other respects, however, the *Magicam* is essentially identical to a typical real-world camera. In particular, both a *Magicam* and a regular camera can be used to make anywhere from one to a very large number of pictures per day or per month. It is up to the owner to decide how many pictures to take per period of time.

This fact does not mean that every consumer who has a *Magicam* will take a huge number of snapshots. After all, they have to pay for the film cartridge and spend time taking pictures rather than doing other things. Presumably, consumers differ in this regard. Suppose that there are one thousand low-demand consumers each with a monthly demand for pictures described by $Q = 12 - P$, and one thousand high-demand consumers each with a monthly demand for pictures given by $Q = 16 - P$. In other words, if cartridges of film were free, the first group of consumers would each take twelve pictures per month and the second group sixteen pictures. Unfortunately, Rowling Corp. has no way, magical or otherwise, of identifying these different types.

Because of the sensitive nature of the technology incorporated in *Magicams* we assume that Rowling Corp. does not sell the cameras but rather uses its monopoly power to offer them on monthly lease agreements that include servicing the camera to maintain its magical properties.[6] Given that the lease fee is set such that each of the two thousand consumers will lease a *Magicam* the manufacturing costs of the cameras become effectively fixed costs for Rowling Corp. The same is not true for the camera film. Suppose that film production takes place under competitive conditions and that the marginal cost of producing film is \$2 per photograph that the film can take. This means, of course, that film will be priced at the competitive price of \$2 per picture. Now consider Rowling Corp.'s potential strategies for leasing its cameras.

If a *Magicam* and camera film are all that is needed for producing the wonderful pictures, Rowling Corp. might find the situation somewhat frustrating. Because the firm cannot tell one type of consumer from another, the firm cannot easily lease its *Magicams* at different prices to each type. About the best that Rowling Corp. can do is to charge a monthly lease rate of \$50. Why? Because this is the consumer surplus earned by a low-demand consumer faced with a film price of \$2 per picture and Rowling Corp. cannot price discriminate across the two consumer types. (You should check that this is indeed the consumer surplus for a low-demand consumer when film is priced at \$2 per picture.)

Both types of consumer will lease the camera. High-demand consumers will use it to take fourteen pictures per month while low-demand consumers will take ten pictures per month. Rowling earns a monthly profit of \$50 on each of the 2,000 cameras leased—1,000 to the low-demand and 1,000 to the high-demand types—or \$100,000 per month.

The situation is not desperate, but like any good profit-maximizer, Rowling wonders if somehow the firm can do better. After thinking a bit, Rowling management realizes that with some redesigning of the camera and a bit of clever marketing it can tie the lease of a *Magicam* to the use of its own *Magifilm*. This gives Rowling an idea. Why not implement a tying strategy and sell *Magifilm* cartridges at \$4 per exposure?

Both low- and high-demand consumers now pay \$4 at the margin for a picture. The low-demand consumers will therefore reduce their monthly demand for *Magicam* photos to just eight. And if low-demand consumers pay the \$4 per picture price of *Magifilm*, they will enjoy a surplus of \$32. Thus this surplus is the rental rate at which Rowling can lease the *Magicam*. (Notice the connection between this and our discussion of two-part pricing in

[6] This is actually the strategy that IBM, Kodak. and Xerox used initially with their machines.

Chapter 6.) As a result, Rowling earns \$32 from each of the 1,000 low-demand consumers in camera rentals and \$16 from each in cartridge sales, giving a total profit of \$48,000 from the low-demand customers.

High-demand consumers will also lease the *Magicam* at \$32. However, at \$4 per picture in film costs, these consumers will shoot twelve photos per month. Hence, Rowling earns a profit of \$32 on cameras and \$24 on film cartridges from each of the 1,000 high-demand customers, giving a total profit from this group of \$56,000. In total, Rowling now earns a combined profit of \$104,000 —greater than the \$100,000 it earned without the tie-in. It has achieved this profit increase by exploiting its ability to *tie* the use of its camera to the use of its film.

To understand the way that tying helps Rowling, first note that high demand consumers receive a quantity discount under either of the two regimes. When the *Magicam* is leased for \$50 and the film is purchased competitively at \$2 per photo, high-demand consumers take fourteen photos and pay only \$5.57 per shot, while low-demand consumers take ten pictures and pay \$7 for each. Under the tied film arrangement, high-demand consumers pay a total charge of \$80 for twelve pictures, or \$6.67 per photo. By contrast, low-demand consumers pay a total of \$64 and take only eight pictures per month, or \$8 per photo. Thus, the tied sale is not attractive solely because it permits a quantity discount.

What tying does accomplish is to permit Rowling to solve the identification and arbitrage problems by exploiting its post-lease position as the monopoly seller of *Magifilm*. Now, the high-demand consumers are revealed by their film purchases to Rowling and the quantity discount is put to work in a profit-increasing way. Nor is arbitrage capable of undoing the discrimination. After all, both the camera and the film are readily available to all consumers at the same prices. Given that a single *Magicam* can serve either a low-demand consumer or a high-demand consumer equally well, solving the identification and arbitrage problems can only be achieved by tying its use to another product whose volume does change depending on the consumer's type. No consumer will ever lease more than one *Magicam*, but they will differ in terms of how much *Magifilm* they purchase.

Now let's take Rowling's case one step further. The low- and high-demand functions we have used may look familiar to you. They are the same ones we used in Chapter 6 in our discussion of quantity discounts with second-degree price discrimination. If you look back at that earlier example, you may get an idea of how Rowling can redesign and package the camera to do even better. For example, suppose that Rowling redesigns the *Magicam* so that the cartridge of *Magifilm* becomes an integral part of the camera that only Rowling's film developers can take out without destroying the camera.

Rowling can then design two varieties of its new, integrated *Magicam*, one of which has a ten-shot capacity and the other a fourteen-shot capacity.[7] The firm can offer to lease the ten-shot *Magicam* for \$70 per month and the fourteen-shot *Magicam* for \$88 per month. In both cases, the lease agreement also offers free developing as well as the free replacement of the cartridge. From our analysis in Chapter 6, we know what will happen in this case. Low-demand consumers will lease the ten-shot *Magicam* while high-demand consumers will lease the fourteen-shot *Magicam*. Rowling will then earn an even greater profit of $\$50{,}000 + \$58{,}000 = \$108{,}000$. This technological integration plus the monthly leasing agreement has enabled Rowling to identify and separate the different customers even more profitably.

[7] With marginal film costs of \$2, these are the socially efficient quantities to offer.

**8.2**

**Practice Problem**

Consider the *Magicam* story in the text. Again, let there be 1,000 high-demand and 1,000 low-demand consumers and let them have inverse demand functions of $P = 16 - Q$ and $P = 12 - Q$, respectively. Show that the price of $**4** per photo is, indeed, the profit-maximizing price for *Magifilm* when the film is sold separately from the camera. Now suppose that Rowling Corp. produces the integrated camera plus film cartridge in eight-shot and fourteen-shot varieties. What rental rates will be charged for the two varieties? What are Rowling Corp.'s profits? Finally, suppose that there are 1,000 low-demand consumers and $N_h$ high-demand consumers. How many high-demand consumers would there have to be for Rowling to wish to manufacture only the fourteen-shot variety of integrated *Magicam* given that the other variety is

a. ten-shot;
b. eight-shot.

We have seen that, like bundling, tie-ins can be used to implement price discrimination schemes. This is no doubt one reason that tie-ins are frequently used, especially in situations where one of the components, like our fictitious *Magicam*, is capable of different intensities of use covering a very large range. Some tying is contractual, as in the case of IBM requiring the use of its punch cards for users of its punch card machines in the early days of computing. Some tying is technologically forced as in the *Magicam* and *Magifilm* example, or in the real-world case where Polaroid instant picture cameras used only Polaroid film. *Nintendo 64* players and *Game Boys* use only Nintendo or Nintendo-licensed games. Every manufacturer of computer printers designs their printers so that they use only their own ink cartridges. Again, these can be very useful product design strategies for extracting surplus from the market.

Price discrimination is not the only reason, however, that we may observe bundling and tying practices. As Judge Stevens made clear, an additional reason is that such practices may enhance monopoly power. At the same time, we also need to recognize that bundling and tying based on actual cost considerations will be observed in relatively competitive markets where they have little to do with discriminatory practices. We turn to these issues shortly, after first considering some aspects of complementary goods pricing.

