Reverse Pricing: The Role of Customer Expectations

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ABSTRACT

In a reverse-pricing system (also known as a "Name-Your-Own Price" (NYOP) format), a prospective buyer bids for a retailer's product, and a sale occurs if the bid exceeds a hidden threshold price. Consumers' expectations about the hidden threshold price are an important factor that affects bidding behavior (i.e., whether consumers bid at all and how much they bid) and, in turn, retailer profitability. Furthermore, it is likely that consumers' expectations evolve over time as they become more informed. In this paper, I examine how bidders' expectations affect a NYOP seller and how a seller is affected as consumers form more accurate expectations about its threshold price. While one might speculate that the NYOP seller's profits are eroded as consumers become better informed, I find that there are situations in which profit increases as consumers become better informed about the true price threshold. Interestingly, I find that uninformed customers can be detrimental to the firm either if these consumers are over-optimistic (i.e., consumers expect the threshold price is lower, on average, than it truly is) OR if consumers are sufficiently over-pessimistic (i.e., consumers think the price threshold is much higher than it truly is). Furthermore, if customers accurately anticipate the true distribution of threshold prices, a seller may benefit from either (1) rejecting profitable bids in order to induce other consumers to form higher expectations (and thus place higher bids) or (2) accepting bids below its costs (in order to raise participation rates).

Keywords: Name-Your-Own-Price, reverse auctions, pricing, expectation formation, consumer learning

1. INTRODUCTION

The Name-Your-Own-Price (NYOP) business model determines market outcomes (prices and distributive allocations).in a non-traditional way. In this selling format, a retailer sets a hidden threshold price (P_{NYOP}) and interested consumers place bids for units of the product, where any bid that exceeds the threshold price is accepted. Since P_{NYOP} is the seller's private information, consumers' expectations about the threshold price play a critical role in determining their bidding strategies. Consumers may have biased expectations (e.g., on average, overestimate P_{NYOP} or underestimate P_{NYOP}). Such biases are likely to occur in markets in which the NYOP retailer has just entered or for consumers who have little if any experience with the NYOP retailer. In other cases, a consumer's expectations may better reflect the actual pricing of the retailer. Consumers are likely to have accurate expectations if they have a lot of experience with a particular NYOP site or have benefited from word-of-mouth from other users. In such a scenario, an interesting interaction between the seller and consumers occurs—the seller's optimal price threshold depends on what beliefs the consumers hold and the consumers' beliefs depend on the price thresholds chosen by the seller over time.

The current paper seeks to understand how a NYOP seller is impacted as consumers become better informed. Notice that in a variety of market situations, firms benefit from consumers' lack of information. For example, uninformed consumers may be less price sensitive (Salop and Stiglitz 1977, Varian 1980); incomplete information about a product's attributes can create brand loyalty (Anand and Shachar 2004); advertising and sales efforts can be most persuasive when the audience is less knowledgeable about the marketplace, e.g., children or some other vulnerable population (Brenkert 1998, Laczniak 1999, Pine and Nash 2002, Wolburg 2005), and store loyalty can at least partially be attributed to shoppers not fully considering alternatives (Reynolds, Darden, and Martin 1975; Dwyer, Schurr, and Oh 1987). In the context of NYOP markets, the seller accrues information rent because the threshold price is unobservable to consumers (Fay 2004, Hann and Terwiesh 2003). Specifically, consumers may bid in excess of the threshold price and thus over-pay for the NYOP seller's product.

However, emerging research suggests that many consumers act in a sophisticated manner. For instance, Zeithammer (2006) finds that eBay bidders act very rationally. In particular, they take into account upcoming auctions when deciding upon bids for a current auction. Villas-Boas (1999), in line with the literature on customer targetability (e.g., Chen and Iyer 2002, Chen, Narasimhan, and Zhang 2001), suggests that consumers are forward-looking when purchasing from a particular firm since they realize future products or prices offered by that firm may depend on one's current purchase decision. Hence, strategic customers may undergo actions to protect their privacy (e.g., delete cookies, use a variety of credit cards, refuse to join loyalty programs) in order to avert the negative effect of targeted prices (Acquisti and Varian 2005).

Such sophisticated behavior is often detrimental to the seller. For example, in the durable good market of video games, Nair (2007) finds that strategic, forward-looking customers significantly "reduce the profitability of price-skimming." In particular, "the present discounted value of profits under myopic consumers is 172.2% higher than under forward-looking consumers" (Nair 2007). Similarly, Zeithammer (2006) finds forward-looking bidders in eBay auctions bid lower than myopic consumers. Such "bid-shading reduces seller profits [and] reduces her incentive to sell" (Zeithammer 2007).

An important conclusion from the extant literature is that it is crucial for the seller to recognize the degree of consumer sophistication and to adjust accordingly. For instance, optimal prices in a durable good market depend on the degree to which consumers are forward-looking (Nair 2007). And, if consumers are concealing their identities, then a firm may need to provide additional incentives, such as enhanced services to repeat customers, in order to get consumers to reveal their identities (Acquisti and Varian 2005). Zeithammer (2007) suggests that sellers in auctions may benefit from altering the timing of when their products are offered in order to best respond to bid-shading. In the context of NYOP markets, Fay (2004) finds that a seller may benefit from openly allowing consumers to place multiple bids when a segment of consumers use sophisticated bidding strategies to circumvent a single-bid policy the NYOP seller has adopted.

In NYOP markets, the degree of customer sophistication is especially critical since the threshold price set by the seller is concealed, and thus consumers inherently face uncertainty. In some situations, consumers may have very little knowledge about how the threshold price is set. Lack of information can lead to potential biases. A consumer may be "pessimistic", i.e., underestimate the true probability of acceptance of any particular bid. Or, one may be "optimistic," i.e. overestimate the probability of a successful bid. Such an environment in which consumers do not have "any knowledge about the supplier's decision-making process" (Hann and Terwiesch 2003, p. 1571) may be representative of markets in which information flows between customers are very limited or one in which the NYOP retailer has just recently entered.

While it is unlikely for consumers to become so informed that they know the threshold price that is in place at every point in time, it is likely that over time consumers will become better informed about the "average" threshold price. Internet word-of-mouth may hasten such information flows. And, the impact of word-of-mouth may grow over time, e.g., as third-party information sites are introduced, become better structured, and induce greater participation rates among customers. For example, Priceline (www.priceline.com), an e-tailer of travel services, is the most prominent example of a NYOP firm. Several third-party sites such as flyertalk.com, betterbidding.com, and biddingfortravel.com now allow users to post the winning (and losing) bids from Priceline. Over time, consumers should learn through such communications and thus be able to form accurate expectations about the threshold price (Kannan and Kopalle 2001).

When consumers have accurate expectations, on average, of the NYOP seller's threshold price, there is a possibility for the seller to use its choices of threshold prices to influence future expectations. In other contexts, researchers have explored how sellers can build their reputations when consumers can learn about a seller's past actions (Dellarocas 2005, 2006, Resnick and Zeckhauser 2002). For instance, Gazzale (2005) argues that in environments when "interactions between particular buyers and sellers are infrequent, repeat interaction with a particular market may substitute for repeated interaction with a particular buyer." The Internet is especially suited to provide appropriate feedback systems. By collecting information about a particular seller, it is possible for a credible third-party to aggregate the information in a meaningful way and transmit it to all interested parties at nearly zero marginal cost (Gazzale 2005).

While several papers in the NYOP literature assume consumers' expectations are exogenously given (Spann, Skiera, and Schafers 2004; Spann and Tellis 2006; Terwiesch, Savin, and Hann 2005), other research (Fay 2004) assumes consumers form accurate expectations. The current paper formally considers how consumers' beliefs about the threshold price impacts the NYOP seller and how the seller can optimally use its pricing policy to manipulate beliefs. In particular, I contribute to the extant literature by addressing the following research questions:

1. Is a NYOP seller better or worse off as consumers become more knowledgeable?
2. How should a NYOP seller choose its threshold price? How does this optimal level depend on how consumers form expectations about the threshold price?
3. Should a NYOP seller treat each transaction independently? When can a seller benefit from considering long-term implications of its pricing rule? Do long-term considerations lead to lower or higher threshold prices?

