reliance on documented cost savings as a justification of a merger. With this change, the antitrust authorities have indicated an increased willingness to judge a merger to be pro-competitive if it generates cost savings that are likely to translate into lower consumer prices. As we have already noted, however, most analysis finds that the cost savings necessary to generate lower prices are substantial. Hence, the full implication of the 1997 cost efficiencies amendment is yet to be seen.

We should also note that merger-generated cost efficiencies are not necessarily completely beneficial once entry possibilities are considered. If a merger generates lower marginal costs, then any potential entrant will know that *if it enters* price competition will be relatively fierce. If the entrant has fixed costs, this will mean that the market will need to be larger for entry to be profitable. In other words, for a given market size, merger-generated cost efficiencies make post-merger entry less likely. Thus, cost savings can have two price effects. One is the downward pressure on prices exerted by lower costs while the other is the upward pressure exerted by the reduced likelihood of rival entry. Cabral (2003) shows that it is possible that the former outweighs the latter.

15.7 EMPIRICAL APPLICATION: EVALUATING THE IMPACT OF MERGERS WITH COMPUTER SIMULATION

In recent years, the important new tool of merger simulation has emerged to assist with the evaluation of mergers. Merger simulation as pioneered by Werden and Froeb (1994, 2002) and extended recently by Epstein and Rubinfeld (2002) works in two steps. The first is to obtain relevant information on such variables as firms' costs, prices, and demand elasticities, among others. This is usually accomplished with the aid of modern econometric techniques. The second step is to use this evidence to run computer-simulated models of the market in question both before and after a proposed merger. In effect, merger simulation allows economists to conduct laboratory experiments to examine a merger's likely effects. While not necessarily conclusive, such experiments can be very helpful as an evaluative tool.

To understand merger simulation better, consider an industry with four firms, each of which produces a differentiated product and competes in prices against its rivals. For any one firm, the first-order condition for profit maximization is effectively the Lerner condition. That is,

$$\frac{p_i - c}{p_i} + \frac{1}{\eta_{ii}} = 0 \qquad i = 1 \text{ to } 4 \tag{15.41}$$

Here, η_{ii} is the (negative of) the elasticity of the firm i's demand with respect to its own price. If we denote the price-cost margin term as μ_i; firm i's market share as s_i; and then multiply through by the elasticity of demand, equation (15.41) becomes:

$$s_i + s_i\eta_{ii}\mu_i = 0 \tag{15.42}$$

If two firms merge, however, the first-order condition will change as we saw in Section 15.5. Now, the merged firm will coordinate the prices of its two separate products by taking account of the cross demand effects between the two products. Specifically, assume that firms 1 and 2 merge. Then it is straightforward to show that for the merged firm, the first-order condition is:

$$s_1 + s_1\eta_{11}\mu_1 + s_2\mu_2\eta_{21} = 0$$
$$s_2 + s_2\eta_{22}\mu_2 + s_1\mu_2\eta_{12} = 0 \qquad (15.43)$$

where η_{ij} is the cross-elasticity of good i with respect to the price of good j. It is clear from equations (15.42) and (15.43) that measures of the own and cross-price elasticities for each good are critical to estimating the impact of a proposed merger. Indeed, once these elasticities are known, it is relatively straightforward to work out the implied post-merger equilibrium and, therefore, the post-merger prices.

In order to estimate the elasticities, one needs a model of market demand. One commonly used model is derived from what is referred to as the Almost Ideal Demand System (AIDS) as first described by Deaton and Mulbauer (1980). Essentially, such a system describes the demand facing each firm as a function of its own price and the prices charged by other firms, similar to the linear demand that we used to describe our initial model of Bertrand competition with differentiated products. In the case of our four-firm example above, a conventional approach would be to describe market demand with a system of equations something like the following:

$$s_1 = a_1 + b_{11}\ln p_1 + b_{12}\ln p_2 + b_{13}\ln p_3 + b_{14}\ln p_4$$
$$s_2 = a_2 + b_{21}\ln p_1 + b_{22}\ln p_2 + b_{23}\ln p_3 + b_{24}\ln p_4$$
$$s_3 = a_3 + b_{31}\ln p_1 + b_{32}\ln p_2 + b_{33}\ln p_3 + b_{34}\ln p_4$$
$$s_4 = a_4 + b_{41}\ln p_1 + b_{42}\ln p_2 + b_{43}\ln p_3 + b_{44}\ln p_4 \qquad (15.44)$$

The b_{ij} coefficients in the above system are directly linked to the demand elasticities needed to run the merger simulation. Thus, econometric estimation of those coefficients is the first step in obtaining a simulated outcome.

Not counting the a_i coefficients or intercepts, this still leaves 16 b_{ij} coefficients to estimate even in our small four-product example. In general, unless some restrictions are imposed on the nature of the own and cross-price effects, there will be on the order of n^2 coefficients to estimate in a general n-product demand system of the type illustrated above. This is a rather large number of estimates to make with any degree of precision. To simplify matters, it is common to impose restrictions that reduce the number of parameters to be estimated directly.

For example, suppose that our four-firm example is characterized by $q_1 = 250$; $q_2 = 100$; $q_3 = 100$; and $q_4 = 50$, or $s_1 = 50$ percent; $s_2 = s_3 = 20$ percent; and $s_4 = 10$ percent. One way to proceed is to calibrate the model under the assumption of proportionality. As developed by Epstein and Rubinfeld (2002), Proportionally Calibrated AIDS (PCAIDS) assumes that the output loss for good 1 caused by an increase in p_1 will be allocated to the other products in proportion to their market shares. Suppose that the overall elasticity of market demand $\eta = -2$ and the own price elasticity of good 1 is $\eta = -4$. If we think of the overall industry price as the share-weighted average price across the four firms, then a 1 percent increase in firm 1's price p_1 translates into a ½ percent increase in the industry price, all else equal. Firm 1's price increase will then reduce industry output by ½ of 2 percent, or by 1 percent, which in this case is five units. Firm 1's own output will fall by 4 percent, or ten units. Thus, five of these ten units will be picked up in the demand for the other firms if the net industry demand decline is to be just five units. The proportionality assumption is that $[0.2/(0.2 + 0.2 + 0.1)] \times 5$ or 2 units will be diverted to each of firms 2 and 3, while the remaining one unit will be diverted to firm 4. Note that this implies that a 1 percent increase in firm 1's price will raise the demand at each of the other firms by 2 percent, i.e., the cross elasticities η_{21}, η_{31}, and η_{41} are -2 in each case.

What we have just shown is that with the proportionality restriction, the knowledge of just the market demand elasticity and firm 1's own price elasticity has permitted us to deduce three other of the elasticity measures needed for simulation. As it turns out, we can go much farther. In fact, the proportionality assumption permits the complete derivation of all the relevant elasticities once the elasticity is known for the market and for one firm. To put it slightly differently, knowing the market elasticity and own-price elasticity of one firm permits complete calculation of all the b_{ij} coefficients in equation (15.44). The proportionality assumption reduces the number of parameters to be estimated from n^2 to just 2. Once that estimation is complete, we may use the resulting elasticity and market share data to solve the first-order conditions in (15.42) and (15.43) for both the pre-merger and post-merger market. We can then evaluate the price effects of the merger.

Of course, proportionality is a strong assumption. Other techniques for simplifying the estimation procedure also exist. Unfortunately, which technique is chosen can affect the predicted post-merger price change by a factor of ten, as Slade (2007) in particular, has emphasized. Moreover, even if proportionality is assumed there are still two elasticity parameters to be estimated. There is ultimately no way to avoid the use of some econometric analysis in the merger evaluation process.

Efforts to estimate the relevant parameters from a demand system such as the one in (15.44) are tricky at best. Even if only a few parameters are required, there remain difficult measurement questions. And while the specification in (15.44) is common it is not the only way to structure market demand. Alternative specifications will imply different functional forms and cross-product elasticity restrictions that in turn will have different effects on the post-merger equilibrium. For example, the linear demand function that we use in most of the examples in this text implies that demand becomes more elastic as prices rise. This imposes a constraint on post-merger prices even if a merger raises market power because it means that consumers become increasingly sensitive to such price increases. In contrast, a log-linear demand function implies a constant price elasticity of demand that will yield a notably higher price rise for the same market power increase. Yet it is often far from clear what precise specification is most appropriate.