## 8.3 COMPLEMENTARY GOODS, NETWORK EXTERNALITIES, AND MONOPOLY PRICING

The *Magicam* and *Magifilm* are complementary goods. In the days before the advent of digital cameras, there was no point in buying a camera—magical or otherwise—unless one also bought some film. Today, there is little point in owning a CD player without also purchasing CDs, an e-book reader without buying e-books, a PC without buying some software applications, or in buying bolts without buying nuts. In passenger airline manufacturing, it is necessary to have both engines and avionics equipment.

Sometimes the market for at least one of the complementary goods is reasonably competitive. Other times, the same firm may control both goods. However, there is a third possibility. This is that each of the complementary goods is produced by a different monopolist. There might be just one camera corporation and one separate film company.

## Reality Checkpoint

## The Bundled Skies

If you have purchased an airline ticket in the past year or two, you will have noticed that it is no longer a simple choice of aisle, center, or window, even if you restrict yourself to coach travel. These days air passengers can also select from options such as "Choice Plus," "Cabin Express," "Ascend," or "Lift." Airlines are rapidly becoming highly skilled at bundling choices in packages just as the cable companies, carmakers, and others have before them.

For example, American Airlines now offers both a *Choice Essential* and a *Choice Plus* travel option. For an extra $68, the first option permits one free checked bag and assigns the passenger to the first group to board. The second includes the privileges of *Choice Essential* but adds in an alcoholic beverage plus 50 percent extra frequent flyer miles, now for an additional $88. Delta's *Ascend* package costs $42 extra but gives the passenger priority boarding and free wi-fi. For just $120, JetBlue offers an *Even More Space* bundle of coach ticket, extra legroom, priority boarding, and express security clearance.

Originally, these options were offered as "extras" on airline websites. A passenger trying to obtain a ticket would first see the regular coach price and then each additional perk and the extra fee it required. Increasingly, however, the airlines are simply offering the bundles right up front. Thus, a visit to the American website in search of a Boston-to-LA flight may not find the generic coach ticket at all. Instead, the customerwill see the various options—*Choice Essential*, *Choice Plus*, and so on—and have to pick one. Delta in fact is taking this bundling practice to the next level by tracking a customer's choice and designing a consumer-specific bundle for that person the next time he or she travels. Thus, having flown on Delta once already, a returning business customer may be targeted with an option that includes free wi-fi and a rental car on return.

As one might expect, these bundling efforts appear to have paid off. A number of estimates suggest that they have raised airline revenues by 10 percent. Those extra profits may be the biggest bundle of them all.

Source: S. McCartney, "Bundles of Travel Deals for Fliers," *Wall Street Journal*, January 31, 2013, p. D1.

As the French mathematical economist, Augustin Cournot, recognized over 150 years ago, this last situation may have particularly bad implications for both profit and efficiency.

Cournot's (1838) basic insight can be shown fairly simply. Suppose that the two complementary goods in question are nuts and bolts. A separate monopoly firm produces each and, to keep things simple, marginal production cost for each firm is zero. (We provide in the Appendix an alternative solution in which we allow the two firms to have different marginal costs.) The two goods are perfect complements. A consumer who wants to purchase 100 bolts also wants to purchase 100 nuts. In other words, the two goods are always consumed in the fixed proportion of one-to-one. For this reason, consumers care only about the combined price, $P_B + P_N$, in determining their demand. As you can see, the demands for the two products are clearly interrelated. The price of bolts will affect the demand for nuts and vice versa.

Suppose that the demand for nut and bolt pairs is given by the demand function

$$Q = 12 - (P_B + P_N) \tag{8.10}$$

Because consumers always buy the two goods together—one nut for every bolt—equation (8.10) also describes the separate demand facing each monopolist. That is, the bolt producer and the nut producer each face demand curves

$$
\begin{aligned}
Q_B &= 12 - (P_B + P_N) \quad \text{Bolt Demand Curve} \\
Q_N &= 12 - (P_B + P_N) \quad \text{Nut Demand Curve}
\end{aligned}
\tag{8.11}
$$

The problem with separate production is easy to see. The nut producer's pricing decision affects the bolt producer's demand curve, and vice versa. A change in the price of nuts not only changes the quantity demanded in the nut market but also in the bolt market. This implies that each firm's pricing decision has profit implications not just for itself but for the other firm as well. In other words, the pricing policy of either of the two firms imposes an externality on the other firm. In this situation, we might reasonably expect that a merger or creation of a business network to coordinate the pricing decisions of the two firms will offer significant advantages for them by at least partially correcting the market failure associated with the externality. Less obviously, but as we shall see nonetheless true, it is also possible that consumers will gain from such coordination.

Let's calculate the profit-maximizing decisions of the two firms, first without and then with coordination between them. We can rewrite the demand curves of equation (8.11) in inverse form.

$$
\begin{aligned}
P_B &= (12 - P_N) - Q_B \qquad \text{Inverse Demand Curve for Bolts} \\
P_N &= (12 - P_B) - Q_N \qquad \text{Inverse Demand Curve for Nuts}
\end{aligned}
\tag{8.12}
$$

From this we know that the marginal revenue curve facing each firm is

$$
\begin{aligned}
MR_B &= (12 - P_N) - 2Q_B \qquad \text{Bolt Marginal Revenue} \\
MR_N &= (12 - P_B) - 2Q_N \qquad \text{Nut Marginal Revenue}
\end{aligned}
\tag{8.13}
$$

Not surprisingly, just as each firm's demand curve depends on the other firm's price, so each firm's marginal revenue is affected by the other firm's price. When each firm independently maximizes its profit then each firm will choose an output where marginal revenue equals marginal cost, here assumed to be zero. So, setting each of the equations in (8.13) to zero and solving for $Q_B$ and $Q_N$ gives

$$
\begin{aligned}
Q_B &= (12 - P_N)/2 \qquad \text{Bolt Production} \\
Q_N &= (12 - P_B)/2 \qquad \text{Nut Production}
\end{aligned}
\tag{8.14}
$$

If we now substitute these outputs into the individual demand curves, we obtain each firm's optimal price as a function of the other firm's price, as follows:

$$
\begin{aligned}
P_B &= (12 - P_N)/2 \qquad \text{Bolt Price Rule} \\
P_N &= (12 - P_B)/2 \qquad \text{Nut Price Rule}
\end{aligned}
\tag{8.15}
$$

These equations show that each producer's corresponding profit-maximizing price depends on the price set by the other firm. Alternatively, the equations identify each firm's profit-maximizing choice of price given the price of the other firm's good. Whatever price is being charged by the nut firm is communicated to the bolt firm through the effect on the demand curve facing the bolt producer. If nut prices are high, the demand curve will be low. Alternatively, if nut prices are low, bolt demand will be strong. Taking the demand curve as given, the bolt producer simply picks the price–quantity combination that maximizes profits using the familiar profit-maximizing $MR = MC$ rule.

We can identify what the price equilibrium in the two markets will be by graphing equations (8.15) in a diagram with the two prices $P_B$ and $P_N$ on the axes. This is done in Figure 8.7. The more gently sloped line gives the bolt company's best choice of $P_B$ for every nut price, $P_N$. For example, if the nuts were priced at zero, the profit-maximizing bolt price would be \$6. If the nut price rises to somewhere near \$12, the profit-maximizing bolt price falls to near zero. Higher nut prices reduce bolt demand and lower the bolt firm's profit-maximizing price. The more steeply sloped line describes the same strategic choices from the perspective of the nut company. This line describes the profit-maximizing choice of $P_N$ for every choice of $P_B$.

Equilibrium occurs at the intersection. At this point, each firm has selected a price that is best given the price choice of the other firm. Accordingly, neither has an incentive to change. In order to identify this equilibrium, we substitute the equation for the nut price, for example, into the equation for the bolt price. This gives

$$P_B = \frac{1}{2}(12 - P_N) = \frac{1}{2}\left(12 - \frac{1}{2}\left(12 - P_B\right)\right) = \frac{12}{4} + \frac{P_B}{4} \text{ so that } \frac{3P_B}{4} = 3 \text{ or } P_B = 4 \tag{8.16}$$

This tells us that the profit-maximizing bolt price is $P_B = \$4$. Substituting into equation (8.15) gives the profit-maximizing nut price as $P_N = \$4$. As a result, the combined nut/bolt price is $P_B + P_N = \$8$, and from the demand equation (8.10), the number of bolt and nut pairs sold is four. The bolt firm makes profits of $P_B Q_B = \$16$, as does the nut producer.

