, \theta_B]$ switch from B to A and consumers in the interval $[\theta_B, 1]$ buy again from B. In A's turf, each firm solves the following problem

$$\underset{p_A^o}{Max}\left\{p_A^o\left(\frac{1}{2}+\frac{p_B^n-p_A^o}{2t}\right)\right\}$$

$$\underset{p_B^n}{Max}\left\{p_B^n\left(\theta_1-\frac{1}{2}-\frac{p_B^n-p_A^o}{2t}\right)\right\}$$

Firm A´s best response is

$$p_A^o = \frac{1}{2}t + \frac{1}{2}p_B^n$$

and firm B's best response is

$$p_B^n = \frac{1}{2}p_A^o - \frac{1}{2}t + t\theta_1$$

It thus follows that

$$p_A^o = \frac{1}{3}t(2\theta_1 + 1)$$

$$p_B^n = \frac{1}{3}t\left(4\theta_1 - 1\right)$$

It is straightforward to obtain that the equilibrium prices in turf B are

$$\begin{aligned} p_B^o &= \frac{1}{3}t\left(3 - 2\theta_1\right) \\ p_A^n &= \frac{1}{3}t\left(3 - 4\theta_1\right) \end{aligned}$$

Note however that it is a dominated strategy for each firm to quote a poaching price below the marginal cost, which in this case is equal to zero. From $p_B^n \geq 0$ it must be true that $\theta_1 \geq \frac{1}{4}$. Otherwise, i.e., when $\theta_1 \leq \frac{1}{4}$ it follows that $p_B^n = 0$, and and so firm A's best response in order no to lose the marginal consumer located at θ_1 is to quote $p_A^o + t\theta_1 = t\left(1 - \theta_1\right)$, from which we obtain $p_A^o = t\left(1 - 2\theta_1\right)$. Thus, when $\theta_1 \leq \frac{1}{4}$ second-period equilibrium prices are

$$p_A^o = t\left(1 - 2\theta_1\right);\; p_A^n = \frac{1}{3}t\left(3 - 4\theta_1\right)$$

$$p_B^o = \frac{1}{3}t\left(3 - 2\theta_1\right);\; p_B^n = 0$$

Similarly it is straightforward to find that if $\theta_1 \geq \frac{3}{4}$

$$p_A^o = \frac{1}{3}t\left(2\theta_1 + 1\right);\; p_A^n = 0$$

$$p_B^o = t(2\theta_1 - 1);\; p_B^n = \frac{1}{3}t\left(4\theta_1 - 1\right).$$

This completes the proof.■

Proof of Corollary 1. From these second-period equilibrium prices it is easy to obtain that each firm second-period market share, s_A^2 and s_B^2. At the interior solution $\theta_1 \in \left[\frac{1}{4}, \frac{3}{4}\right]$

$$s_A^2 = \frac{2 - \theta_1}{3} \text{ and } s_B^2 = \frac{1 + \theta_1}{3}$$

When $\theta_1 \in \left[0, \frac{1}{4}\right]$

$$s_A^2 = \frac{2\theta_1 + 3}{6} \quad \text{and} \quad s_B^2 = \frac{3 - 2\theta_1}{6}$$

When $\theta_1 \in \left[\frac{3}{4}, 1\right]$

$$s_A^2 = \frac{1}{6}\left(2\theta_1 + 1\right) \quad \text{and} \quad s_B^2 = \frac{1}{6}\left(5 - 2\theta_1\right).$$

Straightforward computations prove that when $\theta_1 \in \left[\frac{1}{4}, \frac{3}{4}\right]$, $s_A^2 > \frac{1}{2}$ $\left(s_B^2 < \frac{1}{2}\right)$ iff $\theta_1 < \frac{1}{2}$ while $s_A^2 < \frac{1}{2}$ $\left(s_B^2 < \frac{1}{2}\right)$ iff iff $\theta_1 > \frac{1}{2}$. In the interval $\theta_1 \in \left[0, \frac{1}{4}\right]$, $s_A^2 > \frac{1}{2}$ $\left(s_B^2 < \frac{1}{2}\right)$ iff $\theta_1 > 0$, which is always true. Finally, when $\theta_1 \in \left[\frac{3}{4}, 1\right]$ it follows that $s_A^2 < \frac{1}{2}$ $\left(s_B^2 > \frac{1}{2}\right)$ iff $\theta_1 < 1$ which is always true.■

