

Oligopoly Price Discrimination by Purchase History*

Yongmin Chen[†]

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Abstract

This article provides a review of the economics literature on oligopoly price discrimination by purchase history. Two basic models of repeated purchases with two firms and two periods are discussed in detail, one in which firms produce a homogenous good ex ante but where there is ex post product differentiation due to consumer switching costs, and another in which firms' products are differentiated because consumers have intrinsic differences in their brand preferences. Price discrimination based on purchase history arises as equilibrium pricing strategies by competing firms, and such a practice tends to lower industry profits but may or may not benefit consumers. From a welfare point-of-view, there is too much consumer switching between firms. These results extend to models with multiple firms and multiple periods. Further discussions are provided on the effects of long-term contracts and other loyalty-inducing arrangements, on marketing innovations and the legal protection of consumer privacy that affect firms' ability to gather consumer information, and on the antitrust implications of purchase-history based price discrimination.

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[†]Department of Economics, University of Colorado at Boulder, Boulder, CO 80309, USA. Phone: (303)492-8736; E-mail: Yongmin.Chen@colorado.edu.

1. INTRODUCTION

In markets with repeated purchases, firms can use consumers' past purchase information to offer different prices to different consumers. For example, a long-distance telephone firm offers a lower price to a customer who has been using a competitor's service; a credit card company offers a lower interest rate to a consumer who transfers balance from another credit card company; a cable company offers a lower monthly fee to a customer who previously uses the satellite TV. The type of price discrimination in these examples has two common features. First, the prices depend on consumers' past purchases, and thus incorporate explicit dynamic considerations. Furthermore, the information about a consumer's past purchase takes a particularly simple form, namely whether or not the consumer purchased from a rival in past. Second, firms tend to operate under competition, often in oligopoly markets. Such price discrimination by purchase history, sometimes also called behavior-based price discrimination or dynamic price discrimination, by competing firms, has received much attention in the recent economics literature. How does oligopoly price discrimination by purchase history arise in these markets? How does such pricing strategy affect competition and consumers? Should public policies facilitate or prevent the practice of such price discrimination? This article provides a review of the insights on these questions from the economics literature and discusses possible directions for future research.¹

The economics literature on oligopoly price discrimination by purchase history has followed two main approaches. In one approach, consumers initially consider competing firms' products as homogeneous products, but past purchases create switching costs for the consumers, which provides a natural way for firms to segment and price-discriminate consumers. In an early contribution to the literature, Chen (1997) takes this approach of ex ante homogeneous product. In the other approach, which I shall call ex ante product differentiation, consumers have different preferences for competing firms' products, and past purchases allow firms to learn about consumers' brand preferences, which enables firms to engage

¹Stole (2004) and Armstrong (2005) are two recent and more comprehensive surveys on the economics of price discrimination, from which the present article has greatly benefited.

in price discrimination. An early contribution in this approach is Fudenberg and Tirole (2000). Each of these two approaches may reflect certain realities in different industries.² In the telephone industry and the credit card industry, for instance, it would seem that the products are homogeneous *ex ante*, but they may become differentiated once a consumer has purchased from and attached to a particular firm. In the competition between cable and satellite TV, on the other hand, perhaps consumers have different preferences for the two technologies to start with. Although the modeling of competition differs in these two approaches, their analytical results have several common features. First, each firm's price discrimination favors the firm's competitor's customers. That is, it takes the form of "paying customers to switch" or "poaching rival's customers". Second, firms tend to be worse off being able to recognize consumers and price discriminate. This is because the price discrimination is based on consumers' preference differences across firms, which intensifies competition. Third, there is a deadweight loss to the society due to inefficient customer switching, while consumers can be better off in one period but worse off in another. However, there are also important differences between these two models' implications. For instance, in Chen's model, equilibrium prices increase over time, while equilibrium prices decrease over time in Fudenberg and Tirole's model.

There are many interesting issues that are related to and go beyond the basic analyses in Chen (1997) and in Fudenberg and Tirole (2000). One issue concerns what happens if the restrictive assumption that there are only two firms and two periods is relaxed. Taylor (2003) extends Chen (1997) to many firms and many periods, and in doing so obtains several new and interesting insights. In a different direction, Villa-Boss (1999) considers an infinite horizon dynamic duopoly model with overlapping generations of consumers that is closely related to the analysis of Fudenberg and Tirole (2000).³ Another issue deals with the

²Economic analysis on dynamic price discrimination under monopoly, which I do not discuss in this paper, originates from Stokey (1979); a survey of this literature can also be found in Fudenberg and Villa-Boss (2005), which focuses on models of *ex ante* product differentiation when discussing behavior-based price discrimination under oligopoly.