Now consider what happens if the two firms merge and the newly combined firm markets a single, "bundled nut-and-bolt" product. Such a firm faces the joint demand curve of equation (8.10) and so recognizes that the relevant price to customers is the sum of individual bolt and nut prices, or the total price paid for the bundled nut-and-bolt product. The marginal

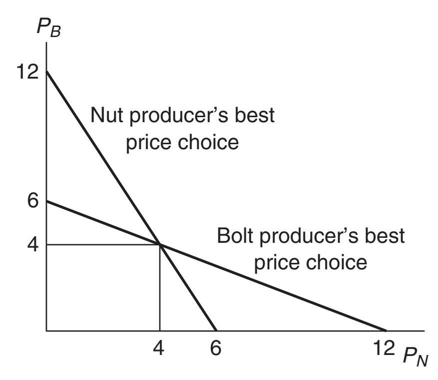


**Figure 8.7** Pricing of complementary goods: the nuts and bolts case

revenue curve associated with the demand curve of equation (8.10) is $MR = 12 - 2Q$, where $Q$ is the number of nut-and-bolt pairs sold. Equating marginal revenue with marginal cost identifies the optimal quantity of nut-and-bolt pairs to sell. Because we have assumed that marginal cost is zero, it is easy to see that the optimal quantity of nut-and-bolt pairs that the merged monopolist should offer for sale is $Q^* = 6$. The demand function then tells us that each pair can be sold at a combined price of $P^* = \$6$ (or separate prices of \$3 each). The merged firm's total profit is $P^*Q^* = \$36$.

Comparing these values with those obtained earlier, when the firms set their prices independently of each other, shows that a merger of the two firms leads to lower prices and more output than when the two firms act separately. This is because the merged firm understands the interaction of demands between the two products. As a result of coordinating nut and bolt production and pricing, consumers are made better off by this merger. Moreover, the profit of the combined firm exceeds the sum of profits earned by the two separate firms. This was Cournot's basic point.[8] By internalizing the interdependence of the two firms, both consumers and producers gain.

Merger is not the only way to achieve this outcome. Alternative means of coordinating the separate decisions of the two firms exist. For example, they could decide to form a product network. Examples include Automatic Teller Machine (ATM) networks, airline computerized reservation systems (CRS), real estate multiple-listing services (MLS), markets for interactive components such as computer CPUs and peripherals, and long-distance and local telephone services. Where they exist, such networks have been created by the joint action of many firms with the aim of taking better account of the interactions between the demands for the firms' complementary products.

Alternatively, we might hope for one or both markets to become competitive. If this happened in only one of the two markets, say bolts, then the bolt price would fall to marginal cost, which in this case was assumed equal to zero. Each firm in the bolt market would be so small that it could not possibly impose any external effects on the nut-producing monopoly. Given a zero price for bolts, equations (8.15) imply that the profit maximizing price for nuts—and therefore of a nut-and-bolt combination—would be \$6. Accordingly, this outcome would duplicate that which occurs under merger. If both markets were to become competitive, then bolt price and the nut price would each fall to marginal cost. This, of course, would yield the maximum total surplus and all of that surplus would accrue to consumers.

There is a factor that can work against the emergence of competition in markets for complementary goods. That factor is the presence of network externalities. For some goods and services, there is a scale economy effect that operates on the demand side of the market. For example, the more consumers that are connected to a phone system, the more valuable the phone system is to existing and new consumers. Each consumer who connects to the phone system generates an external benefit to all those already connected and makes the system more attractive to potential consumers. Sometimes this feature is described as a positive feedback.

Product complementarities of the sort we have been discussing here can also give rise to a positive feedback. Consider the Microsoft case. Microsoft's operating system *Windows* serves as the platform from which software applications such as word processing packages,

8 Allen (1938) made the same point with regard to the price-reducing effects of merging two complementary-goods monopolies. A calculus-based presentation of a more general form of our analysis is provided in the Appendix.

computer games, and graphic arts programs can be launched. A technical aspect of this relationship is that the code for a particular application must include an applications program interface (API) in order to work with the operating system. Typically, the API that works with one operating system will not work with another. In other words, applications such as *Stata* or *Mathematica* must be written to work on a specific operating system such as *Windows*, *Mac OS*, or *Linux*. The two products, the applications and the operating system, are therefore complements.

Two additional features of the design and production of applications programs are also important. First, their production exhibits substantial scale economies. The cost is almost entirely in the design phase. Once the underlying source code is written, the program can be put on CD-ROMs (or websites) and sold (or downloaded) to millions of consumers almost costlessly. Second, there is a network externality in that the more people use the application, the more consumers will want to use it. It is convenient to know that I can put my presentation graphics on a memory stick or in an e-mail attachment and have it read by a colleague miles away because we both use the same graphics software. For both of these reasons, firms that make these software applications have an incentive to design them to work with the most widely used operating systems because this permits the firms to exploit these supply-side and demand-side scale economies more effectively.

By exactly the same reasoning, the operating system that consumers will want the most is the one for which there are the most applications. The complementary relationship between applications and operating system has resulted in a very favorable positive feedback for Microsoft's *Windows*. As *Windows* became the dominant operating system, applications were increasingly written to run on it. In turn, this ever-expanding menu of applications greatly fortified the position of *Windows* as the dominant system. This interaction is sometimes called the *applications barrier to entry*. The idea is that any would-be rival operating system will have a great deal of difficulty entering the market. Applications producers will not have an incentive to design their products to run on the alternative system until it has a significant market share. Yet the system will never get any sizable market share unless applications are written for it.

What this analysis suggests is that there is a countervailing force to the benefits from closer coordination in the production and marketing of complementary products. Although it is generally true that coordination is profitable and, as our nut and bolt example indicates, is beneficial for consumers, when there is monopoly power in the production of the complementary goods the network effects, and the positive feedback that they generate means that monopoly power can be enhanced. This is one way in which monopoly power in one product line could be extended or leveraged to others.

## 8.4 ANTITRUST, BUNDLING, AND TIE-IN SALES

We are now in a better position to consider the antitrust issues raised by bundling and tie-ins. The main question is whether such practices may be used by firms with significant market power either to sustain or to extend that power against competitors or potential competitors. We illustrate these issues first with a review of the Microsoft case with which we opened this chapter. We then briefly discuss other cases and legal developments in this area. (See Economides and Salop (1992) for a more complete discussion.)

### 8.4.1 Bundling and the Microsoft Case

A central issue in the government's case against Microsoft was the claim that Microsoft had integrated or bundled its browser, *Internet Explorer*, directly into its operating system *Windows* as a means to eliminate the rival browser, Netscape's *Navigator*, from the market. The argument was that because Microsoft had monopoly power in the operating systems market, every consumer of *Windows* would now find *Internet Explorer* as the default browser thereby eliminating or greatly reducing Netscape's market share. To prove its claim and demonstrate a violation of the antitrust laws, the government would have to show 1) that Microsoft did possess monopoly power, 2) that an operating system and a browser were two related but distinct products that did not need to be tightly bundled, and 3) that Microsoft's practices constituted an abuse of its power motivated by the firm's desire to maintain or extend its dominant position.

In light of the foregoing, it is worthwhile recalling Judge Jackson's three key findings of fact. First, the judge found that Microsoft is indeed a monopoly in the sense of the Sherman Act. The evidence for this finding appears reasonably strong. At the time of the trial, *Windows* had over 90 percent of the operating systems market and had maintained that share of the market for well over a decade. Additionally, Microsoft's use of mixed bundling and other price discriminatory practices provided further evidence of something less than a competitive market. Both the structural and behavioral evidence provided some support to Judge Jackson's finding that Microsoft possessed monopoly power.

The judge's second finding was that an operating system and an Internet browser are two separate albeit complementary products. Microsoft had argued that a browser was really just an integrated part of a modern operating system. Just as flash bulbs that used to be sold separately had become technologically embedded in cameras themselves, Microsoft claimed that similar technological developments had led it to make its browser, *Internet Explorer*, an integral part of its *Windows* operating system. Microsoft further alleged that separation of the two could not be achieved without damaging at least one of them. However, the fact remained that Netscape still marketed its *Navigator* browser independently, suggesting that consumers did not demand an integrated operating system and browsing experience. In addition, evidence was presented at the trial showing that it was relatively easy to separate *Internet Explorer* from the operating system with which Microsoft had bundled it, without harming either product. Therefore, Judge Jackson's finding that *Windows* and *Internet Explorer* are separate products could also be justified.

