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Strategic Bundling of Products and Prices: A New Synthesis for Marketing

Bundling is pervasive in today's markets. However, the bundling literature contains inconsistencies in the use of terms and ambiguity about basic principles underlying the phenomenon. The literature also lacks an encompassing classification of the various strategies, clear rules to evaluate the legality of each strategy, and a unifying framework to indicate when each is optimal. Based on a review of the marketing, economics, and law literature, this article develops a new synthesis of the field of bundling, which provides three important benefits. First, the article clearly and consistently defines bundling terms and identifies two key dimensions that enable a comprehensive classification of bundling strategies. Second, it formulates clear rules for evaluating the legality of each of these strategies. Third, it proposes a framework of 12 propositions that suggest which bundling strategy is optimal in various contexts. The synthesis provides managers with a framework with which to understand and choose bundling strategies. It also provides researchers with promising avenues for further research.

Bundling is the sale of two or more separate products in a package. This strategy is pervasive in markets today in one form or another. In the past decade, bundling has received growing attention in the marketing literature. However, the published studies are fuzzy about some basic terms and principles, do not discuss the legality of bundling, and do not provide a comprehensive framework on the economic optimality of bundling. As a result, marketing researchers may not appreciate the full meaning of bundling and the variety of strategies encompassed by the term. Marketing managers may not appreciate the hazards involved in this strategy and fully exploit the advantages of bundling in various markets.

Examples of bundles that come to mind readily are opera season tickets (tickets to various events sold as a bundle), luggage sets (various luggage items sold as a bundle), and Internet service (bundle of Web access, Web hosting, e-mail, personalized content, and an Internet search program). Less straightforward examples include multimedia personal computers (PCs), fixed-price menus, executive MBA programs, and premium brokerage accounts. The multimedia PC is a bundle of the traditional PC plus speakers, a CD-ROM, and other multimedia gadgets. A fixed-price menu is a bundle of a choice of appetizer, entrée, and dessert. The executive MBA is a bundle of selected business education modules

that managers could otherwise obtain separately at various conferences and educational organizations. A premium brokerage account provides stock trades, stock research, margin trading, retirement planning, and free check writing in one account.

These examples show the pervasiveness and strategic importance of bundling. Firms need to resort to bundling cautiously because of the legal pitfalls involved. For example, the landmark antitrust case against Microsoft is, at the core, a case against its bundling of Windows and Explorer. Indeed, the U.S. Congress has a long history of legislating on bundling issues, and the U.S. Department of Justice extensively monitors its use by firms. Recently, the Justice Department has prosecuted substantially more cases. For example, the number of antitrust cases it handled between 1996 and 1999 is approximately double the number of cases it handled between 1890 and 1996.

Prior marketing literature on bundling has examined the optimality of bundling (Bakos and Brynjolfsson 1999, 2000; Eppen, Hanson, and Martin 1991; Guiltinan 1987; Wilson, Weiss, and John 1990), consumer evaluation of bundles (Johnson, Herrmann, and Bauer 1999; Soman and Gourville 2001; Yadav 1994, 1995; Yadav and Monroe 1993), and firms' pricing and promoting of bundles (Ansari, Siddarth, and Weinberg 1996; Ben-Akiva and Gershenfeld 1998; Hanson and Martin 1990; Mulhern and Leone 1991; Venkatesh and Mahajan 1993). Economists have focused mainly on the optimality of bundling for monopolists (Adams and Yellen 1976; Burstein 1960; Carbajo, De Meza, and Seidman 1990; Long 1984; McAfee, McMillan, and Whinston 1989; Pierce and Winter 1996; Schmalensee 1982, 1984; Stigler 1963; Whinston 1990), equilibrium theories of bundling (Chen 1997; Kanemoto 1991; Matutes and Regibeau 1992), and the welfare implications of bundling (Dansby and Conrad 1984; Martin 1999; Salinger 1995; Whinston 1990).

We identify the following three shortcomings in the literature: First, the domain of bundling is ill defined, and

terms that refer to distinct phenomena are used interchangeably. Second, there is no clear, comprehensive, and coherent discussion of the legality of bundling. Third, there is no integrative framework that explains the optimality of bundling conditional on various factors. On the contrary, the literature contains ambiguity about some key conditions for optimality, and theory on others is incomplete or absent.

This article provides a new synthesis of the field of bundling based on a critical review and extension of the marketing, economics, and law literature. In particular, this synthesis makes three important contributions to the literature. First, it clearly and consistently defines bundling terms and principles. It identifies two key underlying dimensions of bundling that enable a comprehensive classification of bundling strategies. Second, it formulates clear rules to evaluate the legality of each of these strategies. Such rules must complement any discussion of economic optimality to ensure that economically optimal strategies are optimal in practice, after taking into account legal proscriptions and risks. Third, it proposes a framework of 12 propositions that prescribe the optimal bundling strategy in various contexts. The framework is a logical one that uses uniform terms and assumptions. The propositions incorporate all the important factors that influence bundling optimality. These propositions synthesize a body of knowledge that is at least partly supported by verbal logic, mathematical proof, or empirical evidence.

The rest of the article is organized as follows: The next section presents a primer on bundling strategies. The following section develops a set of key propositions about bundling. The final section presents our conclusions, implications, and limitations.

A Primer on Bundling Strategies

This section first defines terms used in bundling. It then classifies the entire domain of bundling strategies and clearly demarcates their legality.

Definitions

This subsection first explains the current confusion in the bundling literature. It then proposes clear definitions of key terms that are parsimonious and rooted in the law literature.

Confusion in literature. The confusion in the literature arises from inconsistent use of terms, ambiguous distinctions between important constructs, and an unclear domain of application. We explain each of these problems with relevant examples.

First, bundling does not have consistent, universally accepted definitions. Adams and Yellen (1976, p. 475) define bundling as "selling goods in packages." Guiltinan (1987, p. 74) defines bundling as "the practice of marketing two or more products and/or services in a single package for a special price." Yadav and Monroe (1993, p. 350) define it as "the selling of two or more products and/or services at a single price." Without consistent definitions, the legality of bundling becomes fuzzy and its practical implications become imprecise.

Second, the distinction between a product and a bundle is not clear. For example, Salinger (1995) treats a pair of

shoes as a bundle of a left and a right shoe. Telser (1979) considers a car a bundle of different parts, such as the engine, wheels, and so forth. As such, every product would be a bundle of parts, and the term would lose its strategic and legal importance.

Third, the domain of bundling strategies is not clear. Mulhern and Leone (1991, p. 66) introduce the concept of implicit price bundling as "the pricing strategy whereby the price of a product is based on the multitude of price effects that are present across products without providing consumers with an explicit joint price." By this term, the authors imply that retailers that decrease price in one category must consider potential sales increases or decreases in other categories. However, this extension of the meaning of bundling runs the risk of increasing ambiguity about the concept and its domain without enhancing understanding of the core concepts and principles of bundling.

In the interest of generality, we use definitions that are parsimonious, rooted in the law literature, and as close as possible to the intent of authors in economics and marketing.

Bundling. Bundling is the sale of two or more separate products in one package.[1] The term "separate" has enormous implications for understanding the legality and optimality of the phenomenon, so it merits precise definition. We define *separate products* as products for which *separate markets* exist, because at least some buyers buy or want to buy the products separately. For example, combined offerings of banking and insurance products are bundles because at least some consumers buy insurance and banking separately. A travel package including air and ground travel is a bundle consisting of procedurally separate services. Note that products can be separate at one level in the channel, while being mere parts of a product at another level. Although a processor and a hard disk drive are parts in a PC for an end user, they are separate products for a PC manufacturer. This article focuses on bundling from an end user's perspective and does not deal with bundling in a channel context.

Bundling focus: product versus price bundling. At present, researchers use the terms product bundling and price bundling interchangeably without clearly distinguishing between the two strategies. Our article is the first in marketing to clarify this distinction, articulate the ramifications of each strategy, and relate the two to each other.

We define *price bundling* as the sale of two or more separate products in a package at a discount, without any integration of the products. Because the products are not integrated, the reservation price for the price bundle is, by definition, equal to the sum of the conditional reservation prices of the separate products.[2] In other words, bundling itself does not create added value to consumers, and thus a discount must be offered to motivate at least some consumers to buy the bundle. Think of a set of luggage items, a six-pack of beer, a combo meal, a software suite, or a season ticket for the opera.

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[1] The term "product" in this definition and the rest of the text refers to both goods and services.

[2] The reservation price of a product is the maximum price a consumer is willing to pay for the product. The conditional reservation price is the reservation price of a product, conditional on the consumer buying another product.

We define *product bundling* as the integration and sale of two or more separate products or services at any price. This integration generally provides at least some consumers with added value, such as compactness (integrated stereo systems), seamless interaction (PC systems), nonduplicating coverage (one-stop insurance), reduced risk (mutual fund), interconnectivity (telecom systems), enhanced performance (personalized dieting and exercise program), or convenience from an integrated bill (telecom calling plans). The greater value raises consumers' reservation prices for the product bundle compared with the sum of the conditional reservation prices of the separate products.

