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Decision Support

Optimal decisions for sellers considering valuation bias and strategic consumer reactions

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ABSTRACT

In the online market for new and innovative products, valuation bias commonly occurs between the initial valuation before purchase and the true valuation after purchase as a result of the consumer's lack of knowledge regarding the product. Valuation bias works in a complex manner. On the one hand, positive valuation bias increases the seller's demand, while on the other hand, it can also cause consumers to return their purchases, which results in losses for the seller. This paper first investigates the effect of the bias on the seller's optimal pricing. The optimal price is determined always to increase strictly in the valuation bias if and only if the valuation bias does not exceed the consumer's return cost. This result remains true regardless of whether the seller decides on the stocking quantity. In addition to the valuation bias, we consider strategic consumer reactions to the bias in two selling periods, namely, the advance period and the spot period. Our analysis finds that the seller's selling strategies (e.g., pre-announcing pricing trends) are significantly affected by the relationship between valuation bias and the strategic consumer's estimation of the bias. In addition, though the optimal selling period is either the advance selling term or the spot selling term, the seller does not need to provide for both periods sequentially. We also determine that the unannounced pricing trend strategy and the announced non-increasing pricing trend strategy are equivalent when the seller faces strategic consumers.

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1. Introduction

Often, when people buy items on the Internet, while the process of purchasing is convenient, the actual product is not as good as the seller described it to be or it does not meet the consumer's original expectations. We call this situation valuation bias (denoted as a), i.e., the valuation ex-ante purchase is different from the true valuation after purchase. Valuation bias is becoming more common as consumers grow increasingly dependent on online shopping, such as via the Internet and mobile terminals, and adapt to accepting information provided over the Web. In the consumer electronics industry, one of the main reasons for product returns is that the consumer determines that the product does not meet his/her expectations. In fact, only approximately 5% of consumer returns are due to product defects (Lawton, 2008).

While on the one hand, a positive valuation bias increases the demand for the product, on the other hand, the resulting disappointment with the purchase leads to product returns (Hu, Li, & Govindan, 2014; Xiao, Shi, & Yang, 2010; Xu, Li, Govindan, & Xu, 2015; Yao, Leung, & Lai, 2008), thereby resulting in losses for the seller. Valuation bias exists when consumers are not fully informed

about a product. This situation can easily occur if the product is a new or innovative item (e.g., a complex product such as an Apple iPhone) or a media item (such as a movie, book, or video game), though it also occurs with many other types of items. Valuation bias can be increased or decreased, to some extent, via a number of tactics. For example, a consumer's valuation bias is increased by advertisements in which the advertisers place one-sided emphasis on the product's positive features and advantages. Conversely, by experiencing new product previews and sampling, the consumer's valuation bias in the initial valuation and valuation uncertainty caused by the valuation bias are decreased. In this paper, we consider the valuation bias that results from the consumer's lack of information about the product.

However, even though valuation bias is commonplace, little research has been devoted to the issue. Thus, we are interested in whether and how the seller's optimal decisions will change when considering valuation bias and the strategic buyer's reactions to that bias. As previously mentioned herein, valuation bias has both positive and negative effects on the seller. Therefore, we also want to determine whether a critical point for valuation bias exists. The strategy of offering full refunds is quite popular among sellers. For example, in the European Union, most mass retailers provide full refunds within 30 to 90 days of purchase (Guide, Souza, Van Wassenhove, & Blackburn, 2006). In China, a seven-day

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no-questions-asked return policy is written into the regulations for online shopping. A survey has shown that more than half of the respondents (63%) believe that offering generous and clear return policies is one of the most efficient tools for enabling Internet sellers to remain competitive (Rogers, Tibben-Lembke, & Council, 1999). Similar to the setting of Chen and Bell (2011), we build our models based on full refunds to provide practical guidance for sellers.

First, we research how valuation bias affects the seller's optimal pricing. The optimal price is found always to increase in valuation bias if and only if the valuation bias does not exceed the consumer's return cost; otherwise, the optimal price remains constant. This result is independent of stocking decisions of the seller. We prove that a unique critical bias exists that can maximize the seller's profit if the seller always meets the market demand.

Furthermore, we consider the reactions of strategic consumers who are affected by valuation bias and divide the sale season into two periods. For strategic consumers, the existence of valuation bias causes uncertainties in their initial valuations. Thus, these consumers estimate the valuation bias before deciding to purchase. Consequently, two selling periods exist for strategic consumers. The first is an advance period when strategic consumers are not fully informed and will estimate the valuation bias in their initial valuations, and the second is a subsequent spot period with respect to fully informed strategic consumers. During the advance period, buyers may strategically delay their purchases, reasoning that the seller might offer a lower spot price in the next spot period. Therefore, whether a seller pre-announces the pricing trend could substantially affect buyers' decisions. Our analysis indicates that pre-announced price increases or non-increasing pricing is conditionally optimal depending on the relationship among valuation bias, the strategic consumers' estimate of that bias and the return cost. Accordingly, we provide a benchmark regarding that relationship. To the best of our knowledge, this paper is the first to identify how valuation bias affects a firm's pricing strategy in two-period sales. We also find that the unannounced pricing trend strategy and pre-announced non-increasing pricing trend strategy are equivalent when the seller faces strategic consumers. As a complement to the extant literature, we study the roles of the return cost and the reaction to bias of consumers in deciding whether the seller should adopt the pre-announced markup or the non-increasing pricing strategy.

