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Working Paper

Lectures on Antitrust Economics, Chapter 3: Horizontal Mergers

CSIO Working Paper, No. 0041

Provided in Cooperation with:

Department of Economics - Center for the Study of Industrial Organization (CSIO), Northwestern University

Suggested Citation: Whinston, Michael D. (2003) : Lectures on Antitrust Economics, Chapter 3: Horizontal Mergers, CSIO Working Paper, No. 0041, Northwestern University, Center for the Study of Industrial Organization (CSIO), Evanston, IL

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THE CENTER FOR THE STUDY
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AT NORTHWESTERN UNIVERSITY

Working Paper #0041

Lectures on Antitrust Economics
Chapter 3: Horizontal Mergers^{*}

By

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Lectures on Antitrust Economics

Chapter 3: Horizontal Mergers

Michael D. Whinston*

Draft — Comments Welcome

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1 Introduction

In this chapter our attention turns to horizontal merger policy. The Sherman Act's prohibition on "contracts, combinations, and conspiracies in restraint of trade," whose application to price fixing we discussed in Chapter 2, also applies to horizontal mergers, but with an important difference: horizontal mergers are evaluated by the courts under a Rule of Reason analysis based on the presumption that they often have important efficiency benefits. In addition, the Clayton Act's Section 7 includes a more specific prohibition on mergers where the effect may be "substantially to lessen competition, or to tend to create a monopoly."

Despite the potential for efficiencies arising from horizontal mergers, from the 1950's through the 1970's the U.S. courts were extremely hostile toward them, often condemning horizontal mergers in markets that were and would remain very unconcentrated.¹ Since 1980, however, with a more conservative judiciary and an increasing influence of economic reasoning, horizontal merger policy has become much more permissive. During this same period, there has also been substantial progress in economists' ability to analyze proposed horizontal mergers. In what follows we will review this progress, while also noting some of the significant open questions that remain.

2 Theoretical Considerations

2.1 The Williamson Trade-off

The central issue in the evaluation of horizontal mergers lies in the need to balance any reductions in competition against the possibility of productivity improvements arising from a merger. This trade-off was first articulated in the economics literature by Williamson [1968], in a paper aimed at getting efficiencies to be taken seriously. This "Williamson tradeoff" is illustrated in Figure 3.1.

¹Indeed, concern over the fate of small (and often inefficient) businesses frequently led the courts during this period to use merger-related efficiencies as evidence *against* a proposed merger.

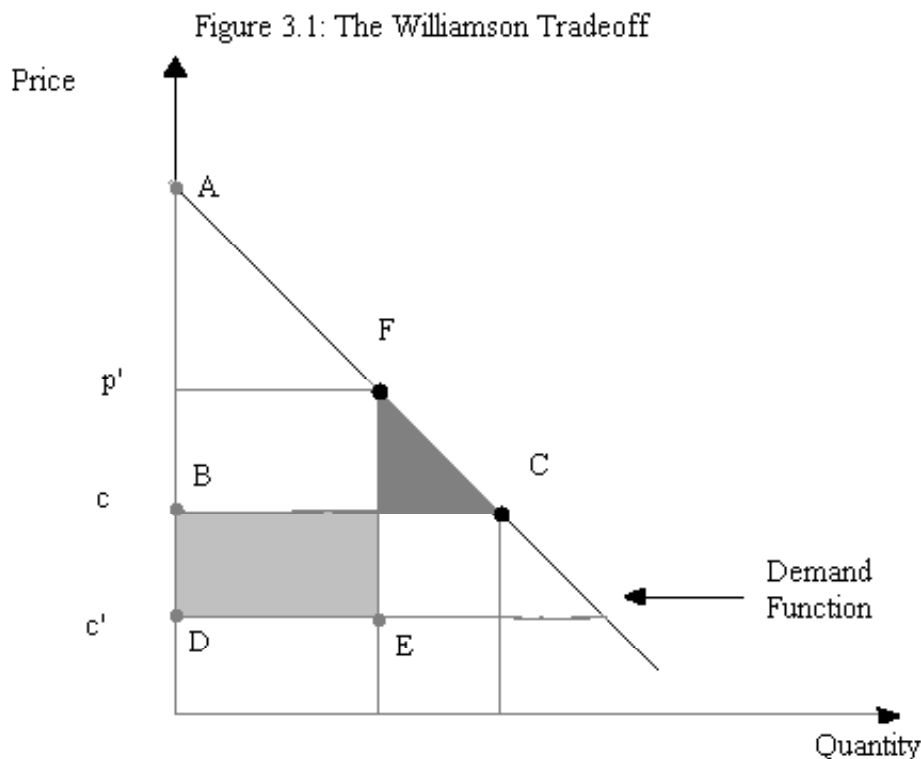


Figure 1:

Suppose that the industry is initially competitive, with a price equal to c . Suppose also that after the merger, the marginal cost of production falls to c' and the price rises to p' .² Aggregate social welfare before the merger is given by the area ABC , while aggregate welfare after the merger is given by area $ADEF$. Which is larger involves a comparison between the area of the dark grey shaded triangle, equal to the deadweight loss from the post-merger supracompetitive pricing, and the area of the light grey shaded rectangle, equal to the post-merger cost savings (at the post-merger output level). If there is no improvement in costs, then the area of the rectangle will be zero and the merger reduces aggregate welfare; if there is no increase in price, then the area of the triangle will be zero, and the merger increases

²We assume here that these costs represent true social costs. Reductions in the marginal cost of production due to, say, increased monopsony power resulting from the merger would not count as a social gain. Likewise, if input markets are not perfectly competitive, then reductions in cost attributable to the merger must be calculated at the true social marginal cost of the inputs rather than at their distorted market prices.

aggregate welfare. Williamson's main point was that it does not take a large decrease in cost for the area of the rectangle to exceed that of the triangle: put crudely, one might say that "rectangles tend to be larger than triangles". Indeed, in the limit of small changes in price and cost, differential calculus tells us that this will always be true: formally, the welfare reduction from an infinitesimal increase in price starting from the competitive price is of second-order (i.e., has a zero derivative), while the welfare increase from an infinitesimal decrease in cost is of first-order (i.e., has a strictly positive derivative).

Four important points should be noted, however, about this Williamson trade-off argument. First, a critical part of the argument involved the assumption that the pre-merger price was competitive; i.e., equal to marginal cost. Without this assumption we would no longer be comparing a triangle to a rectangle, but rather a trapezoid to a rectangle (see Figure 3.2) and "rectangles aren't bigger than trapezoids": that is, even for small changes, both effects are of first-order.³ Put simply, when a market starts off at a distorted supra-competitive price, even small increases in price can cause significant reductions in welfare.

Second, the Williamson argument glosses over the issue of differences across firms by supposing that there is a single level of marginal cost in the market, both before and after the merger. However, since any cost improvements are likely to be limited to the merging firms, it *cannot* be the case that this assumption is correct both before and after the merger, except in the case of an industry-wide merger. More importantly, at an empirical level, oligopolistic industries (i.e., those in which mergers are likely to be scrutinized) often exhibit substantial variation in marginal cost across firms. The import of this point is that a potentially significant source of welfare variation due to a merger is entirely absent from the Williamson analysis, namely the welfare changes arising from shifts of production across firms having differing marginal costs; so-called, "production reshuffling." We shall explore this point in some detail in the next section.

³Specifically, the welfare loss caused by a small reduction in output is equal to the price-cost margin.

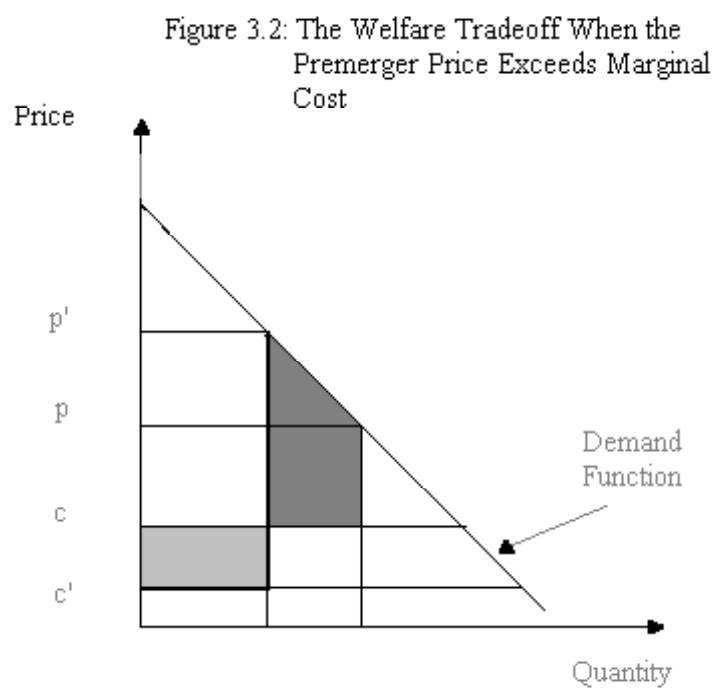


Figure 2:

Third, the Williamson analysis takes the appropriate welfare standard to be maximization of aggregate surplus. But, as we discussed in Chapter 1, there is a question about distribution that arises with the application of antitrust policy. Although many analyses of mergers in the economics literature focus on an aggregate welfare standard, current law as well as the DOJ/FTC Horizontal Merger Guidelines (which we discuss below in Section 3) are probably closest to a consumer surplus standard when considering the effects of merger-generated efficiencies. (See also the discussion in Baker [1999a].) If so, then no trade-off needs to be considered: the merger should be allowed if and only if the efficiencies are enough to ensure that price does not increase.

Finally, the Williamson argument focuses on price as the sole locus of competitive interaction among the firms. In practice, however, firms make many other competitive decisions, including their choices of capacity investment, R&D, product quality, and new product introductions. Each of these choices may be affected by the change in market structure brought by a merger. We will return to this point at the end of the next section.

2.2 Formal Analyses of the Welfare Effects of Mergers

Careful consideration of these issues requires a more complete model of market competition. Farrell and Shapiro [1990] provide such an analysis for the special case in which competition takes a Cournot form.⁴ They investigate two principal questions: First, under what conditions are cost improvements sufficiently great for a merger to reduce price? As we have noted, this is the key question when one adopts a consumer surplus standard. Second, how can we use the fact that proposed mergers are profitable for the merging parties to help us identify mergers that enhance aggregate welfare? In particular, note that one difficult aspect of evaluating the aggregate welfare impact of a merger involves assessing the size of any cost efficiencies. But since the merging parties internalize these efficiency gains, we might be able to develop a *sufficient* condition for a merger to enhance aggregate welfare by asking when the merger has a positive net effect on parties other than the merging firms.

⁴For a related analysis, see McAfee and Williams [1992].

Consider the first question: When does price decrease as a result of a merger in a Cournot model? To be specific, suppose that firms 1 and 2 contemplate a merger in an N -firm industry and, without loss of generality, suppose that their premerger outputs satisfy $x_1 \geq x_2 > 0$. Following Farrell and Shapiro, we shall assume that an increase in the aggregate best-response function of the merging firms (that is, an increase in their optimal joint output, whether individually or jointly determined) leads to an increase in aggregate output — and hence a decrease in the price — in the market.⁵ Letting X be the aggregate premerger output in the market, the premerger Cournot first-order conditions for these two firms are

$$P'(X)x_1 + P(X) - c_1^0(x_1) = 0 \quad (1)$$

$$P'(X)x_2 + P(X) - c_2^0(x_2) = 0. \quad (2)$$

Hence, adding these two conditions together we have

$$P'(X)(x_1 + x_2) + 2P(X) - c_1^0(x_1) - c_2^0(x_2) = 0 \quad (3)$$

Now suppose that the merged firm's cost function will be $c_M(\cdot)$. Assuming that the merged firm's profit function is concave in its output, its optimal output (given its rivals' premerger outputs) is greater than the sum of the two firms' premerger outputs $x_1 + x_2$ if and only if

$$P'(X)(x_1 + x_2) + P(X) - c_M^0(x_1 + x_2) > 0, \quad (4)$$

or equivalently,

$$c_2^0(x_2) - c_M^0(x_1 + x_2) > P(X) - c_1^0(x_1). \quad (5)$$

Since $c_1^0(x_1) \leq c_2^0(x_2) < P(X)$ [this follows from the pre-merger first-order conditions (1) and (2) and the fact that $x_1 \geq x_2$], this can happen only if

$$c_M^0(x_1 + x_2) < c_1^0(x_1). \quad (6)$$

⁵Sufficient conditions for this are that (i) the industry inverse demand function $P(\cdot)$ satisfies $P'(\mathbf{x}) + P''(\mathbf{x})\mathbf{x} < 0$ and that (ii) $c_i''(\mathbf{b}_i) > P''(\mathbf{x})$ for all $i \neq 1, 2$ and all output levels \mathbf{b}_i and \mathbf{x} . Condition (i) also implies that all firms' best-response functions are decreasing in the aggregate output of their rivals.

