CHAPTER 7

Additional Tools for Analysis of Revenue Management Decisions

In this chapter, we first revisit the topic of contribution margin analysis. A classic case is used to illustrate the limitations of this methodology. We then consider the economic tool of analysis of price elasticity. Finally, we discuss willingness to pay as a factor in the analysis of revenue management decisions.

The Special Order Problem

Special order problems are used in managerial accounting as a common illustration of the application of contribution margin analysis for revenue management decisions. The problem is characterized as an opportunity for additional business coupled with a reduction from usual prices. This is a common format for many revenue management decisions: Will a price reduction bring additional revenues and additional profits? Special order problems typically assume that the special order is somehow separate from the company's normal business, and that accepting the reduced price will not have an adverse impact on pricing for other customers. But that assumption should be viewed with considerable caution.

The *Baldwin Bicycle Company* case is a classic instructional case in special order pricing.[1] Based on a real company's situation, it takes place in a historical time frame where big discount stores are just emerging on the retail scene. Baldwin, a bicycle manufacturer, currently sells its product through sporting goods stores, bicycle shops, and other local retailers. Baldwin now has an opportunity to contract for a large volume of private-label bicycles for a national discount chain, at a price well

below its normal selling price. An initial contribution margin analysis shows this opportunity to be very profitable. Even though the order is large, the existence of adequate excess capacity removes the need for investment in additional production resources. Some additional working capital investment is required, in the form of additional inventories and accounts receivable. Baldwin estimates that sales to its regular customers may decline by 3 percent, but the contribution margin analysis remains very positive. When the case is analyzed further, however, one concludes that the long-term outlook for Baldwin is dismal.

Initially, the special pricing appears to apply to 20 percent of Baldwin's sales. But several events will likely occur as time passes:

- Retail customers will purchase more and more bicycles through discount stores, gradually eroding Baldwin's normal business base.
- Baldwin's regular customers will press for price reductions to remain competitive.
- Baldwin's practice of selling to different customers at different prices is likely to create customer ill will.
- The discount chain will likely seek further price reductions in the future.

As Baldwin sells more and more product at reduced prices, it will be increasingly unable to operate at an overall profit.

The analysis also suggests that Baldwin's decline will occur whether or not it accepts the special order. If Baldwin does not produce the private-label bicycles for the discount store, another manufacturer surely will. Either way, Baldwin's current situation cannot be sustained.

The Lesson of Baldwin Bicycle

Although special pricing, in whatever context, may initially contribute incrementally to profits, keep the long-term picture in mind. Where will this special pricing lead? It may signify a fundamental change in the industry, as in the Baldwin Bicycle case, where retail distribution was about to undergo a major structural transformation. Even though initially limited,

the special (lower) pricing may gradually become the pricing norm, as with low airline fares and automobile rebates. In either case, a simple contribution margin analysis does not suffice. The lesson states that revenue management techniques in themselves are not harmful, but inadequate analysis of their long-term effects can be devastating.

Beyond Contribution Margin

Contribution margin analysis is relevant for revenue management applications that are limited in scope, apply to a small subset of sales, and will not erode significant sales at normal prices. Where these assumptions do not hold, analysis of a revenue management application becomes more complex.

A panel discussion at the 1989 annual meeting of the American Accounting Association featured some of the leading scholars in management accounting commenting on the pros and cons of contribution margin as a metric for short-term pricing decisions.[2] The following are some of the highlights of that discussion:

- Companies don't get rich using a contribution margin approach. John Shank cited what he called Shank's axiom: *If the problem is small enough so that contribution margin analysis is relevant then it can't have a very big impact on a company. And if the possible impact in a decision setting is major, if it can really affect a company in a major way, then it's silly to consider most of the factors to be fixed.*[3]
- Shank could identify no major successes from contribution margin analysis in the real world, but could find many failures, in industries such as airlines, steel, and paper.[4]
- Robert Kaplan, a major advocate of activity-based costing—a full-cost rather than contribution approach—pointed out that fixed costs keep growing within the cost structures of virtually all companies. Although he acknowledged that contribution margin analysis is valid for short-term optimization, he emphasized that there is also a role for full-cost information. Contribution margin works well in relatively simple

situations, but most companies have extensive product lines and complex product interactions. Full cost data—especially if it is activity based—helps identify which products are currently profitable and which are not. Contribution analysis may then help make incremental improvements to products that need them.[5]

- Kaplan acknowledged the positive results from a special order price that exceeds variable cost. The danger, he felt, is that more and more of these special-pricing opportunities will present themselves. As this type of pricing grows, the conclusion that fixed costs are not affected becomes less and less valid.[6]

These views support the cautions expressed earlier. Some of the major examples of a contribution-pricing form of revenue management—airlines, automotive companies, and others—have not been successful from a profit viewpoint. Contribution analysis is relevant for short-term optimization only. Initially, revenue management (in the form of pricing just above marginal cost) did help to fill unused capacity on short notice or combat a competitor. Once marginal cost became the basis for widespread pricing, failing to consider fixed costs became a serious problem. The message? Use contribution analysis sparingly!

