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Research Note

Contingent Pricing to Reduce Price Risks

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The price for a product may be set too low, causing the seller to leave money on the table, or too high, driving away potential buyers. Contingent pricing can be useful in mitigating these problems. In contingent pricing arrangements, price is contingent on whether the seller succeeds in obtaining a higher price within a specified period. We show that if the probability of obtaining the high price is not too high, sellers profit from using contingent pricing while economic efficiency increases. The optimal contingent pricing structure depends on the buyer's risk attitude—a deep discount is most profitable if buyers are risk prone. A consolation reward is most profitable if buyers are risk averse. To motivate buyers to participate in a contingent pricing arrangement, the seller must provide sufficient incentives. Consequently, buyers also benefit from contingent pricing. In addition, because the buyers with the highest willingness-to-pay get the product, contingent pricing increases the efficiency of resource allocation.

Key words: pricing; price risks; contingent selling formats; standbys; price discrimination; pricing under uncertainty
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Introduction

• Owners who put their house on the market declined an immediate offer that was $10,000 below the asking price. The house remained on the market for another year before finally being sold for $15,000 less than the original offer.

• Participants in a conference offered to pay top dollar for additional meeting rooms at a hotel. The hotel manager offered compensation to other customers if they would agree to stay at a nearby hotel, but many declined the offer.

• Three weeks prior to the date of a booked wedding, another party insisted on booking the same date and was willing to pay $15,000 more. The owner offered the first party $10,000 to reschedule, but they declined.

The above anecdotes (all from the authors' personal experiences) illustrate the risks that sellers face in setting prices: (1) losing the opportunity to sell at a low price when they wait for a high-price customer who does not arrive and ultimately having to salvage the product at an even lower price (as illustrated in the first anecdote); (2) rejecting a high-price buyer because a low-price offer has already been accepted (as illustrated in the last two anecdotes). The potential losses from such risks can be large, especially for products that must be sold within a specified time (for example, services such as airline flights, vacation packages, advertising, and transportation). In the above anecdotes the sellers could have improved their profits using *contingent pricing*.

It is no surprise that contingent pricing was not used in those cases. There are only a few examples of the use of contingent pricing methods in industry, and those examples resulted from trial and error rather than the application of a coherent body of knowledge. One of the goals of theory models in marketing is to go beyond and challenge common managerial practices (Shugan 2002). In this paper we continue this tradition, attempting to rectify the dearth of understanding of contingent pricing, demonstrate its benefits, and describe the conditions under which it should be used.

To illustrate, suppose that the home owners from the first anecdote had offered the first potential buyer $2,000 in exchange for 30 days to consider the offer. At the end of that period, the sellers, having received no better offer, could have accepted the original one, gaining an additional $13,000 in profit from the sale. By paying the $2,000, the sellers could have locked in the original offer and still looked for a higher price. Although there is a cost for the sellers to lock in the low-price offer, the expected gain from the increased flexibility could exceed this cost, thus making the arrangement attractive.

This hypothetical alternative is an example of contingent pricing. We define contingent pricing as an arrangement to sell a product at a low price if the seller does not succeed in obtaining a higher price during a specified period. If a higher price is obtained during the arranged time period, the original sale does not take place, and the first potential buyer receives the agreed-upon compensation. Otherwise, the original buyer receives the product for the agreed-upon price.

This research addresses the following questions: (1) When should a seller use contingent pricing? (2) How much can contingent pricing improve profits? (3) What factors impact the profitability of contingent pricing and optimal contingent pricing arrangements? (4) How does a consumer's risk attitude affect the optimal contingent pricing arrangement? (5) Is contingent pricing economically efficient?

We first describe the literature related to contingent pricing and then present a simple theoretical model for recommending when and how to use contingent pricing arrangements. We will demonstrate that contingent pricing can improve profits substantially and is economically efficient. We conclude by discussing the results and their implications.

Literature Review

This paper is related to several research streams. First, there is a tradition in marketing of looking at contingent arrangements to reduce a buyer's risks in a transaction. Such arrangements include satisfaction guarantees—arrangements under which buyers can return unsatisfactory products and receive refunds (Davis et al. 1995, Moorthy and Srinivasan 1995, Fruchter and Gerstner 1999). Such an arrangement reduces the buyer's risk of purchasing a poor product. Similarly, price guarantees are designed to reduce the buyer's risk of paying too much. The buyer receives a refund from the seller if she finds an advertised lower price by another seller (Salop 1986, Belton 1987, Zhang 1995, Jain and Srivastava 2000), making the price contingent on whether the customer finds a lower price. The research on satisfaction and price guarantees concentrates on mechanisms that reduce the risks customers face when purchasing products. However, sellers also face risks in these transactions. This study thus looks at the problem of reducing sellers' price risks and focuses on contingent pricing as a way to do that.

