PRINCIPLES OF PRICING

AN ANALYTICAL APPROACH

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Principles of Pricing

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To Sangeeta, Sonya, and Akhil
Rakesh V. Vohra

To my father, who valued his son very highly
Lakshman Krishnamurthi

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ONE

Introduction

Many businesses focus on driving volume or reducing costs, rather than increasing price, under the mistaken belief that they have greater control over volume and costs than price. Yet, a 1 percent increase in price (holding volume fixed) has a greater impact on operating profit than a 1 percent increase in volume or a 1 percent decrease in cost. By not seizing the initiative on price, businesses abrogate decisions about price to competitors, customers, and the channel. A careful analysis and understanding of those same actors could help them price in a more profitable manner – hence, this book, which is designed to communicate the fundamental principles of pricing.

There is a science to pricing rooted in economic theory. Under a set of assumptions about consumer and market behavior, we can derive prescriptive pricing rules. These rules provide guidelines and help in understanding how prices will and should change when the underlying environment changes. As nothing straight ever came from the crooked timber of humanity, there is also an art to pricing as well.[1] How products and services are positioned and communicated to consumers can affect their price perception. Even objectively identical products are able to command different prices.

The first step in formulating a pricing strategy is to understand the behavior of buyers. We start with the assumption that buyers are rational, suggesting that mad dogs and Englishmen are not the only ones who go out into the noonday sun. The assumption attracts criticism and deserves discussion. First, what precisely does it mean to be *rational*?[2] Second, why is it reasonable to assume that buyers are rational?

---

[1] Macaulay's advice on the relationship between theory and practice applies: "he who has actually to build must bear in mind many things never noticed by D'Alembert and Euclid."

There are two aspects to the definition of rationality. First, buyers are *consistent* in their likes and dislikes *all the time*. For example, if on a given day one likes oranges, then one should, other things equal, consider five oranges to be at least as preferred as four oranges.[3] In other words, more of a good thing is better than, and certainly no worse than, less. If one prefers apples to oranges and oranges to cherries then, other things being equal, one should prefer apples to cherries. These kinds of restrictions do not eliminate the possibility that on hot days one prefers ice-cold beer to hot chocolate, and the reverse on cold days.[4] Note the qualifier, *other things equal*. Under identical conditions, separated in time, one's likes and dislikes are the same. The second aspect requires that when asked to choose from a set of things, outcomes or possibilities, one will chose that which one likes the most. Pride, shame, and guilt play no role in the definition of rationality.

Does this provide an accurate description of how buyers behave?[5] Not always, but it does not mean that the assumption is without merit. Buyers may not be rational all the time, but they are not (unless they are lunatics) irrational all the time either.[6] Further, even if buyers occasionally depart from rational behavior, these departures can take many different forms. The view we take here is that the rationality assumption is a useful and powerful starting point to understanding pricing strategy. The art of pricing enters when one leavens the conclusions based on rationality with both experience and an understanding of how the context of the purchase decision affects the buyer. These issues are discussed in greater detail in Chapter 2.

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[2] The reader who thinks that rationality does not require a definition should ponder the following: I'll give you a million dollars to do something irrational.

[3] We assume that one can, at no cost, dispose of oranges if one chooses.

[4] Except in England, where warm beer is preferred in all weather.

[5] Amartya Sen offers this parable on life in a world of rational people: "Where is the railway station?," he asks me. "There," I say, pointing at the post office, "and would you please post this letter for me on the way?" "Yes," says he, determined to open the envelope and check whether it contains something valuable.

[6] It brings to mind an anecdote related by the economist Vilfredo Pareto about Gustav Schmoller. At a conference, Pareto presented a paper, only to be to interrupted repeatedly by Schmoller with the assertion, "There are no laws in economics!" The following day, Pareto spied Schmoller in the streets. Hiding his face and pretending to be a beggar (which Pareto could do, as he dressed badly), Pareto approached Schmoller. "Please, sir," Pareto inquired, "can you tell me where I can find a restaurant where you can eat for nothing?" According to Pareto, Schmoller replied, "My dear man, there are no such restaurants, but there is a place around the corner where you can have a good meal very cheaply." "Ah! So there *are* laws in economics!" replied Pareto.