Understanding how a NYOP seller is impacted as consumers become better informed is critical since such understanding helps assess the long-run viability of the NYOP business model. Furthermore, this research provides insight about whether a NYOP seller should try to encourage consumers to become better informed (e.g., by advertising and/or supporting web forums that accurately convey information about the probability a given bid will be accepted) or whether a NYOP seller should attempt to curb such information flows. Finally, this paper identifies strategies a seller can use in order to adapt to an environment in which consumers form accurate expectations about the true threshold price.

The analysis in this paper yields several important insights. First, as expected, in some cases a NYOP retailer is less profitable as consumers become better informed. Second, and more interestingly (especially in light of the preceding discussion of the impact of sophisticated customers in non-NYOP markets), I find that under several plausible conditions, a NYOP seller benefits from having consumers be better informed about the true distribution of its threshold prices. Two critical factors are: (1) consumers' current expectations of the threshold prices, and (2) consumers' bidding costs (i.e., the frictional costs associated with visiting a NYOP site and placing a bid). In particular, a NYOP seller benefits from consumers becoming better informed if either (a) current consumers consistently underestimate the actual threshold price and have low-to-moderate bidding costs; or (b) consumers consistently overestimate the actual threshold price and have sufficiently large bidding costs. In the former case, customer optimism results in low bids, and bid levels would increase if customers were better informed about the true distribution of prices. In the latter case, pessimism dissuades consumers from bidding, but if they were familiar with the true distribution of threshold price, they would be willing to bid.

Third, the NYOP seller may benefit from trying to inflate or deflate expectations about the threshold prices. However, to decide which direction is desirable, the seller needs to ascertain both consumers' current expectations as well as their bidding costs. For example, if bidding costs are very low, then the NYOP seller would benefit from inducing more pessimistic expectations (in order to induce higher bids). But, if bidding costs are high and consumers are currently pessimistic, then it is advantageous to encourage customers to be more optimistic (in order to induce higher participation rates).

Fourth, if consumers form unbiased expectations, the seller benefits from committing to a pricing rule that does not maximize profit from each individual transaction.[1] In particular, when consumers are uninformed, the NYOP seller (who limits each customer to a single bid) should accept any bid that exceeds its wholesale cost. However, if consumers are informed, a seller should be more strategic in setting its pricing rule. For example, rejecting some bids that exceed its costs can be a desirable means to increase (future) bid levels (even though such a pricing rule sacrifices short-term profits).[2] Interestingly, I find cases where it is optimal to establish a negative markup, i.e., the retailer should accept some bids which are below its costs. Such a policy can be optimal because it encourages customers to bid who otherwise would not and these customers can be very profitable when wholesale costs turn out to be low.

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[1] Notice that the NYOP business model is most readily implemented in online environments. Thus, acceptance decisions are most likely to be computer-automated so that the rules for accepting/rejecting bids are determined by an algorithm specified by the NYOP seller. For example, Priceline employs a "randomizer" program (a complicated computer formula which includes a random element) for deciding whether to accept a bid for an airline ticket, hotel room, or car rental (Malhotra and Desira 2002, Haussman 2001, Segan 2005).

[2] There is some evidence of such a strategy being implemented in practice. In particular, under the randomizer program identified in footnote 1, rather than setting the threshold price equal to the lowest rate offered by the entire set of hotels that have rooms available, Priceline only compares the bidder's offer to the rates set by two randomly-selected hotels. Such an action is consistent with the speculation in Kannan and Kopalle (2001) that Priceline may "deliberately forgo a successful transaction" in order to influence consumers' expectations, i.e., persuade consumers to bid higher in the future.

In short, these results suggest that a NYOP seller should not necessarily fret about its customers becoming smarter about their bidding. However, as consumers become more sophisticated, the seller needs to respond likewise. Instead of treating each transaction independently (as is the optimal selling strategy when consumers are uninformed), the seller needs to adopt a more long-term strategy, taking into account how acceptance/rejection decisions will impact bidding by other customers.

The remainder of the paper is organized as follows. In the next section, I introduce a stylized model that illustrates the basic intuition as simply as possible. I first consider the case of uninformed customers and then the case of informed customers. Next, I consider the potential advantage of committing to a pricing rule which does not maximize profit from each individual transaction. The final section offers concluding remarks including managerial implications and directions for future research. The Appendix contains proofs of the Propositions.

2. THE MODEL

The NYOP retailer obtains products at a wholesale price of w, where $w \sim U[\bar{w} - d, \bar{w} + d]$. The wholesale price is not observed by customers but is observed by the retailer before the retailer selects its threshold price, P_{NYOP}. The threshold price is also not observed by consumers. Any bid below this threshold is rejected, while any bid at or above P_{NYOP} is accepted and results in the consumer paying his/her bid. I assume each consumer is restricted to placing at most one bid for the item as is done in practice by the leading NYOP retailer, *Priceline*. I begin by considering the case where the NYOP seller is "transaction-focused", i.e., chooses P_{NYOP} to maximize expected profit from the current transaction, i.e., given w. Then, I consider whether there is a long-run benefit from committing to a pricing rule that differs from the "transaction-focused" solution.

2.1. Customer Behavior

I begin the analysis by considering a single consumer, i.e., the NYOP seller chooses P_{NYOP} for each transaction independently. In section 2.4, I extend the analysis to multiple consumers. The consumer has a reservation value of R_i for one unit of the product.[3] I assume condition (1) holds, which allows me to focus on the most interesting setting in which the consumer values the product more than it costs to produce under the lowest cost realization, yet bids may be rejected under some high-cost conditions:

(1) $$\overline{w} - d < R_i \leq \overline{w} + 3d$$

I assume the consumer incurs a cost of c_i for placing a bid through the NYOP channel. This cost represents the opportunity cost of time to a consumer to visit the NYOP seller and place a bid, as well as any cognitive costs associated with learning how to use the NYOP site and to decide what bid to place. Hann and Terwiesch (2003) and Spann et al. (2004) provide evidence that consumers incur significant frictional costs when they use the NYOP channel. In particular, Hann and Terwiesch (2003) estimate that the median frictional cost per bid is approximately \$4.17.[4] These costs vary significantly across consumers, having a standard deviation of \$4.74 and ranging from a minimum of \$.26 to a maximum of \$65.59. Consumers with large bidding costs are especially relevant in this current paper since, for these consumers, bidding costs potentially discourage participation in the NYOP channel.[5]

Since a consumer cannot observe the actual price threshold, P_{NYOP}, she must instead use expectations in order to decide on her bidding strategy. The text of this paper focuses on the case where lack of information results in biased expectations. Being uninformed could also lead to less precise estimates of P_{NYOP}, i.e., higher variability. The appendix presents the results from this additional analysis, in which it is shown that the impact of imprecision is qualitatively similar to the impact of bias. A biased

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[3] Since R_i reflects the maximum willingness-to-pay of the consumer, one plausible interpretation of this value is the price one could acquire this good from the posted price channel. For example, prior to visiting and bidding at Priceline, a consumer may visit Hotwire.com (a website that also sells opaque travel goods, but at posted prices) to obtain a price quote using the same parameters. Here R_i would equal the minimum of the Hotwire price and the consumer's intrinsic valuation for the product. See Fay (2008) and Fay and Xie (2008) for a more detailed discussion of opaque travel goods.

[4] The mean estimated frictional costs (in EURO's) for the 3 products, PDA's CD-RW drives, and MP3 players are 6.08, 4.29, and 3.54, respectively. Standard deviations of costs are 7.57, 4.42, and 3.81. The numbers in the text are averages across these three products converted into dollars (at a rate of EURO 1 = \$.90, which was the exchange rate when the original data was collected).

[5] Furthermore, the estimates in Hann and Terwiesch are based on consumers who placed three or more bids for a particular item. (The NYOP seller in their study allowed multiple bids). Frictional costs would likely be even higher among all potential consumers, i.e., including those who chose to purchase from an alternative posted-price retailer (and thus avoided presumably very high bidding costs).

consumer expects that the mean value of P_{NYOP} equals $\overline{P}$ and that P_{NYOP} ~ U[$\overline{P}$ - d, $\overline{P}$ + d]. I assume $\overline{P} \geq d$ and that $\overline{P}$ is given exogenously, exploring how such expectations affect bidding behavior, and in turn, the retailer's profit. In section 3.1, I discuss expectation formation in greater depth and in section 2.3, I analyze the case where consumers are informed, i.e., $\overline{P}$ is directly linked to the actual price thresholds used by the retailer.