In light of these first two findings, Microsoft's only remaining defense is that even though it possesses monopoly power, its practice of bundling its distinct operating system and browser products did not amount to "acting badly." In other words, arguing that its integration of *Windows* and *Internet Explorer* was not done with a view to hurt competition but instead to help consumers in order to avoid a finding that it had violated the antitrust laws. One way to make such a defense would be to pursue the coordination argument that we discussed above. That is, Microsoft might argue that the complementarity between an operating system and a browser requires coordination of the marketing of the two products in order to ensure that consumers receive both goods at low prices. Microsoft could then make a case that its behavior was in fact pro consumer.

As we saw in the previous section, the existence of a complementary relationship between two products can lead to serious inefficiencies if each product is produced by a separate monopoly. This was arguably the case in the software industry. Microsoft's *Windows* controlled the lion's share of the operating systems market and Netscape's *Navigator* dominated the complementary browser market. There was a good case to be made that some mechanism for coordinating the marketing of these two products was desirable. One way to achieve this coordination is by means of a merger of the two firms.[9] What happens, however, if one of the firms does not want to merge?

For example, suppose that Netscape feels that, as a much smaller company, any merger would amount to its being swallowed up by Microsoft and losing all its managerial independence. Its management might then decide to reject a merger proposal and to continue the separate marketing of its browser. In these circumstances, we can imagine that Microsoft might decide to create its own browser and bundle it with its operating system.

We can illustrate how the market outcome might evolve, again using our simple nut/bolt example. Suppose that the demand by consumers who want both an operating system and a web browser is given by

$$Q = 12 - (P_O + P_B). \tag{8.17}$$

where the subscripts "$O$" and "$B$" now indicate operating system and browser, respectively. Again, let us also simplify by assuming that marginal costs for both products are zero. (We noted earlier that for software, this assumption is actually quite realistic.)

Our nut/bolt example above tells us that, when operating independently, Microsoft will sell its operating systems at $P_O = \$4$ and Netscape will sell its browser at $P_B = \$4$, so that the price of a combined operating system and browser service is \$8. We also know that this is an inefficient outcome. If the two firms coordinate or become one firm, the price of a combined system falls to \$6. Total profit of the two firms would simultaneously rise.

If a merger with Netscape is rejected, Microsoft might then develop its own browser, which we also assume can be produced at a marginal cost of zero. It would then appear that Microsoft could offer the operating system at \$3 and the browser at \$3, or a package price of \$6. However, this ignores the competition from Netscape. If Microsoft proceeds with this plan, Netscape can no longer offer its browser at a price of \$4. It could, however, offer to sell its browser at a price of \$2. After all, this is still well above marginal cost. Moreover, this price is sufficiently low that consumers would then be attracted to the Netscape browser while still buying Microsoft's operating system at the price of \$3. Of course, Microsoft would then want to reduce the price of its browser, perhaps to \$1.95. Netscape would then respond by selling its browser at perhaps \$1.80, and so on.

What we have just described is an outbreak of price competition in the browser market. The ultimate effect of this price competition will be to drive the browser price to marginal cost—in this case to zero. This is certainly bad news for Netscape. What about Microsoft? A review of its optimal pricing strategy as given by equations (8.17) implies that when the browser price falls to zero, Microsoft's optimal price for operating systems rises to \$6. Further, a browser price of 0 implies that \$6 is also the best price for a combined operating system and browser package—exactly as would occur if the two firms merged. Moreover, the profit increase that a merger would bring is also realized, although it now goes entirely to Microsoft. In other words, a merger is not the only way to solve the coordination problem. Competition in one of the markets will remove the inefficiency that would otherwise result when each market is monopolized and the monopolists fail to coordinate their pricing. Prices are lower and both consumer and producer surplus have increased.

[9] In June of 1995, Microsoft did in fact offer to work cooperatively with Netscape in the browser market and, allegedly, even suggested a merger—a proposal that was rejected by Netscape.

It is insightful to note that the outcome of the "browser war" just described involves a final browser price of zero. That is, in equilibrium Microsoft sells its operating system for $6 and then throws in its browser for free. This looks very much like bundling, the only complicating factor being that Netscape is also offering a free browser and so can be expected to retain a share of the browser market.

Review of the foregoing scenario should make clear that the accusation that Microsoft bundled its browser with its operating system to exploit its monopoly power and harm competitors can be challenged. Microsoft could legitimately argue that it has simply acted in a way that promotes price competition and that the lower browser prices are just a reflection of this fact. In this view, Microsoft's actions have been pro-competitive, not anti-competitive.

There is, however, an additional aspect to the case that we must consider. This involves the interaction between complementary products and network externalities. The complementarity between operating systems and the applications written for them has created a substantial positive feedback loop for Microsoft. Because *Windows* had a monopoly in operating systems, the majority of applications were written to run on *Windows*. In turn, because most applications were written for *Windows*, no other operating system could challenge the *Windows* dominance. Internet browsers, however, offered a potential way around this problem. The advent of the JAVA programming language developed by Sun Microsystems and other technical advances make it possible to run applications on an Internet browser. The browser itself therefore can serve as a platform from which to launch applications.

If *Navigator* can serve as an applications platform, then even after the development of *Internet Explorer*, *Navigator* would be expected to retain a reasonable share of the browser market. In turn, the existence of this alternative platform with a substantial market share means that design firms could begin to write their applications to run on an alternative to *Windows*. As this happened, *Navigator* would benefit from the same positive feedback that *Windows* enjoyed. As more applications could be run from the browser, the browser would become more popular and still more applications would be written for it. Clearly, such a development would strike at the core of Microsoft's success by leading to fierce competition in the platform market. Testimony at the trial revealed that Microsoft management was both aware and fearful of this development.

In light of the foregoing, Microsoft's explicit bundling of *Internet Explorer* with its *Windows* operating system takes on a different light. Instead of a competitive act that reduces a coordination inefficiency between complementary products, Microsoft's bundling can also be viewed as a deliberate effort to reduce Netscape's share of the browser market so that the Netscape browser becomes an unattractive alternative to applications designers. In turn, this would eliminate Netscape as a threat to Microsoft's operating system monopoly. Indeed, Microsoft initially required that PC manufacturers such as Compaq and Dell, who installed *Windows* as their operating system also install *Internet Explorer* as the default browser appearing on the *Windows* desktop. They did this presumably on the supposition that most consumers want only one browser even if a second can be obtained for free. The subsequent integration of *Internet Explorer* into the *Windows* software could be viewed as an attempt to replace contractual bundling with technological bundling.

Whatever the type of bundling, however, the foregoing analysis sees the motive as the same—namely the prevention of Netscape developing a viable competitor to Microsoft. This alternative interpretation of Microsoft's behavior does imply a violation of the antitrust laws because it alleges that Microsoft abused its power primarily to sustain its monopoly, that is, to hurt competition. In support of this argument, the Justice Department offered much suggestive evidence only a portion of which we can summarize here.

First, there were internal Microsoft documents revealing management's concern over the potential threat that Netscape might pose to the dominance of *Windows* as the applications platform. Second, some additional evidence of malicious intent was that in addition to its bundling strategy that effectively required *Windows* users to acquire *Internet Explorer* as their default browser, Microsoft also pressured Macintosh to support *Internet Explorer* as its default browser. It did so by refusing to develop applications, such as its *Office* products, for the Macintosh computers unless Macintosh complied. Because Macintosh computers do not use the *Windows* operating system, this action was hard to justify as reflecting a technical improvement to *Windows* in the way that an internal flash device was an improvement to cameras. Finally, and perhaps even more damaging, was the fact that Microsoft actually paid Internet service providers such as America-On-Line (AOL) to adopt its browser and even gave AOL a space on the *Windows* desktop. Because AOL competed directly with Microsoft's own Internet service, this action is again hard to understand except as a way to foreclose the AOL market to Netscape. [See also Rubinfeld (2003)]

Ultimately, Judge Jackson found the evidence compelling that Microsoft abused its market power and used bundling to extend its dominance to the browser market. To some extent, this is what the appellate court later found as well. However, that court differed strongly with Judge Jackson regarding his opinion that the appropriate remedy for violation was to break up Microsoft into separate companies much as John D. Rockefeller's Standard Oil was broken up ninety years earlier. Instead, the court remanded the case to Judge Colleen Kollar-Kotelly who worked out a less drastic remedy based on restrictions on Microsoft's actions along with monitoring to ensure that those restrictions were enforced.[10] While this settlement went forward and the case is now over, the issues it raised remain to this day. As we noted in the introduction to this chapter, Microsoft continued to be the object of European antitrust lawsuits most notably in connection with its audio-visual software, *Media Player*. Likewise, both Google and its Android operating systems have been the focus of antitrust investigations rooted in bundling/tying and complementarities, e.g., the Android operating system and its several mobile applications.

