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Loyalty intelligence and price discrimination in a duopoly

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ABSTRACT

Business intelligence tools have enabled novel and relatively low-cost capabilities to collect and analyze vast amount of customer information. Accumulation of customer specific information along with transactional data empowers firms to categorize customers into segments and offer customized prices. We study the impact of price discrimination and market segmentation on competition and consumer purchase behavior in a game-theoretic model with two asymmetric firms. At equilibrium, both firms price discriminate and segment the market. Contrary to previous price discrimination and market segmentation findings, the game is not necessarily a prisoner's dilemma. The firm dominating the industry is likely to improve its profits at the expense of the rival firm, and consumer welfare will increase with segmentation. We define two fundamental parameters, *market dominance* and the *technology cost to industry dominance ratio*, to drive segmentation technology adoption decisions, as a basis for our analytical approach.

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1. Introduction

Market segmentation is the practice of splitting customers into different groups within which customers have similar characteristics, needs and wants. Interest in market segmentation has been growing lately in both the real and the virtual economy, spurred by the availability of sophisticated business intelligence and data mining tools, which provide relatively low-cost capabilities to collect and analyze vast amount of customer information.¹ Firms can also infer customers' price-sensitivity from large data warehouses of customer information such as age, income, and purchasing history. For example, Principal Financial Group (PFG)² is a firm that manages retirement savings, investments and insurance for more than fifteen million employees. By collecting high-quality data about demographics, life milestones, and benefits-enrollment habits of its customers, PFG delivers personalized investment advice and customer service to a fragmented customer base and sells retirement plans, supplementary mutual funds and insurance.

Market segmentation today can be carried out to an extent never envisioned before. The granularity of segments is only limited by the amount of data available, the sophistication of the technological tools, and cost. In their seminal paper, Dickson and Ginter (1987) state that segments form homogeneous sub-markets, where customers within the same segment respond similarly to firms' product offerings. Wedel and Kamakura (2000) extensively reviewed the marketing segmentation literature, compiling a list of methods and identifying the variables used to assign customers to segments. Frank et al. (1972) categorized segmentation research into two main streams: microeconomic theory and behavioral sciences. Our focus in this paper will be on the economical implications of market segmentation rather than on the segmentation methods and variables.

In general, when firms decide to charge different prices to different segments, three important questions arise: What should be the price for a particular segment? What will be the impact of segmentation and price discrimination on market share? How would consumer welfare change with segmentation and price discrimination? In this study, we address these issues and the impact of segmentation technology cost in a duopolistic price discrimination model, and specifically investigate the impact of segment granularity on price, market share and social welfare. A duopoly is a market situation in which two firms are dominant. Unlike monopolistic price discrimination and segmentation models (Board 2008, Jing 2007, Saak 2008) which have been extensively studied, duopolies, especially in the case of asymmetric firms, have received less attention, as will become clear in the literature

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E-mail addresses: aris@uic.edu (A.M. Ouksel), ferdi@eruysal.net (F. Eruysal).¹ Gartner Group, a leading market research firm delivering technology-related insights, reported that companies made business intelligence initiatives top priority in 2006. IDC, another firm that provides advisory services on information technology trends, predicted that business intelligence's popularity will grow significantly (Lawton 2006).² Principal Financial Group, ranked number one by InformationWeek's 500 report, collects data about customers' demographics, life milestones and benefits-enrollment habits to offer customized products (Ricadela 2006).

review section. Yet duopolies occur in many sectors of the economy. Examples include Pepsi and Coca-Cola in the soft drink industry, Intel and AMD in microprocessors, FedEx and UPS in package delivery, and Airbus and Boeing in aircraft manufacturing.

Our model will consist of two asymmetric firms competing over a population of customers with distinct levels of loyalty. We will use a game-theoretic model where firms may or may not segment the market and offer different prices to each segment when they do. We assume that firms make their pricing decisions simultaneously. Our work is an extension of Shaffer and Zhang's (2000) model to address the impact of multiple segments on price, market share and social welfare. We show that firms have a strong incentive to segment the market, as price discrimination coupled with market segmentation does not necessarily lead to prisoner's dilemma when the dominance of a firm is high, where *dominance* is a decision-making measure we defined as the product of its market share and customer loyalty. The dominant firm is very likely to increase its profits at the expense of its rival. Segmentation leads to lower prices for price-sensitive customers, but higher prices for loyal customers. Consumer welfare improves due to intensified competition.

We found also that a firm's decision to implement segmentation technology compels its rival to do the same to remain competitive. However, this decision is impacted by the technology cost. A very dominant firm and a high segmentation technology cost may inhibit its rival from acquiring the technology. As a result, a manager in practice may be interested in tools to support technology acquisition decisions. We define a simple measure called the *technology cost to industry dominance ratio* to drive technology acquisition decisions.