One stream of research that considers sellers' risks is literature on overbooking (Desiraju and Shugan 1999). Airlines overbook flights to mitigate the risk posed by passengers who have reservations but do not show up. Biyalogorsky et al. (1999) showed that such overbooking can be profitable even if all the passengers show up, as long as there are large differences in passengers' valuation. Deliberate overselling combined with consolation rewards is example of contingent pricing in the airline industry.

By contrast, this paper considers all possible types of contingent pricing in a general setting, thus providing a more complete characterization of the conditions under which contingent pricing is profitable. In addition, we derive the optimal structure of contingent pricing arrangements and consider the impact of buyers' risk attitudes.

Literature on contingent contracts is also related. Parties can fail to trade because of disagreements about the likelihood of future events (Bazerman and Gillespie 1999). Contracts that specify outcomes contingent on a realized future state can help solve this problem. In this paper, we examine situations where a buyer and seller have the same information about the seller's likelihood of obtaining a high price. Therefore, the benefits of contingent pricing lie not in aligning the beliefs of the parties but in the flexibility the contract offers to the seller in responding to future demand.

This study is also related to research on price discounting and clearance sales (Conlisk et al. 1984, Stockey 1981, Lazear 1986, Pashigian 1988, Pashigian and Bowen 1991, Smith and Achabal 1998, Sallstrom 2001). The purpose of such discounts is either to price-discriminate between consumers with different willingness-to-pay (WTP) or to reduce inventory risk. We show that there are times when contingent pricing relies on a similar form of discounts. However, depending on the conditions, contingent pricing may take different forms that do not involve price discounts.

Contingent pricing contracts rely on the fact that buyers often purchase products or services well before anticipated consumption. Shugan and Xie (2000) showed that one implication of the separation of purchase and consumption is the usefulness of advance selling. In their model, buyers are uncertain about their valuations in the consumption period. Sellers cannot price-discriminate because willingness-to-pay is private information. Xie and Shugan (2001) showed that advance selling can help a monopoly exploit buyers' uncertainty about future valuations and extract more surplus than through spot-selling, which takes place only in the consumption period. Png (1989) showed that reservations are the best pricing strategy when risk-averse customers are uncertain about their valuations.

Both advance selling and reservation methods focus on the effects of buyers' uncertainty about valuations. Our work instead focuses on the implications of separation of purchase and consumption when the buyers are certain about their valuations but the seller is not certain about future demand. This provides opportunity to use contingent pricing in which the seller waits until the uncertainty is resolved. In advance selling, the seller prefers to complete the transaction before the uncertainty is resolved.

Harris and Raviv (1981) showed that, when potential demand exceeds capacity, some type of prioritizing whereby customers with higher valuations have the first opportunity to obtain the product is optimal. In a model geared toward utility services, Harris and Raviv (1981) and Wilson (1989) suggested accomplishing this by using a nonlinear priority pricing menu where customers wishing to have higher service priority pay a higher price. Revenue/yield management approaches prioritize over a fixed capacity by allocating it into predefined classes that are opened and closed dynamically, depending on demand conditions (Weatherford and Bodily 1992, Desiraju and Shugan 1999, McGill and Van Ryzin 1999). Our paper adds to this literature by showing that one can use contingent pricing to implement such prioritizing. Contingent pricing can be used when other methods do not apply or to complement methods like revenue management.

The Model

Our model captures several crucial elements that lead to the consideration of contingent pricing.

(1) Demand Is Spread Over Time

Demand is spread over time, i.e., consumers do not show up at the same time. As a result, the seller faces a risk in waiting for a high-price consumer, because the opportunity to sell at the lower price may not be available later. To capture this in a simple way, consider a seller offering a unique product. Demand is spread over two periods, with different consumers appearing during each period. Such spreading of demand over time is nearly universal. For example, some consumers reserve movie tickets days in advance, while others show up at the box office minutes before the movie starts.

(2) Purchase and Consumption Can Occur at Different Times (Shugan and Xie 2000, Xie and Shugan 2001)

Thus, we assume that consumption only takes place at the end of Period 2. This corresponds to situations involving time-sensitive categories such as flights, sporting events, and restaurant meals. Moreover, it describes situations where consumers are willing to defer consumption or purchases for various reasons. For example, many consumers will wait for sales before buying durable products.

(3) Demand for the Product Can Exceed Its Availability

Such short-term imbalances are common in made-to-stock systems. We model this by assuming that the seller has a single unit for sale and that the size of potential demand in each period is for one unit. Therefore, the seller faces demand for two units, which raises the issues of how and to whom to sell the single available unit. Formally, we make the following assumptions.