A consumer chooses her bidding strategy in order to maximize her expected consumer surplus (given the information she possesses). I normalize the utility from not participating in the NYOP auction to zero. The expected utility from placing a bid of b_i is

(2) $$U(b_i) = (R_i - b_i)\left(\frac{b_i - (\overline{P} - d)}{\overline{P} + d - (\overline{P} - d)}\right) - c_i$$

The optimal bidding strategy is:

(3) $$\begin{cases} \text{place a single bid of } b_i^B & \text{if } c_i \leq \hat{c}_B \\ \text{do not bid at all} & \text{if } c_i > \hat{c}_B \end{cases}$$

$$\text{where } b_i^B = \frac{R_i + \overline{P} - d}{2},\ \hat{c}_B = \frac{(R_i - \overline{P} + d)^2}{8d}$$

2.2. Profitability

Having received a bid of b, the retailer earns a profit of $b - w$ if it accepts the bid; else the retailer earns a profit of zero. Thus, a retailer maximizes its profit by accepting any bid that is at least as large as w, i.e., $P^*_{\text{NYOP}} = w$. Notice that this pricing rule does not require any information about the consumer's reservation value or bidding costs. Given the bidding strategy identified in (3), the expected profit (with a biased customer and a transaction-focused retailer), before the cost realization, is:

(4) $$\Pi^{B,TF} = \int_{w=\overline{w}-d}^{\overline{w}+d} \Psi_0 \left(b_i^B - w\right) \mathrm{f}(w)\ \mathrm{d}w \qquad \text{where } \Psi_0 = \begin{cases} 1 & \text{if } c_i \leq \hat{c}_B \ \&\ b_i^B > w \\ 0 & \text{else} \end{cases}$$

The closed form expression for profit is provided in Lemma 1.

2.3. Informed Customers

The scenario in Section 2.2 reflects an information-poor setting where the customer does not have any information about how the threshold price will be determined. Notice that the consumer expects that P_{NYOP} ~ U[$\overline{P}$ - d, $\overline{P}$ + d] when in fact P_{NYOP} ~ U[$\overline{w}$ - d, $\overline{w}$ + d]. Over time, one might expect that customers' expected distribution of the threshold price would converge to the actual distribution, i.e., $\overline{P}$ = $\overline{w}$. In this subsection, we examine the scenario in which the customer has become fully informed so that she expects that the threshold price is uniformly distributed over [$\overline{w}$ - d, $\overline{w}$ + d], which it is in fact.

In this case, the optimal bidding strategy is:

$$\begin{cases} \text{place a single bid of } b_i^I & \text{if } c_i \leq \hat{c}_I \\ \text{do not bid at all} & \text{if } c_i > \hat{c}_I \end{cases} \tag{5}$$

$$\text{where } b_i^I = \frac{R_i + \overline{w} - d}{2}, \ \hat{c}_I = \frac{\left(R_i - \overline{w} + d\right)^2}{8d}$$

Given this bidding strategy, the expected profit (with an informed customer and a transaction-focused NYOP retailer who accepts any bid above wholesale cost), before the cost realization, is:

$$\Pi^{I,TF} = \int_{w=\overline{w}-d}^{\overline{w}+d} \Phi_0\left(b_i^I - w\right) \mathrm{f}\left(w\right)\, \mathrm{d}w \qquad \text{where } \Phi_0 = \begin{cases} 1 & \text{if } c_i \leq \hat{c}_I \ \& \ b_i^I > w \\ 0 & \text{else} \end{cases} \tag{6}$$

The closed form expression for profit is provided in Lemma 1.

2.3. Comparison of Biased and Informed Customers.

Lemma 1 records the profit with biased customers and with informed customers, when the NYOP seller is transaction-focused.

Lemma 1 Profit when the NYOP Retailer is Transaction-Focused

Customer Type	**Profit**
Biased	$\frac{R_i + \overline{P} - d - 2\overline{w}}{2}$ if $c_i \le \hat{c}_B$ & $R_i \ge 2\overline{w} + 3d - \overline{P}$ $\frac{\left(R_i + \overline{P} + d - 2\overline{w}\right)^2}{16d}$ if $c_i \le \hat{c}_B$ & $2\overline{w} - d - \overline{P} \le R_i < 2\overline{w} + 3d - \overline{P}$ 0 Else
Informed	$\frac{\left(R_i + d - \overline{w}\right)^2}{16d}$ if $c_i \le \hat{c}_I$ & $R_i \ge \overline{w} - d$ 0 Else

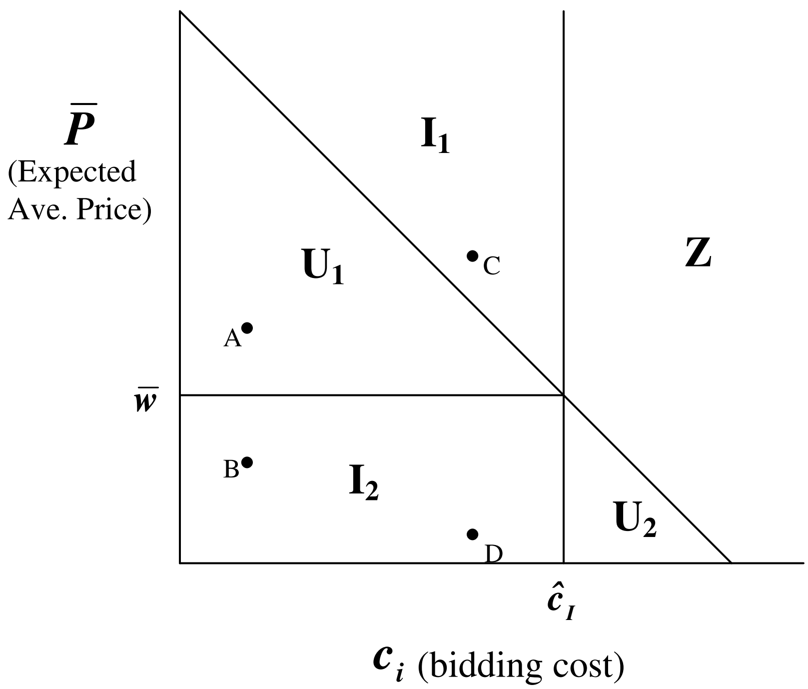
Proposition 1 compares the profits depending on whether a consumer is biased.

> ***Proposition 1 (Single Consumer):*** *When the seller is transaction-focused, seller profit is higher if a customer is biased rather than informed if either:*
> *(a) the customer is pessimistic about the threshold price and has low bidding costs; or*
> *(b) the customer is optimistic about the threshold price and has high bidding costs.*
> *Specifically,* $\Pi^{B,TF} > \Pi^{I,TF}$ *if either (a)* $\overline{P} > \overline{w}$ & $c_i \le \hat{c}_B$*; or (b)* $\overline{P} < \overline{w}$ & $\hat{c}_I < c_i \le \hat{c}_B$.

Figure 1 illustrates this comparison. The triangles U_1 and U_2 represent regions in which the NYOP retailer benefits from a consumer being biased rather than informed, whereas areas I_1 and I_2 represent the scenarios in which the retailer would prefer that the consumer be informed. First, consider region U_1. Here, a consumer is pessimistic about threshold price, namely she believes the threshold price is higher, on average, than it really is ($\overline{P} > \overline{w}$). The belief that getting a good deal is unlikely, induces the consumer to bid more than she otherwise would (i.e., $b_i^B > b_i^I$), which in turn leads to higher profit for the firm. Notice that this region is relevant only if bidding costs are sufficiently small. If costs were higher, we would move to region I_1 in which profits would be higher if the consumer were informed. In such a case, pessimism about the threshold price would induce the consumer to forego bidding (and thus $\Pi^{B,TF} = 0$). Therefore, the retailer would be better off if the consumer had realistic beliefs so that a bid would be made. However, if costs are too large ($c_i > \hat{c}_I$), even an informed consumer would not bid (Region Z).