Condition (6) indicates that for price to fall the merged firm's marginal cost at the pre-merger joint output of the merging firms must be below the marginal cost of the more efficient merger partner. This is a relatively stringent requirement. First, as is no surprise, it implies that a merger that reduces fixed, but not marginal, costs cannot lower price. More interesting, however, it also tells us that in the presence of increasing marginal costs, a merger whose only efficiencies involve a reallocation of output across the firms, so that

$$c_M(x) = \min_{x'_1, x'_2} [c_1(x'_1) + c_2(x'_2)] \text{ s.t. } x'_1 + x'_2 = x,$$

cannot result in a lower price. To see why, consider the simple case of two single plant firms. Observe that with increasing marginal costs, efficient production rationalization in which both firms remain operational involves equating the marginal costs of the two firms, and so must result in the merged firm's marginal cost lying between the marginal costs of the two merger partners. Hence, condition (6) cannot be satisfied in this case. On the other hand, if one plant is shut down after the merger to save on fixed costs, then at the premerger joint output level of the two merging firms, the other plant will see its output increase relative to its premerger level. Hence, the merged firm's marginal cost will be at least as high in this case as the lowest premerger marginal cost, and could in fact be higher than both of the firms' premerger marginal costs. Once again, (6) cannot hold.⁶

Let us now turn to the second question by supposing that the merger does increase price. Under what circumstances does it nevertheless increase aggregate welfare? To see this, suppose that firms in set I contemplate merging. Let x_i denote firm i 's output and let $X_I = \sum_{i \in I} x_i$. Now consider the effect of a small reduction in the output X_I of the merging firms, say $dX_I < 0$ (by our previous assumptions, if price is to increase — and hence aggregate output is to decrease — it must be that the output of the merging firms falls), and the accompanying reduction in aggregate output $dX < 0$. Let dx_i and dp be the corresponding changes in firm i 's output (for $i = 1, \dots, N$) and the price.

⁶With decreasing marginal costs it is possible for such a merger to satisfy (6) and therefore reduce price. However, Farrell and Shapiro show (see their Proposition 2) that even this is impossible if $c''_i(x_i) > P''(X)$ for $i = 1, 2$.

The key step in Farrell and Shapiro's analysis is their use of the presumption that proposed mergers are profitable for the merging firms. If this is so, then we can derive a *sufficient condition* for the merger to increase welfare based on the *external effect* of the merger on non-participants; that is, on consumers and the non-merging firms.⁷ Specifically, the welfare of non-participants is given by

$$E = \int_{P(X)}^{\infty} x(s)ds + \sum_{i \notin I} [P(X)x_i - c_i(x_i)]. \quad (7)$$

If a privately profitable merger increases E , then it increases aggregate welfare.

To examine the effect of the merger on E , Farrell and Shapiro study the external effect of a “differential” price-increasing merger. That is, they examine the effect on E of a small reduction in output by the merging parties, $dX_I < 0$, along with the accompanying differential changes in the outputs of rivals, dx_i for $i \notin I$. These changes dx_i arise as the non-merging firms adjust their optimal outputs given the reduction in the merged firms' output $dX_I < 0$. Under the Farrell and Shapiro assumptions, these changes reduce the overall output in the market: $dX = dX_I + \sum_{i \notin I} dx_i < 0$. Totally differentiating (7) we see that their effect on E is

$$= -XP'(X)dX + \sum_{i \notin I} x_i P'(X)dX + \sum_{i \notin I} [P(X) - c'_i(x_i)]dx_i. \quad (8)$$

The first two terms in (8) are, respectively, the welfare loss of consumers and welfare gain of the non-merging firms due to the price increase. The former is proportional to consumers' total purchases X , while the latter is proportional to the non-merging firms' total sales $\sum_{i \notin I} x_i$. The third term in (8) is the welfare change due to production reshuffling. Combining the first two terms and replacing the price-cost margin in the third term using the first-order condition for the non-merging firms we can write:

$$= -X_I P'(X)dX + \sum_{i \notin I} [-P'(X)x_i]dx_i \quad (9)$$

⁷Note that in the Cournot model a merger need not increase the profits of the merging firms because of rivals' resulting output expansion (Salant, Switzer, and Reynolds [1983]; see also, Perry and Porter [1985]).