Assumption 1 (Period 1 Demand). *With probability* 1, *a consumer appears in Period* 1. *The consumer values the product at* v_L *and has a utility function over income* U_L. *The minimum acceptable utility from a transaction is* $\underline{U}_L$.

Assumption 2 (Period 2 Demand). *With probability* q, *a consumer appears in Period* 2. *The consumer values the product at* v_H ($v_H > v_L$) *and has a utility function over income* U_H. *The minimum acceptable utility from a transaction is* $\underline{U}_H$.

The consumer's utility from buying the product at a price p is $U_{L,H}(v_{L,H} - p)$. Let

$$p_L \hat{=} \{p \mid U_L(v_L - p) = \underline{U}_L\}, \tag{1}$$

and

$$p_H \hat{=} \{p \mid U_H(v_H - p) = \underline{U}_H\}. \tag{2}$$

Equations (1) and (2) define the willingness-to-pay of Period 1 and Period 2 consumers.

Assumption 3 (Willingness-to-Pay). *Period* 2 *consumers exhibit higher willingness-to-pay than Period* 1 *consumers* (*i.e.*, $p_H > p_L$).

Assumption 4 (Separation of Periods). (a) *Consumers leave the market at the end of each period*.

(b) *The timing of consumer appearance is exogenous and consumers cannot change the period in which they appear in response to seller prices*.

The second-period consumer is willing to pay more for the product. The seller, however, is uncertain if a consumer will show up in the second period. Moreover, the first-period consumer leaves the market before this uncertainty is resolved (see Assumption 4a). Therefore, waiting for a high-valuation consumer is risky.

The assumption that second-period consumers exhibit higher willingness-to-pay reflects behavior in industries like travel. Assuming a strict sequence of arrivals, however, is not necessary. As long as the probability that a consumer willing to pay a higher price will follow a consumer with low willingness-to-pay is high enough, the results hold.

Assumption 4a states that consumers who, for whatever reason, are not able to buy the product leave the market. This can occur, for example, if consumers continue to search until they find the product elsewhere. Such behavior leads to some probability that the seller will lose a potential customer if the price quoted is too high. In Assumption 4, we assume that this probability is one.

Assumption 5 (Supply). *The seller has one unit to sell. Production takes place before the beginning of Period* 1 *at a cost* c. *No selling or transaction costs are incurred.*

The fact that no selling costs are incurred means that dealing with more consumers or engaging in a more complex contract such as contingent pricing is not more expensive than a fixed price strategy. Furthermore, because production takes place before Period 1, the production cost is sunk and there are no relevant costs that impact the pricing decision.

In many markets, sellers have access to secondary channels that enable them to dispose of unsold merchandise. For example, unsold goods can be shipped to overseas markets. In our model, the seller may still have an unsold unit at the end of Period 2. Access to salvage markets may impact pricing decisions. We model this access as follows:

Assumption 6 (Salvage). *The seller can sell the unit for salvage at a price* s $(s < p_L)$. *Consumers do not have access to the salvage market.*

The condition that $s < p_L$ guarantees that the seller prefers to sell to the low willingness-to-pay consumer over salvaging the unit.

We now consider which pricing strategy the seller should pursue and under what conditions. We assume that there is full information in the market. The only uncertainty is whether a high WTP consumer will appear in the second period, with the probability of this event known. Further, we assume that the time frame covered by the model is sufficiently short so that the effect of the discount rate can be ignored.

Low-Price Strategy

Under the low-price strategy, the seller targets low WTP consumers and forgoes the opportunity to sell to high WTP consumers. The reservation price of the low WTP consumer is p_L (Equation (1)); therefore, the profit-maximizing price is p_L. The seller is guaranteed a sale at this price, and the expected profit is

$$\Pi_L = p_L. \tag{3}$$

High-Price Strategy

Under the high-price strategy, the seller targets high WTP consumers and forgoes the opportunity to sell to low WTP consumers. The reservation price of the high WTP consuemr is p_H (Equation (2)); therefore, the profit-maximizing price is p_H. The seller will sell with probability q and will otherwise salvage the unit for s, leading to an expected profit of

$$\Pi_H = qp_H + (1-q)s. \tag{4}$$

Comparing the expected profit from high- and low-price strategies (Equations (3) and (4)), we find that a high-price strategy is preferred if

$$q \geq \frac{p_L - s}{p_H - s}. \tag{5}$$

Contingent Pricing Strategy

The seller offers the first-period consumer the opportunity to participate in a contingent pricing contract. This contract gives the seller the right to sell the unit to the first-period consumer at the end of the second period for an agreed-upon price of $p_L - T_1$, with T_1 being a discount off the consumer's WTP. The contract specifies a payment (a consolation reward), T_2, to the consumer if the consumer does not get the product.

