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Pricing for shipping services of online retailers: Analytical and empirical approaches

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ABSTRACT

We develop an analytical model and conduct subsequent empirical analyses using data collected from the online retailers of digital cameras and video games. We find that (1) Internet retailers' base prices are positively associated with on-time delivery probability but shipping charges are negatively associated with on-time delivery probability; (2) Internet retailers will increase base prices when they offer free shipping; and (3) Internet retailers' shipping price difference between the standard and expedited shipping modes increases with the shipping time of standard shipping, but decreases with the shipping time of expedited shipping and also the Internet retailer's on-time probability. Our findings suggest that Internet retailers, to maximize profits, can strategically determine base price and shipping prices, and they can also strategically pace menu pricing for different shipping options.

1. Introduction

The advent of Internet technology has given rise to electronic commerce. A key feature of electronic commerce is the spatial separation between buyers and sellers. As a result, the buyers rely on shipping to fulfill their orders. Hence, how e-tailers should price their shipping services, in addition to their product prices, has invoked a lot of discussion among managers and researchers alike [1,16]. Although economics theory has predicted that prices on the Internet are likely to converge due to reduced search cost [4], especially for homogenous goods, empirical studies have nonetheless found significant price dispersion on the Internet [6–9,12,14,29]. One source of price dispersion comes from the variation in retailers' shipping and handling charges (henceforth referred to as simply *shipping charges* as in Pan et al. [24]) [3]. Such variation often exists for strategic reasons; that is, how a retailer prices shipping services is a valuable method to differentiate itself from competitors. Appropriate shipping fees are also essential to winning business, given that shipping charges are considered a main reason why online shoppers abandon their shopping carts and discontinue the purchase process [10].

Retailers have several options for designing shipping prices: they can charge nothing (i.e., free-shipping) by subsidizing the shipping cost, they can share some of the costs with customers [12,15], or they can charge shipping fees that are higher than the actual shipping cost in order to make a profit (i.e., profit-shipping) [27]. Anecdotal evidence has shown that Internet retailers use all of these options. For example, Amazon.com, BN.com, and Buy.com have been practicing a free-shipping policy with a minimum order amount. Even Wal-Mart.com and ebay.com have decided to offer free shipping as their competitive strategies [15,16]. In contrast, CDNow.com exercises a profit-shipping policy. At the time of Tedeschi's [30] research, CDNow.com charged a price that was higher than the average cost of shipping a CD: $3 for the first item shipped and $1 for each additional item. These shipping charges yielded a profit margin (15–20%) that was similar to the actual CD sale. There are, of course, other retailers, such as Ashford.com, who charge exactly the cost of shipping in order to gain customers' trust and loyalty [10].

In some cases, when retailers charge shipping fees that are higher than actual shipping costs, they are doing so not to increase profits but rather to offset a reduced product price that was designed to help win business. In other words, a retailer may simply transfer part of its profit margin from the product price to the shipping charges by charging a shipping fee higher than actual shipping costs [10]. Research has indeed shown that strategically allocating the total price between the product price and its shipping charges can be an effective marketing strategy for Internet retailers [22,23,21].

Therefore, how to determine prices for products and shipping services is a clear challenge for Internet retailers [5,15], especially given that these retailers have limited knowledge about customers' price and time sensitivity. Given this information asymmetry between Internet retailers and customers, whether or not to bundle the pricing of product and shipping together (i.e., the free shipping model), and if it is profitable not to bundle, how to set prices for product and shipping separately (i.e., the profit shipping model)? The objective of this paper is to answer these questions through a game-theoretic model and empirical analysis of data collected from Internet retailers selling digital cameras and video games. In particular, we first built an analytical model that studied the equilibrium pricing decisions of the

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base product and shipping schedules of Internet retailers and the purchasing and shipping choices of customers. Considering heterogeneous customers' self-selection in terms of retailers and shipping options as well as the competitor's response, each retailer sets a base price plus a menu price for shipping services of different levels to maximize his own profit. We then performed empirical analyses to validate the results from the analytical model, using the data collected from major Internet retailers.

Our major findings include: (1) Internet retailers' base prices are positively associated with on-time probability, but shipping charges are negatively associated with on-time probability; (2) Internet retailers will increase base prices when they offer free shipping; and (3) Internet retailers' shipping price premium of expedited shipping over standard shipping increases in the time of the standard shipping mode, but decreases in the time of the expedited shipping mode and the Internet retailer's on-time probability. All of these results are supported by subsequent empirical analysis using data collected from the Internet on the retailers selling digital cameras and video games. Our findings suggest that Internet retailers, to maximize profits, may strategically determine base price and shipping prices, and they also may strategically pace menu pricing for different shipping options.