³In Villa-Boss, firms can only discriminate between returning customers and non-returning customers, without being able to distinguish between newly arrived customers and existing customers of a rival.

possibility that firms may offer long-term contracts that fix their future prices. Such price commitment can create endogenous consumer switching costs, as in Banerjee and Summers (1987) and Caminal and Matutes (1990). Fudenberg and Tirole (2000) addresses this issue in the context of price discrimination. Still another interesting issue concerns firms' incentives and effectiveness in gathering consumer information for the purpose of price discrimination. Taylor (2004) compares the outcomes of two regimes in which either firms can trade customer information or such information trading is not possible. He finds that the welfare effects of protecting consumer privacy, when firms can practice dynamic price discrimination, depends importantly on whether or not consumers anticipate the possibility of information trading. Chen (2004) considers the incentives and effects of marketing innovations that increase firms' abilities in acquiring consumer information. He finds that firms tend to have (inefficiently) too much incentive to develop new marketing technologies and methods for the purpose of gathering consumer information. Armstrong (2005) also contains interesting discussions on this issue.

Like other forms of price discrimination, price discrimination by purchase history can have antitrust implications. However, if the economic theory on such pricing practices is relatively new, the discussion of their antitrust ramifications, to our knowledge, is virtually non-existent in the economics literature. Nevertheless, several antitrust cases may suggest to us when price discrimination by purchase history is likely to raise significant antitrust concerns. In *AKZO*, the European Court of Justice upheld the principle established by an earlier decision of the European Commission that it is abusive for a dominant firm to offer selectively low prices to customers of a small competitor while maintaining substantially higher prices for its existing customers. The Court viewed such behavior as showing AKZO's adopting a strategy with the intention to damage its (smaller) competitor.⁴ In *Irish Sugar*,⁵ the Court agreed with the European Commission that a company would commit abuse of its

⁴Judgment of the Court of Justice of 3 July 1991 in case C-62/86, *AKZO Chemie BV v Commission*, European Court Reports 1991, I-3359.

⁵Case T-228/97, *Irish Sugar PLC v. Commission*, 1999 European Court Reports II-2969 (European Court of First Instance) and C-497/99 P, 2001 European Court Reports I-5333 (European Court of Justice).

dominant position by offering selectively lower prices to (potential) customers of its smaller rival(s) for the purpose of excluding or deterring competition. Unlike the theoretical models in the existing economics literature, these two cases both involve a market structure with asymmetric (dominant) firms.

The rest of the article is organized as follows. In section 2, we discuss and compare two basic models in oligopoly price discrimination by purchase history, based on Chen (1997) and Fudenberg and Tirole (2000). In section 3, we discuss extensions of these basic models and developments on related issues. We first discuss Taylor (2003) and Villa-Boss (1999), and highlight the additional insights one may obtain in considering multiple firms and periods. We then consider how firms may endogenously change their abilities to engage in dynamic price discrimination, through long-term contracts or marketing innovations, and discuss issues related to the technology to gather consumer information and the protection of consumer privacy. We further discuss the antitrust implications of purchase-history based price discrimination. Section 4 concludes.

2. TWO BASIC MODELS

2.1 Price Discrimination with Switching Costs

We first review a model, developed in Chen (1997), in which initially firms produce a homogenous product, but consumers have real costs to switch suppliers after the initial purchase.⁶ It is assumed that two firms, A and B, produce a homogeneous product with constant and equal marginal cost $c \geq 0$. There is a unit mass of consumers, and each consumer demands one unit of the product per period with reservation price V . In the first period, both firms simultaneously set their prices, resulting in portion α of consumers purchasing from A and portion $1 - \alpha$ of consumers purchasing from B, where $0 \leq \alpha \leq 1$. Thus α and $1 - \alpha$ are the market shares of firms A and B in the beginning of period 2.

⁶For the literature on markets with consumer switching costs, see, for instance, Klemperer (1987), Farrell and Shapiro (1988), and Nilssen (1992); Farrell and Klemperer (2004) provides an excellent survey of the literature.

Whether a consumer has purchased from A or B in the first period is known to both firms. If a consumer switches to purchase from a different seller, she incurs a switching cost, s , which is the realization of a random variable uniformly distributed on $[0, \theta]$ and which she privately learns in the beginning of the second period. Firms again compete in prices in the second period, but now each firm can offer different prices to its own customers and customers who purchased from the rival earlier. Firms and consumers have the same discount factor $\delta \in (0, 1]$.

Since firms cannot commit to their future prices, the game needs to be solved by backward induction. In the second period, let p_2^i and r_2^i denote firm i 's prices to its own and the rival's customers, respectively. In the equilibrium of the second period, Chen (1997) shows

$$\begin{aligned} p_2^{i*} &= p_2^* = c + \frac{2}{3}\theta, \\ r_2^{i*} &= r_2^* = c + \frac{1}{3}\theta. \end{aligned}$$

Thus, each firm charges a lower price to the rival's customers than to its own customers in the second period (the price difference is $\frac{1}{3}\theta$). The ratio of price mark-up for the two customer groups is $\frac{c+\frac{2}{3}\theta-c}{c+\frac{1}{3}\theta-c} = 2$. Consumers with low switching costs ($s < \frac{1}{3}\theta$) change suppliers in the second period, while those with higher switching costs stay with its first-period supplier. In equilibrium, 1/3 of the consumers switch suppliers in the second period.