A firm's market share will depend heavily on the definition of the market employed. Yet as we can see from the first-order conditions (15.41–43), these share values are crucial to understanding market dynamics. Indeed, they are crucial to understanding whether or not the merger raises antitrust concerns in the first place.

The difficulties posed by the econometrics in merger analysis were dramatically illustrated by the proposed 1996 merger of two office superstore chains, Staples and Office Depot.[24] Along with Office Max, the merging firms dominated the office superstore retail market. Of course, these three firms are not the only retailers of office supplies. While Staples and Office Depot had between 70 and 75 percent of the market defined by office superstores alone, their combined share of the retail sales of office supplies by all stores, including large

[24] For a more complete discussion of the econometric evidence in this case, see Ashenfelter et al. (2004).

discounters such as Wal-mart, drug store chains, and stationary stores, was probably under 10 percent. Accordingly, the question of whether the merger even crossed the threshold of concern established by the Merger Guidelines had to be addressed.

Moreover, even within the category of office superstores, market definition remains problematic. In the Staples case, it was widely agreed that there was not one national market but many local ones. In principle, this means that estimation of a demand structure like that in equation (15.44) would have to take the specific nature of each localized market into account. That is, account would need to be taken of variation across locations in the extent of competition. How should this variation be modeled?

The government argued that the local market boundaries were those of the Metropolitan Statistical Area (MSA) used by the Census Bureau. For any Staples store, competitors included all other Office Depot and Office Max stores in the same MSA. In contrast, the merging firms argued that there was a difference within an MSA depending on the actual distance between rivals. That is, an Office Depot store exerted greater price pressure on a Staples store if it were only five miles away than if it were ten, or twenty miles away. Again, these seemingly small changes in specifying the competitive interaction can (and did) have a large effect on the results. Just this one alteration led to more than a 3 percentage point difference between the firms' prediction that the merger would raise prices by about 0.8 percent and the government's estimate of a rise of 4.1 percent. Together, these and other modest econometric modifications meant that the range in predicted price increases varied from less than 1 percent to almost 10 percent.

In short, simulating merger effects inevitably requires different estimation techniques and structural demand assumptions that vary according to the conceptualization of the market environment. Assumptions to ease the estimation burden do not alleviate other measurement and econometric issues. We can expect self interest to lead each side in a merger case to choose the framework and associated econometric techniques that yield parameter values and other evidence most favorable to its own objective. Unfortunately, it is typically the case that each approach has some objective justification. It becomes very difficult even for economists to separate the truth from self-interest in interpreting the results. It is even more difficult for the courts to resolve such debates. One of the striking features of the Staples case is that the final court decision never mentions the econometric evidence despite the fact that this case probably involved more econometric presentation than virtually any prior merger litigation.

Summary

Horizontal mergers are combinations of firms that are rivals within the same industry. Because they result in the joining of firms that were previously competitors, horizontal mergers raise obvious antitrust concerns. Such mergers may, in fact, be a means to create a legal cartel. One major puzzle in economic analysis is the merger paradox. This paradox reflects the fact that many commonly used economic models suggest that a merger is not profitable for the merging firms and that the true beneficiaries of a merger are the nonmerging firms.

The clue to resolving the merger paradox is to find some means of credibly committing the newly merged firm to a profit-enhancing strategy. One way to do this in quantity-setting models is to permit the merged firm to take on the role of Stackelberg leader whose increased production is credible. Another way is to consider merger decisions sequentially. Either of these approaches is capable of generating profitable mergers that also have adverse consequences for consumers. The sequential merger approach can also help explain the "domino effect" often observed, by which a merger of two firms in an industry is quickly followed by similar marriages among other firms in the same industry.

The merger paradox does not arise in markets where firms offer differentiated products and compete in price for customers. In these markets, the merging firms can easily make a convincing commitment to specific locations or product designs—namely, those used by the firms before they merged. The ability to make such a commitment is sufficient to make merger profitable.

The ambiguous effects of mergers found in economic theory are also found in empirical analysis. To date, there is little clear evidence that horizontal mergers have resulted in legalized cartels with significant monopoly power. Instead, what is clear is that the combination of theoretical and empirical ambiguity has led the legal authorities to take a much less aggressive and much less rigid stand against proposed mergers, a point to which we return in the policy discussion of the next chapter.

Policy also increasingly includes formal attempts to model the post-merger market and to evaluate mergers on a case-by-case basis. The theory behind this approach builds on the first-order conditions for profit maximization and uses these along with the estimates of the relevant price elasticities to analyze the optimal pricing decisions of the merged firm and its rivals in the post-merger market. In practice, this is hard work and typically requires a number of simplifying assumptions to identify the needed parameters. However, there appears to be little alternative.

In sum, there is no general rule regarding the impact of mergers. The merger paradox suggests that only mergers that are associated with large cost efficiencies will be profitable. Because firms do not pursue unprofitable opportunities, this suggests that any proposed merger must have very large cost efficiencies and, perhaps, should be approved. On the other hand, we know if merged firms can acquire the ability to commit to a production level before others, then the merger can be profitable without cost savings and thus, would be anticompetitive. Antitrust authorities cannot rely solely on economic theory to determine whether or not a specific merger should be challenged. This is an area where empirical work based on advanced econometrics can be predicted to play an important role.

Problems

For problems 1, 2, 3, and 4 consider a market containing four identical firms, each of which makes an identical product. The inverse demand for this product is $P = 100 - Q$, where P is price and Q is aggregate output. The production costs for firms 1, 2, and 3 are identical and given by $C(q_i) = 20q_i$; (i = 1, 2, 3), where q_i is the output of firm i. This means that for each of these firms, variable costs are constant at \$20 per unit. The production costs for firm 4 are $C(q_4) = (20 + \gamma)q_4$, where γ is some constant. Note that if $\gamma > 0$, then firm 4 is a high-cost firm, while if $\gamma < 0$, firm 4 is a low-cost firm ($|\gamma| < 20$). Note also that $Q = \sum_{i=1}^{4} q_i$.

1. Assume that the firms each choose their outputs to maximize profits given that they each act as Cournot competitors.
   a. Identify the Cournot equilibrium output for each firm, the product price, and the profits of the four firms. For this to be a “true” equilibrium, all of the firms must at least be covering their variable costs. Identify the constraint that γ must satisfy for this to be the case.
   b. Assume that firms 1 and 2 merge and that all firms continue to act as Cournot competitors after the merger. Confirm that this merger is unprofitable.
   c. Now assume that firms 1 and 4 merge. Can this merger be profitable if γ is positive so that firm 4 is a high-cost firm? What has happened to the profits of firm 2 as a result of this merger?

2. Now assume that each firm incurs fixed costs of F in addition to the variable costs noted above. When two firms merge the merged firm has fixed costs of bF where $1 \le b \le 2$.
   a. Suppose that firms 1 and 2 merge and that $\gamma > 0$. Derive a condition on b, F, and γ for this merger to be profitable. Give an intuitive interpretation of this condition.

b. Suppose by contrast that firms 1 and 4 merge. Repeat your analysis in (a).
c. Compare the conditions derived in (a) and (b). What does this tell you about mergers that create cost savings?

3. Assume that if two firms merge, the merged firm will be able to act as an industry leader, making its output decision before the non-merged firms make theirs. Further assume that $\gamma = 0$ so that the firms are of equal efficiency.
   a. Confirm that a merger between firms 1 and 2 will now be profitable. What has happened to the profits of the non-merged firms and to the product price as a result of this merger?
   b. Confirm that the two remaining firms will also want to merge and join the leader group given that the leaders act as Cournot competitors with respect to each other (hint: this merger will create a leader group containing two firms and a follower group containing none). What does this second merger do to the market price?

4. Continue with the conditions of question 3 but now suppose that for a merger to be undertaken, the merging firms each have to incur a fixed cost, f (this might include costs of identifying a merger partner, negotiating the terms of the merger, legal fees, and so on).
   a. How high must f be for the merger between firms 1 and 2 to be unprofitable?
   b. How high must f be for the subsequent merger between firms 3 and 4 to be unprofitable?