The rest of the paper is organized as follows. We survey the relevant literature and provide a motivating example is provided in Section 2. The model is described in Section 3. An extensive analysis is given in Section 4, and the various segmentation strategies are then summarized. The implications of the model and the impact of segmentation technology costs are discussed in Section 5. We conclude in Section 6 with a summary of the issues investigated and the results contributed. The proofs of our main results are mostly relegated to appendices.

2. Survey of relevant literature

We briefly review the state-of-the-art in market segmentation and price discrimination research. As Smith (1956) stated, "market segmentation involves viewing a heterogeneous market as a number of smaller homogeneous markets, in response to differing preferences, attributable to the desires of consumers for more precise satisfaction with their varying wants". Segmentation technology enables firms to discover differing preferences. Even though firms have limited information about a competitor's customers, they can still make use of internal and external data sources to uncover customers' preferences. It is now possible to purchase lists of people who bought skimpy swimwear, and college students sorted by major or other characteristics (Sovern 1999). By purchasing lists and databases, a firm can gain insights about rival firms' loyal customers and discover differing preferences of individual customers. Even in the early 1990s, firms had information about their competitors' customers. For example, AT&T was reported to have sent personalized checks to its rivals' customers to entice them to switch, with varying amounts depending on customers' purchase history (Turco 1993).

Dickson and Ginter (1987) defined product differentiation as a marketplace condition in which products are not commodities and differ from each other in terms of physical and non-physical characteristics, including price. In our duopolistic price discrimina-

tion model, firms engage in product differentiation and customize prices. Price discrimination occurs when a product is sold at different prices which cannot be explained by differences in product costs. Our emphasis is on the price discrimination component of market segmentation.

Thisse and Vives (1988) used a game-theoretic model to explore perfect price discrimination where each customer incurs a linear transportation cost proportional to the distance between a customer and a firm. They found that price discrimination intensifies competition, customers benefit from lower prices, and the game is a prisoner's dilemma. Shaffer and Zhang (1995) reached the same conclusion for the setting where promotional discount coupons are introduced in the competition among symmetric firms to attract new customers.

Chen (1997) considers a duopolistic two-stage game where customers are indifferent among firms but become locked-in with their initial purchase. A customer will switch to a rival firm in the second stage to take advantage of lower prices if the price differential compensates for the switching cost. The strategy of the firms is to deflate their prices initially to attract new customers and thereby expand market share, only to increase them sufficiently in a second stage to recover the losses in revenue in the first stage. Both firms are worse off due to price deflation; yet, customers are not necessarily rewarded as they incur switching costs. Similar to previous findings, switching intensifies competition and leads to prisoner's dilemma.

Shaffer and Zhang (2000) explored a duopolistic model where each firm offers promotions either to its own customers or to its competitor's. If demand is symmetric, a firm's best strategy is to offer discounts to its competitor's customers, but the game also is a prisoner's dilemma. On the other hand, the game will not necessarily be a prisoner's dilemma when demand is asymmetric. One of the firms or both firms can be better off depending on their initial market share and the intensity of their customer's loyalty. Shaffer and Zhang (2002) extended their study to examine the impact of one to one promotions on market share and competition in a duopolistic perfect price discrimination model where asymmetric firms incur a targeting cost to deliver promotions. Contrary to earlier price discrimination findings above (Chen 1997, Shaffer and Zhang 1995), they found that their game model is not necessarily a prisoner's dilemma. The firm with very loyal customers and greater market share is likely to be better off. Shaffer and Zhang (2002) attributed the prisoner's dilemma conclusion of the earlier results to the fact that firms are assumed to be symmetric.

While price discrimination alone has been investigated extensively in the past, its combination with market segmentation is relatively recent. Liu and Serfes (2004) studied market segmentation and price discrimination in a symmetric duopoly model. The analysis showed that the case also has the characteristics of a prisoner's dilemma. Liu and Serfes (2005) later examined the effect of segmentation in a vertically differentiated market, where one of two firms offers a higher quality product. Customers are inclined to purchase the higher quality product, but the premium a customer is willing to pay differs. The high quality firm has sufficient upward price flexibility to increase its market share at the expense of the low quality firm through segmentation. The low quality firm has no incentive to segment the market.

Motivated by the work of Shaffer and Zhang's (2000), we build an asymmetric duopoly firm model to explore the impact of price discrimination and market segmentation on firm pricing strategies. Firms collect customer information (gender, age, income group, purchase history) to determine consumer preferences. Once customer information is analyzed, firms segment the market. Higher availability of data and advanced information technology tools improve segment granularity, but at a cost. Current studies often ignore how technology cost affects firms' market segmentation

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