A product bundle can therefore be thought of as having an *integral architecture* (Ulrich and Eppinger 1995). It implements the different functions of the bundled products in a single product bundle. The multimedia PC has an integral architecture, in that it integrates functions such as connection (e.g., modem), data storage, and retrieval (e.g., CD-ROM), which were separate physical chunks before the advent of the multimedia PC.

The distinction between price and product bundling is important because it entails different strategic choices with different consequences for companies. Whereas price bundling is a pricing and promotional tool, product bundling is more strategic in that it creates added value. Managers can therefore use price bundling easily, at short notice, and for a short duration, whereas product bundling is more of a long-term differentiation strategy. In the case of physical goods, product bundling requires a new design, research to optimize the design, and retooling to manufacture the product bundle. In the case of services, product bundling requires redefinition of services, optimization of the interfaces among the services, and redesign of service delivery processes. Managers frequently approach product bundling from a (new) product development perspective, involving the research and development and manufacturing departments. Price bundling decisions are often the sole prerogative of the marketing department.

For example, consider the strategic options of Dell, which markets to consumers who want to buy a portable computer system consisting of a basic laptop, a modem, and a CD burner. First, it can sell these products as separate items, such that the price of each item is independent of consumers' purchase of the other item. In this case, consumers could easily forgo purchasing a modem or CD burner, or they could purchase it from a competitor. Second, Dell can sell the products as a price bundle. For example, it could, without physically changing any of the products, give a discount to consumers if they buy all three products together. This offer would probably motivate at least some consumers to buy all three products from Dell. Third, Dell can sell the three items as a product bundle. To meet the latter classification, Dell must design some integration of the three separate products. For example, it could create an enhanced laptop. Not only could this trigger some consumers to buy all products from Dell, but through the value added they might even do so at a premium price.

Bundling form: pure versus mixed. Bundling may take one of three forms: pure, mixed, or unbundling (Adams and Yellen 1976). *Unbundling* is a strategy in which a firm sells only the products separately, but not the bundle. Typically, because this strategy is a base strategy for most firms, the strategy is called unbundling only when contrasting it with a bundling strategy. *Pure bundling* is a strategy in which a firm sells only the bundle and not (all) the products separately. Pure bundling is sometimes called "tying" in the economics and legal literature.[3] A *tying product* is a separate product that is bundled with other separate products. Tie-ins are secondary products that are bundled with the primary product. *Mixed bundling* is a strategy in which a firm sells both the bundle and all the separate products in the bundle separately. Table 1 presents a tabular view of these terms.

Classification and Legality of Bundling Strategies

Classification of bundling strategies. To classify and relate various bundling strategies, we identify two key dimensions of bundling: (1) the focus of bundling, whether on price or product, and (2) the form of bundling, whether pure or mixed. These dimensions encompass a rich set of bundling strategies that have substantially different charac-

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[3]Many economics scholars will approach tying more narrowly, as the pure bundling of products in fixed proportions; for example, a bundle of a car and car insurance is always the combination of one car with one insurance policy.

TABLE 1
Bundling Terms

Term	Definition	Examples
Bundling	Bundling is the sale of two or more separate products in one package.	Opera season tickets, multimedia PC
Price bundling	Price bundling is the sale of two or more separate products as a package at a discount, without any integration of the products.	Luggage sets, variety pack of cereals
Product bundling	Product bundling is the integration and sale of two or more separate products at any price.	Multimedia PC, sound system
Pure bundling	Pure bundling is a strategy in which a firm sells only the bundle and not (all) the products separately.	IBM's bundling of tabulating machines and cards
Mixed bundling	Mixed bundling is a strategy in which a firm sells both the bundle and (all) the products separately.	Telecom bundles

teristics and implications. By using these two dimensions, focus and form, Figure 1 classifies the domain of bundling strategies. The focus of bundling is along the horizontal axis, that is, on either price or product. The form of bundling is along the vertical axis, that is, none, pure, or mixed. Figure 1 considers a general case with two products, X and Y. Combinations of X and Y represent the terms of the sale. Thus, (X, Y) represents the sale of a price bundle, (X⊕Y) represents the sale of a product bundle, and X and Y without parentheses represent the sale of separate products.

When the products are sold separately, the strategy is unbundling and remains the same for the price and product columns (Cell 1). Sears sells Kenmore home appliances unbundled. Cell 2 represents a case of pure price bundling. In this case, a firm bundles the two products for one fixed price, without integrating the products or offering them separately. A classic example would include restaurants that offer only a fixed price menu, with appetizer, entrée, and dessert. Cell 3 represents a case of mixed price bundling, in which case the firm sells the separate products (unchanged) in a price bundle and also sells the products separately at their regular prices. An example would be Samsonite's strategy of selling different sizes of suitcases separately as well as complete sets at a discounted price. Cell 4 represents a case of pure product bundling. In this case, the firm physically integrates the products and sells only this integrated product bundle. An example is Apple Computer's strategy of selling its computers and software as one package. Cell 5 represents the case of mixed product bundling. In this case, the firm sells an integrated product bundle at one price and also sells the separate products at their regular prices. An

FIGURE 1
A Classification of Bundling Strategies

Focus Form	Price	Product
Unbundling	❶ X Y	
Pure bundling	❷ (X,Y)	❹ (X ⊕ Y)
Mixed bundling	❸ (X,Y) X Y	❺ (X ⊕ Y) X Y

� Pure price bundling is illegal for firms with market power.

▢ Pure product bundling is illegal for firms with market power if the benefits to consumers do not offset potential damage to competition.

example would be Circuit City's sale of integrated stereo systems alongside those for the separate products in the system.

Legality of bundling. The preceding classification helps us sort out the legality of various strategies (see Figure 1). This is valuable in view of the limited attention devoted to a clear delineation of the legal rules on bundling in the marketing, economics, and law literature. In particular, the marketing literature avoids all discussion of the legality of bundling, though it covers the legality of truth in advertising or price discrimination substantially (also see Werner 1991, 1993). Yet bundling is pervasive in marketing and is as important as price discrimination or advertising. Moreover, understanding the legality of bundling is crucial to developing successful price and product bundling strategies.

Legal and economic analysts have not made an effort to abstract clear rules from past cases, despite a body of case law. On the basis of a review of the law literature and case law, we synthesize the proscriptions contained in the relevant federal laws in two clear rules, the per se rule and the rule of reason. This simple distinction helps explain much of the apparent conflict in court rulings on various cases over the past century. The spirit underlying both rules is that the bundling strategy of a firm should not hurt buyers by limiting competition. The per se rule is the more stringent of the two rules.

We describe the *per se rule* in terms of four conditions, as follows: Bundling is illegal per se when it involves (1) pure bundling (2) of separate products (3) by a firm with market power and (4) when a substantial amount of commerce is at stake. We have already clarified the meaning of pure bundling and separate products. Here, we explain market power and substantiality.

Market power means that the bundling firm can "force a consumer to do something that he would not do in a competitive market" (Soobert 1995, n. 87) with regard to the tying product. Although a monopoly is a clear indication of dominant market power, a company's power does not have to be complete over all buyers in the market (*Fortner Enterprises v. United States Steel Corp* 1969).

Substantiality means that the amount of commerce that is at stake should be high. If this amount is not high, the practice is legal. How high is high? The U.S. Supreme Court has noted that as little as $60,800 would be considered substantial (*United States v. Loew's* 1962). This small number means that this condition is easily met in most markets.

Note that a firm may try to circumvent the law by adopting a mixed bundling strategy in which it prices individual products so high that consumers buy only the bundle. In this case, mixed bundling is de facto pure bundling and will receive the same legal treatment (*Northern Pac Ry v. United States* 1958).

We describe the *rule of reason* in terms of six conditions, as follows: Bundling is illegal under the rule of reason when it involves (1) pure bundling (2) of separate products (3) by a firm with market power, (4) involving a substantial amount of commerce, (5) which poses a threat that the bundling firm will acquire additional market power over at least one of the products that is bundled with the tying product, and (6) no plausible consumer benefits offset the potential damage to

competition. Therefore, under the rule of reason, each of the four conditions mentioned under the per se rule is still necessary, but not jointly sufficient, for bundling to be illegal. Although assessing the legality of bundling under the per se rule can be relatively easy and objective, doing so under the rule of reason is generally more difficult because of these two additional conditions, which we explain next.