$$= -P'(X)dX \left[X_I + \sum_{i \notin I} x_i \frac{dx_i}{dX} \right] \quad (10)$$

$$= -P'(X)XdX \left[s_I + \sum_{i \notin I} s_i \frac{dx_i}{dX} \right], \quad (11)$$

where s_i is the market share of firm i (s_I is the collective market share of the firms in set I), and $\frac{dx_i}{dX}$ is the (differential) change in non-merging firm i 's output when industry output changes marginally.⁸ Thus, $dE > 0$ if and only if

$$s_I < - \sum_{i \notin I} s_i \frac{dx_i}{dX}. \quad (12)$$

Farrell and Shapiro establish conditions under which signing this differential effect at the premerger point is sufficient for signing the global effect.⁹ Note one very important aspect of condition (12): it allows us to establish that a merger is welfare-enhancing without the need to quantify the efficiencies created by the merger. The reason is that the external effect is purely a function of the output reduction of the merging parties (and the reactions to this decrease by nonmerging firms).

As one example, consider a model with linear demand and constant returns to scale. It is straightforward to see that we then have $\frac{dx_i}{dX} = -1$, so we find that the external effect is positive when

$$s_I < \sum_{i \notin I} s_i; \quad (13)$$

i.e., if the merging firms have a share below $\frac{1}{2}$.

As another example consider the case of the inverse demand function $P(X) = a - X$ and let the cost function for a firm with k units of capital be $c(x, k) = \frac{1}{2} \frac{x^2}{k}$. (A merger of firms with k_1 and k_2 units of capital results in a merged firm with $k_1 + k_2$ units of capital.) Farrell and Shapiro show that in this case the external effect is positive if

$$s_I < \frac{1}{\varepsilon} \sum_{i \notin I} (s_i)^2; \quad (14)$$

⁸We get $\frac{dx_i}{dX}$ from implicitly differentiating the expression $P'(X)x_i + P(X) - c'_i(x_i) = 0$. Note that $\frac{dx_i}{dX} = \frac{dx_i}{dX_{-i}} / \left(1 + \frac{dx_i}{dX_{-i}} \right)$, where $dX_{-i} \equiv \sum_{j \neq i} dx_j$ and $\frac{dx_i}{dX_{-i}}$ is the slope of firm i 's best-response function.

⁹In particular, this is so if $[P''(\cdot), P'''(\cdot), c''_i(\cdot), -c'''_i(\cdot)] \geq 0$.

that is, if the share of the merging firms is less than an elasticity-adjusted Herfindahl of the non-merging firms.

Observe that in these two examples the external effect is more likely to be positive when the merging firms are small. This is so because of two effects. First, there is less of a welfare reduction for consumers and the non-merging firms in aggregate resulting from a given price increase when the output of the merging firms is low (to first-order, this welfare reduction for consumers and non-participating firms is proportional to the output of the merging firms, X_I). Second, after the merger, the output of the merged firms decreases, while the output of the non-merging firms increases (although not as much). This production reshuffling has welfare consequences when the marginal costs of the two sets of firms differ. Since in the Cournot model larger firms have lower marginal costs in equilibrium [this follows from (1) and (2)], the welfare effect of this reshuffling of production is positive when small firms merge and negative when large firms merge. It is also noteworthy that, at least in the second example, the external effect is more likely to be positive the more concentrated are the shares of the nonmerging firms.

Conditions (13) and (14) are very simple conditions that require only relatively available data on premerger outputs and, for condition (14), the market demand elasticity.¹⁰ However, the precise forms of these tests are very special and depend on having a lot of *a priori* information about the underlying demand and cost functions. For more general demand and cost specifications, condition (12) requires that we also know the slopes of firms' best-response functions [in order to know $(\frac{dx_i}{dX})$]. These slopes are significantly more difficult to discern than are outputs and the elasticity of market demand.

Several further remarks on the Farrell and Shapiro method are in order. First, using the external effect to derive a sufficient condition for a merger to be welfare enhancing depends critically on the assumption that mergers that are undertaken are privately profitable. To

¹⁰ Although they bear some superficial resemblance to the concentration tests that appear in the DOJ/FTC Merger Guidelines (see the next section), they differ from the Guidelines' tests in some significant ways, such as the fact that increases in the concentration of non-merging firms can make the merger more desirable socially.

the extent that agency problems may lead managers to “empire build” to the detriment of firm value, this assumption may be inappropriate.¹¹ Second, this approach relies as well on the assumption that all of the private gains for the merging parties represent social gains. If, for example, some of these gains arise from tax savings (see Werden [1990]) or represented transfers from other stakeholders in the firm (Shleifer and Summers [1988]), this assumption would be inappropriate. Third, the model ignores the possibility of post-merger entry. Fourth, the Farrell and Shapiro analysis is based on the very strong assumption that market competition takes a form that is well described by the Cournot model both before and after the merger. Many other forms of price/output competition are possible, and — as we mentioned at the end of the last section — important elements of competition may occur along dimensions other than price/quantity.

