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Product bundling or reserved product pricing? Price discrimination with myopic and strategic consumers

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ABSTRACT

Mixed bundling (MB), in which products are sold separately and as a bundle, is a form of second degree price discrimination. In this study we examine how MB and its variants compare against reserved product pricing (RPP), a form of co-promotion. Used by Amazon.com, among others, RPP consists of the firm offering individual products and then enticing single product buyers with a discount on the second product. Our analytical model has a monopolist offering two products to a mix of myopic and strategic consumers. We find that as long as the market consists of a "modest" fraction of myopic consumers, RPP is more profitable than mixed bundling and its special cases. We also present pricing results under RPP. An extension shows that RPP can also be more profitable than a form of price skimming. Limitations and future research directions are discussed.

1. Introduction

Consider the following realistic purchasing scenarios at Amazon.com:

- Scenario 1: "Cracking the SAT, 2013 Edition" (Princeton Review) listed at $15; "Book of Majors 2012" (College Board) listed at $15; price for both (i.e., the bundle) is $28.
- Scenario 2: "Cracking the SAT, 2013 Edition" (Princeton Review) listed at $15; "Book of Majors 2012" (College Board) listed at $15. Consumers can buy both at $30. However, for consumers who bought just one book, Amazon sends a personalized email offering the second at $13.

Which of these two scenarios is optimal for the retailer? This is our study's guiding question.

Scenario 1 is rooted in bundling, the strategy of offering combinations of products as a package. It is widely used by multi-product sellers and is evident in vacation packages, grocery products, wireless plans, and personal technology. A seller with two products can offer them in their standalone form (in a strategy called pure components), as a bundle (pure bundling), or both (mixed bundling). Scenario 1 corresponds to mixed bundling (MB). MB succeeds by targeting premium priced individual products at consumers who value a specific product only and a discounted bundle at consumers who value both products (Schmalensee, 1984).

Scenario 2 is a form of co-promotion. We examine a particular variation of co-promotion that we call reserved product pricing (RPP hereafter). As noted in Scenario 2, a seller offering two products sets their initial prices, observes the purchase behavior of alternative segments and, accordingly, offers discounts to segments that purchased one product but not the other in the first stage. That is, the seller holds the discount on product offerings in reserve so that the segment buying both products at the initial price cannot avail of the discount.

MB and RPP work in distinct ways and their ordering is not apparent a priori. The tie-in effect of the bundle helps in the transfer of consumer surplus from one product to the other and benefits the seller through demand gain (Schmalensee, 1984). Yet unlike MB, which is inherently static, RPP has the benefit of gathering additional information about customers in the initial stage and leveraging that in the later stage. Despite this apparent advantage, the appeal of temporally dropping the price is reduced if consumers have rational expectations about the second stage discount and simply delay their purchase till the discount is offered.

Against this backdrop we formulate an analytical model in which a seller has two products to offer and can adopt pure components (PC), pure bundling (PB), mixed bundling (MB) or reserved product pricing (RPP). The potential consumers are heterogeneous in their reservation

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prices for each product. Each consumer is either myopic (i.e., unaware of or unable to anticipate the second stage discount) or strategic (i.e., forward looking). Myopic behavior is plausible due to the large number of strategic options available to a seller, and can be explained by bounded rationality (Ellison, 2006). We address the following research questions: If the market consists of a mix of myopic and strategic consumers, which strategy is optimal for the seller? How does the mix of consumers impact the optimal strategies and prices?

Our key findings: When the market consists of a mix of myopic and strategic consumers, RPP is optimal if at least half the market is myopic. The domain of optimality of RPP expands as marginal costs increase. In the limit, RPP is optimal when the market is entirely myopic whereas MB is optimal when the market is entirely strategic. Profit under RPP is an improvement over PC (always) and PB (for the most part). MB and RPP do not emerge as equivalent strategies with strategic consumers due to the seller's commitment problem in offering the discount under RPP. Interesting pricing results also emerge and are discussed later.

In an extension (Section 4), we compare MB and RPP against price skimming for a multi-product case. We find that MB and RPP can hold their ground under a wide range of conditions while also being inferior under certain conditions.

2. Literature and positioning

Our study is related to three research streams. On the bundling side, our study is motivated by the analytical modeling work in economics (e.g., Adams & Yellen, 1976; McAfee, McMillan, & Whinston, 1989; Schmalensee, 1984) and marketing (see reviews by Stremersch & Tellis, 2002; Venkatesh & Mahajan, 2009). Like these studies, we focus on the optimality of PC, PB and MB from the perspective of a monopolist and on price discrimination as the primary demand side rationale for bundling. As PC and PB are nested in MB, a known result is that MB is typically the most profitable strategy for the seller. However, strong complementarity among the products, economies of scope, and low marginal costs may cause MB to converge to PB as the optimal strategy (see Bakos & Brynjolfsson, 1999). Strong substitutability and asymmetric marginal costs or network externality among the products may cause MB to converge to PC (see Prasad, Venkatesh, & Mahajan, 2010; Venkatesh & Kamakura, 2003).