Remarkably, the second-period equilibrium prices are independent of the two firms' respective market shares. This independence result, which also holds for more general distributions of consumer switching costs, is an attractive feature of the model that allows relatively tractable extension to multiple periods, as in Taylor (2003). Because of this independence result and the fact that products are ex ante homogeneous, consumers in the first period will all purchase from a firm if it has a lower price, and split evenly between the two sellers if they charge the same price.⁷

⁷If firms cannot price discriminate in the second period, their prices in the second period will depend on their market shares, with a higher price under a higher market share. Then, consumers may choose to purchase from a firm with *higher* price in the first period, if the firm is expected to have a lower price in the second period.

Returning to the first period, we can solve the equilibrium for the entire game. The game has a unique subgame perfect equilibrium, where each firm sets $p_1^* = c - \frac{\theta}{3}\delta$ in period 1, and sets (p_2^*, r_2^*) in period 2. Exactly half of the consumer population purchase from each firm, and hence market share α in the beginning of the second period is equal to $\frac{1}{2}$. At p_1^* , each firm's discounted sum of profit is $\frac{\theta}{9}\delta$, which is the same as each firm's discounted sum of profit if it had sold zero output in the first period. Since the two firms' products are ex ante perfect substitutes, competition in the first period drives the first-period prices just low enough to compete away all profits beyond what a firm can guarantee itself with zero sales in the first period.⁸

Intriguingly, firms earn positive discounted sum of profits, even though they produce ex ante homogeneous goods and are perfect competitors in the first period. But this is due to the fact that each firm is the only firm that can induce the rival's consumers to switch, a point that is made clear by Taylor (2003). In other words, the presence of switching costs creates product differentiation in the second period, which gives each firm market power in the second period. Thus even if a firm makes no sale in the first period, it can earn a positive profit in the second period. And, consequently, competition in the first period will not drive profits to zero.

Chen also solves the equilibrium prices if firms cannot price discriminate, in which case firm i 's second-period price is denoted as \tilde{p}_2^i . In equilibrium,

$$\begin{aligned}\tilde{p}_2^{A*} &= c + \frac{1 + \alpha}{3\alpha}\theta, \\ \tilde{p}_2^{B*} &= c + \frac{2 - \alpha}{3\alpha}\theta,\end{aligned}$$

and $\tilde{p}_2^{A*} \geq \tilde{p}_2^B$ if and only if $\alpha \geq \frac{1}{2}$. Notice that under uniform pricing, a firm's second-period price is increasing in its market share, in contrast to prices under price discrimination. If $\alpha = \frac{1}{2}$, $\tilde{p}_2^{A*} = \tilde{p}_2^{B*} = c + \theta$. Notice also that since a firm with a higher market share will charge a higher price in the second period, consumers become less price sensitive in the first

⁸The equilibrium is unique, because if the lowest price is below p_1^* , the firm charging this lowest price will receive a profit that is lower than its profit when it simply sets a high price and sells zero in the first period; and the equilibrium price cannot be above p_1^* from the usual reasoning under Bertrand competition.

period.

The calculation of equilibrium prices in period 1 under uniform pricing is complicated by the fact the second-period equilibrium profit as a function of α has a kink at $\alpha = \frac{1}{2}$. This gives rise to multiple subgame perfect equilibria of the game under uniform pricing. Chen (1997) shows that one equilibrium that is natural in this context is

$$\tilde{p}_1^{i*} = \tilde{p}_1^* = c + \frac{2}{3}\theta\delta,$$

with $\alpha = \frac{1}{2}$ and $\tilde{p}_2^{A*} = \tilde{p}_2^{B*} = c + \theta$. At this equilibrium, equilibrium prices are higher under uniform pricing than under discriminating pricing in both periods, and consumers are better off under discriminating pricing. However, there can also be other equilibria under uniform pricing, one of which is $\tilde{p}_1^{i*} = c - \frac{27}{36}\theta\delta$, with $\alpha = \frac{1}{2}$ and $\tilde{p}_2^{A*} = \tilde{p}_2^{B*} = c + \theta$. At this "more competitive" equilibrium, prices are lower in the first period under uniform pricing than under discriminating pricing, and price discrimination reduces each consumer's expected surplus. However, equilibrium profit is higher under uniform pricing than under discriminating pricing. As under price discrimination, under uniform pricing firms also charge lower prices in the first period than in the second period.

To summarize, in this model of ex ante homogeneous product, oligopoly price discrimination by purchase history lowers profits for all firms, without necessarily benefiting consumers. There are deadweight losses in social welfare due to the cost of switching.

2.2 Price Discrimination with Brand Loyalty

Rather than assuming that consumers have brand preferences due to switching costs after an initial purchase, Fudenberg and Tirole (2000) postulates that consumers have inherently different preferences for the two firms' products. Below I present a simplified version of their model. Consumers are uniformly distributed on a Hotelling line of unit length. Firms A and B are located at the two ends of the line, with constant marginal cost c . A consumer's location or brand preference, $\theta \in [0, 1]$, is fixed over two periods, and the consumer incurs transportation cost t per unit distance. Firms do not observe consumers' brand preferences, but they can use consumers' first-period purchases to draw inferences about these

preferences and price accordingly. Anticipating this, consumers also adjust their purchase behavior in the first period.