Under the rule of reason, the mere existence of market power over the tying product is not sufficient for bundling to be illegal. In addition, there should be a substantial threat of the bundling firm acquiring additional market power over at least one of the products that are bundled with the tying product. For example, Sandoz Pharmaceuticals bundled Clorazil, a drug for schizophrenia, with CPMS, Clorazil Patient Management System, a system that monitored the side effects of the drug on the patient (Hurwitz 1991). Although Sandoz possessed market power through the patented Clorazil drug, it could not acquire additional market power in the market for monitoring systems because the specific use to monitor schizophrenics' reaction to Clorazil was a small part of the total market for monitoring systems. Therefore, this strategy was not illegal.

The sixth condition for bundling to be illegal, under the rule of reason, is that it produces no benefits to buyers that may offset the potential damage to competition (Meese 1999). If such benefits are present, bundling can still be legal, even though all five previous conditions are met. Typical offsetting benefits are substantial reductions in costs or major increases in value when the products are bundled. By this logic, pure product bundles may be legal if they provide added value and are not merely a bolting together of products. For example, in *United States v. Jerrold Electronics Corp.* (1961), the court used this factor to find an otherwise illegal bundling strategy lawful. Jerrold Electronics, an early producer of cable television equipment, sold community television antennas only bundled with a service contract. The equipment was very sensitive, and customers had no expertise in using it, which thus warranted a bundling strategy to ensure quality. Recently, the D.C. Circuit (appeals court), in the context of the Microsoft case, ruled that any plausible claim of consumer benefits is enough to satisfy this condition (*United States v. Microsoft Corp.* 1998). Note that this statement gives a liberal interpretation of offsetting buyer benefits. Indeed, the D.C. Circuit strongly discouraged courts from second-guessing manufacturers' design decisions (*United States v. Microsoft Corp.* 1998).

Both of these rules, the per se rule and the rule of reason, have been used over the course of different legal cases, and therefore different applications seem to display a "conflicting set of rules" (Dansby and Conrad 1984, p. 377). The IBM case (1936) showed rigid legal scrutiny of bundling practices, in that the Supreme Court applied the per se rule *avant-la-lettre*. The first explicit application of the per se rule occurred in 1947 (*International Salt Co. v. United States* 1947). In this case, International Salt Co. leased patented salt-dispensing machines on the condition that the lessee purchased salt for the machines from the company. Without analyzing evidence of substantial anticompetitive effects or taking into account evidence presented by the company that bundling was necessary to maintain quality control, the court found the company per se guilty of illegal bundling (Soobert 1995).

In 1969, the Supreme Court relaxed the harsh per se rule and moved toward the rule of reason (*Fortner Enterprises v. United States Steel Corp* 1969). Although it is uncertain which of these two rules a court will use in a specific bundling case, use of the rule of reason is growing more common. Therefore, the rule of reason is the most suitable benchmark for judging the legality of various bundling strategies.

Legality of various bundling strategies. We apply the previous discussion on legality to our classification of bundling strategies (see Figure 1). We discuss only the case in which a firm with market power bundles separate products, because these are necessary conditions for illegality. All unbundling (Cell 1) and mixed bundling strategies (Cells 3 and 5) are legal. Pure price bundling (Cell 2) is always illegal, under both the per se rule and the rule of reason. Pure product bundling (Cell 4) is legal under the rule of reason if the benefits to consumers offset potential damage to competition. Note, however, that it would be illegal under the per se rule. Bolting products together is also illegal. Merely bolting products together does not constitute genuine integration and thus cannot be beneficial to consumers.

Although we have specified clear rules for legality and applied them to various bundling strategies, ambiguity may still occur in the factual evidence of specific cases. A good example is the landmark antitrust case *United States v. Microsoft Corp.* If we take the position that Microsoft does not possess a monopoly position (as Massachusetts Institute of Technology economist Richard Schmalensee did) or that the bundling of Windows and Explorer provides consumer value (as Microsoft chief executive officer Steve Ballmer did), then the bundling of Explorer and Windows is legal. However, if we take the position that Microsoft is a monopolist and the bundling of Explorer with Windows by Microsoft does not add value for consumers (as the U.S. government did), then Microsoft's bundling of Explorer and Windows is illegal. Thus, the critical issue in the Microsoft case is the factual assessment of market power and consumer benefits.

First, does Microsoft possess market power? The presence of market power is a difficult fact to establish objectively. In particular, the definition of the relevant market is the subject of intense economic and legal debate. In the Microsoft case, Judge Jackson (1999) defined the relevant market narrowly as "the worldwide licensing of Intel-compatible PC operating systems." In this market, Microsoft Windows indeed has market power because of its dominant market share (95%). However, we question this definition. Would it be more relevant also to include other desktop operating systems such as Apple or Linux? How about network operating systems, such as UNIX or Novell?

Second, does the bundling of Explorer and Windows provide consumers with added benefits, or were the two software packages bolted together just to temper competition? As the D.C. Circuit Court indicated, it is difficult for an outsider to second-guess a company's design choices, especially in high-tech markets. Besides, in this case, what would be the optimal degree of integration between the two software packages? Who would determine that?

Thus, although our identification and formulation of clear rules reduce the ambiguity in case law, ambiguity still remains in the empirical evidence to which the rules apply. This problem can be clarified by separating two stages in the legal process: findings of fact and conclusions of law. Establishing findings of fact is an empirical issue, which could be clear in some cases and highly controversial in others, such as the Microsoft case. However, based on those findings, the conclusions of law should become much clearer with the rules we formulated.

Optimality of Bundling Strategies

This section discusses the optimality of the various bundling strategies. It explains under what factors which strategy becomes dominant. Relative to work done in the literature, this section makes the following contributions: First, the economics literature has focused primarily on profit maximization by a monopolist (Adams and Yellen 1976; Pierce and Winter 1996; Schmalensee 1982, 1984) without considering other objectives of firms, other forms of competition, a firm's cost structure, or consumers' perception of bundles. We formulate propositions that cover all the key factors that affect the optimality of bundling: consumers' conditional reservation prices, objectives of the firm, competition, costs, and consumers' perception of bundles. Second, the literature is ambiguous about the heterogeneity of reservation prices. In particular, most authors focus entirely on asymmetry of reservation prices. However, the distribution of reservation prices involves asymmetry and variation, each of which can affect the optimum strategy. Our discussion clearly explains the role of each. Third, the literature has largely ignored the important distinction between product and price bundling. Product bundling is an important alternative focus for bundling strategies, especially in high-tech markets. We formulate propositions that cover the area of price and product bundling.

Of the propositions we advance, most have never been discussed. Of those previously discussed, at least one (P_2) has previously been imprecisely stated, and a few are at least partially supported in the literature (P_1, P_8, and P_{12}). We discuss and classify all of these propositions in the interest of completeness. Whenever the literature contains a partial or full proof for a proposition, we cite it. Although our propositions are firmly grounded in marketing or economic literature, we also develop a simulation that illustrates the mechanisms underlying most of our propositions. The use of simulation to do this kind of sensitivity analyses is a bit uncommon in marketing, though it has been used successfully before (Rajendran and Tellis 1994; Tellis and Zufryden 1995). Before we proceed to the propositions, we explain the simulation in detail.

Simulation

We illustrate the logic of some of our propositions with numerical examples (see Tables 2 and 3). These examples give the optimal prices for a supplier based on various distributions of consumers' reservation prices or costs of the supplier. To generate these examples, we developed a program that runs on Microsoft Excel. To determine the optimal prices, we use a subroutine called Evolver from Palisade (see www.palisade.com). This is a powerful optimization routine based on an innovative genetic algorithm. It replaces the subroutine, Solver, in Microsoft Excel, which does not work well when a spreadsheet has "if-then-else" statements, as our program does.

Figure 2 provides a flowchart of our program. It consists of the following five steps or components:

A. The user must first specify the segments, their sizes, and the distribution of reservation prices by segment and product.
B. The user then assigns an array for the optimal prices that the program tries to determine.
C. Based on those prices, the program contains formulas to determine consumer surplus for the various offerings (i.e., product and price combinations).
D. Next, an array computes unit sales for each offering. This array contains formulas that incorporate the following rules: (1) Sales occur for a particular offering if and only if consumer surplus is positive and a maximum among alternatives is available. (2) If consumers are exactly indifferent between buying and not buying, they buy a product. (3) If consumers are exactly indifferent between buying a bundle and the separate products in the bundle, they buy the bundle.
E. Finally, the program calculates the revenues based on the product of sales, the segments' size, and the prices offered.

The researcher then uses Evolver to maximize revenues in Cell E by varying values in Array B, subject to certain constraints. The basic constraints specify the minimum (the lowest reservation price) and maximum (the highest reservation price) values that Array B can take. These constraints are not essential, but they ensure a faster convergence to the optimum. (A technical note and the spreadsheet program are available from the authors.)

The program easily determines the optimal prices for a variety of price distributions, segments, segment sizes, and products. As such, it is easier and more flexible than any program available in the literature. It has three benefits. First, it can generate suitable examples with minimal computation effort, for papers, classroom use, or demonstrations. Second, it can help managers determine what strategy is optimal in specific situations. Third, it can be used to evaluate the robustness of various propositions when the user generates examples that stretch the bounds of a particular proposition.