5. In this chapter it was shown that for a two-firm merger to be profitable, the following condition must be satisfied:

$$\pi_l^L(N-1, L+1) = \frac{(A-c)^2}{B(L+2)^2(N-L-1)}$$
$$> 2.\pi_f^F(N, L) = 2\frac{(A-c)^2}{B(L+1)^2(N-L+1)^2}$$

   Assume as in questions 1 and 2 that A = 100, B = 1, c = 20. Further assume that $\gamma = 0$.
   a. Assume that the number of firms in the market is ten, that is, N = 10, and that, as in question 4, a two-firm merger requires that each of the merging firms incurs a fixed cost of f prior to the merger. Derive a relationship, $f(L)$, between f and the size of the leader group, L, such that if $f > f(L)$, the two-firm merger will be unprofitable. Calculate $f(L)$ for $L = 1, 2, 3, 4,$ and 5 to confirm that $f(L)$ is decreasing in L. Interpret this result.
   b. Now assume that there are eight firms in the market, that is, $N = 8$. Repeat your calculations in part (a) to show that the function $f(L)$ rises as N falls. Interpret this result.

6. Normansville consists of a single High Street that is one mile long and has 100 residents uniformly located along it. There are three independent video rental stores located in the town at distances 1/6, 1/2, and 5/6 of a mile from the left-hand edge of Normansville. Each resident rents one video per day provided that the price charged is no more than \$5. If a consumer is located s miles from a store, the transport costs of getting a video from that store is \$0.50s. Suppose first that the two stores do not price discriminate.
   a. What rental charge will the three stores set given that they act as price competitors?
   b. What profits do they earn?

7. Suppose that two neighboring stores in Normansville merge.
   a. What does this do to prices and profits?
   b. Recalculate your answers to and 7(a) assuming that the stores can perfectly price discriminate.

8. Recall that the first-order condition for maximizing profit may be written as: $p = \frac{\varepsilon - 1}{\varepsilon}c$; where ε is the absolute value of the firm's elasticity. Show that this result implies that, as an approximation, the proportional change in a firm's price as a result of a merger can be written as: $\frac{\Delta p}{p} = \frac{\Delta h}{h} + \frac{\Delta c}{c}$; where $h = \frac{\varepsilon - 1}{\varepsilon}$. Suppose that as a result of a

merger and decline in competitive pressure, a firm's demand elasticity falls by the proportion δ, i.e., $\varepsilon' = (1-\delta)\varepsilon$. Show that we may write $\frac{\Delta h}{h} = \frac{\delta}{(1-\delta)\varepsilon - 1}$.

9. Use your results in question 8 to determine the necessary degree of cost efficiencies (i.e., the value of $\frac{\Delta c}{c}$), for the firm's price not to rise if its initial elasticity is $\varepsilon = 2$, and if as a result of a merger, its demand elasticity falls by 10 percent, i.e., $\delta = 0.1$. That is, by what proportion will costs have to decline in this case to keep p constant?

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Appendix

STACKELBERG LEADER-FOLLOWER MODEL WITH SEVERAL LEADERS

Instead of assuming N firms with one leader and $N-1$ followers, let us assume N firms with L leaders and $N-L=F$ followers. Equation (15.21) still describes the best response of the typical follower firm. Because there are $N-L$ such firms, a little algebra quickly reveals that total follower output Q^F is then:

$$Q^F = (N-L)q_f^* = \frac{(N-L)(A-c)}{B(N-L+1)} - \frac{(N-L)Q^L}{(N-L+1)} \quad (15A.1)$$

Denote the output of any one leader firm as q^l and that of all the leaders *other than firm l*, Q_{L-l}. The residual demand function for firm l is then:

$$P = [A - B(Q^F + Q_{L-l})] - Bq_l \quad (15.A2)$$

Substituting for total follower output Q^F from equation (15A.1) and re-arranging yields the typical leader's demand:

$$P = \frac{A + (N-L)c - BQ_{L-l}}{(N-L+1)} - \frac{B}{(N-L+1)}q_l \quad (15.A3)$$

Hence, the associated marginal revenue function is

$$MR_l = \frac{A + (N - L)c - BQ_{L-l}}{(N - L + 1)} - \frac{2B}{(N - L + 1)} q_l \tag{15.A4}$$

Equating this marginal revenue with marginal cost gives the leader firm l's best output response to the output produced by all the other leader firms, Q_{L-l}:

$$MR_l = \frac{A + (N - L)c - BQ_{L-l}}{(N - L + 1)} - \frac{2B}{(N - L + 1)} q_l = c \Rightarrow q_l^* = \frac{A - c}{2B} - \frac{Q_{L-l}}{2} \tag{15.A5}$$

By symmetry, all leader firms produce the same output in equilibrium. Hence, $Q_{L-l}^* = (L - 1)q_l^*$ substituted into equation (15A.5) then yields the stage-one output chosen by each merged leader firm:

$$q_l^* = \frac{A - c}{2B} - \frac{(L - 1)}{2} q_l^* \Rightarrow q_l^* = \frac{A - c}{B(L + 1)} \text{ and } Q^L = Lq_l^* = \frac{L(A - c)}{B(L + 1)} \tag{15.A6}$$

Substituting Q^L into equation (15A.1), total follower output Q^F and individual output for each follower $q_f^* = Q^F/(N - L)$ are:

$$q_f^* = \frac{A - c}{B(L + 1)(N - L + 1)} \text{ and } Q^F = \frac{(N - L)(A - c)}{B(L + 1)(N - L + 1)} \tag{15A.7}$$

Total market output Q and the equilibrium price P:

$$Q^T = Q^L + Q^F = \frac{(N + NL - L^2)(A - c)}{B(L + 1)(N - L + 1)} \text{ and } P = \frac{A + (N + NL - L^2)c}{(L + 1)(N - L + 1)} \tag{15A.8}$$

The price-cost margin and profit for the typical leader firm and typical follower firm are:

$$P - c = \frac{A - c}{(L + 1)(N - L + 1)}; \pi^L(N, L) = \frac{(A - c)^2}{B(L + 1)^2(N - L + 1)}; \text{ and}$$
$$\pi^F(N, L) = \frac{(A - c)^2}{B(L + 1)^2(N - L + 1)^2}. \tag{15A.9}$$

PROOF THAT AN ADDITIONAL MERGER IS PROFITABLE IN THE LEADER-FOLLOWER MODEL

From (15.33), the necessary condition for two firms to merge and join the leader group is

$$(L + 1)^2(N - L + 1)^2 - 2(L + 2)^2(N - L - 1) > 0 \tag{15A.10}$$

Define $x = L + 1$ and $y = N - L - 1$. Then we need to show that

$$x^2(y + 2)^2 \geq 2(x + 1)^2 y$$

Note that $d(y+4+4/y)/dy = 1-4/y^2$ is negative for $0 < y < 2$. For $y > 2$ we have

$$Y + 4 + 4/y \geq 2 + 4 + 4/2 = 8$$

with equality only for $y = 2$. For $x \geq 1$ this inequality can be rewritten

$$(y+2)^2 \geq 8 \geq 2(1+1/x)^2 y = 2((x+1)/x)^2 y$$

giving $x^2(y+2)^2 \geq 2(x+1)^2 y$ as required.

