



Sell by bundle or unit?: Pure bundling versus mixed bundling of information goods

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ABSTRACT

Pure bundling and mixed bundling are two popular pricing strategies for information goods. Pure bundling offers only the product bundle, whereas mixed bundling offers both the bundle and the individual components of the bundle. This paper extends prior research on bundling, which usually assumes consumer heterogeneity along a single attribute of the consumer. However, an individual consumer's demand function can be expressed as the interaction of the intercept and the slope of the demand function. We allow for consumer heterogeneity along both these dimensions. The initial willingness-to-pay (IWTP) of a consumer captures the consumer's willingness to pay for the first unit of the product while the appetite (APP) of a consumer captures the quantity consumed when the product is free. We find that these two dimensions of heterogeneity have opposing effects. APP heterogeneity encourages the adoption of mixed bundling while IWTP heterogeneity moderates the relationship between APP heterogeneity and the preference for mixed bundling in favor of pure bundling. Our results also help explain why sellers tend to change pricing schemes over time.

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1. Introduction

The size of the information goods market including online games and digital content has increased enormously. This has generated research interest in the pricing of information goods, especially information bundling (e.g., [5,7,11,12,25]). Bundling takes advantage of the fact that variation in bundle valuation is typically smaller than variation in the valuation of individual components, thus allowing the firm to extract consumer surplus more effectively. Bakos and Brynjolfsson [3] demonstrate that when marginal cost is negligible, pure bundling is optimal as the number of goods in the bundle approaches infinity.

This paper focuses on pure bundling and mixed bundling, to determine conditions under which the firm should adopt pure bundling versus strict mixed bundling. Pure bundling offers only the pure bundle for sale, whereas mixed bundling sells both the pure bundle as well as the component goods individually. Consider the example of Lineage which is one of the largest MMORPGs (Massively Multi-player Online Role Playing Games) in Asia with 1 million active subscriptions [16]. In 2010, Lineage generated \$164 million and its sequel, Lineage II, generated \$107 million in sales [18]. NCSOFT, the publisher of Lineage, initially provided only subscription-based pricing (\$27 per month in 2010). This is equivalent to a pure bundle

where pricing is independent of actual amount of game play. Later NCSOFT added a time-based pricing option (2 cents per minute) for individual players. This is equivalent to mixed bundling where consumers have a choice between the pure bundle and a la carte pricing based on amount of game play. Similarly, for PC game rooms which connect users to games and provide other services, NCSOFT initially charged US\$60 per IP address per month and later added the time-based pricing option (25 cents per hour). Other online game companies have also taken similar steps to introduce flexible usage-based pricing schemes for their online games [26]. Similarly Adobe used to sell its popular Acrobat software using only perpetual licenses. Adobe has now added per-use conversion pricing for subscribers to create PDF files online. What drives firms to offer one pricing scheme or the other and sometimes switch from one to the other?

In this paper we argue that the tradeoff between mixed bundling and pure bundling can be captured by analyzing heterogeneity in consumer valuations along two dimensions. Prior literature has focused on single-dimensional consumer heterogeneity see for example [5,14,17,19,25]. We introduce the concept of consumer heterogeneity along two dimensions: (1) Initial willingness to pay (IWTP) which is the consumer's willingness to pay for the first unit of the product or service and (2) the appetite (APP) which is the amount of consumption that leads to satiation (willingness to pay for additional consumption is zero once satiation level is reached). Both dimensions of heterogeneity are relevant and differ in their impact on the optimality of mixed vs. pure bundling. For example, BigUniverse.com, an award-winning educational service provider,

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segments its customers into two groups (home users and schools), and charges them different prices for the same services. This type of third degree price discrimination differentiates consumers based on their initial willingness to pay. On the other hand Netflix.com, uses second degree price discrimination to offer a range of plans based on consumers' appetite for the number of DVDs. At the time of writing, 2 DVDs a month plan is \$4.99, the unlimited plans are \$9.99 a month for 1 DVD out at-a-time, \$14.99 a month for 2 DVDs out at-a-time, and 19.99 a month for 3 DVDs out at-a-time. Since consumers vary in terms of their appetite or marginal WTP for additional DVDs, some consumers select the \$4.99 plan while others select more expensive plans. Note that in the two examples consumers' valuations may vary along both dimensions: IWTP and APP but the relative strength of IWTP vs. APP heterogeneity can drive Netflix and BigUniverse.com to adopt different pricing schemes.

Despite the fact that mixed bundling is a common pricing strategy in the digital economy and has been shown empirically to be superior to pure bundling in the pricing of journal articles (Chuang and Sirbu [8]), the literature has not adequately addressed the question of *when* the firm should adopt mixed bundling vs. pure bundling. Some researchers have analyzed pure bundling as a special case of mixed bundling where the component price is set high enough that no one buys using the unit sale scheme (e.g., [27, p.630]). Stremersch and Tellis [24] name this kind of mixed bundling *de facto* pure bundling. Note that mixed bundling in the strict sense where prices are set to entice consumers to buy individual units as well as bundles is not the same as mixed bundling where unit sale prices are set so that consumers do not use the unit sale scheme. From a theoretical and a managerial perspective, it is important to identify the conditions under which pure bundling is optimal relative to strictly mixed bundling. Given the menu costs associated with providing multiple schemes, firms do not design menus to list prices that are too high for all consumers. When pure bundling and *de facto* pure bundling are equally profitable, pure bundling is preferred. Hence, there are many situations where we wish to determine when pure bundling matches mixed bundling in terms of profitability, as argued by Pierce and Winter [19] and Stremersch and Tellis [24].