From the consumer's perspective, the contingent price contract is a gamble with the probability $1-q$ that she will receive the product at a price of $p_L - T_1$ and with the probability q that she will get a payment of T_2. The consumer will agree to the contract only if the compound utility of this gamble is at least as high as her reservation utility $\underline{U}_L$.

A contingent contract effectively keeps the first-period consumer in the market until the end of the second period, enabling the seller to follow a high-price strategy of setting the price at p_H in the second period. If a high WTP consumer appears, the seller sells that consumer the product and gives the first-period consumer the agreed payment of T_2.

The Optimal Contingent Pricing Contract

The optimal contingent pricing contract maximizes the seller's expected profit subject to the first-period consumer receiving his reservation utility. The seller's expected profit is

$$\Pi_{CP} = q(p_H - T_2) + (1-q)(p_L - T_1), \tag{6}$$

where the first term is the difference between the second-period price and the payment given to the first-period consumer if a high WTP consumer appears, and the second term is the price agreed upon with the first-period consumer. Equation (6) can be rewritten as

$$\Pi_{CP}(T_1, T_2) = qp_H + (1-q)p_L - [qT_2 + (1-q)T_1], \tag{7}$$

where the first two terms are the expected revenue from a contingent contract and the last term is the expected cost of the contract. Because the expected revenue does not depend on the structure of the contract, the seller's problem is to minimize the expected cost, subject to satisfying the participation constraint of the first-period consumer. Clearly, the seller will choose contract terms such that the participation constraint will be binding while minimizing the expected cost.

Consider the case where the first-period consumer is risk neutral. The consumer's expected utility from the contract is $qT_2 + (1-q)(v_L - p_L + T_1)$ and the participation constraint is

$$qT_2 + (1-q)(v_L - p_L + T_1) = \underline{U}_L. \quad (8)$$

Rearranging terms, we can rewrite Equation (8) as

$$qT_2 + (1-q)T_1 = \underline{U}_L - (1-q)(v_L - p_L). \quad (9)$$

The left-hand side of Equation (9) is the expected cost of the contract for the seller. If the consumer is risk neutral, the expected cost is a constant and is given by the right-hand side of Equation (9), which is independent of the contract structure. Thus, an infinite set of possible contracts will satisfy the participation constraint at a minimum cost for the seller.

To satisfy the participation constraint of a consumer who is not risk neutral, the seller has to pay a risk premium in addition to the compensation required by a risk-neutral consumer. The risk premium is approximately $-(U''/U')(\sigma^2/2)$ (see Pratt 1964), with σ^2 being the variance of the risky prospect $\{v_L - p_L + T_1$ *with probability* $1-q$; T_2 *with probability* $q\}$.

$$\sigma^2 = q(1-q)^2[(T_2 - T_1) - (v_L - p_L)]^2 + (1-q)q^2[(v_L - p_L) - (T_2 - T_1)]^2. \quad (10)$$

Let $(v_L - p_L - T_{1r}, T_{2r})$ be a contract that satisfies a particular consumer. We can write that as

$$T_{1r} = T_{1n} - \frac{U''}{U'}\frac{\sigma^2}{2}; \quad T_{2r} = T_{2n} - \frac{U''}{U'}\frac{\sigma^2}{2}. \quad (11)$$

By construction, (T_{1n}, T_{2n}) satisfy the participation constraint of a risk-neutral consumer with the same reservation utility. The expected cost of the contract for the seller is

$$qT_{2r} + (1-q)T_{1r} = qT_{2n} + (1-q)T_{1n} - \frac{U''}{U'}\frac{\sigma^2}{2} = \underline{U}_L - (1-q)(v_L - p_L) - \frac{U''}{U'}\frac{\sigma^2}{2}, \quad (12)$$

where the last equality in Equation (12) is obtained by substituting the equality from Equation (9). The only term that depends on the choice of contracts is the variance term.

The seller wants to minimize the expected cost of the contract. For a risk-averse consumer, the last term in Equation (12) is positive because U''/U' is negative. The expected cost is minimized in this case if σ^2 is zero. From Equation (10) we see that setting $(T_1^* = 0, T_2^* = v_L - p_L)$ minimizes σ^2 $(\sigma^2 = 0)$. Further, any other contract that minimizes σ^2 must have both T_1, T_2 strictly greater than the corresponding optimal values for this contract. Therefore, none of the other possible contracts satisfy the participation constraint with equality (i.e., they are not profit maximizing). If a consumer is risk averse, the best contract is offering no discount on the price if the first-period consumer receives the unit and a consolation payment of $v_L - p_L$ if he does not receive the unit.