We next proceed to discuss the propositions under each of the five factors: consumers' conditional reservation prices, objectives of the firm, competition, costs, and consumers' perceptions of bundles. Where appropriate, we integrate legality in the discussion based on the principles we elucidated previously.

Consumers' Conditional Reservation Prices

An important factor in determining which strategy is optimal is the distribution of conditional reservation prices. We first explain the basic principles about heterogeneity of conditional reservation prices. We then develop and explain our propositions. We do so in two general cases: a base case, in which only price bundles are possible, and an extended case, in which product bundles are possible.

Heterogeneity of conditional reservation prices. Many researchers have stated that heterogeneity of conditional reservation prices is an important factor in determining the optimality of bundling strategies. However, this heterogene-

FIGURE 2
Flow Chart of Excel Optimization Program
(Displayed Here to Generate a Two-Segment, Two-Product Example)

A: Segment Sizes and Reservation Prices
(Input by user)

Segments	Segment Sizes	Reservation Prices for Product Combinations		
		X	Y	Bundle
A	*User to fill*	*User to fill*		
B				

⇓

B: Prices to Offer
(Cells to be changed by Excel Evolver)

Prices for Product Combinations		
X	Y	Bundle
Excel Evolver to determine		

⇓

C: Consumer Surplus
(Calculated by Excel with use of formula)

Segments	Consumer Surplus		
	X	Y	Bundle
A	*Formula:*		
B	*reservation price – price offered*		

⇓

D: Sales of Product to Each Segment
(Calculated by Excel with use of formula)

Segments	Sales to Each Segment		
	X	Y	Bundle
A	*Formula:* *If (1) TRUE ⇒ bundle sales* *If (1) FALSE ⇒ separate product sales for products with surplus ≥ 0* With (1) = Surplus from bundle positive and ≥Σ surpluses from separate products		
B			

⇓

E: Revenues
(Objective Function)

Revenues
Excel Evolver to maximize product of (sales, segment sizes, and prices offered)

ity has two dimensions, asymmetry and variation. Mainstream economics and marketing research focus exclusively on asymmetry in reservation prices (Adams and Yellen 1976; Guiltinan 1987; Tellis 1986). Only Pierce and Winter (1996) discuss the effect of variation in reservation prices. This section clearly defines each type of heterogeneity, relates the two types to each other, and presents a comprehensive treatment of the effect of different forms of heterogeneity on the optimality of various bundling strategies.

An *asymmetric* distribution of conditional reservation prices for two products, X and Y, occurs when one consumer segment has a lower conditional reservation price for Product X than another consumer segment and the former segment has a higher conditional reservation price for Product Y than the latter segment. In other words, an asymmetric distribution of conditional reservation prices results in a negative correlation of conditional reservation prices for two products across consumer segments (Adams and Yellen

1976). A *segment* consists of an identifiable group of consumers within a market with relatively homogeneous conditional reservation prices. For example, consider the demand for magazines such as *Sports Illustrated* and *Entertainment Weekly*. Some consumers (sports fans) will be more interested in a subscription to *Sports Illustrated* than in a subscription to *Entertainment Weekly*, whereas others (movie buffs) will prefer the latter to the former (as is displayed in Cases 3 and 4 in Table 2, Part A). This is a case of asymmetric distribution of conditional reservation prices.

Variation refers to the difference among consumers' reservation prices for the bundle of products. Suppose Time Inc. considers bundling *Sports Illustrated* and *Entertainment Weekly*. Although some consumers, who read many magazines or are both sport fans and movie buffs, may value such a bundle, others may not. As a result, valuation of the bundled subscription of *Sports Illustrated* and *Entertainment Weekly* may vary considerably among consumers. Variation refers to the contrast in Cases 2 and 4 from Cases 1 and 3 in Table 2, Part A. We next cover the optimality of bundling strategies in more detail for two cases: (1) a base case, in which only price bundling is possible, and (2) an extended case, in which both price and product bundling are possible.

Price bundling. The base case assumes potential for only a price bundle and not a product bundle. Again consider the magazine example stated previously. The reservation price of a bundled subscription for *Sports Illustrated* and *Entertainment Weekly* is equal to the sum of the conditional reservation prices of both magazines. How does heterogeneity affect the best strategy for a firm in terms of revenues? Under the assumptions outlined previously, we formulate the following proposition:

P$_1$: A price bundling strategy (either pure or mixed) yields higher revenues than unbundling if conditional reservation prices are asymmetric.

Although this proposition has found substantial support in economics (Adams and Yellen 1976; Schmalensee 1982), it has not been stated unambiguously, in that asymmetry has rarely been isolated from variation in reservation prices. The underlying reason for the strategy is the following: When there is asymmetry, different consumer segments highly value different products in the bundle. In such a scenario, a bundle can be designed to appeal (and more profitably sell) to consumers who would otherwise buy only one product or buy both products at prices below their reservation prices. In particular, if a firm wanted to maximize sales, it could price the separate products at the minimum of consumers' reservation prices for them. However, such a pricing strategy would leave untapped a considerable amount of consumer surplus. In contrast, a well-designed price bundle can capture most of the surplus arising from the asymmetry in conditional reservation prices. We call this process the *extraction of consumer surplus*.

We can also consider price bundling a price discrimination instrument. *Price discrimination* is a strategy in which a supplier sells the same product at different prices to different segments that value a product differently. The strict case in which the supplier is charging a different price to each consumer is called *first-degree* price discrimination. The supplier extracts the full value of each consumer's surplus. By properly choosing a price for a bundle, a supplier can capture different segments with substantially different valuations for the individual products in the bundle. As such, price bundling is called *second-degree* price discrimination, because in this case the supplier will not be able to take all the consumer surplus of each consumer.

We illustrate the logic with the example in Table 2, Part A. Suppose (as in Case 3 in Table 2, Part A) some consumers—we call them sports fans (Segment A in this case)—value a subscription to *Sports Illustrated* so highly that they are willing to pay $50 for it, but they are willing to pay only $30 for a subscription to *Entertainment Weekly*. Others—we call them movie buffs (Segment B in this case)—are willing to pay $50 for a subscription to *Entertainment Weekly* but only $30 for *Sports Illustrated*. What pricing strategy will maximize revenues? Table 2, Part B, shows that price bundling generates more revenues than unbundling. Table 2 presents average revenues per consumer, which are derived as total revenues divided by the number of consumers.

Although the sizes of Segments A and B are initially assumed equal, this result applies to every proportion of sports and movie buffs. If 90% of the consumers are sports fans, the optimal unbundled prices for *Sports Illustrated* and *Entertainment Weekly* are $50 and $30, respectively. Revenues are equal to ($50 × .9 + $30 × 1) × (number of consumers). Therefore, all consumers would buy a subscription to *Entertainment Weekly*, but only sports fans would subscribe to *Sports Illustrated*. A price bundle at $80 would generate ($80 × 1) × (number of consumers) in revenues, again larger than the unbundled revenues. Also, if 90% of the consumers are movie buffs, unbundled revenues are maximized at a price of $50 for *Entertainment Weekly* and $30 for *Sports Illustrated*. This generates ($50 × .9 + $30 × 1) × (number of consumers) in revenues. A price bundling strategy, in which the bundle is offered at $80, generates ($80 × 1) × (number of consumers) in revenues, which is again higher than the revenues when the supplier does not offer a price bundle and offers the magazines separately. Thus, the proposition is independent of segment size.

P$_2$: Mixed price bundling yields higher revenues than pure price bundling only when reservation prices for the bundle vary across consumers. In all other cases, pure price bundling yields at least the same revenues.

This proposition contradicts often-cited statements of Adams and Yellen (1976), Guiltinan (1987), and others that mixed price bundling is always at least weakly better than pure price bundling. In contrast, we state that mixed price bundling is superior only when the reservation price for the bundle varies. The reason for our different conclusion is that our analysis disentangles two key dimensions of heterogeneity, asymmetry, and variation in conditional reservation prices. Previous analyses did not make this distinction clear, and their conclusions for optimality were not complete or accurate. In contrast to mainstream bundling literature, this proposition has received partial support in the literature (Pierce and Winter 1996).