Pricing is difficult because of uncertainty about how much the buyer will part with. It becomes important, then, to be able to estimate just how much a buyer will pay. In Chapter 3 we provide an overview of methods for doing just that and discuss the pros and cons of each.

In choosing a price, one must understand how one's buyers, as well as one's competitors, will react to it. To understand their reactions, it is useful to disentangle one from the other. For this reason we focus in Chapter 4 on how a monopolist should set prices. The monopoly case allows us to ignore the presence of competition and focus on how one's buyers react to one's price. In addition, the monopoly price sets an upper bound on the price one can charge, absent collusion. Would it not be helpful to know the best one can do?

The monopoly environment also allows one to compare and contrast the three ways in which prices are set:

1. **Haggling/negotiation**
   The oldest form of price setting and still going strong, even on the Internet.
2. **Posted price**
   The seller announces a price and waits for buyers willing to transact at that price. This is really a particular haggling strategy in which the seller makes a "take it or leave it" offer.
3. **Auctions**
   The seller has buyers compete among themselves to determine the price at which a transaction will be executed. Like a posted price, this should be viewed as a particular haggling strategy.

We discuss the pros and cons of the these three methods for price setting in Chapter 5. An example of the kind of question we ask (and answer) is this: Which of the three price setting methods generates the highest revenue/profit?

A single price is never optimal as long as there is heterogeneity in valuations among consumers. How should one customize the price of the same product or service to different segments (otherwise known as price discrimination, but that sounds so pejorative)? Here, we address three issues of importance. The first is that such customization can lead to gray markets, in which customers who buy at the low price resell to customers facing the higher price. The second is that an offering to one segment may cannibalize sales to another segment. Third, government regulation may limit the kinds of customization in which one can engage. Price customization is discussed in Chapter 6.

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Finally, pricing in the presence of competition is discussed in Chapter 7. Here one can have one of two strategic goals: accommodation or elimination. We cannot say which of these goals is best; that is an exercise in judgment that requires an intimate knowledge of the environment. However, we can say which pricing strategy is appropriate for each goal. There is one unmistakable message, however, about competition: competition depresses prices, which benefits only the buyer.

Now, a warning. This book is not for the faint-hearted. It presumes a familiarity with what is typically covered in the quantitative core of a major MBA program. It requires the willingness to pursue logical arguments, some mathematical, to their conclusion. The reward for the effort is a clear understanding of the factors to consider in setting price, the conditions under which different pricing methods are optimal, and how to set prices under competition.

1.1 Genesis

This book grew from lecture notes the first author uses in an elective course in Pricing taught at the Kellogg School of Management. Portions of it have also been employed in the Managerial Economics course taught in Kellogg's Executive MBA Program.[7] This is complemented by the experiences of the second author, who runs the Kellogg executive program on Pricing Strategies and Tactics. The many years of teaching and interacting with industry participants in that program, as well as consulting for companies, provided a good understanding of issues and concerns that needed to be addressed.

In marked contrast to other books on pricing, this one is based on economic theory. This is not to deny the value to be had from looking at pricing through other lenses. It is simply that these other lenses do not yet provide a systematic and organized way to think about pricing. Economic theory does. Its power is not in the provision of to-do lists or the Gradgrind-like accumulation of facts.[8] Rather, it is in generating the right questions to be asked. Both our own experiences and those related to us by our students who have taken our classes has confirmed this view.

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[7] A third audience are undergraduates in Kellogg's certificate program. For this select group, greater emphasis is placed on the underlying mathematics.

[8] Thomas Gradgrind, a character in Dickens's *Hard Times*, describes himself thus: "Now, what I want is, Facts. Teach these boys and girls nothing but Facts. Facts alone are wanted in life. Plant nothing else, and root out everything else. You can only form the minds of reasoning animals upon Facts: nothing else will ever be of any service to them."