For a risk-prone consumer, the last term in Equation (12) is negative because U''/U' is positive. The expected cost is minimized in this case if σ^2 is maximized. From Equation (10) we see that setting T_2^* to zero maximizes σ^2. Thus, if a consumer is risk prone, the best contract is offering a deep discount on the price if the first-period consumer receives the unit and nothing otherwise. We can summarize these findings in the following result.

Result 1. The optimal contingent pricing contract structures are:

(a) When consumers are risk averse: A price p_L if the consumer receives the product and a consolation reward of $T_2^* = v_L - p_L$ if the consumer does not receive the product.

(b) When consumers are risk prone: A special discount of T_1^* off the price p_L if the consumer receives the product and nothing otherwise.

(c) When consumers are risk neutral: All contract structures that satisfy the participation constraint with equality are optimal.

Result 1 states that the seller should match the contract structure to the risk attitude of the consumer: Risk-averse consumers are given a consolation reward (the least risky); risk-prone consumers are given a deep discount (the most risky). Intuitively, this is because all contingent pricing contracts that satisfy the consumer's participation constraint produce the same revenue; therefore, the seller's objective is really to minimize the expected cost of the contract. This is achieved when the contract is tailored to the consumer's risk attitude.

Comparing Contingent Pricing to the Low- and High-Price Strategies

We now determine when contingent pricing is preferred over low- and high-price strategies.

To facilitate this, we first show that the expected cost of a contingent pricing contract for the seller is equal to or less than $q(v_L - p_L)$. Specifically, it is equal to this amount if the first-period consumer is risk averse or risk neutral and lower if the first-period consumer is risk prone.

The expected cost of a contingent pricing contract is given in Equation (12). For a risk-averse consumer, $\sigma^2 = 0$, and for a risk-neutral consumer, $U''/U' = 0$. Further, from the definition of p, we see that $\underline{U}_L = v_L - p_L$. Thus, for a risk-averse or risk-neutral consumer, the expected cost equals $q(v_L - p_L)$. For a risk-prone consumer, the last term in Equation (12) is negative; therefore, the expected cost is lower than it is for a risk-averse consumer.

Substituting this maximum possible expected cost into the profit function (7), we find that the minimum possible expected profit under an optimal contingent-pricing contract is

$$\underline{\Pi}_{CP}(T_1, T_2) = p_L + q(p_H - v_L). \quad (13)$$

Comparing this expected profit to the expected profit from a low-price strategy, which is p (see Equation (3)), we find Result 2.

RESULT 2. Contingent pricing is more profitable than a low-price strategy if the second-period consumer's willingness-to-pay is greater than the valuation of the first-period consumer (i.e., if $p_H > v_L$).

Because a low-price strategy is more profitable than a high-price strategy for low q (see Equation (5)), it follows that contingent pricing is the most profitable strategy for low q if $p_H > v_L$. Moreover, if the first-period consumer is risk prone, contingent pricing is most profitable, even for some limited range where p_H is not greater than v_L.

Comparing $\underline{\Pi}_{CP}$ to Π_H leads to the following condition for contingent pricing being more profitable than a high-price strategy:

$$q \le \frac{p_L - s}{v_L - s} \hat{=} q_A. \quad (14)$$

Thus, contingent pricing is preferred to a high-price strategy if the probability that a high WTP consumer will appear is sufficiently low. Recall that the expected cost when consumers are risk prone is lower, and therefore the expected profit from contingent pricing in this case is higher than $\underline{\Pi}_{CP}$. If q_S is the probability for which the expected profit from contingent pricing is equal to the expected profit from a high-price strategy when consumers are risk prone, it follows that $q_S > q_A$.

RESULT 3. Contingent pricing is more profitable than a high-price strategy when the probability of a high WTP consumer appearing is less than q_A if consumers are risk averse or risk neutral and less than q_S ($q_S > q_A$) if consumers are risk prone.

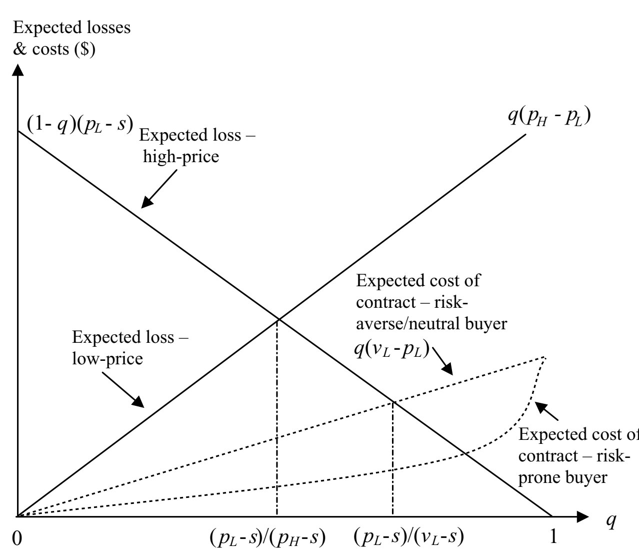
Combining Results 2 and 3, we can state Result 4.