The rationale of the proposition is the following: When the bundle reservation prices vary sufficiently, the firm can price the separate products to extract surplus from the segment that values one of the bundled products highly, while

TABLE 2
Price Bundling Strategies by Symmetry and Variation of Reservation Prices

A: Reservation Prices for X, Y in Four Cases of Symmetry and Variation When Only a Price Bundle Is Possible

Reservation Prices ($)

Products Segments	Case 1: Symmetric Invariable			Case 2: Symmetric Variable		
	Sports Illustrated	Entertainment Weekly	Price Bundle	Sports Illustrated	Entertainment Weekly	Price Bundle
A	50	30	80	50	30	80
B	50	30	80	40	10	50
	Case 3: Asymmetric Invariable			Case 4: Asymmetric Variable		
A	50	30	80	50	30	80
B	30	50	80	10	40	50

B: Prices and Sales Generating Maximum Revenues for Alternative Price Bundling Strategies (Equal-Sized Segments)

Case 1: Symmetric Invariable

Strategy	Prices ($)	Sales A	Sales B	Average Revenue per Consumer ($)
Unbundling	Sports Illustrated = 50 Entertainment Weekly = 30	1 1	1 1	80
Pure price bundling	Price bundle = 80	1	1	80
Mixed price bundling	Sports Illustrated = 50 Entertainment Weekly = 30 Price bundle = 80	0 0 1	0 0 1	80[a]

Case 3: Asymmetric Invariable

Strategy	Prices ($)	Sales A	Sales B	Average Revenue per Consumer ($)
Unbundling	Sports Illustrated = 30 Entertainment Weekly = 30	1 1	1 1	60
Pure price bundling	Price bundle = 80	1	1	80
Mixed price bundling	Sports Illustrated = 50 Entertainment Weekly = 50 Price bundle = 80	0 0 1	0 0 1	80[a]

Case 2: Symmetric Variable

Strategy	Prices ($)	Sales A	Sales B	Average Revenue per Consumer ($)
Unbundling	Sports Illustrated = 40 Entertainment Weekly = 30	1 1	1 0	55
Pure price bundling	Price bundle = 50	1	1	50
Mixed price bundling	Sports Illustrated = 40 Entertainment Weekly = 30 Price bundle = 70	0 0 1	1 0 0	55

Case 4: Asymmetric Variable

Strategy	Prices ($)	Sales A	Sales B	Average Revenue per Consumer ($)
Unbundling	Sports Illustrated = 50 Entertainment Weekly = 30	1 1	0 1	55
Pure price bundling	Price bundle = 50	1	1	50
Mixed price bundling	Sports Illustrated = 50 Entertainment Weekly = 40 Price bundle = 80	0 0 1	0 1 0	60

[a] Note that revenue-maximizing prices here reduce mixed price bundling to de facto pure price bundling (only bundled sales occur). Every pricing strategy in which consumers buy separate products will reduce profits. This further underlines the validity of P_2.

pricing the bundle to attract the other segment. So a mixed price bundling strategy dominates. When bundle prices do not vary, the bundle will be equally attractive to both segments. Thus, a pure price bundling strategy dominates or equals a mixed price bundling strategy. For example, contrast Cases 1 and 3 with Cases 2 and 4 in Table 2, Part B.

Note that in these cases, the revenues from a mixed price bundling strategy merely equal the revenues from a pure price bundling strategy. The reason is that in these cases, mixed price bundling reduces to a de facto pure price bundling strategy. (Recall from the legality section that a de facto pure price bundling strategy is one in which all consumers buy the bundle because the prices of the separate products are relatively high.) In a valid mixed price bundling scheme, the prices of the separate products would need to be such that at least one consumer segment buys one separate product. Then mixed price bundling would become inferior to pure price bundling. For example, one such pricing strategy would optimally charge $49 for *Sports Illustrated*, $50 for *Entertainment Weekly*, and $80 for the bundle. In that case, Segment A would buy only *Sports Illustrated*, and Segment B would buy the bundle. This would generate a revenue of $64.50, on average.

In practice, legality limits the choice of strategies. Although it may be economically optimal for a firm that faces low price variation to use pure price bundling, this choice may be illegal if the firm has dominant market power (see the prior discussion of the per se rule). A mixed price bundling strategy is also illegal if the strategy reduces to a de facto pure price bundling strategy, as discussed previously. Thus, consideration of economic optimality must proceed with evaluation of what is legally prudent.

Product bundling. The possibility of a product bundle enriches the set of potential bundling strategies (see Figure 1).

P_3: A product bundling strategy (either pure or mixed) yields higher revenues than unbundling for both symmetric and asymmetric conditional reservation prices, though the difference in revenues will be larger when reservation prices are asymmetric.

Prior research has not addressed the optimality of product bundling. Product bundling strategies yield higher revenues than unbundling strategies because they exploit consumers' willingness to pay for added value. Because of this added value, the asymmetry in conditional reservation prices is not necessary for the optimality of product bundling. However, the difference in revenues between product bundling and unbundling is larger when conditional reservation prices are distributed asymmetrically rather than symmetrically. The reasoning is the same as in the case of price bundling in P_1—transferring consumer surplus from a segment with high conditional reservation prices to that with low conditional reservation prices. Again, this logic can be easily illustrated by the following example.

Consider the pricing for an integrated stereo system, composed of a receiver and CD player, in Table 3, Part A. Note that a product bundling strategy yields much higher revenues than an unbundling strategy in all four cases (Table 3, Part B). However, note that the difference in revenues is higher when conditional reservation prices are asymmetric (Cases 3 and 4 in Table 3, Part B) than when they are symmetric (Cases 1 and 2 in Table 3, Part B).

P_4: Mixed product bundling can yield higher revenues than pure product bundling only when reservation prices for the bundle vary. Pure product bundling yields equal or higher revenues than mixed product bundling when reservation prices do not vary.

P_3 suggests that product bundling strategies yield higher revenues because they exploit consumers' willingness to pay for added value. In addition, by adopting a mixed product bundling strategy, a supplier can exploit the variation in the bundle reservation prices. If consumers vary in their valuations of the product bundle, offering only the product bundle leads to either a loss of consumers with a low reservation price for the bundle (at the high price) or a loss of potential revenues from the segment with a high reservation price for the bundle (at the low price). Both alternatives result in lower revenue compared with mixed product bundling, in which a supplier can accommodate all possible segments at optimal prices.

For example, in Table 3, Part B, note how mixed product bundling yields higher revenues only in one of the cases (Case 4) when reservation prices vary. In all other cases, mixed product bundling yields the same revenues as pure product bundling. The exact point at which mixed product bundling becomes superior to pure product bundling is dependent on the configuration of the conditional reservation prices. As yet, we have no precise formula to determine this point, though our simulation can determine which strategy is optimal as configurations change.

Although mixed product bundling is superior to other bundling strategies in specific contexts, when a firm has market power or the benefits to consumers are not clear, mixed product bundling is far superior to the other strategies because of the current legal environment. Pure product bundling strategies by high-profile firms with market power are likely to be challenged by the U.S. Department of Justice. Even if the company is not found guilty in court, the legal battle with the government may involve enormous legal costs and management time. In such cases, mixed product bundling is the best defense against prosecution because it is legal. Thus, implementation of the economic optimum must be tempered by legal considerations when strategies are implemented.

P_5: Combining a product with a price bundling strategy is superior to mere product bundling if consumers' conditional reservation prices (a) for the separate products and (b) for the price bundle and the product bundle are asymmetric.

Asymmetry between price and product bundles occurs when one segment values the price bundle but not the integrated product bundle, and another segment values the integrated product bundle but not the price bundle.

No previous research addresses combining a price and a product bundling strategy, let alone its optimality. P_5 states two conditions for the optimality of such a strategy. First, conditional reservation prices for the separate products must be asymmetric. If not, price bundles will gain no more revenues than will selling the products separately (by P_1). Second, consumers' reservation prices for the price bundle and the product bundle must be asymmetric. In this situation, the firm can price the integrated product bundle to demand a premium price from the latter segment and can price the price bundle to exploit the asymmetry in reservation prices of the former segment.

TABLE 3
Product Bundling Strategies by Symmetry and Variation of Reservation Prices

A: Reservation Prices for X, Y in Four Cases of Symmetry and Variation When a Product Bundle Is Possible

Reservation Prices ($)

Products/Segments	Case 1: Symmetric Invariable			Case 2: Symmetric Variable		
	Receiver	CD player	Product Bundle	Receiver	CD player	Product Bundle
A	500	250	800	500	250	800
B	500	250	800	450	100	600

Products/Segments	Case 3: Asymmetric Invariable			Case 4: Asymmetric Variable		
	Receiver	CD player	Product Bundle	Receiver	CD player	Product Bundle
A	500	250	800	500	250	800
B	250	500	800	100	450	600

B: Prices and Sales Generating Maximum Revenues for Alternative Product Bundling Strategies (Equal-Sized Segments)

Case 1: Symmetric Invariable

Strategy	Prices ($)	Sales A	Sales B	Average Revenue per Consumer ($)
Unbundling	Receiver = 500	1	1	750
	CD player = 250	1	1	
Pure product bundling	Product bundle = 800	1	1	800
Mixed product bundling	Receiver = 500	0	0	800[a]
	CD player = 250	0	0	
	Product bundle = 800	1	1	

Case 3: Asymmetric Invariable

Strategy	Prices ($)	Sales A	Sales B	Average Revenue per Consumer ($)
Unbundling	Receiver = 250	1	1	500
	CD player = 250	1	1	
Pure product bundling	Product bundle = 800	1	1	800
Mixed product bundling	Receiver = 500	0	0	800[a]
	CD player = 500	0	0	
	Product bundle = 800	1	1	

Case 2: Symmetric Variable

Strategy	Prices ($)	Sales A	Sales B	Average Revenue per Consumer ($)
Unbundling	Receiver = 450	1	1	575
	CD player = 250	1	0	
Pure product bundling	Product bundle = 600	1	1	600
Mixed product bundling	Receiver = 450	0	1	600
	CD player = 250	0	0	
	Product bundle = 750	1	0	

Case 4: Asymmetric Variable

Strategy	Prices ($)	Sales A	Sales B	Average Revenue per Consumer ($)
Unbundling	Receiver = 500	1	0	500
	CD player = 250	1	1	
Pure product bundling	Product bundle = 600	1	1	600
Mixed product bundling	Receiver = 500	0	0	625
	CD player = 450	0	1	
	Product bundle = 800	1	0	

[a]Note that revenue-maximizing prices here reduce mixed product bundling to de facto pure product bundling (only bundled sales occur). Every pricing strategy in which consumers buy separate products will reduce revenues. This further underlines the validity of P_4 and P_5.

