Information provision and behaviour-based price discrimination

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ABSTRACT

This article examines a model wherein firms first advertise their existence to consumers and, in the two following periods, compete with uniform pricing and then with behaviour-based price discrimination. I show that allowing firms to price discriminate can restore symmetry in equilibrium advertising decisions. I also establish that price discrimination increases (resp. decreases) profits and total welfare but hurts (resp. benefits) consumers when the advertising cost is high (resp. low).

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1. Introduction

Due to significant improvements in the ability to collect and process consumer level information, firms often use behaviour-based price discrimination (BBPD). This widely established pricing practice consists of offering different prices to different consumers according to their past purchase behaviour.[1] In practical terms, firms are able to recognise their previous customers when charging prices. This pricing strategy is already widely established in many important industries (e.g., banks, phones, software, hotels, airlines and e-retailers) and is likely to become more prevalent with the development of new information technologies. The online environment arguably enhances the possibilities for BBPD because consumer information can be easily col-

lected, and it is also possible to alter the price displayed on each screen. It is easy to track consumer behaviour through the cross checking of cookies, IP addresses and installed software. New research by the Electronic Frontier Foundation (EFF[2]) has found that the overwhelming majority of web browsers have unique signatures – creating identifiable "fingerprints" – that can be used to track individuals as they surf the Internet. The EFF found that 84% of the configuration combinations were unique and identifiable, creating unique and identifiable browser fingerprints. Of browsers that had the Adobe Flash or Java plug-ins installed, 94% were unique and trackable.

There are many examples of behaviour-based pricing on the Internet. A recent study, 'Open to Exploitation' (Turow et al., 2005), conducted by the Anneberg Center at the University of Pennsylvania in 2005, identifies multiple instances of price customisation on the Internet. A retail photography web site, for example, charged different

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[1] See Chen (2005), Fudenberg and Villas-Boas (2007) and Esteves (2009b) for surveys on BBPD.

[2] http://www.eff.org/ (last accessed: 17/04/2012).

prices for the same digital cameras and related equipment, depending on whether shoppers had previously visited popular price-comparison sites. In September 2000, Amazon.com's price discrimination policy was uncovered. One buyer reportedly deleted the cookies on his computer that identified him as a regular Amazon.com customer. Consequently, he saw the price of a DVD offered to him for sale drop from $26.24 to $22.74 Baker et al. (2001). Additionally, Amazon.com had apparently experimented with such targeted prices multiple times: in 2000, consumers also discovered that Amazon.com used dynamic pricing when customers comparing prices on a bargain-hunter web site discovered that Amazon was randomly offering the Diamond Rio MP3 player for up to $51 less than its usual $233.95 price. Another more recent example is the antivirus software developer McAfee,[3] which, in 2010, attempted to make some of its previous customers renew their subscriptions for $79.99, while it offered the same software to its new customers at $69.90. A common feature of all these examples is that sellers attempt to take advantage of customers' low levels of information that were revealed thanks to their past purchase (or browsing) behaviours.

Sellers therefore have a strategic incentive to manipulate consumers' levels of awareness though advertising campaigns. The first goal of this article is to evaluate how advertising investments under BBPD competition differ from those under uniform price competition. Ultimately, this adjustment in advertising decisions has feedback effects on the competitive and welfare effects of BBPD. The second objective of this article is to evaluate these effects. I analyse a three-period duopoly model with an initial stage of informative advertising investment followed by two periods of price competition: the first with uniform pricing and the second with BBPD. This model builds on that of Esteves (2009a) with one key modelling difference: Esteves (2009a) assumes that firms make their advertising and first-period price decisions simultaneously, while I consider a sequential timing.

The sequential and simultaneous timings reflect different specificities in the functioning of a market. Sequential timing is more appropriate when providing information is a long-run decision that has a strategic effect on the price equilibrium.[4] When the advertising choice becomes less strategic and easier to change as markets evolve, simultaneous timing is more relevant.[5] Another difference between the two timings is that advertisements contain price information under simultaneous timing, while this is not the case under sequential timing. In addition, under the sequential timing, the provision of information is not necessarily limited to advertising. For instance, it could also account for the density of retail shops, when only consumers in the locality of each shop become informed of the product (Ireland, 1993).

After advertising, each firm has a base of captive consumers who are only aware of its products. They compete for price-sensitive consumers who have been reached by both firms' advertisements. At the end of the first period of price competition, one firm has only served its captive consumers (say firm 1), whereas its rival has served both its captive consumers and the price-sensitive ones[6] (say firm 2). Consequently, firm 1 knows that all the sales it received were from its captive consumers because price-sensitive consumers bought from its rival. As in Esteves (2009a), firm 1 is then the only one that is able to recognise its captive consumers when charging prices in the next period and consequently offers them a different price from the one offered to new consumers. Firm 2 has no actionable information about its captive consumers and hence cannot engage in price discrimination. For fixed levels of advertising, price discrimination clearly benefits firm 1 relative to uniform pricing. The analysis also shows that the firm with the high level of advertising has a higher probability of securing the discriminating position than its rival. Indeed, as in Esteves (2009a), the profitability of the second period price discrimination fosters a competition to acquire the discriminating position in the first period though high prices. This 'race for discrimination' tends to soften first-period price competition. However, I show that when the advertising cost is small enough, allowing firms to price discriminate changes advertising investments in such a way that first-period prices are on average below those that prevail under uniform price competition. These results are diametrically opposed to those of Esteves (2009a). In addition, the overall competitive and welfare effects of BBPD sharply differ under the two different timings. I find that, overall, BBPD increases (resp. decreases) total industry profits and welfare but hurts (resp. benefits) consumers when the advertising cost is relatively high (resp. low). These results contrast with those of Esteves (2009a) who shows that BBPD increases industry profits at the expense of consumers, at least when advertising costs are not excessive, and that BBPD generally has negative welfare effects.

This article also investigates the effects of BBPD on firms' advertising strategies and, in that respect, is related to Ireland (1993), McAfee (1994) and Eaton et al. (2010). These papers study the strategic effects of informative advertising in a two-stage oligopoly model where firms first compete on informative advertising and then on uniform price. They show that despite the a priori symmetry of the firms, the advertising levels in pure strategies are asymmetric in all subgame perfect equilibria. In the present article, I show that competition under BBPD tends to restore symmetry in the firms' advertising investments, a complete symmetrization being achieved when firms' discount factor is equal to one. This phenomenon is due to the balancing effect of BBPD on the pricing strategies of firms that have asymmetric bases of captive consumers. More precisely, in all subgames, the large firm has a stronger incentive to price high in the first period to maintain a substantial margin on its larger base of captive consumers.

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[3] http://www.getelastic.com/customer-retention/ (last accessed: 17/04/2012).

[4] See Fershtman and Muller (1993), Ireland (1993), McAfee (1994), Chioveanu (2008), and Eaton et al. (2010).

[5] See Butters (1977), Stahl (1994), Grossman and Shapiro (1984) and Esteves (2009a).

[6] The equilibrium is in mixed strategies with continuous support so that the probability of a tie is zero.