The game is solved by first deriving the second-period equilibrium. Suppose firms A and B sell to consumers with $\theta \in [0, \alpha]$ and $\theta \in [\alpha, 1]$ in period 1, respectively. Let p_2^i denote i 's period-2 price to consumers on its turf, and r_2^i denote i 's period-2 price to consumers on its rival's turf. In equilibrium,

$$\begin{aligned} p_2^A &= c + \frac{1}{3}t(1 + 2\alpha); & r_2^A &= c + \frac{1}{3}t(3 - 4\alpha); \\ p_2^B &= c + \frac{1}{3}t[1 + 2(1 - \alpha)]; & r_2^B &= c + \frac{1}{3}t[3 - 4(1 - \alpha)]. \end{aligned}$$

Therefore, as in Chen (1997), a firm charges a lower price to the switching customers than to its loyal customers, or price discriminates against its loyal customers. However, an important difference here is that the second period price depends on market shares from the first period: a firm charges its own customers a higher price if it had a higher market share in period 1. If the firms have equal market share the first period, as they will at a symmetric equilibrium, the second period equilibrium prices are simply $p_2^* = c + \frac{2}{3}t$ and $r_2^* = c + \frac{1}{3}t$. Interestingly, here the price mark-up for the two consumer groups is again $\frac{\frac{2}{3}t}{\frac{1}{3}t} = 2$, the same as in Chen (1997).

The first period equilibrium prices can be solved by noticing that the marginal consumer in the first period will switch in the second period and is indifferent between purchasing from A and switching to B and purchasing from B and switching to A . Since the second period price is increasing in market shares, the first-period demand is less elastic than in a static one-shot game. The subgame perfect equilibrium prices are found to be

$$p_1^A = p_1^B = p_1^* = c + t \left(1 + \frac{\delta}{3} \right)$$

for the first period, with the second-period prices as given earlier. Hence equilibrium prices decrease over time. The first-period market shares are split equally at $\frac{1}{2}$, while in the second period consumers with $\theta \leq \frac{1}{3}$ continue to purchase from A , consumers with $\theta \geq \frac{2}{3}$ continue to purchase from B , and consumers with $\theta \in (\frac{1}{3}, \frac{2}{3})$, or $1/3$ of the consumer population, switch suppliers. There is a deadweight loss of social welfare due to this switching.

If price discrimination by purchase history is not possible, then each firm's price in each period is simply

$$p_1 = p_2 = c + t.$$

Therefore price discrimination raises the first period price but reduces the second period price. Since no consumer switches supplier under uniform pricing, price discrimination, which results in inefficient consumer switching, reduces welfare. It can be easily verified that under price discrimination, the consumers who do not switch suppliers in the second period obtain the same surplus as under uniform pricing, while consumers who switch are better off; thus aggregate consumer surplus is higher with price discrimination. Since social welfare is lower under price discrimination, it follows that firm profits must be lower as well.

2.3 Comments on the Two Models

The two basic models capture two different types of markets with repeated purchases. In the first model, dynamic price discrimination is made possible by the presence of consumer switching costs after the initial purchase; products are ex ante homogeneous but ex post differentiated. In the second model, dynamic price discrimination is made possible by consumer's different product preferences that are revealed after the initial purchase; products are ex ante differentiated. The ex ante homogeneous-goods model is more appropriate in markets where switching costs are more important relative to the consumers' initial differences in brand preference, and the opposite is true for the ex ante differentiated-goods model. As a modeling tool, under price discrimination the analysis is simpler in the ex ante homogeneous-goods model than in the ex ante differentiated-goods model, largely because second-period prices are independent of market shares in the former but not in the latter; while under uniform prices the opposite is true, largely because second-period prices are independent of market shares in the ex ante differentiated-goods model but not in the ex ante homogeneous-goods model.

A key common feature of both models is that a consumer's purchase of a rival's product in the first period implies a weaker demand of the consumer towards the firm's product in the

second period. This motivates each firm to offer lower prices to its rival's customers in the second period, or "paying customers to switch", if prices can be based on a consumer's past purchases.⁹ Such price discrimination in both models results in lower equilibrium profits for the competing firms and inefficient consumer switching. With a qualification, social welfare is reduced by price discrimination.

There are also important differences in the models' implications under price discrimination. In particular, prices increase over time in the ex ante homogeneous-goods model, but decrease over time in the ex ante differentiated-goods model. Furthermore, price discrimination may or may not benefit consumers in the ex ante homogeneous-goods model, but it unambiguously increases consumer welfare in the ex ante differentiated-goods model.