An illustration for this proposition is the frequency with which companies combine a product and price bundling strategy in a variety of industries, such as information systems and sound systems, in which consumers are presented the full array of separate products, price bundles, and (integrated) product bundles. The reason is the asymmetry in consumer reservation prices for all these combinations. Some consumers value a CD player, others value a receiver, and still others value a good set of speakers. Also, some consumers value an integrated system, whereas others like to mix and match their own system and buy the separate products.

Objectives of the Firm

The literature on bundling has not dealt with any goals of firms other than profit or revenue maximization. Consequently, the propositions we formulate in this section have not been addressed in any way in previous literature. Further research could refine and test these propositions.

An important alternative goal to profit or revenue maximization may be maximizing market penetration. This goal is relevant for a new product, particularly in high-tech and Internet environments. In the latter case, rapid market penetration becomes paramount because a rapidly growing product has the potential to monopolize the market ("winner takes all"; see Liebowitz and Margolis 1999), so profit maximization may be secondary, at least initially. In such contexts, bundling a new product with an existing product can be a critical strategy for success.

Price bundling. We offer the following proposition:

P_6: When a firm's goal is to maximize market penetration first and profits second, pure price bundling either is the best strategy or is no worse than any other strategy.

Comparing pure price bundling with unbundling is straightforward. If a firm strives for maximum penetration, it would price the separate products in an unbundling strategy at the minimum of consumers' reservation prices for the separate products. In a pure price bundling strategy, it would price the bundle at the minimum of consumers' reservation prices for the bundle. However, from P_1, the revenues from the latter strategy will always be higher than (in case of asymmetric reservation prices) or equal to (in case of symmetric reservation prices) the revenues of the former strategy.

As we discussed previously, the profitability of mixed price bundling stems from selling separate products to consumers with a high valuation for them, while selling the bundle to the other consumers. In other words, its optimality is based on excluding some consumers from buying all products in the bundle. However, if the company's prime objective is to increase market penetration, it will not want to exclude any consumers from buying one of its products. Therefore, if the goal is market penetration, pure price bundling will be superior.

In addition, pure price bundling may have other strategic advantages. Pure price bundling may serve as a means of subsidizing trial. Some segments may not even have heard of the new product. In that case, pure price bundling

provides both visibility and trial for the new product. To the extent that visibility and trial are important in new product diffusion (Rogers 1995), they provide additional reasons for pure price bundling. Although this proposition may appear to be a bold statement at first, many real-life examples provide some validation. New software is often included for free with purchased software or hardware (e.g., Microsoft's Money with the Windows operating system). Free samples of new products are often included with already existing products in fast-moving consumer goods. New financial services often are free at first to existing customers; when they are well adopted, firms start to charge for them.

The following example can explain the intuition of this proposition. Consider the marketing manager at McDonald's responsible for the introduction of a new item, the McFlurry. To maximize market penetration, the marketing manager can bundle the McFlurry with each sandwich on the menu at the additional price that equals the lowest that any consumer is willing to pay for it. This is a strategy of pure price bundling and will ensure that every consumer of any of McDonald's sandwiches tries the McFlurry. Thus, the strategy provides the new product with high visibility, trial, and penetration. In addition, if consumers value the McFlurry more than the additional price added to the bundle, the strategy creates consumer surplus for the bundle. In every other price strategy for the McFlurry, its market penetration would be equal or less.

However, pure price bundling of separate products is illegal if the supplier has market power. In such situations, firms may need to adopt mixed price bundling even when pure price bundling would be superior. Here again, when firms implement bundling strategy, they must temper what is economically optimum with what is legally prudent.

Product bundling. For product bundles, we formulate the following proposition:

P_7: When a firm's goal is to maximize market penetration first and profits second and a product bundle is possible, pure product bundling is as good as, if not better than, any other strategy; the only exception is the case in which consumers' conditional reservation prices (a) for the separate products and (b) for the price bundle and product bundle are asymmetrically distributed. In the latter case, combining a pure price bundling strategy with a pure product bundling strategy may be optimal.

The first part of this proposition is in line with P_6. That product bundling also creates added value for consumers only makes the case for the optimality of pure product bundling stronger. Again, pure product bundling will be superior to mixed product bundling when the optimality depends crucially on the exclusion of certain buyers from buying the bundle. The optimality of pure product bundling over unbundling is even clearer, because a supplier can capture added value by selling the product bundle, compared with selling the separate products. In addition, pure product bundling may provide a new product with higher visibility and trial. Moreover, because it involves a product bundle, the link with perceived functionality is even clearer than in the case of price bundles. Thus, pure product bundling is superior to any other strategy.

The second part of the proposition runs parallel to P_5 for the same rationale as for that proposition.

We now can fully appreciate Microsoft's bundling strategy of Internet Explorer from an economic perspective. Considering Microsoft's objective of rapid market penetration for Explorer, a pure product bundling strategy as implemented by Microsoft makes perfect economic sense. By integrating the browser into the operating system at no extra charge, Microsoft effectively maximized its market penetration by maximizing the browser's visibility and trial and also maximized consumer surplus. However, Microsoft clearly misjudged the optimality of a pure product bundling strategy from a legal perspective. The legality of the practice is not always clear, because it depends on a judgment of a firm's monopoly power and the offsetting benefits of its product bundling. Even if Microsoft were legally right and won on appeal, the whole investigation and court case cost the company dearly. The case consumed a great deal of top management's time and attention, it lowered employee morale, talent left to join competitors, and the firm lost approximately 35% of its market value.

Competition

The literature on how competition influences the optimality of different bundling strategies is rather thin. Further research in this area would be fruitful.

Price bundling. To discuss the impact of competition on the optimality of different bundling strategies, we again start with our base case, in which the supplier cannot develop a product bundle.

> P_8: In competitive markets, a mixed price bundling strategy dominates a pure price bundling strategy.

Research by Matutes and Regibeau (1992) supports this proposition. In competitive markets, from oligopoly to perfect competition, companies cannot differentiate themselves from competitors by bundling. Even if a pure price bundling strategy were more profitable, the strategy would encourage competitors to offer both bundled and separate products. This mixed bundling strategy would be more attractive to consumers and consequently would cut into the market share of the firm using pure price bundling. Consequently, this firm would also adopt a mixed price bundling strategy. It can be shown mathematically that in the long run, both companies sustain their mixed price bundling strategies (Matutes and Regibeau 1992). However, all the firms could be better off if they could collude on an unbundling strategy, because then they could commit to not offering a discount on the bundle, which would increase their combined profits. Of course, price collusion is illegal.

It is still unclear how a mixed price bundling strategy compares with an unbundling strategy from a competition perspective. Anderson and Leruth (1993) provide some reasons firms may prefer unbundling to mixed price bundling in highly competitive environments. First, mixed price bundling is a readily observable strategy and thus an easy signal to trigger a response from competitors. Conversely, if a firm's marginal costs were unobservable and declining, retaining its prices at the same level and thereby increasing its profits would not be detected by competitors. Second, unilaterally adopting a mixed price bundling strategy could likely trigger aggressive pricing by competitors. Third, firms may try to avoid competing on multiple domains, in essence on a separate-products market and a bundle market. However, Anderson and Leruth's (1993) assumption that firms recognize the implications of embarking on a mixed price bundling strategy—that is, lower profits for both firms—is questionable.

An illustration of P_8 is the pervasiveness of mixed price bundling strategies in highly competitive industries, such as telecommunications and banking services. In telecommunications, the degree of asymmetry in consumers' conditional reservation prices is high. Most telecom products are more or less substitutes (cellular versus fixed telephony). Thus, the revenue potential from price bundling strategies is substantial. But competition is so intense that firms cannot force pure price bundles on consumers. Therefore, the number of calling plans (various forms of bundling) has exploded to accommodate the superiority of mixed over pure price bundling.