### 8.4.2 Antitrust Policy, Bundling, and Tying: Additional Developments

The issues raised in the Microsoft case are not new. The fear that large, established firms could abuse their market power and prevent or eliminate competition is what lies at the heart of antitrust policy. As noted in Chapter 1, Section 1 of the Sherman Act explicitly proscribes monopoly power whenever its exercise weakens competition. Moreover, the subsequent Clayton Act speaks rather directly to the issue of bundling or tying: "It shall be unlawful . . . to lease (or sell) goods . . . on the condition, agreement, or understanding that the lessee or purchaser thereof shall not use or deal in the goods . . . of a competitor or competitors of the lessor or seller, where the effect . . . may be *to substantially lessen competition or tend to create a monopoly in any line of commerce*" [emphasis added]. While we postpone a formal analysis of anti-competitive tactics until Chapters 12 and 13, now is a good time to consider antitrust policy responses to the anticompetitive potential of bundling and tying.

Two key cases established a clear legal presumption against tie-in requirements. The first was the United Shoe case of 1922. As a result of over fifty mergers, the United Shoe company had emerged as the dominant maker of shoe-manufacturing machinery in the early twentieth century with a market share on the order of 80 to 90 percent. Shoe-making uses a number of machines, however, and United Shoe faced competition in at least some of these lines. In leasing its machines to shoe manufacturers, it stipulated that the manufacturers could not use any United Shoe machines in combination with those of other rival manufacturers and also that the shoe manufacturers had to buy certain supplies exclusively from United Shoe. Twenty-five years later, the court confronted a similar case with the International Salt Company. That company refused to lease its salt processing machines unless the lessee also agreed to purchase all of its salt from International Salt. In this case, the court inferred International Salt's monopoly power largely from the fact that the company had a patent on its machines. The court found that both the United Shoe and International Salt tying requirements violated the antitrust statutes.[10] In these cases and others (including one involving IBM), the court emphasized the defendant firm's monopoly power in the tying good. As a result, the conventional legal wisdom was that tying requirements imposed by large, dominant firms would almost constitute a *per se* violation of the antitrust laws.

Over the years, the court's views on tying mellowed. In part, this was the result of an important insight of the Chicago School. This insight was that tying contracts as a means of leveraging a firm's power in one market to power in another would make little sense in a wide class of cases. Recall our nut and bolt example. Assume that bolts are monopolized but nuts are competitive. As we showed earlier, the bolt monopolist would then set a price of $6 and earn a profit of $36. Suppose now that this monopoly bolt firm uses a tying clause to require the use of its own nuts and thereby extends its monopoly power to this second market, as well. We know that this would allow the firm to raise the price of nuts to say, $2. However, if it does this, the firm will need to lower the bolt price to $4 because what consumers really want is the nut-and-bolt combination and the profit-maximizing price for that combination is still $6, and the maximum profit earned is still $36. The point of this Chicago School argument is that there is a potential maximum monopoly profit in these two markets and the monopolist can get all of the profit in the bolt market if the nut market is competitive, thereby removing any incentive to extend its monopoly to nuts via a tying requirement.

As both the Nalebuff (2007) theoretical model and the historical practice revealed by the Microsoftcase shows, however, there is a qualification to this argument. When the market for the tied good involves substantial scale or scope economies, an incumbent can use tying (and bundling) and so leverage power from one market into another and can do so profitably. Strategic use of these practices by an incumbent can serve to deny these economies to rivals and potential entrants and thereby weaken or eliminate their ability to compete in either of the tied good markets. As a result, the incumbent can preserve and increase its profits by reaping those economies for itself.

Recognition that the leverage of market power may sometimes be anticompetitive has led the court to move cautiously in relaxing its earlier strict rules against tying and bundling. In 1960, the Supreme Court accepted the use of a tied-sales clause in a case involving Jerrold Electronics Corporation, a pioneer in cable television systems and the community antenna television (CATV) industry, because it felt that this was a legitimate way of guaranteeing quality performance of a service in the early, developmental stage of an

[10] *United Shoe Machinery Corp*. v. *United States*, 258 U.S. 451 *International Salt Co. v. United States*, 332 U.S. 392 (1947). Peterman (1979) argues that the fact that firms were allowed to use salt from producers other than International Salt if it was cheaper suggests that the real purpose of the tying was to reveal to International Salt the pricing practices of its rivals.

industry.[11] Subsequently, in the 1984 *Jefferson Parish* case, the Supreme Court attempted to articulate a clear set of guidelines under which any such arrangement would be *per se* illegal. The case involved a requirement by the Jefferson Parish Hospital that to use its surgical services it was necessary to use the group of anesthesiologists with whom the hospital had an exclusive contract. In its decision, which found for the hospital, the Court stated three conditions, all of which would have to be met for the tie-in to violate antitrust laws.[12] These are

1. the existence of two distinct products, the tying product and the tied one;
2. the firm tying the products must have sufficient monopoly power in the tying market to force the purchase of the tied good; and
3. the tying arrangement must foreclose, or have the potential to foreclose, a substantial volume of trade.

The logic behind these conditions is clear enough. It would be wrong, for example, to consider a computer and its power cord as two separate products and then claim illegal tying. Likewise, the anticompetitive abuse of market power is only plausible if a firm has such power in the first place. Yet the result of these efforts in practice has been a curious mixture of *per se* and rule of reason standards. On the one hand, the *Jefferson Parish* standards are meant to establish conditions under which bundling and tying are *per se* illegal. On the other hand, the interpretation of those standards is open to enough variation that a sort of rule of reason has emerged about whether they apply. Despite this ambiguity, it remains the case that tying arrangements tend to be viewed more harshly than bundling arrnagements by the anti-trust authorities. One result has been that plaintiffs may attempt to argue that a bundling pratice is actually a tying arrangement.

One troubling feature of the foregoing judicial history is that so little attention has been paid to cost-based reasons for bundling and tying. Yet there can be little doubt that such cost-efficiencies are present. This is because we see bundling and tying requirements in many competitive situations where neither price discrimination nor the extension of monopoly power can be the motive. This point has been particularly emphasized in a series of papers by Evans and Salinger (2005) and Evans (2006).

To understand the intuition of the Evans and Salinger (2005) argument, consider the case of head cold remedies. Some cold sufferers primarily endure headaches and sore throats. For these consumers, the main treatment they want is pain relief. Others, however, find sinus congestion and irritation to be the main aggravating symptoms. These consumers want a decongestant in their cold remedy. Of course, there is also a third group that wants both a pain reliever and a decongestant.

As a specific example, let us assume that there are 50 people in each of the first two groups and 100 in the third. Members of each group have a sufficiently high reservation price that they will always buy the product. Let us also assume that to produce, package, and market each cold remedy drug for this market incurs a fixed cost of $300. Further, assume that the marginal cost of producing and packaging either a bottle of pain relief medicine or a package of decongestants is $4, but that there are some marginal cost savings in putting the two in one pill so that the marginal cost of a combined, pain reliever and

[11] *United States v. Jerrold Corporation*, 187 F. Supp. 545 (1960), affirmed *per curiam* at 363 U.S. 567 (1961).

[12] *Hyde v. Jefferson Parish Hospital District No. 2, et al.*, 466 U.S. 2, 15–18 (1984).

decongestant product is just \$7. Finally, rather than assume a perfectly competitive market, we will assume that there is just one firm. However, we will also assume that entry is easy and costless so that that firm is constrained to offer products at prices that just permit it to break even. Table 8.7, below shows the possible product offerings and the associated zero-profit prices.