A more thorough and comprehensive analysis goes beyond basic contribution margin analysis. The following questions might be considered in analyzing discounts or other price concessions:[7]

- What is the current profitability of the business? If currently unprofitable, can price concessions generate enough volume increase to make the business profitable, despite the lower contribution margin? If currently profitable, would price concessions gain new customers or increase volume with current customers?
- If new customers are attracted by price concessions, will they continue to patronize the business?
- If price concessions are offered only to new customers, how will existing customers react?

- If price concessions do substantially increase volume, can the company provide adequate service for the increased demand?
- If price concessions are given frequently, will customers keep expecting lower prices always?
- If competitors match price concessions and lower prices become the industry norm, can the business continue to be profitable?

Revenue Drivers

The term *cost drivers* has become a standard element of cost management; similarly, the concept of *revenue drivers* indicates variables that influence revenues. Perhaps, the most common customer-based revenue driver is customer satisfaction. Many businesses employ follow-up telephone calls, comment cards, and surveys to gain input from customers on their satisfaction with a recent service encounter or product purchase. Among the questions commonly included, each with a range of choices, are *would you patronize us again*? and *would you recommend us to others?* Do these surveys work? One study for a large hotel chain found a statistically significant relationship between customer satisfaction and future financial performance.[8]

Perhaps the most extensive work on revenue drivers has been done by Shields and Shields.[9] They identified 25 revenue drivers implicit in existing management concepts, such as activity-based costing, the balanced scorecard, and strategic cost analysis. Many characteristics can drive revenues. Some are marketing-type measures such as brand image, price, market share, and customer satisfaction. Others are internal, production-based characteristics, such as capacity, quality, employee skill, economies of scale, and the development of new products and services. External forces such as the extent of competition also impact revenues, though often in a negative fashion.

Elasticity of Demand

Elasticity of demand is another consideration to be evaluated in applying revenue management. Elasticity of demand with respect

to price—commonly called simply *price elasticity* or *price elasticity of demand*—is a measure of the expected change in demand in response to a change in price. Attributed to 19th-century economist Alfred Marshall,[10] price elasticity measures the percentage change in quantity demanded (Q) relative to (divided by) the percentage change in price (P).

$$\text{Price elasticity} = (\Delta Q/Q)/(\Delta P/P)$$

where Δ signifies the amount of change. Price elasticity is typically negative, following the usual economic assumption that demand falls as price rises and vice versa.

Revenue equals price times quantity of items sold. Increasing the price will increase revenue in the absence of a quantity change, but increasing price usually decreases the quantity sold. Similarly, decreasing the price will decrease revenue in the absence of a quantity change, but decreasing price usually increases the quantity sold. The net outcome of a price change can be estimated if we have an idea of the price elasticity of that product. Price elasticity outcomes fall into one of five categories:

1. A price is *perfectly inelastic* (elasticity = 0) if a price change will have no effect on quantity demanded in either direction. Thus, a price increase will increase revenue and a price decrease will decrease revenue. It is unlikely that goods with perfectly price-inelastic demand exist at all, except in a narrow range or a narrow time period.
2. A price is *relatively inelastic* (elasticity < 0 but > −1) if a price change will result in a proportionately smaller change in quantity demanded. Thus, a price increase will still increase revenue even though the quantity sold decreases somewhat, and a price decrease will decrease revenue, even though the quantity sold increases somewhat. For example, suppose 10,000 units are currently sold at $10 each, generating revenue of $100,000. If price elasticity is −0.5, a 10 percent price increase would reduce demand by 5 percent; 9,500 units would now be sold at $11, increasing revenue to $104,500. Similarly, a 10 percent price reduction would increase demand by 5 percent; 10,500 units would now be sold at $9, decreasing revenue to $94,500.