RESULT 4. Contingent pricing is the most profitable strategy if the second-period consumer's willingness-to-pay is greater than the valuation of the first-period consumer ($p_H > v_L$) and the probability that a consumer will appear in the second period is low ($q \le q_A$). If consumers are risk prone, these conditions can be relaxed somewhat and contingent pricing is the most profitable even for some lower WTP values and higher probabilities that a second-period consumer will appear.

To understand this result, recall that the use of a low-price or a high-price strategy entails price risks to the seller. Using a low-price strategy, the seller may lose the opportunity to sell at a high price; using a high-price strategy, the seller may not be able to sell at that price. The full lines in Figure 1 depict the opportunity losses due to these price risks. Contingent pricing helps the seller avoid these opportunity losses, but at a cost, because compensation is required to convince consumers to participate. As can be seen in Figure 1, the cost of the contingent contract and the expected opportunity loss from a low-price strategy are both increasing in q. As long as v_L is smaller than p_H, the cost lies below the opportunity loss, and contingent pricing is more profitable than a low-price strategy. As v_L increases, the cost of the contract increases (reflected in a counter-clockwise rotation of the cost curves in Figure 1) until it is higher than the opportunity loss, at which point contingent pricing is no longer preferable to a low-price strategy.

The opportunity loss of a high-price strategy, on the other hand, decreases with q. Thus, at low values of q, the cost of the contract is lower than the opportunity loss and contingent pricing is preferred. As q increases, the cost of the contract increases, and at the same time, the opportunity loss from a high-price strategy decreases until the contingent pricing cost exceeds the opportunity loss and contingent pricing is no longer profitable. This point is

Figure 1 **Expected Losses from Price Risks vs. Expected Cost of Contract**



at a higher value of q if consumers are risk prone because it is easier to convince risk-prone consumers to participate in contingent contracts, and therefore the cost curve for risk-prone consumers lies below the one for risk-averse and risk-neutral consumers.

The threshold at which contingent pricing is no longer better than a high-price strategy is determined by the interplay of the opportunity loss and the expected cost of the contract. The opportunity loss depends on the difference between the low-valuation consumer's WTP and the salvage value, $p_L - s$. The cost of the contract depends on the consumer's minimum required utility $\underline{U}_L = U(v_L - p_L)$. Therefore, the threshold will be higher if (a) the WTP p_L is higher (because the opportunity loss is larger), (b) the salvage value is lower (the opportunity loss is larger), or (c) the consumer's valuation of the product is lower (because the cost of the contingent contract is smaller).

An Illustrative Example
The profit improvement from the use of contingent pricing can be substantial as we demonstrate using the following example. Assume that low WTP is $200, high WTP $800, and v_L $350, with the probability of a high WTP consumer being 0.25 and the salvage value being 0. These values are chosen to resemble a reasonable situation for a coach seat on a domestic U.S. flight as of the time of writing.

For this example, the expected profit of a low price strategy is $200, and the expected profit of a high-price strategy is $200 as well ($0.25 * 800 + [1 - 0.25] * 0 = 200$). The results outlined in this paper can be used to determine the profit improvement from using contingent pricing, and the optimal contract to offer.

Risk-Averse Consumers. From Result 1 we know that the optimal contract for risk-averse consumers consists of a consolation reward. In this case the reward amount is $150 ($350 - 200 = 200$). Therefore, the seller's expected profit (using Equation (6)) is $312.5 ($0.25 * [800 - 150] + [1 - 0.25] * 200 = 312.5$). This is a substantial $112.5 or about 56% improvement in the expected profit as a result of using contingent pricing. Further, as the minimum acceptable utility of the consumer decreases the seller's expected profit increases, and the profit improvement can be as high as 100%.

Risk-Prone Consumers. In this case the results depend on the specific characteristics of the utility function. We will assume that the utility function is $U(x) = x^2/150$, which gives $\underline{U}_L = 150$ (the same as the value assumed for the risk-averse case above). The participation constraint requires that the expected utility from the contingent contract is at least as high as her reservation utility, i.e., $0.25 * U(0) + [1 - 0.25] * U(350 - 200 + T_1) = 150$. Solving for the discount T_1 we get $T_1 = \$23$. This is a significantly lower figure than the $150 compensation required by the risk-averse consumer. Indeed the seller's expected profit in this case is $332.75, which is higher than the expected profit of $312.5 in the risk-averse case, and of course higher than the expected profit of $200 of the high- and low-price strategies.