Proof of Proposition 3. Look first at firm A's turf. Given that in the second stage of period 2 firm A offers a discount $d_A = \frac{p_A^o}{2}$ to consumers showing an intention to leave firm B anticipates this behaviour and solves the following problem in the first stage of period 2:

$$\underset{p_B^n}{Max}\ \pi_B^n = p_B^n \left(\theta_1 - \frac{1}{2} - \frac{p_B^n - p_A^o + d_A}{2t} \right) \text{ s.t } d = \frac{p_A^o}{2}$$

From the FOC we obtain:

$$p_n = \frac{1}{4} p_A^o - \frac{1}{2} t + t\theta_1$$

In the first stage of period 2 firm A solves the following problem:

$$\underset{p_A^o}{Max} \{ p_A^o x_A^c + (p_A^o - d_A)(x_A - x_A^c) \}$$

from which we obtain:

$$p_A^o = \frac{2}{3} t + \frac{2}{3} p_B^n$$

Thus,

$$\begin{aligned} p_A^o &= \frac{2}{5} t (2\theta_1 + 1) ; \\ d_A &= \frac{1}{5} t (2\theta_1 + 1) ; \\ p_B^n &= \frac{2}{5} t (3\theta_1 - 1) \text{ as long as } \theta_1 > \frac{1}{3} \end{aligned}$$

Note that if $\theta_1 \leq \frac{1}{3}$, $p_B^n = 0$ and so the best response of firm A is to quote $p_A^o = t(1 - 2\theta_1)$.

In the group of firm B's past consumers there is group of consumers who might be induced to switch given p_A^o and p_B^n. Under Losing Provider Led this consumers will contact firm B as a way to switch to A. Given this contact firm B offers a discount d as a way to retain these customers. The indifferent consumer between buying again from B at price $p_B^o - d$ and switching to A is located at x_B:

$$p_A^n + t x_B = p_B^o + t(1 - x_B) - d$$

from which we obtain

$$x_B = \frac{1}{2} + \frac{p_B^o - p_A^n - d_B}{2t}$$

Note that the indifferent consumers between contacting firm B is located at x_B^c such that:

$$\begin{aligned} U(p_B^o, d &= 0) \geq U(p_A^n) \\ p_B^o + t(1 - x_B^c) &= p_A^n + t(x_B^c) \\ x_B^c &= \frac{1}{2} + \frac{p_B^o - p_A^n}{2t} \end{aligned}$$

Thus in the second stage firm B solves the following problem

$$Max\, (p_B^o - d_B)(x_B^c - x_B)$$

From FOC it follows that

$$d_B = \frac{p_B^o}{2}$$

In the first stage of period 2 firm A solves the following problem:

$$\underset{p_A^n}{Max}\ \pi_A^n = p_A^n\left(x_B - \theta_1\right)\ \text{ s.t. }\ d_B = \frac{p_B^o}{2}$$

From the FOC we have that:

$$p_A^n = \frac{1}{2}t + \frac{1}{4}p_B^o - t\theta_1$$

In the first stage of period 2 firm B solves the following problem:

$$\underset{p_B^o}{Max}\ \left\{p_B^o\left(1 - x_B^c\right) + (p_B^o - d_B)(x_B^c - x_B)\right\}$$

It follows that

$$\begin{aligned} p_B^o &= \frac{2}{5}t\left(3 - 2\theta_1\right) \\ p_B^o - d_B &= \frac{1}{5}t\left(3 - 2\theta_1\right) \\ p_A^n &= \frac{2}{5}t\left(2 - 3\theta_1\right)\ \text{ for } \theta_1 < \frac{2}{3} \end{aligned}$$