On the other hand, consider a consumer with optimistic beliefs ($\overline{P} < \overline{w}$). As long as frictional costs are sufficiently small, the belief that getting a good deal is likely induces the consumer to bid less than she otherwise would (i.e., $b_i^I > b_i^B$), which in turn leads to lower profit for the firm when consumers are biased. However, notice that for sufficiently high costs ($c_i > \hat{c}_I$), the retailer prefers to face a biased customer (region U_2). In this case, an informed consumer would realize that it is not optimal to bid. However, an optimistic customer would still be willing to bid. Thus, optimism spurs bids that would not otherwise take place and thus can potentially benefit the NYOP retailer.

Figure 1 Comparison of Expected Profit When the Seller is Transaction-Focused



In regions I_1 and I_2, expected profit is strictly larger if the consumer is informed rather than biased. In regions U_1 and U_2, expected profit is strictly larger if the consumer is biased rather than informed. In region Z, expected profit is zero regardless of whether the consumer is biased or informed.

2.4. Heterogeneous Consumers

Relying on Figure 1, it is straight-forward to extend the analysis to a heterogeneous group of consumers. A customer with the characteristics $\left(R_i, c_i, \overline{P}\right)$ will fall into one of the five regions depicted in Figure 1. For each of these 5 regions, we can calculate the difference in expected profit from a consumer that is biased rather than informed. In particular:

(7) $$\Pi_i^B - \Pi_i^I = \begin{cases} -\dfrac{R_i + \overline{w} - d}{2} & \text{if } i \text{ is in } \mathrm{I}_1 \\ \dfrac{\overline{P} - \overline{w}}{2} & \text{if } i \text{ is in } \mathrm{U}_1 \text{ or } \mathrm{I}_2 \\ \dfrac{R_i + \overline{P} - d}{2} & \text{if } i \text{ is in } \mathrm{U}_2 \\ 0 & \text{if } i \text{ is in Z} \end{cases}$$

In general, whether the NYOP retailer prefers to face biased or informed consumers will depend on how consumers are distributed across these five regions. For example, if most consumers are located in region U_1 (e.g., on average consumers are pessimistic and have low bidding cots), the retailer would prefer that consumers remain uninformed. In contrast, if most consumers are located in region I_1 (e.g., on average consumers are optimistic and have low bidding costs), the retailer would prefer that consumers become informed about the price threshold distribution.

Furthermore, Proposition 2 reports several additional interesting results when the NYOP retailer faces heterogeneous consumers:

Proposition 2 (Heterogeneous Consumers): *When the seller is transaction-focused:*

(a) If no consumer has a very large bidding cost (i.e., $c_i \le \hat{c}_I \quad \forall c_i$*) and there is a symmetric distribution of expectations (i.e., consumers as a group, on average, have accurate expectations), then expected profits for the NYOP retailer would be (weakly) higher if consumers were informed rather than biased.*

(b) As long as bidding costs are not too heterogeneous, a "gained" informed consumer is more valuable to the NYOP retailer than a "lost" biased customer.

Proposition 2 (a) tells us that if consumers biases are balanced (e.g., if half of the consumers underestimate the true average threshold price and half overestimate it – with the bias in each direction being of the same magnitude) and bidding costs are not too large ($c_i \le \hat{c}_I \quad \forall c_i$), then profit would (weakly) increase if these consumers all became informed. This result can be inferred by examining equation (7) along with Figure 1. Notice that consumers in regions U_1 and I_2, would bid regardless of whether they are biased or informed. The difference is only in the magnitude of the bid, which depends on whether the expected mean threshold price is greater or less than the true mean threshold price. Notice that a symmetric distribution across these two regions would exactly offset. For example, suppose there are two consumers. Consumer A overestimates the true threshold by x and consumer B underestimates the true threshold by x, i.e., $\overline{P}_A - \overline{w} = x$ and $\overline{w} - \overline{P}_B = x$. Here, the firm would earn the same total profit across these two consumers if they both were to become informed (i.e., $\overline{P}_A = \overline{P}_B = \overline{w}$). But, now consider two symmetric consumers, C and D, where C lies in region I_1 and D is in region I_2. In this case, the NYOP retailer strictly benefits from these two consumers becoming informed. Consumer C would place a strictly larger bid if she was informed and consumer D would now bid if she becomes informed (whereas her previous pessimism would have discouraged her from bidding).

Now consider Proposition 2 (b). Refer back to Figure 1. Consider a consumer located in the region I_1. She has such pessimistic beliefs that she would not bid if she remains uninformed about the true distribution of price thresholds. However, if she were informed of the true distribution, she would place a bid. Such as customer is termed a “gained” informed consumer – a customer the retailer would possibly sell to if she became informed, but not if she remains biased. On the other hand, consider a consumer in region U_2. He has such optimistic beliefs that he would bid if he remains uninformed about the true distribution of price thresholds. But, if he were informed of the true distribution, he would not bid. Such a customer is termed a “lost” biased consumer – a customer the retailer would possibly sell to if he remains biased, but not if he becomes informed. Proposition 2(b) asserts that each “gained” informed customer is more valuable to the retailer than each “lost” biased customer. The key to understanding this result is to consider the bid levels of these two types of customers. A “lost” biased customer would place a lower bid (assuming she remains uninformed) than a “gained” informed customer. This is because the biased customer is only bidding because he thinks the price threshold is likely to be low. As a result, he places a low bid – a bid which in actuality will likely be rejected.

Together, these two parts of Proposition 2 suggest that a NYOP retailer often would benefit from having consumers become better informed about the true price threshold distribution.

2.5 Deviating from the Transaction-Focused Solution

Now suppose the NYOP retailer can add a markup, μ, when setting its threshold price. In particular, the seller accepts any bid at or above $\overline{w}+\mu$. Proposition 3 summarizes the impact of committing to such a pricing rule when consumers are uninformed:

> ***Proposition 3 (Deviating from being Transaction-Focused – Uninformed Customers):*** *When customers are uninformed, there is never an advantage to the seller of deviating from the transaction-focused solution, i.e.* $\mu^* = 0$.

Proposition 3 shows that deviating from the transaction-focused pricing rule cannot benefit the NYOP retailer if consumers are uninformed. Rejecting a bid above marginal cost causes the firm to forego a profitable transaction and accepting a bid below marginal costs leads to a loss. And, for uninformed customers, in all other situations, there is no gain in revenue since the seller's pricing rule does not affect bidding participation or bid levels.

However, if consumers are informed, the NYOP seller's decisions regarding which bids to accept can influence expectations, which in turn, affect bidding behavior and profit. Specifically, when a seller commits to a markup of μ, the actual price thresholds are uniformly distributed on [$\overline{w}+\mu$ - d, $\overline{w}+\mu$ +d]. Here, I examine the equilibrium that results when consumers have become fully informed, i.e., they expect that P_{NYOP} ~U[$\overline{w}+\mu$ - d, $\overline{w}+\mu$ +d]. The optimal bidding strategy for such an informed customer is:

(8)
$$\begin{cases} \text{place a single bid of } b_i^I(\mu) & \text{if } c_i \le \hat{c}(\mu) \\ \text{do not bid at all} & \text{if } c_i > \hat{c}(\mu) \end{cases}$$

$$\text{where } b_i^I(\mu) = \frac{R_i + \overline{w} + \mu - d}{2},\ \hat{c}(\mu) = \frac{\left(R_i - \overline{w} - \mu + d\right)^2}{8d}$$

Given this bidding strategy, the NYOP retailer's expected profit is:

(9)
$$\Pi^I(\mu) = \begin{cases} \displaystyle\int_{w=\overline{w}-d}^{\frac{R_i+\overline{w}-\mu-d}{2}} \left(b_i^I(\mu) - w\right) \mathrm{f}(w)\ \mathrm{d}w & \text{if } c_i \le \hat{c}(\mu) \\ 0 & \text{if } c_i > \hat{c}(\mu) \end{cases}$$

The NYOP seller chooses μ in order to maximize $\Pi^I(\mu)$:

(10) $$\mu^* = \text{Min}\left[R_i - \overline{w} + d - 2\sqrt{2c_i d}\,, \frac{R_i - \overline{w} + d}{3} \right]$$

Proposition 4 summarizes the impact of deviations from being transaction-focused when a customer is informed:

Proposition 4 (Deviating from being Transaction-Focused – Informed Customer): *When a customer is informed, it is almost always advantageous for a NYOP seller to deviate from the transaction-focused solution. Specifically,*

(a) A deviation from the transaction-focused pricing rule is advantageous whenever $c_i < \overline{c}$ *and* $c_i \neq c_0$ *where* $\overline{c} = \dfrac{2\left(R_i - \overline{w} + d\right)^2}{9d}$ *and* $c_0 = \dfrac{\left(R_i - \overline{w} + d\right)^2}{8d}$.