It is also easily verified that given the optimal contingent pricing offers above, a risk-averse consumer prefers the consolation reward offer to the deep discount, and a risk-prone consumer (with the assumed utility function) prefers the deep discount offer to the consolation reward. Thus, it is possible to offer a menu consisting of these two offers, and allow the consumers to self-select the offer of their choice.

Economic Efficiency
Besides improving the expected profit of the seller, contingent pricing also improves efficiency compared to low- and high-price strategies.

First, although the seller's profit improves with contingent pricing, no consumer is worse off. The first-period consumer pays p_L (or less in the case of a deep discount contract) for the product, the same amount as in a low-price strategy. Further, the compensation offered in the contingent contract satisfies the participation constraint of the consumer, thus guaranteeing the same expected utility as in a low-price strategy. Similarly, the second-period consumer gets the product for a price of p_H, which is equal to that of a high-price strategy. Thus, the expected consumer surplus does not decrease, and the seller's profit increases.

From an economic efficiency perspective, it is desirable to allocate a unit to the highest valuation consumer. Thus, the product should be sold to the second-period consumer if that consumer appears, and to the first-period consumer otherwise (instead of salvage). The low- and high-price strategies do not allocate the product efficiently. Using a low-price strategy, the first-period consumer gets the product even if a second-period consumer shows up. Using a high-price strategy, the product must be salvaged if a second-period consumer does not show up even though a first-period consumer existed. Contingent pricing, on the other hand, leads to efficient allocation. A second-period consumer who appears gets the unit; if a second-period consumer does not appear, the first-period consumer gets the unit, and salvage is not needed. Therefore, we have Result 5.

Result 5. Contingent pricing helps allocate products efficiently.

In conclusion, contingent pricing improves seller profit, overall consumer surplus, and allocative efficiency, thus creating a win-win-win outcome.

Discussion

The opening anecdotes of the paper describe real events, in which sellers facing price risks, could have used contingent pricing to reduce those risks. In none of these cases was contingent pricing actually used. An important message of this paper is that contingent pricing is a useful tool to reduce sellers' price risks, and that sellers in different industries can benefit from using it. We show that, compared to a constant high- or low-price strategy, contingent pricing (a) mitigates the expected losses from price risks, (b) can be profitable regardless of buyers' risk attitudes even if buyers are more risk averse than sellers are, (c) benefits buyers as well as sellers, and (d) improves economic efficiency. We also show that the optimal contingent pricing structure depends on buyers' risk attitudes (*price discount* is most profitable when customers are risk prone, and *consolation rewards* are most profitable otherwise).

The results are particularly important for industries in which unsold products are highly perishable and when variation in willingness-to-pay is high. Examples of such industries include airlines, travel, advertising, transportation, and factory production. Contingent pricing can allow these sellers to seek high prices but keep back-up customers for any excess capacity in case high prices cannot be obtained. Contingent pricing is useful in mitigating price risks resulting from imbalances between inventory/capacity and demand. Clearly, sellers facing "hard" capacity constraints, such as airlines, can benefit from contingent pricing. However, almost any seller may face (at least in the short term) imbalances between capacity and demand. If supply chains cannot address these imbalances quickly, contingent pricing may prove beneficial. Thus, a store that has to wait six months for replenishment of trendy fashion items and a car dealer that is running out of a favored color of a popular model are both candidates for the application of contingent pricing.

More generally, the opportunities to use contingent pricing will increase as it becomes easier and cheaper to implement sophisticated pricing mechanisms through the Internet. For example, Internet shopping agents could make fees contingent on the number of hits or the size of the audience (Iyer and Pazgal 2003).

The results are important to policy makers because they show that contingent pricing improves resource allocation. Products end up with the customers who value them most, and the customers who do not get products receive adequate compensation. Therefore, everybody wins. Policy makers should be mindful of the welfare benefits of contingent pricing in making decisions that impact the opportunity to use such methods.

The beneficial effects of contingent pricing arise because these methods offer incentives to low-price consumers to remain active in the market. They also allow sellers to continue looking for higher paying customers, thus providing added flexibility because there is no need to commit to a fixed price. Price can be high if such a customer shows up, and low if high-price customers do not appear. In addition, the fact that low-price consumers remain active allows sellers to increase profits using price discrimination. The seller price discriminates by offering a menu of probabilistic goods—one good is low priced but uncertain, while the other is high priced and certain. Thus, contingent pricing allows both added flexibility and the ability to practice price discrimination.