A second point of contrast with other treatments of pricing is that we convey principles through stylized examples, rather than anecdotes. The simplicity of stylized examples allows one to see clearly which forces drive a particular outcome. It also makes errors in thinking harder to conceal. Complexity is introduced through the relaxation of the assumptions in the stylized examples or through the juxtaposition with reality. This approach has worked well, in our experience, with MBA students and executives.

Supplemented with suitable cases and problems, this book can be used in a quarter or semester long course on pricing strategy. A list of such cases and problems can be obtained from the authors.

1.2 Acknowledgments

As always in these matters, one's debts are many, and one forgets more of them than one should. While we remember, our thanks to Michael Sara who was enormously helpful in preparing this manuscript (diagrams, indexing, and typesetting). A nod to our many students who provided the impetus for this book with their questions. A bow to our immediate colleagues, as well as members of the wider company of scholars whose teachings allowed us to answer those questions. The suggestions and comments of the anonymous reviewers were very helpful in improving the book and avoiding confusion. Finally, thanks to the Kellogg School of Management. Without its commitment to the idea that "theory" matters, this book would not have been possible.

TWO

Buyer Behavior

To begin, we consider the simplest nontrivial pricing problem.

2.1 The Ultimatum

The world contains just two people: a buyer and a seller. The seller has a book that she values at zero that she wishes to sell to the buyer. It is the only book of its kind in the world and the buyer is fully aware of its contents and condition. The buyer values the book at $10, neither more nor less. Each is aware of how the other values the book. The seller has one chance to set a price. Once the price is fixed, the buyer has one chance to buy at the price posted or to decline. No other inducements, counteroffers, or promises are permitted. What price should the seller set to maximize her revenue?

The usual mysteries that cloud a pricing situation have been stripped away. There is no uncertainty about the nature or quality of the product. The value of the product to the buyer is known, as is the seller's opportunity cost. There are only one seller and one buyer. The dance between seller and buyer is limited to a single take-it-or-leave-it offer.

It is clear that the chosen price should not exceed $10, the value of the book to the buyer. Thus, the only question is just how close to $10 the seller can set the price and have the buyer accept. If one believes, as seems reasonable, that more money is better than less, any price below $10 will be accepted by the buyer, as it leaves the buyer with positive profit from the transaction. The largest amount the seller can charge (given that the smallest unit of currency is a penny) and still leave the buyer with a positive profit is $9.99.

It is possible that the buyer may view the $9.99 price as an outrageous instance of gouging. Refusing the book at that price means that the buyer is out a penny, but it is a small price to pay to make a point. If one believes fairness of the transaction, as measured by relative profits, is salient, a price lower than $9.99 is merited. One might argue that $5 is the only fair price.

Therefore, the price one chooses depends on how one believes a buyer will respond to that price. Hence, any discussion of pricing must begin with a model of how buyers respond to prices. In this book we adopt one particular model, called the **rational buyer** model. In the next section we describe it, warts and all.

2.2 Rational Buyer Model

The rational buyer model rests on three assumptions.

1. **Assumption 1**
   A buyer is able to assign a monetary value to each transaction and product, and that value is fixed and immutable. This value is called the buyer's **reservation price** (RP). It is the maximum price a buyer is prepared to pay for an additional unit of the product (or service). Determining a buyer's RP, though difficult, is not impossible; we discuss how this can be done in the next chapter.
2. **Assumption 2**
   A buyer evaluates a transaction in terms of its **consumer surplus**. Suppose a buyer's RP for one pound of sugar is $5 and we sell it to her for $3. If she buys the sugar from us, she will enjoy a consumer surplus of $5 − $3 = $2. In general, a buyer's consumer surplus is the difference between the RP and the price the buyer pays.[1] A buyer will never purchase a product that yields negative consumer surplus.
3. **Assumption 3**
   In choosing between transactions, the buyer will choose the transaction that maximizes consumer surplus.