Product bundling. The analysis is similar in the case when a supplier can introduce a product bundle, though with a slightly different outcome. We propose the following:

> P_9: In competitive markets, if the supplier can introduce a product bundle, mixed product bundling strategies dominate unbundling and pure product bundling strategies.

This proposition is consistent with P_8 and can be supported, at least partially, by the same logic. Competitive markets preclude clearly differentiated positions. Even if a firm develops a unique, superior product bundle, a differentiated position is not sustainable. Competitors imitate the product bundle immediately, with substantial downward pressure on prices. In addition, consumers who wish to mix and match products and compose their own system are left unserved. This creates an opportunity for firms to escape price pressure by adopting a mixed product bundling strategy. A mixed product bundling strategy increases variety, which in turn increases consumer demand. This result will motivate competitors to adopt and sustain mixed product bundling strategies (Matutes and Regibeau 1988).

An unbundling strategy is also not optimal. When adopting an unbundling strategy, a company would forgo a profitable opportunity, namely, offering a product bundle to consumer segments that value integration at a premium price. Note that if markets are not competitive, in the sense that product bundles can create sustainable differentiation, pure product bundling can be optimal. In this case, the product bundle will provide the company with a local monopoly and thus reduce price competition (Chen 1997).

To clarify P_9, consider Apple's strategy. Initially, the Apple Macintosh was sold as a pure product bundle of hardware and software. This strategy was optimal because the Apple Macintosh was unique in performance and ease of use as a result of its graphical user interface. However, as time went on and other suppliers rapidly gained on Apple through product improvements, the Macintosh lost its uniqueness. Consumers found more flexibility and choice possibilities with competing suppliers, which led to a

decline in Apple's market shares. At that time, a mixed product bundling strategy would have been superior for Apple.

Costs

Little work has been done in marketing or economics that relates costs to the optimal bundling strategies. Still, costs may be as important to the optimality of bundling as are the other factors we identified. Therefore, costs warrant further academic attention.

Three cost aspects appear relevant to bundling: the relative contribution margin, economies of scale and scope, and additivity of costs in the bundling process. Note that the immediate impact of price bundling is to increase revenues. The relative contribution margin is relevant to price bundling because it increases profits from revenue increases. Economies of scale and scope are relevant to price bundling because they decrease the costs of additional sales. Additivity of costs is relevant to product bundling because it determines the extra margin that the product bundling strategy generates.

However, costs will not be pertinent to the optimality of mixed versus pure bundling strategies because the costs do not vary much between these two strategies. For example, the costs for an opera house of selling only season tickets (pure bundling) or season tickets as well as individual tickets (mixed bundling) will not be very different.

The *relative contribution margin* is equal to (price – variable costs) divided by price. Products such as home appliances, with high variable costs relative to price, have a low contribution margin. Products such as software, with low variable costs relative to price, have a high contribution margin.

Economies of scale are decreases in costs per unit as the scale of operation increases. *Economies of scope* are decreases in costs per unit of two or more products due to producing or marketing them together instead of separately. Economies of scale and scope are often present in technology and telecommunication markets.

Almost all articles on bundling assume costs to be additive. The term *additive* means that the ratio of the costs of the bundle to the sum of the costs of the separate products is equal to 1 (for an exception, see Hanson and Martin 1990). A variety pack of cereals is a good example of a price bundle with approximately additive costs. *Subadditive* costs, in which the ratio is smaller than 1, or *superadditive* costs, in which this ratio is greater than 1, have largely gone unresearched. The multimedia PC is an example of a product bundle with subadditive costs. Because the modem, CD-ROM, and speakers can be miniaturized (no casing, separate ports, cable, and so forth) and integrated in the PC, production, packaging, and distribution costs are lower than the sum of the costs of the separate products. A turnkey computer network is a product bundle with superadditive costs. Beyond the costs of the separate components (such as server, terminals, network software, and application software), the supplier has extra costs in seamlessly integrating the network. Again, we first develop the base case in which only price bundles are possible.

Price bundling. We can formulate the following proposition:

P$_{10}$: The profitability of price bundling is likely to be higher than that of unbundling (a) the higher the relative contribution margin and (b) the stronger the economies of scale or scope.

The rationale for P$_{10a}$ is that discounts on high-margin products are better able to raise profits than discounts on low-margin products, assuming constant price elasticity. For example, consider a marketing manager at Sears who is considering a bundle of a blender and a food processor. Assume that the blender has variable costs of $80 and sells for $100 and the food processor has variable costs of $700 and sells for $800. If Sears offers a bundle of the two products at $810 (amounting to a 10% discount), it gains only $30 contribution per bundle sold. Because this bundled offer will cut into regular sales margins, the sales increase must be 300% to make bundling profitable. Compare this with a marketing manager at Microsoft who considers offering a temporary price bundle, in cooperation with original equipment manufacturers, of Microsoft Windows and Microsoft Office. Assume that these products sell at $100 and $60, respectively, and have variable costs of $4 and $5, respectively. If Microsoft prices the bundle at $144 (10% discount), it will gain $135 in contribution per bundle sold. A sales increase of only 12% will make bundling profitable. Therefore, assuming constant price elasticity and equal incremental and cannibalized sales, Microsoft will benefit more from a price bundling strategy than Sears will.

When economies of scale exist, an increase in sales volume will lower costs and increase profits. Because price bundling can increase sales, it will be more profitable than unbundling strategies when economies of scale are present. When economies of scope are present, a firm can jointly produce and market a portfolio of products more economically than doing so separately. Price and product bundling can increase sales of a portfolio of products. Thus, such bundling strategies are more profitable than unbundling strategies when economies of scope are present.

Product bundling. Product bundling strategies almost always call for attention to costs of the bundling process. This situation contrasts sharply with price bundling, in which the cost structure of the individual products is important. The reason is that in price bundling, the bundled products do not change.

P$_{11}$: If costs of product bundling are subadditive, a product bundling strategy is always superior to an unbundling strategy, irrespective of consumers' reservation prices, the firm's strategic objectives, or the nature of competition.

In many cases, product bundling will generate diverse cost savings. The multimedia PC is a good example of such cost savings. By internalizing the CD-ROM in the PC, costs can be saved in the casing and the connection of the CD-ROM. The same goes for the speakers and the modem. Also, on-site assembly costs may be lower. Costs that would accrue from connecting and installing separate components on-site, such as the CD-ROM and modem, to the reseller (e.g., CompUSA) or the manufacturer directly (e.g., Dell) are avoided by the "out of the box" multimedia PC.

In case product bundling generates extra costs, the optimality of product bundling depends on the trade-off

between the extra costs generated and extra revenues from the added sales to consumers who appreciate the product bundle. The existence of system integrators in many industrial markets (Wilson, Weiss, and John 1990) points to the potential profitability of such a strategy. System integrators typically integrate a set of different products into a system. For example, companies can buy an entire computer network through a system integrator, such as Andersen Consulting, versus mixing and matching the separate components, such as server, terminals, and software, from different vendors. In many cases, companies will contract from a system integrator, though its total price may be higher.

Consumers' Perceptions of Bundles

The previous discussion is largely driven by economic principles. However, in the past two decades, considerable behavioral research has focused on consumers' perceptions of bundles. Insights developed from these studies may help companies in fine-tuning their formulation and presentation of bundling strategies. We synthesize the main conclusions of this literature in these final propositions on optimality. Previous research shows support for these propositions. Research in this area is so recent and the area is so rich with phenomena that further research promises to be quite fruitful.

Most of the behavioral research on bundling is grounded in prospect theory (Kahneman and Tversky 1979) and mental accounting (Thaler 1985). Central to prospect theory is the value function. In prospect theory, outcomes are framed as positive (gains) or negative (losses) deviations from a reference point. The value function is concave in gains and convex in losses. Mental accounting suggests that people perceive multiple gains as more rewarding and multiple losses as more punishing than a single gain and a single loss of the same amount. What are the implications of these principles for bundling strategies?

> P_{12}: For price information, it is optimal for companies to (a) integrate all price information in a single bundle price rather than present it in a list of separate product prices and (b) separate the bundle discount in multiple savings rather than present it as a single saving.

This optimality is driven by considerations on purchase likelihood as well as subsequent consumption behavior. Several researchers show that presenting consumers with a single bundle price lowers price sensitivity and increases purchase likelihood (Drumwright 1992; Gaeth et al. 1990; Yadav and Monroe 1993). The theoretical rationale is the following: Consumers perceive a single loss as less punishing than multiple losses. Therefore, they value a single bundle price more than one that explicitly sums the prices of the separate products.