The result here that price discrimination leads to lower equilibrium profits for both firms is related to the findings in other studies on oligopoly price discrimination (e.g., Thisse and Vives, 1988; Holmes, 1989; Corts, 1998; and Chen, 1999). A general insight from this literature is that price discrimination can be related to two types of price sensitivities (elasticities). Different consumers may differ in their price sensitivities towards different firms, and/or they may differ in their valuations towards a product. The effects of price discrimination along these two dimensions depend on the underlying market conditions. For instance, In a model of competing retailers selling both to captured and switching customer segments, Chen (1999) suggests that price discrimination based on differences in consumers' valuations towards a product allows firms to extract consumer surplus and tends to increase firms' profits; but price discrimination based on consumers' differences in their across-firms price elasticities tends to cause primarily the business-stealing effect and to intensify competition, resulting in lower profits for all firms in equilibrium.¹⁰ However, Armstrong

⁹Shaffer and Zhang (2000) considers a static model that is similar to the second period of Chen (1997) but allows asymmetric demands to the two firms. They show that it is then possible in equilibrium for a firm to charge lower prices to its loyal segment, or "paying customers to stay", as it could be the case if, for instance, one firm's loyal customers have lower switching costs on average than the other firm's.

¹⁰For convenience, each consumer is often assumed to have unit demand per period in the literature on price discrimination by purchase history. When a consumer demands multiple units, firms may also use nonlinear pricing or second-degree price discrimination (e.g., Stole, 1995).

(2005) shows in a Hotelling setting that discrimination based on valuations has no impact on outcomes at all; while discrimination based on “choosiness” (i.e., transportation cost) *increases* profits.

An important assumption in both models is that firms are ex ante symmetric. In reality, firms are often asymmetric: they may differ in sizes, costs, etc. Asymmetric firms raise interesting additional issues. For instance, if a dominant firm adopts a pricing strategy that offers the customers of its rival(s) a price that is lower than what it charges its own customers, it can damage the rival’s ability to compete, resulting in the exclusion of the rival(s) from competition. We shall return to this issue later in our discussion of antitrust implications.

3. FURTHER DEVELOPMENTS AND DISCUSSIONS

3.1 Allowing Multiple periods and/or Multiple Firms

A significant extension of the basic models is to allow more than two periods and/or more than 2 firms. The importance of such extensions is not necessarily because multiple periods and/or multiple firms are more realistic, but because such extensions may yield new economic insights.

Consider first Taylor (2003), which extends Chen (1997) to multiple periods and multiple firms. Among other things, Taylor’s analysis reveals the following two interesting points: First, with three or more firms, there are at least two outside firms competing for each firm’s loyal customers to switch, which leads to zero profits from switching customers, and in turn to zero expected discounted sum of profits for all firms. It is an interesting point that a change from two firms to three firms leads to qualitative differences in economic outcomes. Because of the intensified competition for switching customers under three or more firms, prices are lower for both switching and non-switching consumers, and the price difference between these two types of consumers is larger. Second, with multiple periods, consumers can potentially switch suppliers more than once. This raises the interesting issue that a consumer may want to switch early on to signal her low switching costs, and a seller faces

subtle strategic considerations in observing the past switching behavior of the customer: targeting a consumer with high switching costs may not be worthwhile, but attracting a consumer with low switching costs has the difficulty of retention.¹¹

Next consider Villas-Boas (1999), which provides an analysis similar to Fudenberg and Tirole (2000) but in an infinite-period, overlapping-generations duopoly model. A firm in this model cannot distinguish between its rival's customers and customers who are new to the market, and can thus only discriminate between customers who are its previous customers and who are not. Unlike in Fudenberg and Tirole, where price discrimination raises price early on but lowers price later, Villas-Boas shows that dynamic price discrimination in his model lowers all prices, because of the intensified competition when firms attempt to attract the rivals' previous customers. As in the other models we have discussed, there is equilibrium customer switching here as well.

3.2 Long-Term Contracts and Other Loyalty Inducing Arrangements

In our discussion so far, consumers have loyalty to their supplier for exogenous reasons, either because they need to incur costs to switch supplier or because they prefer the supplier's brand. But firms can also use contracts to create endogenous switching costs/loyalty for consumers in repeated purchases. Banerjee and Summers (1987) and Carminal and Matutes (1990) are early contributions on this issue. Carminal and Matutes consider a two-period Hotelling model where a consumer's location is an independent realization at each period. Thus a consumer's first period location contains no information about her second period location. Fudenberg and Tirole (2000) considers both this preference-changing case and the case where any consumer's location (preference) is the same in both periods. The basic timing assumption is that firms first simultaneously choose their first period prices, and pre-commit (if they choose) to offer a second-period price to customers who purchase at

¹¹This is reminiscent of the academic job market for (senior) economists in the U.S., where typically there is a significant salary premium attached to a faculty member resulting from switching universities.

the first period.¹² In the second period, each firm simultaneously offers a pair of prices to its own previous customers and its rival's previous customers, subject to any price commitment that it may have made in the first period.