Let's first think about our firm just offering the pain reliever and the decongestant separately. The first group of consumers will buy the pain reliever, the second will buy the decongestant, and the third group will want to buy both products. So, demand for each product is 150 implying an average fixed cost for each drug of $\$300/150 = \$2$. When added to the marginal cost of \$4, the break-even price is \$6. However, this outcome is not an equilibrium. Any firm could enter the market and sell just the bundle for \$10.00. This would attract all of the 100 consumers who want a combined medication, because they currently pay $\$6 + \$6 = \$12$ to get both types of relief. In turn, the loss of these customers would make the continued offering of the two separate products at a price of \$6 impossible as the average cost of each of these would now rise to \$10. Indeed, because this price is the same as the bundle price, we might imagine that some of these consumers will actually buy the bundle as it gives them the relief they want plus a little something extra. As this happens, however, the bundle price falls further due to additional fixed cost savings while the individual prices must rise further. This will push all 200 customers to buy the bundle at which point the break-even price for the bundle drops to \$8.50. This is, in fact, the only sustainable price and product combination. It is therefore the equilibrium in this imperfectly competitive but contestable market.[13]

The scenario just described is worth some reflection. Competitive pressures police the market and force prices to equal costs. Even so, the firm in the market offers only the two goods, pain reliever and decongestant, together in one package. No consumer can buy this firm's pain relief medicine without also buying its decongestant. This is definitely a case of tying. Yet the tying is not done either to price discriminate or to extend monopoly power. It is simply another result of the competitive pressure to offer low-cost medication.

The idea that competition underlies much of the tying and bundling we observe is precisely the point that Evans and Salinger (2005) and Evans (2006) make. In their view,

**Table 8.7** Pure bundling as the sustainable equilibrium

| *Demand Volume* | *Product* | | |
|---|---|---|---|
| | *Pain Relief 50* | *Decongestant 50* | *Bundle 100* |
| *Costs* | | | |
| Fixed Cost | \$300 | \$300 | \$300 |
| Marginal Cost | \$4 | \$4 | \$7 |
| *Possible Prices Under:* | | | |
| Separate Goods | \$6 | \$6 | — |
| Pure Bundling | — | — | \$8.5 |
| Mixed Bundling | \$10 | \$10 | \$10 |
| Bundle and Good 1 | \$10 | — | \$9 |
| Bundle and Good 2 | — | \$10 | \$9 |

13 A review of Table 8.7 will make it clear why either mixed bundling or offering a bundle and one good separately also cannot be an equilibrium.

these practices are far too common to be explained either by price discrimination or monopolization motives. They note as well that even when price discrimination is the cause, the market outcome does not merit policy intervention. Hence, the only time that tying or bundling is definitely harmful is when it is used for leveraging market power. Given that some large scale and possibly scope economies are required to make the leveraging argument powerful, these authors and others have argued that all attempts at a *per se* illegal rule is misguided. Instead, they call for an explicit use of a rule of reason with a general presumption that the tying is legal unless the intent and ability to extend market power is explicitly shown.

## 8.5 EMPIRICAL APPLICATION: BUNDLING IN CABLE TV

As we have seen, the enhanced profitability that a firm with market power can gain from bundling stems from reducing the variation in consumers' willingness to pay. As a result, selling the bundle to a large range of consumers requires a much smaller price reduction than selling each product individually to an equally large group. In other words, bundling makes demand more sensitive to prices—more price elastic.

The prediction that bundling makes demand more elastic and that, as a result, it can be used to enhance a firm's profit is examined in recent work by economist Gregory Crawford (2008) in the specific case of cable television. The intuition is straightforward. Any one cable channel is likely to have some viewers who like it a lot and are willing to pay a great deal for it and others who do not value it very much and are not willing to pay much at all for its inclusion as part of a cable service. Hence, by combining more stations in its Basic Service offering, the cable service provider eliminates the extreme values and shrinks the dispersion of the customer population's willingness to pay for the overall bundle.

For example, a useful measure of dispersion of a variable is the coefficient of variation defined as the ratio of a variable's standard deviation to its mean. Let consumer $i$ have a willingness to pay for network $j$ be of $\alpha_{ij}$ and let this be distributed normally across the population of consumers with a mean $\overline{\alpha}$ and variance $\sigma^2$, common to all networks. For a cable service that includes $n$ networks, consumer $i$'s willingness to pay for the entire cable service $V_i$ is therefore:

$$V_i = \sum_{j=1}^{n} \alpha_{ij} \tag{8.18}$$

Of course, the average willingness to pay for the cable network will just be: $\overline{V} = n\overline{\alpha}$.

If we assume that each $\alpha_{ij}$ is distributed independently, then the standard deviation of the total willingness to pay $V_i$ will be given by $\sigma\sqrt{n}$. Hence, the coefficient of variation for the $V_i$ will be:

$$\text{Coefficient of Variation} = \frac{\sigma\sqrt{n}}{n\overline{\alpha}} = \frac{\sigma}{\overline{\alpha}\sqrt{n}} \tag{8.19}$$

This clearly shrinks as the number $n$ of cable stations bundled together in the package increases. Moreover, this shrinkage will be even greater if, instead of independent station valuations, the valuations for at least some of the stations are negatively correlated. That is, if those customers who tend to have either very high or very low valuations for say, station 1, have inversely, very low or very high valuations for station 2, then putting these two stations together in one cable package will shrink the variation of the bundle even more.

Crawford (2008) investigates these effects using data from 1,159 cable systems offered across the United States in 1996. Cable service operators typically offer different types of bundled packages. One of these is a Basic Service package that usually includes the major broadcast networks such as ABC, CBS, FOX, and NBC as well as cable networks such as ESPN, CNN, and MTV. In more recent years, the Basic Services package has been further differentiated into one limited bundle that hast just a subset of broadcast and cable networks, and an Expanded Basic Services that includes a larger collection of such networks. In addition, cable operators also typically offer unbundled premium channels such as HBO to which customers may subscribe in addition to either a Basic or Expanded Basic Service. However, it is the fixed bundle of which the component stations are only accessible as part of that complete package that is the focus of Crawford's (2008) investigation.

Specifically, Crawford (2008) estimates a demand for cable services equation with a view to testing two hypotheses. First, does demand grow more elastic as additional networks are added to the bundle? Second, is the increase in elasticity particularly large when a network whose valuations are likely to be negatively correlated with those of other networks are added to the bundle?

The essential details of Crawford's (2008) approach are as follows. For the period covered by his data, the fifteen most important cable networks are: WTBS, the Discovery Channel, ESPN, USA, CSPAN, TNT, the Family Channel, the Nashville Channel, Lifetime, CNN, A&E, the Weather Channel, QVC, the Learning Channel, and MTV. Most Basic Service (or Expanded Basic Service) packages offer some of these in addition to broadcast networks. Some offer all of them. Note that some of these cable networks are not general interest stations but instead appeal to a narrow consumer interest. Thus, MTV caters to young adults while Lifetime focuses primarily on the concerns of adult women. It is these special interest channels for which consumer values are most likely to be negatively related to the consumer valuations of the general interest stations. Thus, it is especially as these stations are included that the elasticity of demand ought to increase.

Crawford (2008) therefore specifies a cable service demand equation as follows:

$$w^*_{sn} = X'_{sn}\beta + D'_n\theta_s + (\alpha_s + X'_{sn}\gamma + D'_n\theta^p)p_{sn} + u_{sn} \tag{8.20}$$

Here, $w^*_{sn}$ is a measure of the share of consumers in market $n$ who subscribe to cable system $s$; $X'_{sn}$ is a vector indicating which of the fifteen important cable networks system $s$ carries; $D'_n$ measures demographic characteristics of the population in market $n$, such as age, education, etc.; $p_{sn}$ is the price of service $s$ in market $n$; and $u_{sn}$ is a random error term reflecting unobserved factors that affect demand for cable services. Note that the individual stations—the $X'_{sn}$—have two effects on demand. They shift the *level* of demand, as indicated by the coefficients in the vector $\beta$, as well as materially alter the effect that impact that the system price $p_{sn}$ has on cable demand via the coefficient vector $\gamma$. If the addition of a cable station makes demand more elastic—more sensitive to price—then the $\gamma$ estimates should be negative. Crawford's (2008) basic estimates and their implications for demand elasticity are shown in Table 8.8 below. The values in bold indicate the statistically significant estimates.