While RPP is a form of co-promotion, our motivating examples and conceptualization are distinct from prior work on cross-market discounts such as Dhar and Raju (1998), Goic, Jerath, and Srinivasan (2011), and Gilbride, Guiltinan, and Urbany (2008). In each of these extant studies, every consumer who buys one product is eligible for a discount – a coupon, reward miles or a price cut – toward the purchase of another product. However, with RPP the seller holds the product discount in reserve, revealing it later but only to consumers that buy either product but not both. Under RPP, the segment that is willing to buy both products at the full price does not receive any discount at all, as in the Amazon.com example noted earlier.

Our development of RPP is also motivated by markdown pricing (e.g., Pashigian, 1988; Su, 2007). The key finding is that if a monopolist sets a price higher than the static equilibrium price and then lowers it, profits can increase. Yet if consumers are strategic, they will wait for the price to drop, and the seller can do no better than price at the discount immediately (Coase, 1972). As in the above studies, consumers in our model can be either myopic or strategic. While RPP retains the idea of markdown pricing, our conceptualization of RPP complements extant research by considering a multi-product setting in which the seller blends inter-temporal pricing and cross selling. RPP mitigates the problem arising out of the Coase Conjecture in the following sense: The consumer under RPP cannot get a lower price on all items by waiting. Getting the discount requires the consumer to buy a regularly priced item, and so some units are assuredly sold at the regular price even in a market entirely composed of strategic consumers.

Overall, while past studies have focused on bundling (or its subtypes) *or* inter-temporal pricing, our objective is to bring these within a broader strategy space for the seller, and examine analytically which of these strategies work better and under what conditions.

3. Model and analysis

We set up the general model consisting of a mix of myopic and strategic consumers. Myopic consumers represent a proportion α of the market. The rest (proportion $1-\alpha$) are strategic. Later we will examine the special cases of only myopic ($\alpha = 1$) and only strategic ($\alpha = 0$) consumers as corollaries to the main result.

The seller is a profit maximizing monopolist offering products, 1 and 2. The two-product assumption is typical in normative articles on bundling (e.g., McAfee et al., 1989; Schmalensee, 1984; Venkatesh & Kamakura, 2003). On the practitioner side, Amazon, despite its wide product range, usually restricts its book recommendations to bundles of two or, sometimes, three products. In other categories (e.g., consumer electronics or videogames) the two-product assumption is arguably even more reasonable.

Potential consumers maximize their individual surplus and each has a demand for at most one unit of each product. The market size is normalized to 1. Consumer k has a reservation price R_{ki} for product i, where $i \in \{1, 2\}$, and the reservation price for the bundle is additive in its component reservation prices. Following Carbajo, de Meza, and Seidmann (1990), Matutes and Regibeau (1992), and Nalebuff (2004), among others, we assume that (R_{k1}, R_{k2}) is uniformly distributed over the unit square $[0, 1] \times [0, 1]$ to capture heterogeneity. The assumption of independently and uniformly distributed reservation prices is common in the bundling literature (e.g., Bhargava, 2013; Carbajo et al., 1990; Nalebuff, 2004; Prasad et al., 2010). We assume that products have identical marginal cost $c \in [0, 1)$ (see Nalebuff, 2004; Venkatesh & Kamakura, 2003).

The strategy space consists of four strategies: PC, PB, MB and RPP. We present the results under the three bundling strategies first and then analyze RPP.

3.1. Alternative bundling strategies

As the products are symmetric in their marginal costs and market valuations, their prices in equilibrium are also symmetric. Under PC, each product is offered at price P ($=P_1 = P_2$). The price of the bundle under PB is P_{12}. With MB, the individual products are offered at price P and the bundle at price P_{12}. We avoid additional suffixes to denote the strategy (unless the context is unclear). Analysis with asymmetric marginal costs presents little additional difficulty and is suppressed for ease of exposition.

Bundling strategies are static and the distinction between myopic and strategic consumers does not have a bearing on the results. The PC, PB and MB results are available from extant studies (e.g., Venkatesh & Kamakura, 2003). Closed form solutions for optimal prices and profits under PC and PB are provided in Table 1. Explicit solutions for optimal prices under mixed bundling are unavailable for the commonly modeled

Table 1
Prices, demand and profit under PC and PB.

	Pure components	Pure bundling
Profit	$\Pi = 2(P-c)D$	$\Pi = (P_{12} - 2c)D_{12}$
Demand	$D = 1 - P$ (for each product)	$D_{12} = \begin{cases} 1 - P_{12}^2/2 & \text{for } P_{12} \le 1, \\ (2 - P_{12})^2/2 & \text{for } P_{12} \ge 1. \end{cases}$
Optimal price	$P = (1 + c)/2$ (for each product)	$P_{12} = \begin{cases} \left(2c + \sqrt{(2c)^2 + 6}\right)/3 & \text{for } c \le 1/4, \\ (2 + 4c)/3 & \text{for } c \ge 1/4. \end{cases}$