If preferences are independent across periods, the analyses of Carminal and Matutes (1990) and of Fudenberg and Tirole (2000) lead to the following results: First, in equilibrium firms choose to commit to second period prices for its returning customers. The price commitment creates endogenous switching costs and inefficiently too little switching in the second period. Second, each firm commits to an equilibrium price path that is decreasing. In fact, in the second period, each firm prices its good to its first period customers at an effective price below marginal cost, while each firm's price for the switching customers is higher. Third, firms receive lower equilibrium profits if they are able to offer long-term contracts and to offer prices in the second period based on consumers' past purchases.¹³

If preferences remain the same across the two periods, Fudenberg and Tirole (2000) shows that firms will choose to offer both long-term and short-term contracts in the first period. Consumers will self-select: those with strong brand preferences will choose a long-term contract; and those with weak brand preferences will choose a short-term contract, some of whom will switch suppliers in the second period. By locking in some of its most captive customers, a firm, say firm *A*, can commit itself to more aggressive second-period pricing. This commitment helps *A* because it induces the other firm to lower its second-period poaching price, which makes it more attractive for consumers to purchase from *A* in the first period, and this in turn allows *A* to charge a higher first-period price. There is less equilibrium switching when long-term contracting is possible. Since switching is

¹²Fudenberg and Tirole (2000) allows firms to offer both long-term (two periods) contracts and spot contracts in period 1.

¹³These analyses assume that consumers do not know their future preferences when making purchase decisions. Matutes and Regibeau (1992) consider situations where consumers know their future preferences when making first-period purchases. There is also inefficiently too little consumer switching in their model. The effects of long-term contracts for the model in Chen (1997) have not been studied; and I conjecture that long-term contracts would reduce the inefficient consumer switching (and hence increase social surplus) there.

not efficient here, long-term contracting improves social welfare. Compared to a duopoly with only short-term contracts, long-term contracting also reduces firms' profits and raises consumer surplus.¹⁴

The fact that long-term contracts have opposite welfare effects in models where brand preferences are independent across periods and in models where brand preferences are perfectly correlated across periods suggest that the proper public policy towards the use of long-term contracts by businesses depends importantly on the industries involved. In industries such as the airlines, a consumer is likely to have different travel needs for different trips. This means that a model with changing brand preferences is likely to be a better description about the economic environment in such industries. Alternatively, in industries such as that for long-distance telephone services or for credit card services, it seems that consumers are likely to have the same brand preferences each month. These industries may be better modeled as industries with an ex ante homogenous product, where brand loyalty is more likely created by switching costs. (What is the difference between a long distance call connected through one company versus another, or between using a Visa card issued by one bank versus another bank?)

In addition to long-term contracts, firms may also use other means to create or increase consumer switching costs. For instance, by making each other's product less compatible, firms can increase consumers' switching costs (see Farrell and Klemperer, 2004 for further discussions). Conversely, as is analyzed in Gans and King (2001), technology exists that allows a consumer to have the same phone number when changing phone companies, which would reduce the consumer's transaction costs (switching costs) to purchase from her current service provider's competitor. Firms, on the other hand, may not introduce this technology since it can intensify competition, and then government regulation would be needed to make

¹⁴Armstrong (2005) considers the situation where firms can commit fully to future prices, and points out an equilibrium where firms sell a pure bundle of products for two periods, resulting in no second-period switching and higher profits. This provides an interesting contrast to Fudenberg and Tirole's result on the effects of long-term contracts on profits. The lack of ability by firms to commit not to offer "poaching" contracts in the second period in Fudenberg and Tirole seems to be responsible for the difference.

it happen.

3.3 Technology, Privacy, and Price Discrimination

Firms' abilities to engage in price discrimination are constrained by technologies and the legal environment. On the technology side, to be able to price according to consumers' purchase history, a firm needs to have the information technology to track consumer purchase histories. The technology may be relatively simple if all one needs to know is from which firm a consumer has purchased before, but more detailed and effective consumer targeting may require rather sophisticated information technologies and/or marketing methods. In recent years, new ways of gathering consumer information through innovative marketing programs and technologies have enabled firms to reach consumers more effectively and to use pricing strategies that were previously not feasible. Chen (2004) uses the term "marketing innovation" to describe such new marketing tools and methods. For example, in recent years, retailers have introduced preferred-customer cards or loyalty cards. When the card is swiped at the point of sale, the retailer's information system records the name of the shopper, the time of the transaction, and the content of the purchase. These cards, in combination with the new information systems developed, enable retailers to target consumers with individualized promotions and, effectively, individualized prices. As another example, the recent development of Internet stores enable sellers to use consumer-tracking technologies such as clickstream tracking, online registration, and cookies. Selling on the internet with such technologies enables a firm to better understand each individual customer's tastes and to offer individualized prices. What are the incentives and effects of marketing innovation? How are these incentives affected by the possible imitation from the rivals? How does competition affect these incentives? And, how do the private and social incentives differ? Chen (2004), which in addition also considers marketing innovations that reduce consumer transaction costs, offers insights on these issues.