(b) Such deviations are advantageous either because (1) they increase the level of the customer's bid (if $c_i < c_0$*), or (2) they encourage customers to bid who otherwise would not (if* $c_0 < c_i < \overline{c}$ *).*

(c) There are conditions under which a NYOP seller benefits from committing to accept some bids below cost, i.e., $\mu^* < 0$ *if* $c_0 < c_i < \overline{c}$ *.*

(d) The optimal markup, μ^* *, is increasing in* R_i*, decreasing in* $\overline{w}$ *and* c_i*, and can be either increasing or decreasing in d, i.e.,* $\dfrac{\partial \mu^*}{\partial R_i} > 0$, $\dfrac{\partial \mu^*}{\partial \overline{w}} < 0$, $\dfrac{\partial \mu^*}{\partial c_i} < 0$, *and*

$$\frac{\partial \mu^*}{\partial d}\begin{cases} > 0 \ \text{ if } c_i < \dfrac{d}{2} \\ < 0 \ \text{ if } c_i > \dfrac{d}{2} \end{cases}.$$

The impact of deviating from a simple pricing rule of accepting all bids above marginal cost hinges critically on whether a consumer is informed. Whereas altering one's pricing rule never improves profit when a consumer is uninformed (Proposition 3), it almost always increases profit when a consumer is informed (Proposition 4(a)). When consumers are informed, there are only two situations in which it is not advantageous to a NYOP retailer to commit to a pricing rule that differs from the transaction-focused optimal solution. First, if bidding costs are so high that it is impossible for the seller to induce the customer to participate in the market and still earn a positive expected profit $\left(c_i \geq \overline{c}\right)$, then the seller cannot earn strictly positive profit regardless of the pricing rule it uses. Second, there is a single point where the optimal markup is zero (i.e., $\mu^* = 0$ if $c_i = c_0$).

Proposition 4(b) indicates that setting a positive markup can be advantageous because this action induces higher bids. But, the optimal markup is tempered by that fact that higher markups increase the probability of rejecting a bid above marginal cost and thus foregoing a profitable transaction. Therefore, an internal solution exists. Markups are further constrained by the fact that if the markup is too high, the consumer would not bid at all and thus eliminate profit altogether. This constraint sometimes results in a corner solution in which μ is as high as it can be and still induce the consumer to bid. Interestingly, if costs are very large $\left(c_i > c_0\right)$, then $\mu^* < 0$. In this case, it is advantageous for the retailer to accept bids below its wholesale cost. Committing to accept such bids induces a consumer to bid who otherwise would not. The losses when the bid is accepted even though it is below cost are more than offset by the revenue generated when marginal costs are very low and thus the bid significantly exceeds these costs. To make this situation concrete, consider the following parameters: $R_i = 1$, $d = .3$, $\overline{w} = .5$, and $c_i = .3$. For these parameters, $\mu^* = -.05$. Commitment to a negative markup induces a bid of .58 (which is accepted as long as $w < .63$) and a profit of .116. In contrast, if $\mu = 0$, a consumer would earn negative expected surplus from bidding (U = -.033) and thus refrains from bidding.

Furthermore, Proposition 4(d) shows that μ^* is increasing in R_i, but decreasing in $\overline{w}$ and c_i. The motivation for a positive markup is that it can increase bid levels and reduce the shading of bids. As (R_i - $\overline{w}$) increases, there is greater opportunity cost to the NYOP seller of setting the threshold price equal to its cost, i.e., the consumer would be willing to bid much more if she thought that was necessary to secure the good. Thus, as (R_i - $\overline{w}$) increases, the optimal markup, μ^*, also increases. However, this incentive to increase the markup is tempered by bidding costs. As such costs increase, it is more difficult for the seller to induce the consumer to bid and thus the optimal markup falls.

Interestingly, μ^* can be either increasing or decreasing in d. Recall that an increase in d represents an extension of the range of wholesale prices by decreasing the lowest possible wholesale cost and increasing the upper-most wholesale cost. Therefore, changes in d impact the probability that a given bid is accepted. In particular, if a consumer is bidding below the average acceptable price, i.e., $b_i < \overline{w} + \mu$ (which is equivalent to the condition $c_i > \frac{d}{2}$), then an increase in d increases the probability that the bid will be accepted. Notice that this increases the consumer's expected surplus from bidding. Thus, in this case, the markup can be increased while still inducing the consumer to participate. In contrast, if a consumer is bidding above the average acceptable price, i.e., $b_i > \overline{w} + \mu$ (which is equivalent to the condition $c_i < \frac{d}{2}$), then an increase in d decreases the probability that the bid will be accepted. Since this decreases the consumer's expected surplus from bidding, the markup must be decreased in order to induce the consumer's participation.

3. CONCLUDING REMARKS

3.1. Formation and Manipulation of Expectations

In this subsection, I discuss several factors that may impact expectations and also explore how a strategic NYOP retailer may attempt to influence these expectations. First, this paper has found that a critical factor that affects the profitability of the NYOP format is customers' expectations about what bids are likely to be accepted. In particular, optimism or extreme pessimism could undermine profitability. It is not obvious what expectations consumers will have in the face of limited information. Do consumers tend to be optimistic or pessimistic? In many different contexts, people exhibit overconfident in their abilities (Fischhoff and Slovic 1980, Mahajan 1992). Applying this prevalent finding in the literature, we might expect that consumers consistently underbid, e.g., due to overconfidence in their ability to find a better deal from a competing retailer or at a later date. Furthermore, evidence suggests that consumers underestimate retailers' costs and thus overestimate retailers' margins. For instance, Bolton, Warlop and Alba (2003) find that "consumers tend to attribute store price differences to profit rather than costs" and "have a poor appreciation of the costs faced by firms." Presumably, a major influence on customers' expectations of the price threshold would be costs, such as the wholesale cost the NYOP retailer purchases at and the costs associated with operating a NYOP channel. Underestimating these costs would lead customers to underestimate the NYOP retailer's price threshold distribution, and thus undermine the retailer's profitability.

Second, a NYOP retailer may be able to influence price expectations. Notice that even in posted price channels, "it has been proven time and again over the past 40 years that consumers do not know the exact price of the products they regularly buy" (Von Freymann 2002). As a result, consumers rely on imperfect price perceptions which shape internal reference prices (Monroe and Lee 1999). Furthermore, there has been much research on how external information can shape price perceptions and willingness-to-pay (see Miao and Mattilla 2007 and the literature cited therein). For instance, Kopalle and Lindsey-Mullikin (2003) find that external reference prices can lead consumers to update their price expectations. For example, consumers raise their price expectations when an external reference price exceeds their initial price expectations. There seems to be large latitude for retailers to influence price expectations given the poor price recall of shoppers (Dickson and Sawyer 1990) and evidence that consumers are willing to believe pricing claims that exceed their initial price expectation by over 200% (Kopalle and Lindsey-Mullikin 2003).

While some authors have suggested that posted price firms have "considerable scope for potential deception by manipulating the external reference price" (Kopalle and Lindsey-Mullikin 2003), it is not entirely clear that NYOP retailers can manipulate expectations as easily. Notice that the NYOP format is most easily implemented in an online environment. Due to the ease with which word-of-mouth spreads on the Internet, consumers may easily obtain information about the distribution of price thresholds in an online setting. For instance, numerous web forums, e.g., biddingfortravel.com, betterbidding.com, and flyertalk.com, allow consumers to discuss their experiences (including postings of accepted and rejected bid levels) at *Priceline*. Furthermore, the lack of transparency of prices on a NYOP format may lead customers to harbor suspicion about any external information provided by the NYOP retailer.[6] Indeed,

[6] See the working paper by Shapiro and Zillante (2008) for an intriguing exploration of how external information, such as posted prices, can influence bidding behavior in an (experimental) NYOP setting.