There is a growing body of literature on Internet retailers' pricing issues [13]. Smith and Brynjolfsson [29] and Brynjolfsson and Smith [9], in analyzing price dispersion online, found that customers are very sensitive to shipping fees and shipping times. Similarly, Lewis et al. [19], using data collected from an online grocery store, showed that shipping fees significantly impact order incidence as well as basket size. Pan et al. [24] found that the shipping options adopted by retailers contribute to the variation in firms' prices. Dinlersoz and Li [17], using data collected from the Internet book retailing industry, found that firms with lower product prices offer higher shipping quality (measured by delay in shipping) and lower shipping fees than firms with higher product prices. Schindler et al. [27] conducted an experiment to show that customers skeptical of shipping charges prefer a bundled-price format, whereas customers not skeptical of shipping charges prefer a base price and shipping charge format, when an external reference price is available. Also, Kauffman and Lee [22] tracked price changes for 387 books online for 309 days, and found empirical evidence that some Internet retailers use shipping price changes, instead of product price changes, for competitive advantage.

However, the pricing of shipping services remains under-studied. Our paper is different from previous works and makes important contributions in a number of ways. First, we are one of first studies that comprehensively capture the dynamics of purchase, shipping, and return between Internet retailers and customers, whereas most of prior paper focused on a segment of the purchase processes. Second, our paper builds a theoretical foundation for Internet retailers' optimal choices of shipping strategy, and provides supporting empirical evidence on how a shipping price scheme can be designed. The findings from both the analytical model and the empirical analysis reveal that product prices and shipping charges can be strategically manipulated by Internet retailers to their benefit. Overall, to our best knowledge, our research is one of very few in the literature that studies pricing issues with respect to Internet retailers' product prices and shipping services.

2. Analytical model

2.1. Modeling framework

We model a business-to-consumer (B2C) setting starting with an Internet retailer interacting with customers. In Section 2.3, we extend the model to a market with two competitive retailers. We consider a single product that is transacted between the retailer and the customers. Due to the nature of Internet retailing, i.e., spatial separation between retailers and customers [19], customers have to wait a certain amount of time before they receive an order placed online. The time to wait depends on the shipping mode customers choose—for example, 3–5 day ground service versus overnight service. Customers, of course, differ in their willingness to wait for product delivery. Hence, we model customers who are heterogeneous in terms of their marginal waiting cost.

Following the Hotelling's [18] location model treatment for heterogeneous customers in the literature (e.g., [26]), we assume that customers differ in their marginal disutility in terms of shipping time (i.e., days) θ, which is uniformly distributed on the support of [0, 1].[2] The higher the θ, the higher the marginal waiting cost. In other words, customers with higher θ would pay more to have the needed product delivered in a faster fashion than would those with lower θ. The Internet retailer does not know the sensitivity to shipping speed of a specific customer, but knows its distribution. We use w to measure the customer's waiting disutility for ordered products to arrive and write w in the following functional form: $w=\theta(d+fd_0)$, where d is the shipping mode measured by shipping time (i.e., days), f is the probability that the order is delayed, and d_0 is the expected number of days delayed.[3] We assume there are two modes of shipping, expedited and standard, $d\in\{d_1,d_2\}$, measured in days of delivery. We assume that the expedited mode (d_1) represents faster shipping than standard mode (d_2) plus the expected shipping delay, i.e., $d_1+fd_0<d_2$. We use $f_q=1-f$ to represent the on-time probability for a retailer.

We specifically modeled consumers' self-selection behaviors among all possible choices. When an order is delivered later than the estimated shipping window, the customer would have the choice to either keep the product or return it to the retailer. When an order is delayed, the customer will determine whether to accept it when it arrives, or to purchase from another source and return the delayed order when it arrives. When the customer returns it, the customer can purchase from an alternative source (e.g., a physical store). Without loss of generality, we normalize the net utility of this outside option for a customer to zero. The customer will be refunded the base price (i.e., product price) but not the shipping charges, and pay for the return shipping, as Internet retailers typically indicate in their return policies that the retailer is only responsible for defective products. (Note that most Internet retailers have a 30-day return policy. The buyer pays the return shipping fees unless the product is defective. For example, the return policy maintained by Buy.com states, “If you are returning a non-defective product, you must pay return shipping fees.”)

The product return results in a cost for both the customer (i.e., c_r^C) – for example, in the form of the return shipping fee – and the retailer (i.e., c_r^R) – for example, in the form of a restocking cost. We assume p is the base price; v is the consumption utility which is independent of customer types, and v is sufficiently large to guarantee a non-empty market coverage. The shipping charge is denoted by p_s, where $s\in\{1,2\}$. Table 1 presents the mathematical notation for all variables in the analytical model.

In summary, there are four courses of action that a customer can take in addition to the outside option. The customer can choose either expedited shipping mode d_1 or standard shipping mode d_2. For either shipping mode, when a delay occurs with probability f, the customer can choose either to return or keep the product. Therefore, let subscripts 1 and 2 denote expedited and standard shipping, respectively, and r denote returning if delayed, the utility for each of them can be written as follows:

$$U_{1r}(\theta|p_1,d_1,f,c_r^C)=(1-f)(v-p)-p_1-\theta d_1-fc_r^C \tag{1}$$

[2] Our model applies to the situation where multiple products are independent in terms of pricing and shipping practice.

[3] We have also solved the case under the assumption that the shipping delay and delay probability differ according to the shipping mode. All propositions in this paper still qualitatively apply in the more complicated case. Those results are available in the Appendix B.