In this paper we focus on answering the following questions: When is pure bundling better than mixed bundling? How do the two dimensions of consumer heterogeneity – IWTP and APP heterogeneity – impact the optimality of mixed bundling vs. pure bundling? We refer to the sale of individual goods as the *unit sale scheme*. While pure bundling has been the focus of a number of studies (e.g., [1,3,21,22]), research focusing on mixed bundling is limited. Exceptions include McAfee et al. [15], Pierce and Winter [19], Chuang and Sirbu [8], and Stremersch and Tellis [24]. These studies are reviewed in the Literature review section.

Let us take a closer look at the effects of IWTP and APP at the individual level. A consumer's IWTP affects the consumer's willingness to pay for the information goods in general. It may be affected by the consumer's income level. For example, consumers in developed countries may in general have a higher IWTP for digital music than consumers in developing countries. IWTP may also be affected by the person's interests. For example, a person who loves music from a specific artist may have high IWTP for music from that artist but low appetite since the marginal WTP for music from other artists may be very low. A consumer's appetite (APP) for information goods affects the rate of diminishing utility for additional units of the information good. For example, a person who likes many genres of movies may be happy to see many movies, while another movie lover who is interested in a specific genre such as horror may wish to see fewer movies. A person with a high APP will receive a relatively low diminishing rate of utility from additional units of the information good and tend to have a higher level of consumption. Meanwhile, a person with a low APP will have a rapidly diminishing rate of marginal WTP for additional units and will thus consume fewer units.

We seek to extend prior research by analyzing the impact of consumer heterogeneity in IWTP and APP on the firm's bundling decision. The degree of consumer heterogeneity for particular information goods is likely to increase over time for the following reason: When a new product is introduced to the market, it is likely to attract a small group of consumers with homogenous characteristics (known as the "innovators" in the diffusion of innovation literature). This group of people may have a greater IWTP for new products. However, as the new product gets further along in the diffusion cycle and becomes increasingly 'mainstream', it attracts a more diverse group of users, including the early adopters, early majority, late majority and laggards. Increasing diversity in the consumer base is likely to lead to greater consumer heterogeneity in terms of both IWTP and APP, which in turn may affect the firm's bundling and pricing decisions. Our analysis suggests that only the pure bundle scheme should be provided when there is limited APP heterogeneity among consumers. The unit sale scheme can be introduced later when the technology begins to attract a more diverse set of users who have very different APP levels. This general trend holds true in the presence of IWTP heterogeneity. However, heterogeneity in IWTP tends to moderate the relationship in favor of pure bundling. Thus our theoretical findings can help explain this pattern of changes in pricing schemes over time.

This paper is organized as follows: related literature is reviewed in Section 2. Section 3 presents the model setup. Section 4 analyzes the effects of heterogeneity in APP and IWTP on the firm's preference for mixed bundling vs. pure bundling. Section 5 discusses the theoretical contribution and business implications of our findings. Section 6 concludes the paper and identifies future research directions.

2. Literature review

There is substantial literature on the economics of bundling. Stigler [23] is often credited with the first account of the benefits of bundling by showing how a firm's profit can increase when it bundles together two goods which valuations are negatively correlated. Based on a series of examples, Adams and Yellen [1] graphically analyze and compare welfare implications of unit sale, pure bundling and mixed bundling of two goods. Their analytical framework has since become a basis on which a number of subsequent studies on bundling are developed. Using a Gaussian demand model, Schmalensee [22] shows that pure bundling can be profitable even when valuations of two goods across the population are positively correlated. Bakos and Brynjolfsson [3] extend this idea to the bundling of a large number of goods when marginal cost is negligible, which is a common assumption for digital goods. Other papers on pure bundling have looked at the effect of competition [10] and the complementarities and substitutabilities of individual items within the bundle [28]. This paper, however, focuses on the effect of *price bundling* in a monopolistic setting. Price bundling refers to the sale of two or more separate products in a package at a discount. It is different from *product bundling* which creates additional consumer value by bundling complementary products [24,30].

Analytical work comparing pure bundling and unit sale has identified conditions under which pure unit sale is more profitable than pure bundling, e.g., budget constraint [3] and decreasing marginal utility of information goods [11]. In this paper, when we say mixed bundling to be preferable over pure bundling, the number of consumers purchasing from the pure bundle scheme and the unit sale scheme must be both strictly positive. This definition is consistent with Pierce and Winter [19] and Stremersch and Tellis [24], both suggesting that mixed bundling cannot be always better than pure bundling. However, Pierce and Winter [19] present a one-dimensional consumer heterogeneity model with two consumer types, and Stremersch and Tellis [24] illustrate their idea only with numerical examples. In this paper, we generalize the results of Pierce and Winter's [19] and Stremersch and Tellis [24].

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