Miao and Mattilla (2007) find that it is especially difficult to use externally-supplied information in order to influence perceptions in low transparency contexts, such as the NYOP channel. Therefore, a NYOP retailer may need to turn to credible third-parties in order to provide information about its price threshold distribution to potential bidders. For instance, by financially supporting biddingfortravel.com, Priceline may facilitate customers becoming more sophisticated and thus learning that the typical price savings over the posted price channels is not as large as they may have initially expected. Further research is needed to identify additional tools that would enable NYOP retailers to shape price expectations to their advantage.

3.2 Managerial Implications

The current paper has several important implications for sellers who use or intend to use the NYOP format. First, it is essential to assess the information available to one's customers and how they use it to make bidding decisions. For instance, if consumers lack information about the process used to set price thresholds (or do not incorporate such knowledge into their decision-making), then a NYOP retailer may be able to profit from fooling customers, e.g., trying to inflate consumers' expectations of the price threshold, but then setting a low price threshold in order to capture a large market share. Or, if customers have extremely pessimistic expectations, then a NYOP retailer needs to convey (perhaps through advertisements) that it is possible to get much better deals than consumers currently believe. The "Tough Love' commercial used by Priceline is one example of a communication that conveys such a message:[7]

William Shatner:	A guy is worried about naming his own price?
(Priceline Negotiator):	I'm on it. Naming your own price, huh?
Purchaser:	Yeah, they want $200 for a 4-star on the Vegas strip. I'm going $190.
Priceline Negotiator:	Oh, you're a wuss.
Purchaser:	What?
Priceline Negotiator:	Go lower.
Purchaser:	$160.
Priceline Negotiator:	Namby-pamby.
Purchaser:	$140?
Priceline Negotiator:	Cupcake.

[7] http://tickets.priceline.com/promo/shatner_pcln_negotiator.asp

Purchaser: I want to get a room.
Priceline Negotiator: It's a guaranteed 4-star room, mama's boy.
Purchaser: $99?
Priceline Negotiator: Now you're negotiating.

On the other hand, if consumers know more about the process for setting price thresholds and are able to form accurate expectations, a much different policy may be optimal. In this case, the NYOP retailer is unable to impact price expectations unless it alters the actual price threshold distribution it uses. In particular, a NYOP retailer may benefit from "tying its hands", e.g., committing to a price threshold that differs from the wholesale cost. Most often, this would involve the NYOP retailer establishing a fixed positive markup. Notice that such commitment may cause the seller to reject profitable bids. But, in the long run, this may have the benefit of raising bid levels. Notice that this reasoning may also help to explain why Priceline uses the "randomizer" program (which leads to foregoing profitable transactions) described in footnotes 1 and 2. It is important to notice that the online environment may facilitate such commitment since an automated platform can easily be augmented to include a fixed markup.

This paper also suggests that there may be situations in which a NYOP retailer may benefit from accepting bids below cost. Such a strategy might induce greater participation rates in the channel and thus, on average, benefit the firm. While this strategy may be unconventional, there is evidence that NYOP retailers have used such a strategy. In particular, in its early days, Priceline would "subsidiz[e] part of the cost of the ticket to help build traffic" (Seymour 2000). Such actions initially led to the extremely low gross margins (e.g., Lacey (1999) reports that the company's gross margin percentage was just 4% in the third quarter of 1999). However, the increase in traffic that resulted may have been a significant factor for the relative prosperity that Priceline enjoys today.

3.3. Future Research

There are a number of directions in which this research could be extended. The modeling assumptions could be relaxed in order to explore the robustness of these results. For example, one may want to consider risk aversion, and other, more complicated market environments, e.g., allowing for multiple bidding opportunities, competition, imperfect product substitutability, and capacity-constrained firms. Furthermore, the current paper has focused on sophistication of consumers in terms of their accuracy in forming expectations about the threshold prices. However, there are other dimensions of sophistication that may be interesting and important to study. For example, Fay (2004) considers the impact of customers becoming more sophisticated in their bidding strategies by finding loopholes in a single-bid restriction so that they can place multiple bids. Other sophisticated bidding strategies may involve varying the timing of bids to take advantage of prices that change over time or using multiple channels in order to locate the best deal. It would be interesting to analyze how a NYOP retailer might best respond to such challenges.

REFERENCES

Acquisti, Alessandro, and Hal R. Varian (2005), "Conditioning Prices on Purchase History," *Marketing Science*, 24(3), 367-381.

Anand, Bharat N. and Ron Shachar (2004), "Brands as Beacons: A New Source of Loyalty to Multiproduct Firms," *Journal of Marketing Research*, 41(2), 135-150.

Bolton, Lisa E., Luk Warlop, and Joseph W. Alba (2003), "Consumer Perceptions of Price (Un)Fairness," *Journal of Consumer Research*, 29 (4), 474-491.

Brenkert, George G. (1998), "Marketing and the Vulnerable", *Business Ethics Quarterly*, Ruffin Series, No. 1, special issue, 7-21.

Chen, Yuxin and Ganesh Iyer (2002), "Consumer Addressibility and Customized Pricing," *Marketing Science* 21(2), 197-208.

Chen, Yuxin, Chakravarthi Narasimhan, and Z. John Zhang (2001), "Individual Marketing with Imperfect Targetability," *Marketing Science* 20(1), 23-41.

Dellarocas, Chrysanthos (2005), "Reputation Mechanism Design in Online Trading Environments with Pure Moral Hazard," *Information Systems Research*, 16(2), 209–230.

Dellarocas, Chrysanthos (2006), "Reputation Mechanisms" in *Handbook on Economics and Information Systems* (T. Hendershott, ed.), Elsevier Publishing.

Dickson, Peter R. and Alan G. Sawyer (1990), "The price knowledge and search of supermarket shoppers," *Journal of Marketing*, 54 (3), 42-53.

Dwyer, F. Robert, Paul H. Schurr, and Sejo Oh (1987), "Developing Buyer-Seller Relationships" *Journal of Marketing*, 51(2), 11-27.

Fay, Scott (2004), "Partial-Repeat-Bidding in the Name-Your-Own-Price Channel," *Marketing Science*, 23(3), 407-418.

Fay, Scott and Jinhong Xie (2008), "Probabilistic Goods: A Creative Way of Selling Products and Services," *Marketing Science* (forthcoming).

Fay, Scott (2008), “Selling an Opaque Product through an Intermediary: The Case of Disguising One’s Product,” *Journal of Retailing* 84.1 (Spring 2008), 59-75.

Fischhoff, Baruch and Paul Slovic (1980), "A Little Leaming ... Confidence in Multi-Cue Judgment," in Attention and Performance, Vol. 8, R. Nickerson, ed. Hillsdale, NJ: Lawrence Eribaum Associates.

Gazzale, Robert S. (2005), “Giving Gossips Their Due: Information Provision in Games with Private Monitoring,” Working Paper (August 2, 2005), Williams College.

Hann, Il-Horn and Christian Terwiesch (2003), “Measuring the Frictional Costs of Online Transactions: The Case of a Name-Your-Own-Price Channel,” *Management Science*, 49(11), 1563-1579.

Haussman, Glenn (2001), “Priceline Urges Property Participation,” *Hotel Interactive*, May 30, [available at http://www.hotelinteractive.com/news/articleView.asp?articleID=1034].

Kannan, P.K. and Praveen K. Kopalle (2001), “Dynamic Pricing on the Internet: Importance and Implications for Consumer Behavior,” *International Journal of Electronic Commerce*, 5(3), 63-83.

Kopalle, Praveen K. and Joan Lindsey-Mullikin (2003),.”The impact of external reference price on consumer price expectations,”.*Journal of Retailing*, 79 (4), 225-236.

Laczniak, Gene R. (1999), "Distributive Justice, Catholic Social Teaching, and the Moral Responsibility of Marketers," *Journal of Public Policy & Marketing*, 18(1), 125-129.

Lacey, Stephen P. (1999), “Priceline.com Offers `Scalability',” *IPO Reporter*, 23 (13), p1-2.

Mahajan, Jayashree (1992), “The Overconfidence Effect in Marketing Management Predictions,” *Journal of Marketing Research*, 29 (3), 329-3429.