BERTRAND COMPETITION IN A SIMPLE LINEAR DEMAND SYSTEM

Start with the inverse demand system of equations (15.35):

$$\begin{aligned} p_1 &= A - Bq_1 - s(q_2+q_3) \\ p_2 &= A - Bq_2 - s(q_1+q_3) \quad (s \in [0, B)) \\ p_3 &= A - Bq_3 - s(q_1+q_2) \end{aligned} \tag{15A.11}$$

Inverting and manipulating this demand system yields:

$$\begin{aligned} q_1 &= \frac{A(B-s)-(B+s)p_1+s(p_2+p_3)}{(B-s)(B+2s)} \\ q_2 &= \frac{A(B-s)-(B+s)p_2+s(p_1+p_3)}{(B-s)(B+2s)} \quad (s \in [0, B)) \\ q_3 &= \frac{A(B-s)-(B+s)p_3+s(p_1+p_2)}{(B-s)(B+2s)} \end{aligned} \tag{15A.12}$$

The Pre-Merger Case

We begin by identifying the equilibrium when each firm acts independently. Profit to firm 1 is

$$\pi_1 = (p_1 - c)q_1 = (p_1 - c)\left[\frac{A\,(B-s)-(B+s)p_1+s(p_2+p_3)}{(B-s)(B+2s)}\right] \tag{15A.13}$$

Differentiating with respect to p_1 and simplifying gives the first-order condition for firm 1:

$$\frac{\partial \pi_1}{\partial p_1} = \frac{A(B-s)-2(B+s)p_1+s(p_2+p_3)+c(B+s)}{(B-s)(B+2s)} = 0 \tag{15A.14}$$

Defines firm 1's best response function. Imposing a symmetric $p^*{}_1 = p^*{}_2 = p^*{}_3 = p^*_{nm}$, substitution into (15A.14) gives: $\dfrac{A(B-s)-2Bp^*_{nm}+c(B+s)}{(B-s)(B+2s)} = 0$. Implying equilibrium prices:

$$p^*_{nm} = \frac{A(B-s)+c(B+s)}{2B} \tag{15A.15}$$

Equilibrium output for each firm is therefore $q_{nm}^{*} = \frac{(A-c)(B+s)}{2B(B+2s))}$ which, in turn, (15A.13) implies that no-merger profit for each firm of:

$$\pi_{nm}^{*} = \frac{(A-c)^2(B-s)(B+s)}{4B^2(B+2s)} \tag{15A.16}$$

Merger of Firms 1 and 2

This post-merger profit-maximizing first-order conditions are

$$\begin{aligned} \frac{\partial(\pi_1+\pi_2)}{\partial p_1} &= \frac{A(B-s)-2(B+s)p_1+2sp_2+sp_3+cB}{(B-s)(B+2s)} = 0 \\ \frac{\partial(\pi_1+\pi_2)}{\partial p_2} &= \frac{A(B-s)-2(B+s)p_2+2sp_3+sp_3+cB}{(B-s)(B+2s)} = 0 \\ \frac{\partial\pi_3}{\partial p_3} &= \frac{A(B-s)-2(B+s)p_3+s(p_1+p_2)+c(B+s)}{(B-s)(B+2s)} = 0 \end{aligned} \tag{15A.17}$$

Solving these for the equilibrium prices gives $p_1^m = p_2^m = \frac{A(2B+3s)(B-s)+c(2B+s)(B+s)}{2(2B^2+2Bs-s^2)}$ for the merged firm and $p_3^{nm} = \frac{A(B+s)(B-s)+cB(B+2s)}{(2B^2+2Bs-s^2)}$ for the nonmerged firm. Hence profits are:

$$\pi_1^m = \pi_2^m = \frac{B(A-c)^2(B-s)(2B+3s)^2}{4(B+2s)(2B^2+2Bs-s^2)^2}; \pi_3^m = \frac{(A-c)^2(B-s)(B+s)^3}{(B+2s)(2B^2+2Bs-s^2)^2} \tag{15A.18}$$

Comparison of the Pre-Merger and Post-Merger Cases

Define $\sigma = s/B$, where σ lies in the interval (0, 1) since we have that $0 \leq s < B$:

$$\pi_{nm}^{*} = \frac{(A-c)^2(B-s)(B+s)}{4B^2(B+2s)} = \frac{(A-c)^2B^2(1-\sigma)(1+\sigma)}{4B^3(1+2\sigma)} = \frac{(A-c)^2(1-\sigma^2)}{4B(1+2\sigma)} \tag{15A.19}$$

Profit of each division of the merged firm is:

$$\begin{aligned} \pi_1^m = \pi_2^m &= \frac{B(A-c)^2(B-s)(2B+3s)^2}{4(B+2s)(2B^2+2Bs-s^2)^2} \\ &= \frac{B^4(A-c)^2(1-\sigma)(2+3\sigma)^2}{4B^5(1+2\sigma)(2+2\sigma-\sigma^2)^2} = \frac{(A-c)^2(1-\sigma)(2+3\sigma)^2}{4B(1+2\sigma)(2+2\sigma-\sigma^2)^2} \end{aligned} \tag{15A.20}$$

Without loss of generality, normalize $(A-c)^2/B$ in unity. Profits are then a function solely of σ. A plot of (15A.19) and (15A.20) in the interval $\sigma \in [0,1)$ confirms that the merger raises profits for all firms.

EQUILIBRIUM PRICES IN THE SPATIAL MODEL WITHOUT A MERGER

Consider firm 3 as a representative firm. Demand for this firm from its left is Nr_{23}, where r_{23} is the marginal consumer given by

$$m_3 + tr_{23} = m_2 + t\left(\frac{L}{5} = r_{23}\right) \Rightarrow r_{23} = \frac{m_2 - m_3}{2t} + \frac{L}{10} \tag{15A.21}$$

Similarly, demand from consumers to the right of firm 3 is Nr_{34}, where r_{34} is

$$r_{34} = \frac{m_4 - m_3}{2t} + \frac{L}{10} \tag{15A.22}$$

Firm 3's profit is, therefore,

$$\pi_3 = Nm_3(r_{23} + r_{34}) = Nm_3\left(\frac{m_2 - m_3}{2t} + \frac{m_4 - m_3}{2t} + \frac{L}{5}\right) \tag{15A.23}$$

Differentiating this with respect to m_3 to give the first-order condition for firm 3:

$$\frac{\partial \pi_3}{\partial m_3} = N\left(\frac{m_2 + m_4}{2t} - \frac{2m_3}{t} + \frac{L}{5}\right) = 0 \tag{15A.24}$$

Since firms are identical, equilibrium requires $m_3 = m_2 = m_4$. Hence, the Nash equilibrium prices is

$$m^* = tL/5 \tag{15A.25}$$

EQUILIBRIUM PRICES IN THE SPATIAL MODEL AFTER FIRMS 2 AND 3 MERGE

Conveniently changing the firms' "labels" in equation (15A.23) we have:

$$\begin{aligned}
\pi_1 &= Nm_1\left(\frac{m_5 - m_1}{2t} + \frac{m_2 - m_1}{2t} + \frac{L}{5}\right)\\
\pi_2 &= Nm_2\left(\frac{m_1 - m_2}{2t} + \frac{m_3 - m_2}{2t} + \frac{L}{5}\right)\\
\pi_3 &= Nm_3\left(\frac{m_2 - m_3}{2t} + \frac{m_4 - m_3}{2t} + \frac{L}{5}\right)\\
\pi_4 &= Nm_4\left(\frac{m_3 - m_4}{2t} + \frac{m_5 - m_4}{2t} + \frac{L}{5}\right)\\
\pi_5 &= Nm_5\left(\frac{m_4 - m_5}{2t} + \frac{m_1 - m_5}{2t} + \frac{L}{5}\right)
\end{aligned} \tag{15A.26}$$

The merged firm chooses m_2 and m_3 to maximize aggregate profit $\pi_2 + \pi_3$. Nonmerged firms choose profit-maximizing prices as before. The first-order conditions are:

$$\begin{aligned}
\frac{\partial \pi_1}{\partial m_1} &= N\left(\frac{m_5 + m_2}{2t} - \frac{2m_1}{t} + \frac{L}{5}\right) = 0 \\
\frac{\partial (\pi_2 + \pi_3)}{\partial m_2} &= N\left(\frac{m_1 + m_3}{2t} - \frac{2m_2}{t} + \frac{L}{5}\right) + N\frac{m_3}{2t} = 0 \\
\frac{\partial (\pi_2 + \pi_3)}{\partial m_3} &= N\left(\frac{m_2 + m_4}{2t} - \frac{2m_3}{t} + \frac{L}{5}\right) + N\frac{m_2}{2t} = 0 \\
\frac{\partial \pi_4}{\partial m_4} &= N\left(\frac{m_3 + m_5}{2t} - \frac{2m_4}{t} + \frac{L}{5}\right) = 0 \\
\frac{\partial \pi_5}{\partial m_5} &= N\left(\frac{m_4 + m_1}{2t} - \frac{2m_5}{t} + \frac{L}{5}\right) = 0
\end{aligned} \tag{15A.27}$$

Solving these equations simultaneously gives the prices in the text. As noted, we assume that no firm i ever finds it profitable to price so low that it actually competes with firms beyond $i - 1$ and $i + 1$.