   For example, suppose our buyer has a choice between a pound of sugar and a pound of salt. To make life simple, assume that she will buy one or the other, but not both. Let her RP for sugar be $5 and her RP for salt be $4. Sugar is sold at $3 a pound, whereas salt is sold at $3.50 a pound. Which will she acquire? We assume that she will choose the option that *maximizes consumer surplus*. In this case, the consumer surplus on sugar is $2, whereas on salt it is $0.50. Therefore, she will buy the sugar.

---

[1] Price is taken to mean the *full* price including switching costs, shipping costs, and so on.

Table 2.1. *A Choice*

	Option *A*	Option *B*
RP	$11	$15
Price	$6	$9
Surplus	$5	$6

To drive the point home, imagine a buyer who must choose between two options. The relevant information for each option is displayed in Table 2.1.

Observe that our hypothetical buyer has a higher RP for option *B* than for option *A*. This means that our buyer derives more value from option *B* than option *A*.

If our hypothetical buyer can choose, at most, one of option *A* or option *B*, she will choose option *B* because it has the larger surplus. Notice that she chooses the option with the higher price. This should not come as a surprise. A buyer is prepared to pay more if he or she gets more.

Consider now the seller of option *A*. How should he change his price to attract our hypothetical buyer? Clearly, he should lower it. How low? Until option *A* delivers at least as much surplus as option *B*.[2] Suppose, for illustration, that the seller of option *A* drops the price to $4.50. Consider Table 2.2.

Option *A* now delivers more surplus than option *B*. Our hypothetical buyer will choose option *A* in this case. Notice that she now chooses the option she considers inferior. Why? If it is priced low enough, it is good enough.[3]

The examples summarized in Tables 2.1 and 2.2 capture the idea that buyers make trade-offs. If one is not prepared to accept this, then one will learn little from this book.

Frequently, a buyer will purchase through an agent. Large companies, for example, employ purchasing agents.[4] In selling to agents, one should keep in mind that the agents' interests need not coincide with those of their lord

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[2] The reader may wonder what happens in the event that option *A* and option *B* deliver exactly the same surplus. We consider this to be a knife-edge case that is not particularly relevant. After all, by changing one of the prices by a penny, we can break the tie. In this book we adopt the convention of resolving the tie in the way most convenient to make the necessary point.

[3] One can imagine extreme cases in which no matter what the price of option *A*, the buyer will never choose it. This can be accounted for in the rational buyer model. It corresponds to the case in which the buyer's RP for option *A* is $0.

[4] In some cases the seller must sell through a hierarchy of agents with varying degrees of authority and incentives.

Table 2.2. *A Choice Redux*

	Option *A*	Option *B*
RP	$11	$15
Price	$4.50	$9
Surplus	$6.50	$6

and master.[5] In the following text we assume that if a buyer works through an agent (who is entitled to make the purchase decision), then the relevant RP is not the buyer's, but the agent's.

2.3 Warts

We highlight some departures from the rational buyer model with a series of thought experiments from Thaler (1985).

1. You are lying on the beach on a hot day. All you have to drink is ice water. For the past hour, you have been thinking about how much you would enjoy a nice cold bottle of your favorite beer. A friend gets up to make a phone call and offers to bring back a bottle of your favorite beer from the only nearby place where beer is sold – a small, run-down grocery store. He says that the beer might be expensive and asks how much you are willing to spend. He says that he will not buy the beer if it costs more than the price you state. What price do you tell your friend?
2. You are lying on the beach on a hot day. All you have to drink is ice water. For the past hour, you have been thinking about how much you would enjoy a nice cold bottle of your favorite beer. A friend gets up to make a phone call and offers to bring back a bottle of your favorite beer from the only nearby place where beer is sold – a fancy resort hotel. He says that the beer might be expensive and asks how much you are willing to spend. He says that he will not buy the beer if it costs more than the price you state. What price do you tell your friend?

Of interest are those who respond with different prices. This is puzzling because the product being consumed is identical in both circumstances:

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[5] In some industrial settings, for example, an equipment purchase locks the buyer into the purchase of spare parts and services. Suppose the buyer's agent is evaluated on initial expenditures. The shrewd seller will price the original equipment low and the spare parts high.

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