Implementation Issues

Contingent pricing benefits consumers as well as sellers. However, sellers have to recognize that consumers are not used to such programs and in some cases may perceive them as inequitable. To avoid consumer backlash, firms that implement contingent pricing programs need to educate consumers about them, and perhaps provide additional appealing features. Consider a pay-for-play program, where the consumer receives an up-front payment regardless of the outcome (i.e., a contingent contract with $T_1 = T_2 = \text{const}$). This contract is not optimal as we show in Result 1, but may serve to alleviate consumer concerns and encourage buy-in, and therefore might be used in some cases.

An important issue for the seller is how to ensure that the first-period consumer remains active in the market and committed to the contingent pricing arrangement. In the formal model we assumed that the seller and consumer enter into an explicit contractual arrangement. This is a viable option in markets where consumers and sellers already employ detailed contracts. This is true for many business-to-business markets. A good example are arrangements in standby equity rights offers (see Bohern et al. 1997, Eckbo and Masulis 1992, Singh 1996). Housing, provides a consumer market example of contracts that already include cancellation and other contingency clauses, which could be easily modified to implement contingent pricing. Indeed, the few anecdotes we encountered suggest that it is not hard to convince house buyers to enter into contingent pricing arrangements, although the practice is not widespread.

Some markets possess institutional characteristics that guarantee that a consumer, who made a commitment to pay for a service, will participate in contingent pricing arrangements even without explicit contracts. For example, a guest must physically show up to claim a hotel room. Thus, the seller is assured that the buyer will show up and has the opportunity to implement contingent pricing.

In other markets, however, the institutional characteristics are not as conducive and contracting is too costly; an example is most fashion items. In such situations our formal model is not directly applicable. It is important to understand, however, that the real issue is the ability of the seller to increase the probability that the first-period consumer will remain active in the market, contracting being one way to achieve this but not the only one. Consider an ad that promises a reduced price at a certain time in the future. One possible effect of such an ad is to increase the probability that price-sensitive consumers will wait until the price goes down (instead of buying a lesser quality product, etc.). This example is consistent with a deep discount contingent price, and is similar to some clearance sale practices such as the Filene's Basement Automatic Price Reduction plan. We conjecture that such noncontractually binding approaches can be used to implement contingent pricing.

Sellers need to figure out ways to tailor contingent pricing arrangements to customers who are heterogeneous in their risk attitude and product valuations. There may be situations in which sellers cannot distinguish between risk-averse and risk-prone buyers, or even know their proportions in the population. One possible approach is to offer a menu of contingent pricing arrangements, allowing each customer to self-select the most appealing contract. At first cut, firms can offer two types of arrangements: a consolation reward that will appeal to risk-averse customers, and a deep discount arrangement that will appeal to sufficiently risk-tolerant customers. A case in point is the last minute e-mail notices used by the travel industry to notify potential customers of low price offers. Such last minute arrangements appeal to risk-tolerant customers but not to risk-averse ones, and can be used as an effective way to implement deep discount contingent pricing. By adding another arrangement that offer consolation rewards firms can offer a menu of contingent pricing arrangements fairly easily.

Sellers must also be aware that the timeframe set for the contract is important. We assumed that consumers' minimum acceptable utility remains fixed over time. The longer the length of the contingent pricing contract, however, the less likely it is that this assumption holds, either because buyers' preferences are time dependent or because of external shocks. In the housing market, for example, economic factors that affect supply and demand may change what is acceptable to buyers. How to design effective contingent programs in such a case is an interesting question for future research.

Future Research

The assumptions underlying our model include a monopoly setting with only a single unit available for sale and strict separation between the periods. One avenue for future research is to consider the effects of relaxing the assumptions. The results hold up if the separation-between-periods assumption is relaxed, and they should not change in a general N unit model and in a competitive setting. An interesting question in a competitive setting is whether equilibrium is symmetric (i.e., whether all firms use contingent pricing or not, and if not, which ones do). Other interesting extensions to the model include the addition of buyer uncertainty and information asymmetry. One possibility under these conditions is to use advance selling strategies (Xie and Shugan 2001) and to consider how they substitute/complement contingent pricing strategies.

This paper presents a theory on how to design profitable contingent pricing arrangements. The results raise a number of issues that need to be empirically addressed. Consumers' reaction to and acceptance of contingent pricing arrangements are important empirical issues that can be tested through, for example, laboratory experiments. Behavioral reactions may lead to implications that are different from the ones our normative economic model suggests. Another empirical issue is how to measure the profit impact of contingent pricing. Data from the few industries that use contingent pricing (such as airlines and financial services) can be used to estimate the profit impact by comparing actual results to the likely outcomes if contingent pricing had not been used. As contingent pricing methods become more common, it will become possible to compare realized average prices when contingent pricing is and is not used. Our theory predicts that sellers who use contingent pricing will realize higher prices compared to those who do not use this pricing technique.

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