16

Vertical and Conglomerate Mergers

In the fall of 2000, General Electric and Honeywell International announced that the two companies would merge with GE acquiring Honeywell. GE is a very well-known firm with annual revenues well over $100 billion. Its businesses are involved in everything from lighting and appliances to television programming (it owns NBC) and financial services. GE is also a major supplier of jet engines for commercial aircraft for which its chief competitors are Rolls Royce and Pratt-Whitney. Honeywell was originally a leader in temperature and environmental controls but has, over time, developed into a major aerospace firm whose products include electric lighting, ventilation units, and braking systems for aircraft and also starter motors for aircraft engines of the type GE builds. The deal was approved in the United States. However, in July of 2001, the European Commission following the recommendation of Competition Commissioner, Mario Monti, blocked the merger.

The proposed GE-Honeywell merger was a marriage of firms making complementary products. The more aircraft engines GE sells, the more starter motors and other related aircraft items Honeywell could sell. As a result, the proposed merger of GE and Honeywell can be thought of as being equivalent to a vertical merger. Most often vertical mergers combine firms operating at different levels of the production chain, say, a wholesaler and a retailer. However, the connection between an upstream and a downstream firm is qualitatively the same as the relation between Honeywell and GE, or that between computer hardware and software, nuts and bolds, or zinc and copper, which are combined to make brass. In all of these cases, two or more products are combined to yield the final good or service. Because an upstream-downstream relationship is just one of the many types of complementary relationships that may exist between firms, the term vertical merger has come to have the more general interpretation of a merger between any firms that produce complementary products.

We showed in Chapter 8 that the separate production of complementary goods—each one produced by a firm with monopoly power—reduces the joint profit of the two firms and imposes an efficiency loss on both firms and consumers. The intuition behind this result is straightforward. Each firm's pricing decision imposes an externality on the other firm. A high price for computer hardware reduces demand for PCs. It also reduces demand for programs and operating systems. The hardware manufacturer takes the first effect into account, but not the second. The same is true, of course, in reverse. The software manufacturer does not take into account the impact its price choice has on the demand for hardware. In the non-cooperative Nash equilibrium, the prices of both goods are too high. If, say, the hardware firm were to cut its price, this would generate additional demand and additional profit for the software firm. However, because the hardware firm does not receive any of this additional profit, its incentive to reduce price is weakened. This suggests that, with cooperation, both firms will lower their prices and be better off. Consumers, too, will gain as a result of lower prices and expanded output.

One way to achieve the profit and efficiency gains of cooperation is for the two firms to merge. Such a merger creates a single decision-making entity and, therefore, permits the externality to be internalized. The combined hardware and software firm maximizes its total profit by reducing the prices of both complementary goods so as to maximize the joint profit from each. Whenever firms with monopoly power produce complementary products, they have a strong incentive either to merge or to devise some other method to ensure cooperative production and pricing of the complementary products.

Precisely the same issues of cooperation arise when the complementary relationships arise because the firms occupy different levels in the vertical production chain. This is important because it sheds light on how vertical mergers affect competition and so consumer welfare. In the 1980s, the realization that vertical mergers can generate efficiency gains led to something of a revolution in antitrust policy related to vertical mergers. In the decades prior to 1980, vertical mergers were often seen as anticompetitive because of the fear that such mergers would facilitate foreclosure. That is, the upstream merger partner would, after the merger, refuse to supply its product to other downstream firms and thereby either drive them out of the market or create barriers to entry that adversely affect them.

Economists primarily associated with the Chicago School challenged this negative view of vertical mergers. They argued that vertical mergers could also achieve complementary efficiencies and that "vertical integration was most likely pro-competitive or competitively neutral" (Riordan 1998, 1232). By the 1980s, the Chicago School approach began to gain in the courts and vertical mergers were treated increasingly favorably by the antitrust authorities. However, by the mid-1990s the pendulum once more began to swing the other way. A post-Chicago approach has now emerged that employs game theoretic tools to build new and logically consistent models of vertical mergers in which once again the potential for consumer harm is real. This counter-revolution has led to a detailed scrutiny of a number of vertical combinations, most notably, those in the telecommunications sector.

We begin this chapter by developing an analysis of vertical mergers based on the proposition that these are pro-competitive and correct market inefficiencies. In section 2, we consider some of the more recent analysis suggesting that such mergers might adversely affect competition in final product markets. Section 3 presents a simple formal model to illustrate this phenomenon.

Section 4 turns to the third and final type of mergers. These are conglomerate mergers involving the combination of firms without either a clear substitute or a clear complementary relationship. Examples include the purchase of Duracell Batteries by Gillette, the purchase of Columbia Pictures by Sony, and the series of acquisitions in 1986 by Daimler-Benz, a luxury car and truck manufacturer, which turned it into Germany's largest industrial concern, producing everything from aerospace to household goods. Finally, section 5 presents a brief overview of antitrust policy with respect to different types of mergers.

16.1 PRO-COMPETITIVE VERTICAL MERGERS

When firms occupy different stages of the production stream the convention is to label those firms farthest from the final consumer of the product as upstream and those closest to that consumer as downstream. Film production companies and movie theaters are an example.

In this case, the production company is the upstream firm and the theater that shows the film is the downstream firm. Manufacturers and retailers have a similar upstream–downstream relationship. All such relationships can be usefully viewed as being complementary to each other. Each firm in the vertical chain provides an essential service to other firms in the chain. Our first order of business is to show that vertical relationships between two firms, each with monopoly power, lead to a loss of economic efficiency in the absence of some mechanism to coordinate the decisions of the two firms. In the case of vertically related firms, this is referred to as the problem of *double marginalization*.

Suppose that we have a single upstream supplier, the manufacturer, who sells a unique product to a single downstream firm, the retailer. The manufacturer produces the good at constant unit cost, c, and sells it to the retailer at a wholesale price, r. The retailer resells the product to consumers at the market-clearing price, P. For simplicity, we assume that the retailer has no other retailing costs. Consumer demand for the good is described by our familiar linear inverse demand function $P = A - BQ$, and we assume of course that $c < A$.

Given that the retailer purchases Q units from the manufacturer at wholesale price r and resells these Q units to consumers at price $P = A - BQ$ the retailer's profit is

$$\Pi^D(Q, r) = (P - r)Q = (A - BQ)Q - rQ \tag{16.1}$$

The retailer maximizes profit by equating marginal revenue with marginal cost. Marginal revenue is $MR = A - 2BQ$ and marginal cost is r. Equating these two terms yields the optimal downstream output,

$$Q^D = (A - r)/2B \tag{16.2}$$

Substituting this expression into the demand function gives the market-clearing retail price $P^D = (A + r)/2$. From equation (16.1) the retailer's profit is, therefore, $\Pi^D = (A - r)^2/4B$. Figure 16.1 illustrates these results.

What about the manufacturer? What wholesale price should be charged? It is clear from equation (16.2) that the wholesale price determines the number of units the upstream

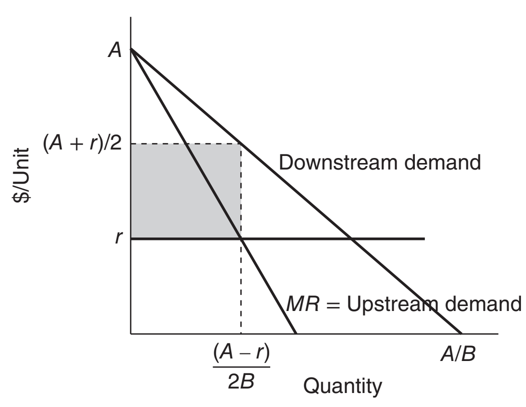

Figure 16.1 Independent retailer's optimal pricing as a function of manufacturer's wholesale price, r

At wholesale price r the retailer will set retail price $P = (A + r)/2$ to maximize profit. Total retail profit is indicated by the shaded region.

supplier is able to sell to the retailer. At the wholesale price r the retailer chooses to sell $Q^D = (A - r)/2B$ units. The retailer must purchase this number of units from the manufacturer. In other words, $Q = (A - r)/2B$ is the demand curve that the upstream manufacturer faces. It describes the relationship between the wholesale price r set by the manufacturer and the quantity of the product demanded by the retailer. But this means that *the inverse demand facing the upstream manufacturer at wholesale price r is* $r = A - 2BQ$, *which is also the marginal revenue function facing the retailer*.[1]

Practice Problem 16.1

The inverse market demand curve facing a monopoly retailer of gold bracelets is described by $P = 3{,}000 - Q/2$. The retailer buys gold bracelets at a wholesale price, r, set by the manufacturer. Show that the inverse demand curve facing the manufacturer is $r = 3{,}000 - Q$. Suppose instead that the retailer has additional marginal costs (labor etc.) of c^D. Show that the inverse demand curve facing the manufacturer is $r = (3{,}000 - c^D) - Q$.