In a dynamic duopoly model where one firm can introduce a marketing innovation while the other firm can imitate with some delay but at a lower cost, Chen (2004) shows that

the marketing innovation that gathers consumer information benefits the innovating firm but hurts some consumers.¹⁵ However, unlike the usual product or process innovations, the adoption of a marketing innovation to obtain more accurate consumer information can actually reduce industry profit. Also, an increase in competition intensity reduces the marketing innovation incentive; and compared to the social optimum, the private incentive is too high for the marketing innovation to gather consumer information but too low for the marketing innovation to reduce consumer transaction costs.

There are several legal issues related to price discrimination through new marketing tools and methods. One concerns the legal treatment of intellectual property embedded in a marketing innovation. In recent years, there has been significant interest in whether business method innovations should receive patent protections (e.g., Gallini, 2002; and Hall, 2003). We may consider marketing innovation as part of the business method innovations. Patent protection will effectively delay imitation, which can increase the incentive for marketing innovation. But since the private incentive for marketing innovations to gather consumer information is already too high relative to the socially optimal level, there is a lack of economic justification for such legal protection. (On the other hand, patent protection for marketing innovations that reduce consumer transaction costs may be desirable since the private incentive for such innovation is inefficiently low.)

Another issue is consumer privacy, which has received much attention in recent years. Of particular interest is the question of whether firms should be allowed to purchase (and sell) consumer information, such as consumers' purchase history, for the purpose of price discrimination. Taylor (2004) provides an interesting analysis on this question.¹⁶ He considers a two-period model where at each period a monopolist sells a distinct product. A consumer's valuations for the two products are positively correlated and are the consumer's private information. A consumer's purchase decision at the first period from firm 1 can thus

¹⁵This result depend on the specific assumptions of the model. Armstrong (2005) shows in a different setting that a firm is worse off being able to gather consumer information.

¹⁶See Liu and Serfes (2005) for another recent analysis of the incentives and effects of customer information sharing by oligopoly firms. There is an earlier literature on information sharing among oligopoly firms (e.g., Gal-Or, 1985), which addresses quite different economic issues.

convey information about the consumer's valuation for the product of firm 2 at the second period, and this information can then be used by firm 2 to offer different prices to a consumer based on the consumer's first period purchase history. Taylor analyzes two settings, a confidential regime where the sale of customer information is not allowed, and a disclosure regime where one firm may compile and sell customers information to another firm. He finds that when consumers are naive, in the sense of not anticipating the sale of customer information by firm 1, firms prefer the disclosure regime to the confidential regime. Social surplus may be either higher or lower under the disclosure regime depending on whether dynamic price discrimination lowers or raises average prices. On the other hand, when consumers anticipate sale of their information, some consumers who have high valuations for both products misrepresent their preferences by strategically refusing to buy from firm 1 if it sets a high price. This strategic demand-reduction undermines the market for customer information since it results in a worthless customer list. It also causes the effective demand facing firm 1 to be more elastic, which can lead to lower prices and higher welfare. Firms prefer the confidential regime to the disclosure regime when consumers behave strategically. Government policies prohibiting the sale of customer information can reduce welfare.¹⁷

In a broader sense, there is also the issue of fairness when firms engage in price discrimination, which has been largely ignored in the economics literature. But fairness considerations can have important implications for consumer and business behaviors. In September 2000, Amazon.com conducted pricing experiments in which DVD movies were sold to different consumers at different prices based on their purchase histories. Amazon's pricing strategies were severely criticized by consumer privacy groups, and the company publicly apologized and made refunds to 6,896 customers (Taylor, 2004). If a consumer feels being treated unfairly or being taken advantage of by a firm, the consumer may decide to boycott the firm's product. This can reduce a firm's incentive to engage in price discrimination.

¹⁷Obviously, antitrust regulation and competition policies can also affect firms' incentive and ability to practice dynamic price discrimination.

3.4 Implications for Antitrust

In the U.S., Section 2 of the Clayton Act, originally signed into law in 1914 and amended by the Robinson-Patman Act (enacted in 1936), makes it unlawful to price discriminate if the effect of discrimination "may be substantially to lessen competition or tend to create a monopoly in any line of commerce." In the European Union, a parallel legal doctrine exists, where price discrimination for the purpose of restricting competition by a dominant firm, or more generally, "applying dissimilar conditions to equivalent transactions with other trading parties, thereby placing them at a competitive disadvantage" by a dominant firm, would be considered as illegal abuse, by Article 82 of the EC Treaty. However, price discrimination by purchase history, as we have discussed so far, is by and large unlikely to raise significant antitrust concerns. In fact, as the economics literature suggests, such pricing practices in oligopoly markets often intensify competition and potentially benefit consumers.¹⁸ But this economics literature is relatively new and has so far focused on markets where firms are symmetric, in which the issues of market dominance by a single firm and the exclusion of competition are not considered. These issues can, nevertheless, be relevant for dynamic price discrimination.