Malhotra, Namit and Christian Desira (2002), “Hotel Internet Distribution Channels,” *HVS Technology Strategies Hospitality Report* February 2 [available at http://www.hotelnewsresource.com/studies/hvs021202.htm].

Miao, Li, and Anna S. Mattilla (2007), “How and How Much To Reveal? The Effects of Price Transparency On Consumers' Price Perceptions,” *Journal of Hospitality & Tourism Research*, 31(4), 530-545.

Monroe, K. and Lee, A. (1999), "Remembering Versus Knowing: Issues in Buyers' Processing of Price Information," *Journal of the Academy of Marketing Science*, 27 (2), 207-226.

Nair, Harikesh (2007), "Intertemporal Price Discrimination with Forward-Looking Consumers: Applications to the US Market for Console Video-Games," *Quantitative Marketing and Economics*, 5(3), 239-292.

Pine, Karen J. and Avril Nash (2002), "Dear Santa: The Effects of Television Advertising on Young Children," *International Journal of Behavioral Development*, 26(6), 529-539.

Resnick, P., and R. Zeckhauser (2002), "Trust Among Strangers in Internet Transactions: Empirical Analysis of eBay's Reputation System" in *The Economics of the Internet and E-Commerce. Advances in Applied Microeconomics*, (Michael R. Baye, ed.), V. 11. JAI Press, Greenwich, CT.

Reynolds, Fred D., William R. Darden, and Warren Martin (1975), "Developing an Image of the Store-Loyal Customer," *Journal of Retailing*, 50(4), 73-84.

Salop, Steven and Joseph Stiglitz (1977), "Bargains and Ripoffs: A Model of Monopolistically Competitive Price Dispersion," *Review of Economic Studies*, 44(138), 493-510.

Segan, Sascha (2005), *Priceline.com for Dummies*. Wiley Publishing, Inc., Hoboken, N. J.

Seymour, Jim (2000) "Livin' la Vida Loca Online," *PC Magazine*, 19 (13), 107.

Shapiro, Dmitry and Arthur Zillante (2008), "Name Your Own Price Mechanisms: Revenue Gain or Drain," Working Paper (January), University of North Carolina Charlotte.

Spann, Martin, Bernd Skiera, and Bjorn Schafers (2004), "Measuring Individual Frictional Costs and Willingness-To-Pay Via Name-Your-Own-Price Mechanisms," *Journal of Interactive Marketing*, 18(4), 22-36.

Spann, Martin and Gerard J. Tellis (2006), "Does the Internet Promote Better Consumer Decisions? The Case of Name-Your-Own-Price Auctions," *Journal of Marketing*, 70 (January), 65-78.

Terwiesch, Christian, Sergei Savin, and Il-Horn Hann (2005), "Online Haggling at a Name-Your-Own-Price Retailer: Theory and Application," *Management Science*, 51(3), 339-351.

Varian, Hal R. (1980), “A Model of Sales,” *American Economic Review*, 70(4), 651-659.

Villas-Boas (1999), “Dynamic Competition wit Customer Recognition,” *RAND Journal of Economics*, 30(4), 604-631.

Von Freymann, Jeffrey (2002), “Grocery Store Pricing and its Effect on Initial and Ongoing Store Choice,” *Marketing Management Journal*, 12(1), 107-119.

Wolburg, Joyce M. (2005), “Drawing the Line Between Targeting and Patronizing: How "Vulnerable" are the Vulnerable? *Journal of Consumer Marketing*, 22(5), 287-288.

Zeithammer, Robert (2006), “Forward-Looking Bidding in Online Auctions,” *Journal of Marketing Research*, 43(3), 462-476.

Zeithammer, Robert (2007), “Strategic Bid-Shading and Sequential Auctioning with Learning from Past Prices,” *Management Science*, 53(9), 1510-1519.

APPENDIX

Proof of Proposition 1

Equation (7) shows the difference in profit between a biased customer and an informed customer, where each of the regions is defined as follows:

$$\text{(A1)}\qquad \begin{aligned} &I_1:\ \overline{P} > \overline{w}\ \&\ \hat{c} < c_i \le \hat{c}_I \\ &U_1:\ \overline{P} > \overline{w}\ \&\ c_i \le \hat{c}_B \\ &I_2:\ \overline{P} < \overline{w}\ \&\ c_i \le \hat{c}_I \\ &U_2:\ \overline{P} < \overline{w}\ \&\ \hat{c}_S < c_i \le \hat{c}_B \\ &Z\ :\ \text{All other parameters} \end{aligned}$$

Using these definitions, we can calculate the difference in profit in each region:

$$\text{(A2)}\qquad \Pi_i^B - \Pi_i^I = \begin{cases} -\dfrac{R_i + \overline{w} - d}{2} < 0 & \text{if } i \text{ is in } \mathrm{I}_1 \\ \dfrac{\overline{P} - \overline{w}}{2} > 0 & \text{if } i \text{ is in } \mathrm{U}_1 \\ \dfrac{\overline{P} - \overline{w}}{2} < 0 & \text{if } i \text{ is in } \mathrm{I}_2 \\ \dfrac{R_i + \overline{P} - d}{2} > 0 & \text{if } i \text{ is in } \mathrm{U}_2 \\ 0 & \text{if } i \text{ is in } \mathrm{Z} \end{cases}$$

High Variability Versus Bias in Expectations

The text models uninformed consumers as having biased estimates of the price threshold. In this section, I consider an alternative model in which consumers' lack of information leads to increased variability in expectations. In particular, the price threshold is actually distributed on U[$\overline{w}$ - d, $\overline{w}$ + d], but an uninformed customer believes that P_{NYOP} ~, U[$\overline{w}-\varepsilon_i$ - d, $\overline{w}+\varepsilon_i$ + d], where $\varepsilon_i > 0$. For such a consumer, the expected utility from placing a bid of b_i is

(A3)
$$U\left(b_i\right)=\left(R_i-b_i\right)\left(\frac{b_i-\left(\overline{w}-d-\varepsilon_i\right)}{\overline{w}+d+\varepsilon_i-\left(\overline{w}-d-\varepsilon_i\right)}\right)-c_i$$

The optimal bidding strategy is:

(A4)
$$\begin{cases}\text{place a single bid of } b_i^V & \text{if } c_i \le \hat{c}_V \\ \text{do not bid at all} & \text{if } c_i > \hat{c}_V\end{cases}$$

where

$$b_i^v=\frac{R_i+\overline{w}-d-\varepsilon_i}{2},\ \hat{c}_V=\frac{\left(R_i-\overline{w}+d+\varepsilon_i\right)^2}{8d}$$

It is important to see that $b_i^v < b_i^I$ and $\hat{c}_V > \hat{c}_I$.

Facing such a bidding strategy, a transaction-focused retailer (prior to the cost realization) earns an expected profit of:

(A5)
$$\Pi^{V,TF}=\int_{w=\overline{w}-d}^{\overline{w}+d}\Omega_0\left(b_i^V-w\right)\mathrm{f}\left(w\right)\,\mathrm{d}w \qquad \text{where } \Omega_0=\begin{cases}1 & \text{if } c_i\le\hat{c}_V\ \&\ b_i^V>w\\ 0 & \text{else}\end{cases}$$

Proposition A1 compares this profit to the profit with informed customers (given in Lemma 1):

Proposition A1 (Uninformed High Variance Customer versus an Informed Customer): *When the seller is transaction-focused, seller profit is higher if a customer us uninformed if the consumer has moderately large bidding costs. In particular,*

(a) $\Pi^{V,TF} < \Pi^{I,TF}$ *if* $c_i \le \hat{c}_I$

(b) $\Pi^{V,TF} > \Pi^{I,TF}$ *if* $\hat{c}_I < c_i \le \hat{c}_V$

(c) $\Pi^{V,TF} = \Pi^{I,TF}$ *if* $c_i \ge \hat{c}_V$

Notice that, as is the case where uninformed customers have biased expectations, when lack of information results in higher variability, then relative profit with informed consumers depends crucially on the level of bidding costs. For instance, either bias or high variance can benefit the NYOP seller if bidding costs are high. However, high variance coupled with low bidding costs cannot benefit the NYOP seller (since an uninformed customer places a relatively low bid under the misconception that low bids are more likely to be accepted than they truly are).