We can now derive the profit-maximizing price that the manufacturer charges for its product. Very simply, the manufacturer equates marginal cost with marginal revenue. The inverse demand curve for the manufacturer is $r = A - 2BQ$, so the marginal revenue curve for the manufacturer is $MR = A - 4BQ$. Equating this with marginal cost c yields the profit-maximizing output and wholesale price. These are, respectively,

$$Q^U = \frac{A - c}{4B} \text{ and } r^U = \frac{A + c}{2} \tag{16.3}$$

This analysis is illustrated in Figure 16.2. When the upstream manufacturer sets the price $r^U = (A + c)/2$, the downstream retailer charges a price $P^D = (A + r^U)/2 = (3A + c)/4$. The retailer sells $Q^D = (A - c)/4B$ units, which is, of course, precisely the amount the upstream manufacturer anticipated it would sell when it set its upstream price $r^U = (A + c)/2$ in the first place. The profit of the manufacturer, shown in Figure 16.2 as the darkly shaded area *wrgv*, is $\Pi^U = (A - c)^2/8B$. The profit of the retailer, shown as the lightly shaded area *refg*, is $\Pi^D = (A - c)^2/16B$. The combined profit of the two firms is, of course, just the sum of these two areas, $3(A - c)^2/16B$.

Suppose now that the two firms merge so that the manufacturer becomes the upstream division of an integrated firm, selling its output to the downstream retail division of the same parent company. The manufactured good is still produced at constant marginal cost, c. This effectively transforms the integrated firm into a simple monopoly whose goal is to maximize monopoly profit through its choice of retail price P. This profit is total revenue PQ minus total cost cQ, which is $\Pi^I = (A - BQ)Q - cQ$.

The marginal revenue curve of the integrated firm is the marginal revenue curve of the nonintegrated retailer, $MR^I = A - 2BQ$. Equating this with marginal cost c gives the profit-maximizing output of the integrated firm, $Q^I = (A - c)/2B$. Substitution of this into the inverse demand curve then gives the retail price to consumers, $P^I = (A + c)/2$.

The merger of the manufacturer and retailer results in consumers being charged a lower price. As a result, the merged firm sells more of the product than did the two independent

[1] If, by contrast, the retailer has additional marginal costs of c^D then the inverse demand facing the manufacturer is $(A - r - c^D) - 2BQ$: see Practice Problem 16.1.

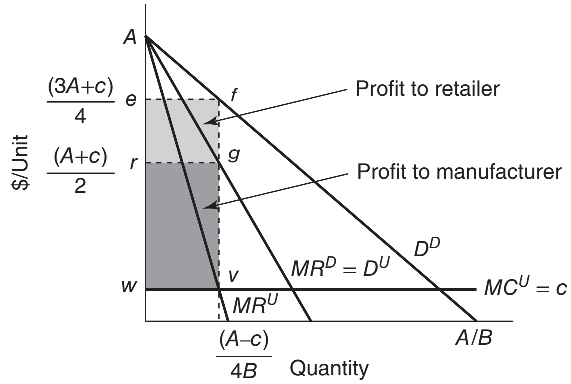

Figure 16.2 Upstream and downstream profit maximization without vertical integration
The retailer's marginal revenue curve MR^B is the manufacturer's demand curve D^U. Double marginalization results when the manufacturer sets its optimal wholesale price $r = (A + c)/2$ above marginal cost c, after which, the retailer adds a further markup by setting retail price $P = (3A + c)/4$. Retail profit is area *refg* The manufacturer's profit is area *wrgv*.

firms. But is this merger profitable? Yes! The profit earned by the integrated firm is $\Pi^I = (A - c)^2/4B$. This is 33.3 percent greater than the aggregate premerger profit of the manufacturer and the retailer, which we saw was $3(A - c)^2/16B$. From a social welfare point of view, *integrating the two monopoly firms has benefited everyone*. Total profit is increased *and* consumer surplus is increased with more of the good being sold at a lower price.

The gains from this vertical merger are illustrated in Figure 16.3. The retailer's premerger profit, area *refg*, is redistributed to consumers as consumer surplus. In addition, consumers gain the area *fgi*. The manufacturer's profit has doubled from area *wrgv* to *wrib* and this more than offsets the loss of the retailer's profit.

Merger of vertically related firms generates an all around efficiency gain because it allows the separate but related activities to be coordinated and, thereby, to internalize the

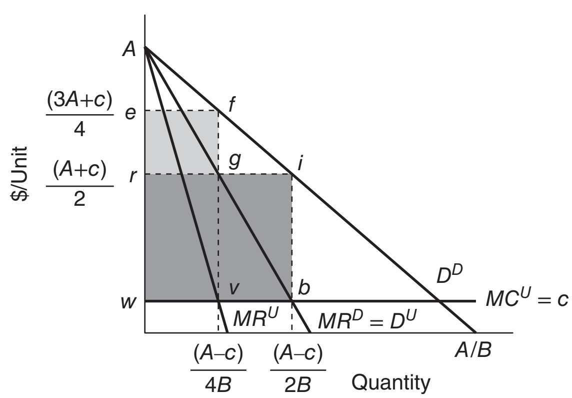

Figure 16.3 Upstream and downstream profit maximization with vertical integration
An integrated manufacturer-retailer sets a retail price to consumers at $P = (A + c)/2$. The area *refg* that would have been profit for a non-integrated retailer now becomes part of consumer surplus. However, the increased sales volume generates a more than offsetting profit gain of area *gjbv*. Total profit for the integrated firm is *rjbw*.

externality that each imposes on the other. In the absence of coordination, the final product price reflects a double marginalization. The independent manufacturer marks up its price to the retailer who then compounds that price-cost distortion by adding a further markup in setting a price to the consumer. This is the basis of the old saying, "What is worse than a monopoly? A chain of monopolies!"

16.2

Practice Problem

Suppose that the downstream market for widgets is characterized by the inverse demand curve $P = 100 - Q$. Widget retailing is controlled by the monopolist WR Inc., which obtains its widgets from the monopoly wholesaler WW Inc. at a wholesale price of w_w per widget. WW Inc. obtains the widgets in turn from the monopoly manufacturer WM Ltd. at a manufacturing price of w_m per widget. WM Inc. incurs marginal costs of \$10 per unit in making widgets. WW and WR each incur marginal costs of \$5 in addition to the prices that they have to pay for widgets.

a. What is the equilibrium widget price to consumers, P, the equilibrium wholesale price w_w, and the equilibrium manufacturing price w_r? What is the profit earned by each firm at these prices?
b. Show that vertical integration by any two of these firms increases profit and benefits consumers.
c. Show that integration of all three firms is even more beneficial.

There are, of course, several qualifications to this analysis that we should mention. Some are noted in the accompanying Reality Checkpoint regarding the auto industry. In addition, it is important to note that the benefits of the vertical merger just described assume that the downstream firm uses a fixed amount of the upstream firm's product for every unit of output that the downstream firm sells. In our example of a manufacturer and a downstream retailer, this assumption makes sense. The retailer has to have one unit of the manufacturer's product for every unit it sells to its customers. But in other situations this assumption could be too strong. For example, if the upstream firm is a steel producer and the downstream firm is an automobile manufacturer, the steel firm's decision to charge the car manufacturer a price that includes a high markup may induce the automaker to reduce its use of steel in favor of aluminum or perhaps fiberglass. In such a case, the potential gains of the car manufacturer integrating backwards into the steel market are less clear-cut.