This paper is structured as follows. After a brief introduction, Section 2 presents a review of the extant literature. In Section 3, we explore how valuation bias influences the seller's pricing. In Section 4, the sales time is divided into two periods, namely, the advance period and the spot period, and we seek to identify the seller's optimal strategies when strategic consumer behaviour is affected by valuation bias. We extend our model by considering a general distribution for strategic consumers' estimates of valuation bias in Section 5. Section 6 presents this paper's conclusions. All proofs are presented in Appendix A.

2. Literature review

This work is the first to consider the effect of valuation bias on sellers' decisions and profits. Several studies, such as DeGaba (1995), Lewis and Sappington (1994) and Xie and Shugan (2001), have focused on a situation in which the buyers' valuations are mean-preserving across the market, although every individual buyer's valuation can decrease or increase over time. By contrast, we focus on the market wherein valuation biases exist and the consumers' valuations are no longer mean-preserving. Zhang, Chiang, and Liang (2014) and Zhang, Gou, Liang, and Huang (2013) consider the scenario where the consumers' reference price differs from the current market price. Chen (2011) considers the

distinction between each consumer's initial estimate prior to the transactions and the updated estimate post purchase, which is similar to the valuation bias in our study. The difference is that the approach of our paper proceeds mainly from the perspective of adding the bias as a factor that impacts the seller's decisions and further considers how strategic buyers will react. That is, upon realizing that their initial valuation might not be accurate, strategic consumers should consider the risk of valuation bias as they determine whether and when to purchase.

Aside from valuation bias, this paper centres on two other issues, strategic consumer reactions with respect to uncertainty and the two-period sales problem. Streams of literature focus on these two aspects.

First, our work considers the uncertainty of valuation and its effect on strategic consumer behaviour. In that vein, Alexandrov and Lariviere (2012) study the value of providing reservations for consumers who face valuation uncertainty, and Su (2009) studies the value of consumer return policies when consumers are uncertain of their valuations. Furthermore, Gefen and Straub (2004) explore the consumer trust in B2C e-Commerce, which can reduce social uncertainty through experiments. Unlike these studies, we focus more on the role of pricing schemes, pre-announced price increases, and non-increasing pricing, factors that, as yet, have not been discussed, and we research the role of return cost in the optimal selling strategies. Moreover, a number of detailed elements in valuation uncertainty are incorporated from other papers. For example, Yu (2007) considers correlated consumer valuations, while multiple consumer types are considered by Koenigsberg, Muller, and Vilcassim (2008) and Bhargava and Chen (2012). In contrast to these papers, the uncertainty in our paper is caused by valuation bias, and the consumers are uncertain because they are not confident in their individual initial valuations ex-ante due to the existence of valuation bias. In addition, we allow different initial valuations, which mean the demand changes continuously with respect to the selling price.

Second, two-period selling is also a topic of interest in this paper. Studies such as Aviv and Pazgal (2008), Liu and van Ryzin (2008), Su and Zhang (2008), and Dasu and Tong (2010) consider consumers who strategically purchase given that prices may change over time. Studies such as Bhargava and Chen (2012), DeGaba (1995), Swinney (2011), and Akan, Ata, and Dana (2015) consider the timing of purchases given that the actual product value will be revealed over time.

Unlike the above research, we incorporate the two driving factors simultaneously in our strategic consumer purchase time model. Moreover, we take into consideration the seller's strategy for pre-announcing pricing trends. Su (2007) discusses the choice of markup and markdown pricing (but not pre-announcing the pricing trend) by verifying that consumers with high valuation are proportionately more strategic or myopic and by arguing that a rising price is optimal when consumers with high valuation are proportionately more strategic. Although the consideration of valuation bias and strategic consumers' reactions to that bias leads to different results, it has been found that increasing the price is not always optimal even if all consumers are strategic.

Consequently, valuation bias, which has not been explicitly modelled before, is the critical issue in this paper. Exploring the optimal selling strategies and selling periods when considering strategic consumers' reactions to bias distinguishes our results and findings from those of previous studies.

3. Optimal pricing considering valuation bias

In this section, we study an optimal pricing model considering valuation bias and offer a model description in Section 3.1. In Sections 3.2 and 3.3, we explore the seller's optimal decisions in

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