Proof of Proposition 2

Proposition 2(a): There is a symmetric distribution of beliefs. In particular, for each $c_i \le \hat{c}_I$, there is a distribution of beliefs $f_i\left(c\right)$ such that $f_i\left(\overline{w}-x\right)=f_i\left(\overline{w}+x\right)\ \forall x\ge 0$. Define $\overline{P}_i$ as the $\overline{P}$ such that

$c_i = \hat{c}_B$:

(A6) $$\overline{P}_i = R_i + d$$

Using Figure 1 and (A2), we can calculate the expected profit (for each level of c_i) when consumers are biased rather than informed:

(A7) $$\Pi_i^{B,TF} - \Pi_i^{I,TF} = \int_{\overline{P}=0}^{\overline{w}} \left(\frac{\overline{P}-\overline{w}}{2} \right) f\left(\overline{P}\right) \mathrm{d}\overline{P} + \int_{\overline{P}=\overline{w}}^{\overline{P}_i} \left(\frac{\overline{P}-\overline{w}}{2} \right) f\left(\overline{P}\right) \mathrm{d}\overline{P} + \int_{\overline{P}=\overline{P}_i}^{\infty} \left(-\frac{R_i+\overline{w}-d}{2} \right) f\left(\overline{P}\right) \mathrm{d}\overline{P}$$

From the assumption of symmetry, we have:

(A8) $$\Pi_i^{B,TF} - \Pi_i^{I,TF} \begin{cases} = 0 & \text{if } f\left(\overline{P}\right) = 0 \ \forall \overline{P} \geq \overline{P}_i \\ < 0 & \text{Else} \end{cases}$$

Proposition 2(b). Let consumer "A" be a "gained" informed customer, i.e., "A" would have been in region I_1 if she were uninformed. Thus, $\overline{P}_A > \overline{w}$ & $\hat{c}_B < c_A \leq \hat{c}_I$. Let consumer "B" be a "lost" biased customer, i.e., "B" would have been in region U_2 if she were uninformed. Thus, $\overline{P}_B < \overline{w}$ & $\hat{c}_I < c_B \leq \hat{c}_B$. The difference in expected profit between (informed) "A" and (uninformed) "B" is:

(A9) $$\Pi_A - \Pi_B = \int_{w=\overline{w}-d}^{b_A^I} \left(b_A^I - w\right)\left(\frac{1}{2d}\right) \mathrm{d}w - \int_{w=\overline{w}-d}^{b_B^B} \left(b_B^B - w\right)\left(\frac{1}{2d}\right) \mathrm{d}w$$

$\Pi_A - \Pi_B > 0$ iff $b_A^I > b_B^B$. Thus to compare the expected profit from "A" and "B", we need only compare their bid levels:

(A10) $$b_A^I - b_B^B = \frac{R_A + \overline{w} - d}{2} - \frac{R_B + \overline{P}_B - d}{2} = \frac{\left(R_A - R_B\right) + \left(\overline{w} - \overline{P}_B\right)}{2}$$

Using the definitions in (3) and (4), the conditions $\hat{c}_I < c_B$ and $c_A \leq \hat{c}_I$ imply:

(A11) $$R_A \geq \overline{w} - d + 2\sqrt{2dc_A}$$

(A12) $$R_B \leq \overline{w} - d + 2\sqrt{2dc_B}$$

Consider two cases: (1) $c_A \geq c_B$; and (2) $c_A < c_B$. If $c_A \geq c_B$, then, together, equations (A11) and (A12) imply that $R_A \geq R_B$. Recall that $\overline{P}_B < \overline{w}$. Thus, from (A7), we have $b_A^I - b_B^B > 0$, i.e., that the "gained" informed customer is more valuable than the "lost" biased customer whenever the bidding cost of the "gained" informed customer is at least as high as the bidding cost of the "lost" biased customer.

Now consider the second case: $c_A < c_B$. From (A11) and (A12), we have:

(A13) $$R_B - R_A \leq 2\sqrt{2d}\left(\sqrt{c_B} - \sqrt{c_A}\right)$$

We have $b_A^I - b_B^B > 0$, only if $\left(R_A - R_B\right) + \left(\overline{w} - \overline{P}_B\right) \geq 0$. Since $\overline{P}_B \geq d$, this condition is satisfied if:

(A14) $$\sqrt{c_B} - \sqrt{c_A} \leq \frac{\overline{w} - d}{2\sqrt{2d}}$$

Condition (A14) formalizes the requirement in Proposition 2(b) that "bidding costs are not too heterogeneous."

Proof of Proposition 3

When consumers are uninformed, bidding behavior is unaffected by the actual distribution of threshold prices. Thus, consumers bid according to equation (3). The NYOP retailer's profit if it commits to setting a markup of μ is:

(A15) $$\Pi^B(\mu)=\begin{cases}\displaystyle\int_{w=\bar{w}-d}^{b_i^B-\mu}\left(b_i^B-w\right)\left(\frac{1}{2d}\right)\mathrm{d}w & \text{if } c_i\le \hat{c}_B\\ 0 & \text{if } c_i>\hat{c}_B\end{cases}$$

For $c_i > \hat{c}_B$, the retailer earns no profit regardless of the level of μ. For $c_i \le \hat{c}_B$, the derivative of $\Pi^B(\mu)$ w.r.t. μ is:

(A16) $$\frac{\partial \Pi^B(\mu)}{\partial \mu}=-\frac{\mu}{2d}$$

Profit is maximized where $\frac{\partial \Pi^B(\mu)}{\partial \mu}=0$. Thus, $\mu^*=0$.

Proof of Proposition 4

Proposition 4(a): Equation (10) gives the internal solution for μ^*. Deviation from the transaction-focused outcome is advantageous whenever $\mu^*\neq 0$ and $\Pi^I(\mu^*)>0$. This first condition reduces to: $c_i \neq \frac{\left(R_i-\bar{w}+d\right)^2}{8d}\equiv c_0$. The second condition reduces to $c_i<\frac{2\left(R_i-\bar{w}+d\right)^2}{9d}\equiv \bar{c}$.

Proposition 4(b): The impact on bids when the seller commits to μ^* is given by:

(A17) $$b_i^I(\mu^*)-b_i^I(0)=\frac{\mu^*}{2}$$

Thus, deviating from the transaction-focused outcome increases bid levels if $\mu^*>0$. Using (10), this condition is: $c_i<c_0$. Now consider $c_i>c_0$. From (8), if the NYOP seller adopts the transaction-focused solution, the consumer will only place a bid if $c_i<\hat{c}(0)$ Notice that $\hat{c}(0)=c_0$. Thus, the consumer would not bid unless the seller commits to a negative markup.

Proposition 4(c): When $c_i>c_0$, the optimal markup, which is given by (10) is: $\mu^*=R_i-\bar{w}+d-2\sqrt{2c_i d}$. Substituting $c_i>c_0$:

(A18) $$\mu^*<R_i-\bar{w}+d-2\sqrt{2d\left(\frac{\left(R_i-\bar{w}+d\right)^2}{8d}\right)}=R_i-\bar{w}+d-\left(R_i-\bar{w}+d\right)=0$$

Proposition 4(d): Using (10), we can calculate the following comparative statics:

(A19) $$\frac{\partial \mu^*}{\partial R_i}=\begin{cases}\frac{1}{3}>0 & \text{if } c_i<c_0\\ 1>0 & \text{if } c_i>c_0\end{cases}$$

(A20) $$\frac{\partial \mu^*}{\partial \bar{w}}=\begin{cases}-\frac{1}{3}>0 & \text{if } c_i<c_0\\ -1<0 & \text{if } c_i>c_0\end{cases}$$

(A21) $$\frac{\partial \mu^*}{\partial c_i}=\begin{cases}0 & \text{if } c_i<c_0\\ -\sqrt{\frac{2d}{c_i}}<0 & \text{if } c_i>c_0\end{cases}$$

$$\text{(A22)} \qquad \frac{\partial \mu^*}{\partial d} = \begin{cases} \dfrac{1}{3} > 0 & \text{if } c_i < c_0 \\ 1 - \sqrt{\dfrac{2c_i}{d}} \begin{cases} > 0 & \text{if } c_i < \dfrac{d}{2} \\ < 0 & \text{if } c_i > \dfrac{d}{2} \end{cases} & \text{if } c_i > c_0 \end{cases}$$