In summary, vertical integration of a chain of producers, each of which has monopoly power, is likely to benefit both firms and consumers by correcting the market failure associated with double (and triple and quadruple . . .) marginalization. These benefits are more likely to arise when the technology operated by downstream firms offers limited opportunities for substitution into other inputs.

16.2 POSSIBLE ANTICOMPETITIVE EFFECTS OF VERTICAL MERGERS

The merger analysis of the previous section suggests that the antitrust authorities should be less concerned about the welfare impact of vertical mergers than the impact of horizontal mergers. However, the analysis is based upon some important assumptions that drive the

Reality Checkpoint

Vertical Disintegration in the Automobile Industry

Our analysis of vertical integration has stressed the gains of eliminating "the middle man" and the problem of double-marginalization. If this were all there were to it, we would see much more vertical integration and very little outsourcing. Quite to the contrary, however, the business news over the last decade has been filled with stories of outsourcing and vertical *dis*integration as firms has spun off their former internal divisions. Nowhere has this phenomenon been more dramatic than in the US automobile industry.

Until the 1990s, the organizational design pioneered by the General Motors Corporation founder, W. C. Durant, and his protégé Alfred Sloan, was the dominant model. The logic of avoiding double-marginalization and other organizational advantages led US car companies to vertically integrate from the development and control of electronics and other parts, to the production of engines and car bodies, to the full assembly of ready-to-ship cars and extending down to official dealerships. In fact, the US firms integrated even further in the 1980s by acquiring rental car firms. Chrysler bought both Thrifty and Dollar Rent-A-Car. Ford bought Hertz and GM acquired a half interest in National.

Over the years, however, problems with this organizational strategy emerged. One stemmed from the incentives it created. To the extent the firms bought virtually all their parts internally, the parts divisions had no outside competition to spur efficiency. Closely related to the incentive problem was the fact that once parts-makers and other units were fully part of GM, Ford, and Chrysler, they gained representation by the United Auto Workers. This typically meant higher wages so these supplies became more expensive after incorporation into the parent carmaker. Often, buyers at the automaking divisions did not even know the names of alternative suppliers.

By the mid 1990s, the car companies began to reverse their vertical integration strategy. They all sold off the car rental companies. In addition, GM spun off its parts division as the independent parts firm, Delphi Automotive Systems. In 1999, Ford followed quickly and spun off its parts division as Visteon Corporation.

Further retrenchment followed. In 2006, both firms began withdrawing from the downstream business of financing car purchases by dealers and customers. GM, for example, sold off a majority interest in its banking operation known as the General Motors Acceptance Corporation (GMAC), which then became Ally Financial. Subsequently, in the wake of bankruptcy and reorganization, both firms greatly reduced their downstream dealer operations. GM closed over 1,000 dealerships including all those associated with the discontinued *Hummer*, *Saab*, and *Saturn* lines. Chrysler terminated over 700 dealerships as well. In addition, exclusive dealerships selling just one brand, e.g., Chevrolet, nearly vanished.

Source: J. Schnapp. "Lesser Than the Sum of Its Parts," *Wall Street Journal*, April 4, 2006, p. 18; J. B. White, "How Automakers Keep You Coming Back," *Wall Street Journal*, January 22, 2013, p. B1.

results. In particular, we have assumed that there is a single market in which the final output is sold and that there is monopoly at each stage in the vertical chain. Before coming to the general conclusion that "vertical mergers are good for firms and consumers," we should check on the effects of relaxing these assumptions.

16.2.1 Vertical Merger to Facilitate Price Discrimination

While life is good for a monopolist, it is even better for a monopolist who price discriminates. This is equally true for an upstream monopolist selling to a number of downstream firms. Moreover, there are many cases in which those downstream firms differ in their willingness to pay for the upstream firm's product. Examples include a wholesaler supplying retailers in different cities, a manufacturer of motorcar parts supplying automakers in different countries, a consultant advising different firms in different industries, and so on. In these circumstances, the upstream firm would like to charge a high price for its product or service to those firms whose demand is inelastic and a low price to those whose demand is elastic.

Our earlier discussion of price discrimination showed, however, that successful price discrimination has two requirements. First, the firm must be able to identify which buyers have elastic and which have inelastic demand. Second, the firm must somehow prevent resale of its product among its buyers. Such arbitrage would clearly undo any price discrimination efforts. We will assume that the firm has somehow solved the identification problem. The question then becomes, what strategies can the firm use to surmount the arbitrage problem?

The simplest approach would be for the upstream firm to write a no-resale contract with its buyers. In many circumstances, however, such contracts are unenforceable—for example when the client firms are in different legal jurisdictions—in which case some other approach is necessary. One such approach is for the upstream firm to merge with some or all of its downstream customers.

Suppose that the upstream firm supplies a series of downstream firms and that, because of financial constraints, the upstream firm can integrate forwards with only some of the downstream firms. Then, as Practice Problem 16.3 shows, *it should merge first into markets with the highest elasticities of demand*. Because the merger allows the upstream firm to prevent resale, it also allows the firm to charge high profit-maximizing prices in the other, low-demand-elasticity markets. Is such a merger pro- or anti-competitive? Successful price discrimination can improve economic efficiency. When success is achieved by means of a vertical merger the effect on economic efficiency is, however, ambiguous. The reason is that while the merger increases profits and removes double marginalization in one group of markets, the merger also leads to increased prices in the remaining markets. In other words, some consumers gain and others lose from the vertical merger. The overall effect is uncertain and can be resolved only when we have more information on the precise nature of demand in the various markets.

16.3

Practice Problem

Assume that Widget International supplies widgets to Gizmo Inc. in Boston, where the demand for gizmos is $P_{gb} = 1 - Q_{gb}$, and TruGizmo Inc. of New York, where demand for gizmos is $P_{gn} = 0.5 - 0.2Q_{gn}$. Assume that WI's marginal costs of supplying both markets is \$0.1 per widget and that both Gizmo Inc. and TruGizmo Inc. need exactly one widget for every gizmo they sell. Both gizmo dealers have other costs of production that amount to \$0.1 per gizmo.

a. What are the profit-maximizing prices for widgets and gizmos in these two markets if Widget International cannot price discriminate? What are the profits of the three firms?
b. What are the profit-maximizing prices for widgets and gizmos in these two markets if Widget International can price discriminate? What are the profits of the three firms?

c. Show that if WI can merge with either Gizmo Inc. or TruGizmo Inc., it prefers to merge with TruGizmo Inc.
d. What is the effect of the merger on consumer prices and consumer surplus when WI (i) cannot and (ii) can price discriminate pre-merger?

16.2.2 Vertical Merger, Oligopoly, and Market Foreclosure

Now consider the second important assumption underlying the analysis in Section 16.1. The gains from the merger hinge crucially on the fact that prior to the merger there is monopoly at both levels of activity, manufacture and retail. Suppose, instead, that we start with either a competitive manufacturing sector upstream selling to a monopoly downstream, or a monopoly upstream firm selling to a competitive retail sector. In the former case, price competition upstream among manufacturers leads to a wholesale price equal to marginal cost. In the latter, competition among retailers downstream drives the retail price equal to the upstream price P^U plus any downstream cost c_D. In either case, no double marginalization can occur, and there is no efficiency gain to vertical integration.

It could be argued, of course, that assuming perfect competition rather than monopoly in either the upstream or downstream market merely replaces one extreme assumption by another. We now turn, therefore, to the more realistic case in which both upstream and downstream markets are oligopolies. This raises another important issue that needs to be considered explicitly. Beyond the desire to reduce or eliminate double marginalization, there is an additional motive for vertical integration that is more clearly anticompetitive. The motive is the possibility of *market foreclosure*. That is, the merger of vertically related firms might result in an upstream–downstream company that can either deny downstream rivals a source of inputs, or upstream competitors a market for their products.