Of course, changes in the level of demand and changes in the slope will each affect the estimated price elasticity. For our purposes then, the third column of Table 8.7 is the critical one. It shows the ultimate impact on the demand elasticity when both the level and slope

**Table 8.8** Impact of cable stations on elasticity of demand for bundled cable services (basic or expanded basic services (standard errors in parentheses)*

| *Variable* | *Level Effect* | *Slope Effect* | *Elasticity Effect* |
|---|---|---|---|
| WTBS | **1.14** | **−0.06** | **−0.53** |
| | (0.19) | (0.01) | (0.11) |
| Discovery | 0.07 | −0.01 | −0.04 |
| | (0.12) | (0.01) | (0.07) |
| ESPN | **0.58** | **−0.06** | **−0.40** |
| | (0.23) | (0.02) | (0.05) |
| USA | −0.19 | 0.01 | 0.10 |
| | (0.14) | (0.01) | (0.09) |
| CSPAN | **0.47** | **−0.03** | **−0.22** |
| | (0.23) | (0.01) | (0.10) |
| TNT | **0.28** | **−0.02** | **−0.14** |
| | (0.13) | (0.01) | (0.06) |
| Family | 0.02 | −0.01 | −0.02 |
| | (0.15) | (0.01) | (0.08) |
| Nashville | 0.10 | −0.01 | **−0.12** |
| | (0.13) | (0.01) | (0.07) |
| Lifetime | **0.28** | **−0.02** | **−0.25** |
| | (0.17) | (0.01) | (0.07) |
| CNN | **0.32** | **−0.03** | **−0.23** |
| | (0.14) | (0.01) | (0.08) |
| A&E | −0.33 | 0.01 | 0.07 |
| | (0.23) | (0.01) | (0.09) |
| Weather | −0.10 | 0.00 | 0.01 |
| | (0.14) | (0.01) | (0.04) |
| QVC | 0.09 | −0.01 | **−0.18** |
| | (0.20) | (0.01) | (0.09) |
| Learning | **0.71** | **−0.05** | **−0.47** |
| | (0.33) | (0.02) | (0.15) |
| MTV | −0.23 | 0.01 | 0.00 |
| | (0.25) | (0.01) | (0.13) |
| Other Networks | −0.14 | — | — |
| | (0.03) | | |
| Bundle Size | — | 0.72 | — |
| | | (0.18) | |
| Average Top 15 Effect | **0.21** | **−0.02** | **−0.16** |
| | (0.03) | (0.00) | (0.04) |

*Instrumental variables used for the potentially endogenous price term.

effects are taken into account. Here, the price elasticity of demand is taken as a negative number. So, anything that makes that elasticity significantly more negative makes demand more sensitive to price—precisely the hypothesized effect for bundling.

It is easy to see that eleven of the fifteen major cable offerings increase the price elasticity of cable service demand and that for nine of these this effect is statistically significant.

This is of course precisely what is predicted by the bundling literature. Overall, the average effect across all of the top fifteen stations is to raise the absolute value of elasticity by 0.16.

It is also noteworthy that the strongest elasticity-raising effects come from those cable stations catering to specialized tastes. Crawford (2008) identifies TBS, USA, TNT, Family Channel, A&E, and the Nashville Network as largely general interest channels, while Discovery, ESPN, Lifetime, the Weather Channel, QVC, MTV, and the Learning Channel all serve consumers with more specialized interests. Indeed, Crawford's (2008) estimates imply that the average elasticity effect of adding one of the specialized networks to the basic cable service is to increase (in absolute terms) the elasticity by a very significant 0.197. In contrast, adding one of the general interest stations has a much more modest and insignificant effect of increasing that elasticity by 0.1. Again, this is precisely what the theory predicts.

In short, Crawford's (2008) analysis suggests that cable service companies know what they are doing when they bundle channels together and offer them as either a Basic Services or Expanded Basic Services package. Moreover, this bundling pays off. Recall our simple model of consumer preferences and willingness to pay for each of the separate stations.

Crawford's next step is to take the elasticity effects shown in Table 8.7 above and to work out the ultimate profit and consumer surplus that are consistent with each of those effects. Given his estimates, he focuses this exercise on the effects of adding one of the top, special interest cable interest networks to the cable operator's bundle. He finds that this typically raises the firm's profit by 4.7 percent while reducing consumer surplus by 5 percent. Thus, as with most price discrimination schemes, producers gain and consumers lose. In Crawford's model, producer surplus is a bit larger to begin with so the overall surplus increases slightly. Bundling hurts those consumers who really only care about access to a few stations but who end up buying the entire bundle to get them. Again, this is what economic theory predicts.

## Summary

In this chapter, we have shown that a firm with monopoly power in more than one product line may have additional opportunities to price discriminate. By bundling its two goods together as a package or, more generally, by tying the sale of one good to the purchase of the other, the firm can induce customers to sort themselves out by their purchase and *ex post* identify who is who. This permits charging a higher net price to those consumers with a greater willingness to pay.

In the case of two complementary products for which a fall in the price of one good raises the quantity demanded of both, sales coordination may occur for reasons other than price discrimination. In the absence of such coordination through a merger or a business network, for example, the separate production and marketing of two complementary products will typically raise prices, reduce output, and reduce profits. By taking account of the interrelationship between the demand for each product, coordination potentially offers benefits to both consumers and firms alike.

There can, however, be a downside to both bundling and tie-in sales. In cases in which large scale economies are present, these strategies may enable a firm to extend its market power in one product to another product line. Indeed, our analysis shows that bundling can be a powerful and credible entry-deterring practice. This was the charge against Microsoft, and it is the central issue in antitrust cases involving tie-in requirements.

However, it is worthwhile recognizing that some fairly strong market conditions have to be met for this outcome to prevail. It is equally worthwhile to remember that much of the tying and bundling occurs in fairly competitive markets. In such cases, there is some presumption that the practices are cost efficient. It follows that when we observe firms with market power using the same tactics, the goal of cost minimization may again be the reason.

So far, our analysis has focused on the strategic choices of a monopoly firm either acting alone or interacting in a second market that is also monopolized. The next step is to consider firms' strategies in the context of imperfect competition where there are just a few firms interacting as opposed to one or many. In such a setting, a firm can no longer simply address the issue of how to extract greater surplus from consumers. Each firm must now also consider how its production and pricing strategies affect not just consumers but the other rival firms. This is the stuff of game theory and it is to this topic that we turn next.

## Problems

1. A university has determined that its students fall into two categories when it comes to room and board demand. University planners call these two types Sleepers and Eaters. The reservation prices for a dormitory room and the basic meal plan of the two types are as follows:

| | Sleepers | Eaters |
|---|---|---|
| Dorm Room | \$5,500 | \$3,000 |
| Meal Plan | \$2,500 | \$6,000 |

   Currently, the university offers students the option of selecting just the dorm room at \$3,000, just the meal plan at \$2,500, or both for a total price of \$5,500. An economic consultant advises the university to stop offering the two goods separately and, instead, to sell them only as a single, combined room and board package. Explain the consultant's strategy and determine what price the university should set for the combined product.

2. Bundling is not always superior to non-bundling. To see this, consider a telecommunications firm that offers both phone service and a high-speed modem service. It has two types of consumers who differ in their willingness to pay a monthly rental fee for either service.

| | Talkers | Hackers |
|---|---|---|
| Phone Service | \$30 | \$$a$ |
| High-Speed Connection | \$16 | \$24 |

   Determine for what values of $a$ bundling would be more profitable than not bundling.

3. Many years ago, the major alternative to xerography in copying was the Electrofax copying process. Electrofax machines used a special paper coated with a heavy wax film. Like Xerox, the Electrofax companies charged a low price for the use of the machine but set a paper price per page of 4 cents. The actual and marginal cost of manufacturing the paper was, in fact, only 1 cent per page.
   a. Explain the pricing policy of the Electrofax producers.
   b. The high markup on Electrofax paper soon attracted new firms offering to supply the paper at a much lower price than the Electrofax producers. How do you think Electrofax would respond to this competition?

4. Computer software, S, and hardware, H, are complementary products used to produce computer services. Customers make a one-time purchase of hardware, but buy various amounts of software. That is, once the hardware is purchased, the price of additional computer services is $P_S$, the price of a unit of software. The software market is competitive. However, the hardware market is monopolized by the firm, HAL, Inc. The cost of producing software and hardware is $c_S$ and $c_H$, respectively:
   a. Assume that all users of computer services are alike, that is, have the same demand curve for computer services. Use a graph to describe the profit-maximizing price HAL can charge.
   b. Would HAL gain anything by buying software at the competitive price, branding it as its own, and then selling its hardware only to customers who use the HAL-brand software?