3. A price is *unit elastic* (elasticity = –1) if a price change results in a proportionately equal change in quantity demanded. The net effect of a price change on revenue should be zero. In practice, a small change would be calculated. Again consider the situation where 10,000 units are currently sold at $10 each, generating revenue of $100,000. A 10 percent price increase to $11 and a 10 percent quantity decrease to 9,000 would yield revenue of $99,000, as would a 10 percent price decrease to $9 and a 10 percent quantity increase to 11,000 units. Although an exact elasticity of –1 is relatively unlikely, what is important is that one is the dividing line between price changes affecting revenue in the *same* direction (as in Category 2) and price changes affecting revenue in the *opposite* direction (as in Category 4, next).
4. A price is *relatively elastic* (elasticity < –1) if a price change results in a proportionately greater change in quantity demanded. Thus, a price increase will cause a large enough decrease in quantity sold so that total revenue falls, and a price decrease will cause a large enough increase in quantity sold so that total revenue increases. Again suppose 10,000 units are currently sold at $10 each, generating revenue of $100,000. If the price elasticity is –1.3, then a 10 percent price increase would reduce demand by 13 percent; 8,700 units would now be sold at $11, decreasing revenue to $95,700. Similarly, a 10 percent price reduction would increase demand by 13 percent; 11,300 units would now be sold at $9, increasing revenue to $101,700.
5. In the extreme case, a price is *perfectly elastic* (elasticity is infinite) if a price increase would cause demand to drop to zero, and a price decrease would cause demand to explode to infinity. Such situations have not been found to exist.

Thus, the critical question is whether one faces a *relatively inelastic* or *relatively elastic* demand. If a company faces a relatively inelastic demand, there is little motivation for price decreases, but price increases may be desirable. If a company faces a relatively elastic demand, then price reductions can lead to greater revenues. Managers must have an understanding of the price elasticity of their products or services in making revenue management decisions.

Is Elasticity Always Negative?

The previous discussion implies that the measure of price elasticity of demand starts at zero and declines from there. There are two extremely limited circumstances, each named after the economist who described the phenomenon, where a positive elasticity exists and quantity demanded *rises* as the price rises.

A so-called *Veblen good* is one where a high price signifies status and exclusivity. A Rolls-Royce automobile or a Rolex watch sells for a very high price. Customers may buy that brand at ever-higher prices, not because it offers superior services, but because it signifies wealth and prestige. A so-called *Giffen good* is one that fills a need, but is inferior to other goods. For example, suppose rice is a basic food and it is the cheapest form of nutrition and hunger satisfaction. Consumers, even the poorest, normally seek to buy a variety of foods—rice, meat, vegetables, and so forth. If the price of rice rises, but remains less than those of alternative foods, the result may be that consumers buy *more* rice. Their limited food budget is increasingly used to purchase this lowest cost form of nutrition, necessitating reductions in the purchase of meat and other superior foods. Both of these situations have very limited applicability. For the analysis of revenue management decisions, price elasticity of demand can be assumed to be negative.

Price Elasticity of Supply

Parallel to the customer response to price changes is the producer's response. Price elasticity of supply has a parallel definition, namely the percentage change in quantity supplied relative to (divided by) the percentage change in price. Demand elasticity is typically negative, whereas supply elasticity is almost always positive. That is, producers will supply more at higher prices than at lower prices.

Among the factors impacting a producer's ability to respond to increased demand are the availability of capacity (physical, personnel, and materials); the presence of inventories; and the complexity and lead times involved in production.[11] For example, an increased demand for agricultural products is affected by the timing and length of the growing season. Although customers generally prefer to purchase greater quantities when

prices are lower, producers may be unwilling to produce these greater quantities (or perhaps any quantity at all) at lower prices. If production is not profitable at lower prices, producers will generally not produce that item, at least in the long run. This duality of price elasticity of demand and price elasticity of supply maintains a degree of overall balance in the system.

Applying Elasticity to Revenue Management

Keep in mind that price elasticity is an economic construct. Although it exists, it is not easily measurable. A company may experiment with a reduced (sale) price for a limited time period. Although it observes an increase in demand while the sale is on, it is not clear that the higher demand will be sustained if the reduced price continues indefinitely. It is possible that offering the sale price merely changed the timing of demand, causing some customers to buy while the sale was on, rather than later. Further, price elasticity may change over time, and may be influenced by one company's prices relative to its competitors. Also, the elasticity may be different at different price levels along the demand curve. A 10 percent change in the price of gasoline may have a different demand effect when gasoline sells for $4.00 per gallon than when it sells at $1.75 per gallon.