Consider a hypothetical case in which two suppliers of computer chips compete for sales to two downstream computer manufacturers who in turn sell to the general public. The chips of the two upstream firms are identical so that, if the two suppliers compete in price, they must sell at marginal cost. Hence, only the two downstream firms earn any economic profit. Suppose now that one of the chip manufacturers and one of the computer firms merge. The argument that this merger may be anticompetitive goes roughly as follows. The upstream chip division of the newly merged firm no longer offers to sell any chips to the remaining independent computer firm, that is, it forecloses sales of its product to this downstream rival. Why? The answer is that such foreclosure leaves the independent computer firm with only one supplier, namely, the remaining independent chip firm. That independent chip producer now has monopoly power vis-à-vis the independent computer firm and, accordingly, sets a monopoly wholesale price for its chips. In turn, this raises the costs of the independent computer firm relative to the pre-merger situation and makes it less able to compete with the downstream computer division of the integrated firm. As a result, the merged firm can raise the price of its computers and earn more profit. Because the upstream market was initially competitive there was no double-marginalization and because there are no other cost savings as a result of the merger, this vertical integration is clearly anticompetitive.[2] The merger raises the cost of the nonintegrated rivals on the supply side and thereby leaves them at a disadvantage relative to the integrated firm.

The telecommunications industry is one in which foreclosure concerns have been quite real for regulatory authorities in both the United States and in Europe. In this industry, the local telephone network has generally been monopolized by a firm that also competes in the more competitive long-distance market. Because a long-distance provider, such as Sprint or say 1st Family, has to gain access to its potential customers by connecting to the local network, the local network provider has the potential to price its long-distance competitors out of the market by charging them a very high price for network access or, in an extreme case, denying them access to the network at all. Accordingly, a major concern of the regulatory authorities has been the prices that suppliers of local telephone networks are allowed to charge for access to the local network.

Alcoa has been accused of subjecting its rivals to a similar price squeeze, both by making contractual arrangements with power companies to prevent them from supplying vital electricity to competing aluminum producers and by charging very high prices for aluminum ingots that were used by rivals that competed with Alcoa in downstream markets such as the aluminum sheet market. In short, foreclosure arguments suggest that monopoly power in one, say upstream, market may be leveraged into power in another, downstream market.

16.4

Practice Problem

Suppose that the downstream market for widgets is perfectly competitive and characterized by the inverse demand curve $P = 100 - Q$. Retailers have zero production costs, but do incur a fee, r, for every unit sold. This fee is the payment that retailers must pay to the only manufacturer of widgets, the monopolist Widget International (WI). WI bears no fixed cost. It does, however, have a constant marginal cost of \$10.

a. What is the equilibrium price to consumers, P, and fee to retailers, r? What is the profit earned by retailers and WI at these prices?
b. Show that vertical integration by which WI becomes the single producer and retailer of widgets does not raise WI's profit and does not lower the price to consumers.
c. What is the price to consumers if both widget manufacturing and retailing are competitive?

16.3 FORMAL OLIGOPOLY MODELS OF VERTICAL INTEGRATION

The conventional foreclosure argument that we just presented is compelling, particularly when buttressed by the accompanying examples. However, there are also some clear weaknesses in the argument that need to be confronted. The local phone network and Alcoa examples are different from our hypothetical computer chip story in that these real world cases begin with something less than competition in the upstream market. We have not

[2] For a description many ways in which an integrated firm can impose a cost squeeze, see Krattenmaker and Salop (1986).

identified why this may be the case. Apart from this practical consideration, the logic of the argument is still incomplete. We have not explained why the integrated firm will definitely stop selling chips to the independent downstream computer firm. Nor have we considered an obvious response by the remaining independent firms, namely, to merge and similarly enjoy the benefits of vertical integration. In the next section, we describe two models of foreclosure through vertical integration that address these concerns. One is due to Salinger (1988) and is based on Cournot competition. The other is due to Ordover, Saloner, and Salop (1990) and is rooted in price competition.

16.3.1 Vertical Integration and Foreclosure in a Cournot Model

To illustrate Salinger's (1988) basic contribution we return to our basic Cournot model except that we now assume that Cournot competition applies both in an upstream market populated by two firms and in a downstream market, also with two firms. The upstream firms produce a homogeneous intermediate good that is used by the downstream firms to make a homogeneous good for final consumption. One unit of downstream output requires exactly one unit of the intermediate product. Each upstream firm has constant marginal costs of c^U per unit and each downstream firm has constant marginal costs, excluding the cost of the intermediate good, of c^D per unit. Inverse demand for the final consumption good is:

$$P = A - BQ = A - B(q_1 + q_2) \tag{16.4}$$

The market game has two stages. In the first stage, the two upstream firms compete in quantities, generating a price P^U for the intermediate product. In the second stage, the downstream firms compete in quantities taking the upstream price P^U as given. Consider first what happens when there is no vertical merger and then compare this outcome with what happens when there is vertical merger. Such a comparison is easier to make when we have a specific numerical example and so later we will use the values: $A = 100$; $B = 1$; and $c^U = c^D = 23$.

(i) No Vertical Mergers

Cournot competition upstream in the first stage leads to a market-clearing intermediate product price of P^U so that each downstream firm in the second stage faces marginal cost $P^U + c^D$. Cournot competition downstream leads each downstream firm to produce:[3]

$$q_1^D = q_2^D = \frac{A - P^U - c^D}{3B} \tag{16.5}$$

and to earn a downstream profit of

$$\pi_1^D = \pi_2^D = \frac{(A - P^U - c^D)^2}{9B} \tag{16.6}$$

We can use equation (16.5) to identify the *derived demand* that the upstream firms face. Aggregate downstream output is $Q^D = 2(A - P^U - c^D)/3B$. Because each unit of final

[3] See Chapter 9 for the derivation of the Cournot equilibrium.

product output requires one unit of the intermediate product, this is also the aggregate demand, $Q^U = Q^D$ for the intermediate product, which we can write in inverse form as:

$$P^U = (A - c^D) - \frac{3B}{2}Q^U \tag{16.7}$$

The next step in the analysis is simplified once we recognize that this is in standard linear form $P = a - bQ$, where $a = A - c^D$ and $b = 3B/3$. In the first stage of the game, the Cournot equilibrium output of each upstream firm is, therefore:

$$q_1^U = q_2^U = \frac{a - c^U}{3b} = \frac{(A - c^D) - c^U}{9B/2} = \frac{2(A - c^U - c^D)}{9B} \tag{16.8}$$

It follows that aggregate output in the upstream market is $Q^U = 4(A - c^U - c^D)/9B$. Substituting this into the upstream demand of equation (16.7) gives the equilibrium upstream price for the intermediate product:

$$P^U = (A - c^D) - \frac{3B}{2} \times \frac{4(A - c^U - c^D)}{9B} = \frac{(A - c^D + 2c^U)}{3} \tag{16.9}$$

Profit of each upstream supplier is $(P^U - c^U)q_i^U$, which from (16.8) and (16.9) gives

$$\pi_1^U = \pi_2^U = \frac{2(A - c^U - c^D)^2}{27B} \tag{16.10}$$

Finally, substituting the upstream price into equations (16.5) and (16.6) gives the equilibrium output and profit for each downstream firm:

$$q_1^D = q_2^D = \frac{2(A - c^U - c^D)}{9B} \tag{16.11}$$

$$\pi_1^D = \pi_2^D = \frac{4(A - c^U - c^D)^2}{81B} \tag{16.12}$$

It is easy to check that, as we would expect, aggregate downstream demand equals aggregate upstream output. Using the numbers from our specific example, total output is 24 units. The wholesale price is \$41 and the price to consumers is \$76. Each upstream firm earns \$216 in profit and each downstream firm earns \$144.

(ii) Vertical Integration of an Upstream and Downstream Firm

Now consider what happens if one of the downstream firms $D1$ and one of the upstream firms $U1$ merge. Assume for the moment that this newly merged firm refuses to supply the independent downstream firm at all. Hence, the downstream firm $D2$ has to turn to the remaining independent wholesaler $U2$ for its input supply, *and* $U2$ *knows this*. It follows that the upstream firm $U2$ has monopoly power over $D2$ and will set a price to $D2$ of $P^U > c^U$. As a result, $D2$ has marginal cost $P^U + c^U$ while $D1$ has marginal cost $c^U + c^D$. In other words, the integrated firm has removed the double-markup in its pricing. As a result, it now competes in the downstream market as a low-cost competitor vis-à-vis $D2$.