5. LRW runs a railroad line from New York to Philadelphia, the LRW line. At present, fixed costs are reasonably large, making it difficult for others to enter the market. Later, Nat Skape discovers that there is a market for travel from Philadelphia to Washington that is sufficiently large to permit offering passenger service between these two cities. His service is called the NSRR. Over time, both the LRW Line and the NSRR learn that many, though not all, of the customers riding from Philadelphia to Washington are actually passengers who originated in New York.
   a. What pricing issues arise between the LRW Line and the NSRR?
   b. Imagine that once it has incurred the sunk costs of setting up the Philadelphia to Washington line, it is possible that with a little experience, NSRR may be able to enter successfully the New York to Philadelphia market. Imagine further that before such entry occurs, the LRW Line builds an extension to Washington and offers riders from New York the advantage of service to Washington without the need to change trains. How should antitrust policy makers respond to this development?
6. Return to Table 8.6. What would be the equilibrium product offering and associate prices if:
   a. All values were unchanged except that there are now 100 consumers in each of the first two groups and only 50 in the group that wants both a pain reliever and a decongestant?
   b. All values were unchanged except that there are now 100 consumers who want pain relief, 100 who want both pain relief and a decongestant, but just 50 who want only a decongestant?
7. Return to the Nalebuff model. Assume that marginal cost of producing products 1 and 2 are both $c$ per unit and of producing the bundle is $2c$ per unit.
   a. Derive the monopoly prices with no bundling and with pure bundling.
   b. Identify a constraint on $c$ such that $p_B < 1$.
   c. Compare profits with and without pure bundling.

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**Appendix**

# Bundling, Entry Deterrence, and Optimal Pricing

## OPTIMAL PURE BUNDLE PRICE

From equation (8.3)

$$q_B(p_B) = D - Dp_B^2/2 = (1 - p_B^2/2) \tag{8A.1}$$

and profit from the pure bundling strategy from equation (8.4)

$$\pi_B(p_B) = Dp_B(1 - p_B^2/2) \tag{8A.2}$$

Maximization of $\pi_B$ with respect to $p_B$ yields: $p_B = \sqrt{2/3} = 0.816$.

## ENTRY-DETERRING LIMIT PRICE

From equation (8.5) the profit of the entrant is:

$$\pi_{\mathrm{E}} = Dp_2(1 - p_2) - F \tag{8A.3}$$

Equating this to zero using the substitution $f = F/D$ gives:

$$p_2^2 - p_2 + f = 0$$

The solution to this consistent with the constraint $p_2 < 1$:

$$p_2^{nd} = \frac{1 - \sqrt{1 - 4f}}{2} = \frac{1}{2}(1 - \sqrt{1 - 4f}) \tag{8A.4}$$

## OPTIMAL ENTRY PRICE WITH PURE BUNDLING

If the incumbent adopts pure bundling with bundle price $p_B$, the entrant's profit equation (8.9) is:

$$\pi_E = Dp_2(1 - p_2)(p_B - p_2) - F. \tag{8.A5}$$

Maximizing this with respect to $p_2$ again yields a quadratic equation with relevant solution:

$$p_2^b = \frac{1}{3}(1 + p_b - \sqrt{1 - p_b + p_b^2}) \tag{8A.6}$$

## OPTIMAL MIXED BUNDLING PRICES

From Figure 8.6, mixed bundling splits consumers into four groups: those who purchase only product 1, those who purchase only product 2, those who purchase the bundle and those who purchase nothing.

Consumers who purchase only product 1 are those in the rectangle *dab* whose area is $(1-p_1)(p_b-p_1)$. Consumers who purchase only product 2 are those in the rectangle *hef* whose area is $(1-p_2)(p_b-p_2)$. Consumers who purchase the bundle lie in the market area *deah*, which is defined by the rectangle of area $(1-(p_b-p_1))(1-(p_b-p_2))$ minus the triangle of area $(p_1-(p_b-p_2))(p_2-(p_b-p_1))/2$. It follows that the profit from mixed bundling is given by:

$$\pi_{mb} = D\begin{bmatrix} p_1\left(1-p_1\right)(p_b-p_1)+ \\ p_2(1-p_2)(p_b-p_2)+ \\ p_b((1-(p_b-p_1))(1-(p_b-p_2))-(p_1-(p_b-p_2))(p_2-(p_b-p_1))/2) \end{bmatrix} \tag{8A.7}$$

Differentiating with respect to $p_1$, $p_2$, and $p_b$ gives the three first-order conditions

$$\begin{aligned} \frac{\partial\pi_{mb}}{\partial p_1} &= (p_b-p_1)(2-3p_1)=0 \\ \frac{\partial\pi_{mb}}{\partial p_2} &= (p_b-p_2)(2-3p_2)=0 \\ \frac{\partial\pi_{mb}}{\partial p_b} &= \frac{1}{2}(2+4p_1-3p_1^2+4p_2-3p_2^2-8p_b+3p_b^2)=0 \end{aligned} \tag{8A.8}$$

The first two equations imply $p_1=p_2=2/3$. Substitution into the third equation then implies:

$$\frac{3p_b^2}{2}-4p_b+\frac{7}{3}=0 \tag{8A.9}$$

which gives the bundle price $p_b=(4-\sqrt{2})/3=0.862$ implying that profit $=0.549D$.

## FIRMS WITH COMPLEMENTARY GOODS AND NONZERO MARGINAL COSTS

Let demand for nuts and bolts be: $Q_N=Q_B=A-P_N-P_B$. Let marginal cost of the nut and bolt production be $c_N$ and $c_B$ respectively. With separate production, profit of the nut producer is: $\pi_N=(P_N-c_N)Q_N=(P_N-c_N)(A-P_N-P_B)$. Maximization with respect $P_N$ yields:

$$P_N=(A+c_N-P_B)/2 \tag{8A.10}$$

By symmetry it follows immediately that the profit-maximizing bolt-pricing rule is:

$$P_B = (A + c_B - P_N)/2 \tag{8A.11}$$

Jointly solving (8A.10) and (8A.11) yields:

$$P_N = \frac{A + 2c_N - c_B}{3}; \quad \text{and} \quad P_B = \frac{A + 2c_B - c_N}{3} \tag{8A.12}$$

If the two firms merge, their joint profit is:

$$\pi_M = (P - c_N - c_B)(A - P) \tag{8A.13}$$

Maximization with respect to $P$ yields:

$$P = \frac{A + c_n + c_B}{2} \tag{8A.14}$$

Comparison of this price $P$ with the sum of $P_N$ and $P_B$ in (8A.12) reveals that $P$ is lower by $\frac{A - c_n - c_B}{6}$, while profits are higher. Both consumers and producers gain from coordinating the prices of these two complementary goods.

# Part Three
# Strategic Interaction and Basic Oligopoly Models

In the next three chapters, we present our analysis of markets populated by just a few firms, that is, oligopolies. In such a setting, the actions of any one firm can change the market environment, for example the market price, not just for itself but for all firms. Thus, such actions will induce reactions that will in turn prompt further actions, and so on. This interaction is of course recognized by each firm and plays a crucial role in determining each firm's strategic choices. Because game theory is the formal framework for analysis of strategic interaction, the next three chapters present the basic game theoretic models of oligopoly behavior.

In Chapter 9, we present the Nash equilibrium concept. We then develop the Cournot model of quantity competition and show that it is consistent with the Nash equilibrium concept, even as the number of firms expands beyond two and differences in costs emerge between them. We conclude with an empirical application based on the Brander and Zhang (1990) paper that supports the modeling of airline competition as consistent with the Cournot predictions.

An important insight of game theory is that the outcome of any game is heavily dependent on the rules of the game. In the Cournot model, firms compete in quantities or production levels. Chapter 10 therefore presents the major rival to the Cournot model, namely, the Bertrand model, which assumes firms compete in prices. Because price competition can be particularly fierce when firms sell homogenous goods, the Bertrand assumption also gives firms an important motivation for differentiating their products. Hence, we also use this chapter to introduce price competition in the spatial setting first considered by Hotelling (1929). We explore price competition in a setting of differentiated consumer tastes by reviewing Hasting's (2004) empirical study of gasoline prices in southern California in the 1990s.

Finally, in Chapter 11, we consider a different alteration of the Cournot analysis, namely, the order of play. The Stackelberg model of Chapter 11 retains the Cournot assumption of quantity competition but now assumes that one firm plays first, i.e., chooses its production level before its rivals. This permits consideration of the benefits of incumbency and first mover advantages, more generally. We then discuss the experimental work of Huck Müller, and Normann (2001), providing experimental evidence on the Stackelberg versus the Cournot model.