If $\theta_1 \geq \frac{2}{3}$ it follows that $p_A^n = 0$ and so the best response of firm B is to charge $p_B^o = t(2\theta_1 - 1)$.■

Proof of Corollary 5. From the second-period equilibrium prices it is easy to obtain that second-period market shares are at the interior solution where $\frac{1}{3} \leq \theta_1 \leq \frac{2}{3}$ given by

$$\begin{aligned} s_A^2 &= x_A + (x_B - \theta_1) = \frac{3}{5} - \frac{1}{5}\theta_1 \\ s_B^2 &= 1 - s_A^2 = \frac{2 + \theta_1}{5} \end{aligned}$$

In this case it follows that $s_A^2 \geq \frac{1}{2}$ $\left(s_B^2 \leq \frac{1}{2}\right)$ iff $\theta_1 \leq \frac{1}{2}$.

When $\theta_1 \in \left[0, \frac{1}{3}\right]$

$$\begin{aligned} s_A^2 &= x_B = \frac{2\theta_1 + 2}{5} \\ s_B^2 &= 1 - s_A^2 = \frac{3 - 2\theta_1}{5} \end{aligned}$$

Thus,

$$\begin{aligned} s_A^2 &\leq \frac{1}{2}\left(s_B^2 \geq \frac{1}{2}\right)\ \text{ iff } \theta_1 \in \left[0, \frac{1}{4}\right] \\ s_A^2 &\geq \frac{1}{2}\left(s_B^2 \leq \frac{1}{2}\right)\ \text{ iff } \theta_1 \in \left[\frac{1}{4}, \frac{1}{3}\right] \end{aligned}$$

Finally when $\theta_1 \in \left[\frac{2}{3}, 1\right]$:

$$\begin{aligned} s_A^2 &= x_A = \frac{2\theta_1 + 1}{5} \\ s_B^2 &= 1 - s_A^2 = \frac{2(2-\theta_1)}{5} \end{aligned}$$

Therefore,

$$\begin{aligned} s_A^2 &\geq \frac{1}{2} \left(s_B^2 \leq \frac{1}{2}\right) \text{ iff } \theta_1 \in \left[\frac{3}{4}, 1\right] \\ s_A^2 &\leq \frac{1}{2} \left(s_B^2 \geq \frac{1}{2}\right) \text{ iff } \theta_1 \in \left[\frac{2}{3}, \frac{3}{4}\right] \end{aligned}$$

■

Proof of Proposition 4. Consider the equilibrium choices of p_A^1 and p_B^1. Firm A's and B's overall objective function are respectively

$$p_A^1 \theta_1 \left(p_A^1, p_B^1\right) + \frac{\delta t}{50} \left(48 \left(\theta_1 \left(p_A^1, p_B^1\right)\right)^2 - 36\theta_1 \left(p_A^1, p_B^1\right) + 19\right)$$

and

$$p_B^1 \left(1 - \theta_1 \left(p_A^1, p_B^1\right)\right) + \frac{\delta t}{50} \left(48 \left(\theta_1 \left(p_A^1, p_B^1\right)\right)^2 - 60 \left(\theta_1 \left(p_A^1, p_B^1\right)\right) + 31\right)$$

Thus from the FOC with respect to p_A^1 and p_B^1 we obtain firms A and B best-response functions respectively given by

$$p_A^1 \left(p_B^1\right) = \frac{125t + 125p_B^1 + 20t\delta - 95p_B^1\delta - t\delta^2}{250 - 70\delta} \tag{13}$$

and

$$p_B^1 \left(p_A^1\right) = \frac{125t + 125p_A^1 + 20t\delta - 95p_A^1\delta - t\delta^2}{250 - 70\delta} \tag{14}$$

from which we obtain

$$p_A^1 = p_B^1 = t\left(1 - \frac{\delta}{25}\right)$$

Second-order condition for this problem is given by $\frac{7\delta - 25}{t(\delta+5)^2}$ which is negative for all $\delta \in [0, 1]$.■

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