One relevant case in this context is *AKZO Chemie BV v Commission*. AKZO Chemie BV (hereafter AKZO) was a company with a dominant market position of the flour additives market in UK and Ireland (with 55% of market share in 1984). Beginning in 1979, it pursued a discriminating pricing strategy that offered prices to the customers of its smaller competitor, ECS (Engineering and Chemical Supplies Limited, with 30% of market share in 1984), that were substantially lower than prices it offered to its own customers. In fact, the prices charged by AKZO to ECS's customers were below its average total costs while those offered to its own customers were above its average total cost. This pricing strategy seems to be a form of "poaching rival's customers", in the terminology of the economics literature,

¹⁸Unlike group price discrimination under monopoly, where it typically benefits some consumers but hurts others, price discrimination under oligopoly can benefit all consumers by making the market more competitive.

but it was exercised by a firm in a dominant position. The European Court of Justice concluded that AKZO's intention was not to pursue a general policy of favorable prices, but to adopt a strategy that could damage ECS; and as such, AKZO's pricing behavior was abusive.

Another relevant case is *Irish Sugar*. In 1997, the European Commission fined Irish Sugar, a dominant firm in the sugar market of Ireland, for abuse of its dominant position on the Irish sugar market. The Commission's decision was based on, among other things, the finding that Irish Sugar sought to restrict competition from imports of sugar from France and Northern Ireland through discriminating pricing. In particular, Irish Sugar targeted selectively lower prices to customers of an importer of French sugar, and to customers located close to the Northern Irish border who were (potential) customers of sugar imports from Northern Ireland. The Commission also found that through its anti-competitive behavior, Irish Sugar was able to maintain a significantly higher price level for packaged retail sugar in Ireland compared with that in other Member States. The Commission's decision was upheld by rulings of the European Court of First Instance and of the European Court of Justice, in *Irish Sugar PLC v. Commission*, even though the Court found that there was insufficient evidence that Irish Sugar offered selectively lower prices to customers of the French sugar importer. Importantly, the Court affirmed the Commission's finding that the selective price cut to border customers had the purpose and effect of restricting competition; and the Court's ruling implied that the selective price cut by Irish Sugar to its competitor's customers, had it been proven, would have been considered illegal restriction of competition as well.¹⁹

Thus, with asymmetric firms, especially in the presence of a dominant firm, dynamic price discrimination, in the form of poaching rivals' customers through selectively lower prices, may have the purpose and effect of excluding or deterring competition. Such price discrimination can be in violation of antitrust laws. This suggests that extending the models

¹⁹Notice that there is potentially a big difference between offering low prices to existing customers of rivals, and offering low prices to markets which are "more competitive" than others (i.e., the border customers here). The latter situation has been considered in Armstrong and Vickers (1993).

reviewed earlier so as to allow for asymmetric firms would be worthwhile. Developing an economic theory that reflects more realities of competition would put us in a better position to inform public policies.

4. CONCLUSION

Oligopoly price discrimination by purchase history has occurred in many markets, and it is becoming increasingly prevalent as information technology advances. The economics literature offers important insights on the incentives for and effects of such pricing practices. Price discrimination by purchase history is an equilibrium pricing strategy of oligopoly firms in several important market environments with repeated purchases, including one where firms produce a homogenous good ex ante but there is ex post product differentiation due to consumer switching costs, and another where firms' products are differentiated because consumers have intrinsic differences in their brand preferences. In both of these two economic environments, oligopoly price discrimination based on purchase history tends to lower industry profits, but may or may not increase consumer welfare. There is inefficiently too much consumer switching between firms. These results hold in models with two firms and two periods, as well as in models with multiple firms and multiple periods. Long-term contracts or other loyalty-inducing arrangements reduce consumer switching and can increase welfare, so long as consumers' brand preferences are unchanged over time. Firms also attempt to increase their ability to gather consumer information through developing new marketing tools and methods. Such marketing innovations differ substantially from the usual product and process innovations in their effects on firms and consumers. The incentives and abilities for competing firms to engage in dynamic price discrimination are affected by laws concerning the protection of intellectual property rights and of consumer privacy.

The economics literature on oligopoly price discrimination by purchase history is relatively new and has focused mostly on markets with symmetric firms, where the issues of market exclusion and dominance are not considered. In these situations, dynamic price

discrimination by competing firms often results in intensified competition; and such pricing practices typically would not raise antitrust concerns. However, when a dominant firm targets the (potential) customers of its competitor(s) with prices lower than what it charges its own customers, such price discrimination, also in the form of "customer poaching" or "paying customers to switch", can have the purpose and effect of restricting competition, in violation of antitrust laws. This article has taken a first step in identifying this possibility, through the discussion of two legal cases. In future research, it would be highly desirable to develop formal economic models that analyze dynamic price discrimination in markets with asymmetric firms.

There are other directions for future research. For instance, the theoretical models have offered interesting opportunities for future empirical work. In particular, the two basic models in Section 2 have opposite predictions on price changes over time. It would be interesting to test empirically whether and when prices decrease or increase over time under dynamic price discrimination. Case studies would also be valuable in this regard.

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