For example, suppose consumers are confronted with two possible offerings for portable PCs:

> a. Take advantage of this great deal: Buy now a portable PC for only $2,500 and get a Deluxe Case at $99 and printer HP DeskJet 932C at $199, or
> b. Take advantage of this great deal: Buy a portable PC, with a Deluxe Case and printer HP DeskJet 923C for only $2,798.

P_{12a} suggests that consumers prefer Offer b to Offer a. Therefore, it is optimal for companies to present consumers with a single bundle price. Also, this mechanism sometimes enables consumers to buy more than they would if products were offered individually.

In contrast, consumers prefer their gains segregated. They perceive multiple savings in the bundle as more favorable than a single saving (Johnson, Herrmann, and Bauer 1999; Mazumdar and Jun 1993). Consider the following two offerings as illustrations:

> a. Take advantage of this great deal: If you buy all your telecom services from AT&T, get $200 cash back on your long distance calls and a credit of $100 on international calling.
> b. Take advantage of this great deal: If you buy all your telecom services from AT&T, get $300 cash back.

Research shows that consumers value Offer a more than Offer b.

Considerations of consumption behavior also may drive the optimality of presenting consumers with a bundled price rather than a list of separate product prices. Recent research has found that consumers who buy a bundle of products at a bundled price consume less of the bundle than do consumers who are presented with separate product prices (Prelec and Loewenstein 1998; Soman and Gourville 2001). Consumers who buy a bundle of products at a bundled price perceive far greater ambiguity on the sunk cost of their purchase than do consumers presented with separate product prices. This greater ambiguity "decouples" the sunk cost of the purchase from the extra benefit of consuming the entire bundle. In other words, consumers who are presented with a bundled price will account less for the sunk costs of their purchase than will consumers who are presented with separate prices.

Consider two consumers, John and Robert, who have purchased tickets for a series of four NBA games at $20 each. John is presented with a bundled price of $80, whereas Robert has paid $20 separately for each of the four games. Because of their mode of payment, Robert has less ambiguity of the cost of each ticket ($20) than does John. As such, the sunk cost of each ticket looms larger for Robert than it does for John. For this reason, prior research shows that Robert has a higher likelihood of seeing all four games.

Although most research indicates support for P_{12}, there may be exceptions to this general guideline. For example, Morwitz, Greenleaf, and Johnson (1998) show that partitioned pricing, in which a firm divides a product's price into two mandatory parts, the product and shipping charges, can increase consumer demand because of lower recalled costs. This example suggests the need for more research on potential causes for the discrepancy. Important topics in this research could be the price differential between products in the bundle, the salience of the product and bundle prices, and the cognitive effort involved in evaluating the bundle.

Conclusion and Directions for Further Research

Although the economics literature has some in-depth analyses of bundling in specific situations, the topic has enjoyed only scattered research in marketing. Moreover, the pub-

lished studies are fuzzy about some basic terms and principles. In addition, the literature lacks a unifying classification of the strategies, clear norms for the legality of the strategies, and a comprehensive framework for the optimality of bundling strategies. We try to address these limitations. This article provides a new synthesis of the field of bundling based on a critical review and extension of the marketing, economics, and law literature. This article makes the following three contributions:

First, the article defines bundling terms and principles to reveal a new, rich set of bundling strategies. It presents a classification of these strategies that provides a clear understanding of the relationship among them. In particular, the classification shows that price bundling and product bundling are independent strategies, which firms can mix and match to best meet consumer demand.

Second, this article reviews the legal literature to articulate certain fairly simple conditions that guide the legality of bundling strategies. In particular, it clarifies the current ambiguity in case law by identifying the per se rule and the rule of reason. The exposition distinguishes between issues of law, in which clear norms are discernable, and issues of fact, in which empirical cases may be quite ambiguous and controversial.

Third, the article develops a framework of 12 propositions that prescribe the optimal bundling strategy depending on five important factors. The literature contains partial empirical or mathematical support for only three of the propositions (P_1, P_8, and P_{12}), and it imprecisely describes one of the propositions (P_2). All the other eight propositions have been proposed here for the first time. The propositions synthesize a body of knowledge about the trade-offs managers must make when choosing among bundling strategies in specific contexts. The article emphasizes that such trade-offs should account for the legality as well as the economic optimality of a bundling strategy.

Implications for Marketing Management

Our synthesis offers answers to the following managerial concerns.

When is bundling illegal? The controversy about and probable strategic errors in the recent Microsoft case show that bundling is not well understood, even by well-financed major corporations. History shows that engaging in illegal or even potentially illegal bundling strategies can be costly. The legal battle takes many years, costing valuable management time and large financial resources. An eventual conviction is even more costly, because in most cases, judges mandate monetary penalties or radical organizational changes. We have defined clear rules by which managers can easily assess whether a certain strategy is illegal. Most important, firms with dominant market power that consider implementing pure bundling strategies should scrutinize the legality of their bundling strategy. Although pure price bundling for such firms is illegal at all times, pure product bundling may be legal if the bundle offers substantial added value to consumers that cannot be achieved when firms sell the bundled products separately. Faced with these legal constraints, companies with dominant market power may find it

optimal to resort to value-added product bundling for long-term benefits rather than to short-term price bundling to gain market share. In this respect, it would have been better for Microsoft to have invested in unambiguous value-enhancing integration of Internet Explorer and Windows at the start, instead of merely packaging the browser and the operating system. This latter initial strategy triggered the original lawsuit.

What are the drivers of the optimality of bundling? This article shows that bundling is profitable for a variety of reasons and thus deserves more attention from managers. In particular, we find that price bundling of existing products may be optimal because it is a form of price discrimination between different consumer groups and because it decreases price sensitivity and increases individual consumers' purchase likelihood. We also find that price bundling yields larger profit increases the higher the relative contribution margin and the stronger economies of scope and scale are. Thus, services or goods with high development costs—such as high-tech products—generally have more to gain from price bundling than do goods with high marginal costs, such as consumer durables or industrial goods. We find that product bundling of existing products may be optimal because it creates added value for consumers, saves costs, and creates differentiation in highly competitive markets. We also argue that bundling a new product with an existing product is an ideal introduction strategy because it allows extraction of more consumer surplus at equal sales levels. In addition, price bundling will increase the visibility and trial of the new product, which are important in new product adoption by consumers. Product bundling may also improve consumers' perceptions of the functionality of the new product when it is bundled with existing complements.

This discussion suggests that firms that exploit opportunities offered by bundling will enjoy increases in market shares and profits. Thus, developing expertise in designing bundling strategies may be of prime importance in achieving long-term success. The guidelines we posit in this article may be the first step in enhancing managerial insights on the optimality of bundling.

Choose mixed or pure bundling? Prior research generally views mixed bundling as at least weakly superior to pure bundling. Our discussion shows that this literature may be misguided because it assumes that pure bundling can never be optimal. In contrast, we propose that mixed bundling is superior to pure bundling only in highly competitive environments or when consumer reservation prices vary a fair amount. Moreover, we argue that for new products, pure bundling strategies tend to outperform mixed bundling strategies. Pure bundling strategies necessarily bring all consumers of an existing product in contact with the new product, so they grow aware of it and can easily try it out. Thus, developing expertise on the proper choice between pure bundling and mixed bundling is important for using bundling strategies profitably.

Limitations and Further Research

This article has several limitations that further research could address. First, product bundling is relatively new, and its use in high-tech markets can benefit from further

research. Two questions seem especially pressing: What factors drive customer preferences for product bundles in high-tech environments? and How can suppliers optimally organize themselves to offer product bundles when they do not have competence on all products in the bundle?

Second, limitations of time and space prevented a formal mathematical proof or empirical validation for each of the propositions. The field would benefit especially from research that defines the domain and validity of the newly proposed propositions. The most promising areas of further research appear to be the impact of competition and alternative strategic objectives on the optimality of bundling. Although prior analytical research has developed some insight on the impact of competition, it is limited mostly to monopoly and relatively simple forms of bundling.

Third, the article does not indicate the relative importance of each of the conditions for optimality. Intuitively, for price bundling, we suspect that the distribution of conditional reservation prices is probably the predominant condition for optimality. The reason is that price bundling, by nature, tries to exploit the heterogeneity in consumers' conditional reservation prices. For product bundling, costs seem to be the important condition for optimality. The reason is that costs determine the amount of value firms can build into the product bundle. Empirical research that tests our intuition on this issue would be fruitful.

Finally, this article focuses on the optimality of bundling toward the end user (either consumers or businesses). It does not discuss the optimality of bundling in channels (i.e., the optimality of bundling by a manufacturer to a retailer). An example of the latter is full-line forcing, in which a manufacturer forces a retailer to carry an entire line of products. Research into this area should be fruitful.

In summary, the current article underscores the centrality of bundling in marketing. It integrates research from a variety of perspectives to provide a deeper and more complete understanding of bundling than is as yet available to marketers. However, it suffers from several shortcomings, which we hope will stimulate further research in this area.

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