In thinking about price elasticity, consider the big picture as well as the firm-specific picture. Suppose the demand for product A is a *derived demand*, dependent on the demand for product B into which it is incorporated. The demand for product A is typically not elastic overall, as price changes for product A are not likely to result in changes in the sales of product B. For example, a decrease in the price of tires sold to auto manufacturers probably will not change the demand for new cars. A price decrease by a supplier of tires may appear elastic, but auto makers are likely merely switching their purchases from other suppliers. If competitors match the price decrease, the apparent elasticity largely disappears. The elasticity concept is thus more difficult to apply on business-to-business sales, many of which represent derived demand for downstream products. Elasticity is most useful for products sold to end users (consumers), where price reduction may result in an increase in overall demand.

Because elasticity depends on many factors, such as the current price level, the time frame of the price change, and the number of sellers making a price change, numerical calculation can be difficult and may not be particularly useful. Rather, we seek to use the concept more generally, to understand the sensitivity of demand to changing prices.[12]

Although price elasticity of demand is not easily measured, some of the factors that contribute to it include the following:[13]

- How necessary is the product? Essential products tend to have lower elasticity.
- How big an expense item is it for the consumer? Buyers may be more price sensitive on expensive items than on low-cost items.
- Consumable goods may be less price sensitive in the short term because buyers have limited opportunities to adjust. An increase in the price of gasoline may lead drivers to reduce travel in the short term, but to buy a car with better gas mileage in the long term. On the other hand, durable goods may be more price sensitive in the short term, as the buyer may be able to put off purchasing until prices are more favorable.
- Are good substitutes available, such as a substantially identical product from another supplier or a similar product that fulfills the same function? If substitutes are available, elasticity is likely to be greater. However, a high degree of brand loyalty or supplier loyalty would lead to less elasticity.
- How long might the price change be in effect? If a price increase is expected to be of short duration, consumers may be able to defer purchasing (or accelerate purchases and build inventories in the face of a short-term price decrease).
- Have all sellers changed their price? If not, short-term reaction may be limited, as consumers continue to buy from their usual supplier. In the longer term, consumers may seek a new supplier. If all sellers have changed prices, consumers may search for substitutes, or forgo the product entirely. As airlines increase fares via add-on fees, and as the intangible costs of flying increase due to fewer flights, increased security, and

other hassles, some passengers will forgo travel, and others will switch to substitutes, such as auto or train travel, or to more indirect substitutes such as virtual business meetings rather than face-to-face meetings.

- Who pays the bill? Health care has been largely price inelastic, in part because it has a high degree of necessity and also because the payer is often a third party, not the consumer.

Understanding something about customer response to price changes, whether upward or downward, is helpful to the effective use of revenue management.

Willingness to Pay

Somewhat related to the concept of price elasticity is the concept of willingness to pay, sometimes referred to as the customer's *reservation price*.[14] For most goods and services, it is assumed that there is a maximum price that a customer will pay. This reservation price likely varies from customer to customer; so a single determination of willingness to pay is impossible.

In revenue management decisions, the motive for a price reduction is usually to increase revenue by bringing in new customers who are unwilling to buy at existing prices. Thus, the goal is to price below the reservation price for an additional group of customers. Another goal is to accomplish attracting new customers without reducing the price to existing customers. Early applications of revenue management by airlines sought to increase purchases by leisure travelers while maintaining the current purchases by business travelers. Techniques such as advance purchase requirements and minimum stay requirements were enacted to try to *build a fence* around the reduced price offerings that would exclude most business travelers.

The economic concept of *consumer surplus* is defined as willingness to pay minus the price actually paid. Again, consumer surplus varies from customer to customer, given that willingness to pay varies. The larger the consumer surplus, the happier the customer. But a large consumer surplus also means that the seller has *left money on the table* by not extracting a price closer to the buyer's willingness to pay. To the extent that revenue

management features different prices for different customers, sellers try to capture as much of the variable consumer surplus as possible but at the risk of customer dissatisfaction. This issue was discussed further in the preceding chapter on customer response.

Conclusion

Contribution margin analysis is a commonly used technique for evaluation of revenue management decisions, but it must be used with caution. Contribution margin analysis is most appropriate for small, short-term changes. When revenue management decisions may have broader, longer-term effects, further analysis is needed.

Economic concepts of price elasticity provide a useful way of thinking about the demand effects of price changes. Although elasticity may be hard to measure, it is useful to consider how both customers and competitors will react to a pricing decision.