At the same time, there is some evidence that the efficiency consequences of production reshuffling that the theory focuses on may well be important in practice. Olley and Pakes [1996], for example, study the productivity of the telecommunications equipment industry following a regulatory decision in 1978 and the 1984 break-up of AT&T that allowed new entry into a market that had essentially been a (Western Electric) monopoly. They document that productivity in the industry varied greatly across plants in the industry. More significantly from the perspective of the Farrell and Shapiro model, Olley and Pakes show that there was a significant amount of inefficiency in the allocation of output across plants in the industry once market structure moved away from monopoly.¹²

There has been no work that I am aware of extending the Farrell and Shapiro approach to other forms of market interaction. Other papers that examine the effect of horizontal mergers on price all assume that there are no efficiencies generated by the merger. Although

¹¹In this regard, it appears from event study evidence that - on average - mergers increase the joint value of the merging firms, although there is a large variance in outcomes across mergers (Andrade, Mitchell, and Stafford [2001], Jensen and Ruback [1983]). One might take the view, in any case, that antitrust policy should in any case not concern itself with stopping mergers based on unresolved agency problems within the merging firms.

¹²In particular, efficiency in this sense *decreased* as the industry went from monopoly to a more competitive market structure. However, overall industry productivity increased because capital was reallocated toward more efficient firms over time.

in simple static pricing models determining the effect on price is straightforward, some interesting issues can arise in dynamic models. Compte, Jenny, and Rey [2002], for example, consider the effects of horizontal mergers on price in a repeated Bertrand model with capacity constraints. In such models, capacity limitations affect both the incentive to undercut the equilibrium price (more capacity allows a greater increase in sales) and also the ability to punish deviators who undercut. In such a model, it is not clear a priori whether a merger — which results in the consolidation of the capacities of the merging firms — would or would not result in higher prices, and the question of which mergers would lead to higher prices and which to lower ones when firms are initially in asymmetric positions holds substantial interest.¹³ Different dynamic issues arise when merging firms operate in a durable goods market, a setting that has been considered by Carlton and Gertner [1989]. In this case, used goods on the market may provide a constraint on the pricing of even a monopolist. Moreover, even a monopolist may have limited market power in such cases because of its inability to commit to limit its future sales (Coase [1972]).

Once one is focusing on dynamics, one can begin to consider other, more long run aspects of competition among firms, such as capacity investment, R&D, and new product development. In principle, a merger's effect on welfare may be as much or more through changes in these dimensions than through changes in prices/outputs. Work on these issues is limited at this point. Some progress has been made through the use of computational techniques. Berry and Pakes [1993], for example, discuss simulations of a dynamic oligopoly model with capacity investment in which a merger's long-run effects on profitability and welfare through changes in investment indeed swamp its static price/output competition effect. Further work along these lines which attempts to endogenize the merger process itself can be found in Gowrisankaran [1999].

¹³The ambiguous effect of capacity on pricing in a repeated oligopoly game was first noted by Brock and Scheinkman [1985].

3 The Department of Justice/FTC Merger Guidelines

The Department of Justice (DOJ) and Federal Trade Commission (FTC) have periodically issued joint guidelines outlining the method they would follow for evaluating horizontal mergers. The most recent Guidelines were issued in 1992, with a revision to the section on efficiencies in 1997. A copy of these Guidelines is reprinted in Appendix B.

The merger analysis described in the Guidelines consists of four basic steps:

1. Market Definition
2. Calculation of Market Concentration and Concentration Changes
3. Evaluation of Other Market Factors
4. Pro-competitive Justifications

3.1 Market Definition

For simplicity suppose that the two merging firms produce widgets. The DOJ/FTC will first ask the following question:

Can a hypothetical monopolist of widgets profitably impose a “small but significant and non-transitory” increase in the price of widgets given the pre-merger prices of other products?

In practice, a “small but significant and non-transitory” price increase is taken to be 5 percent of the pre-merger price. If the answer to this question is “yes”, then this is the relevant market. If it is “no”, then they will include the next closest substitute product (the product that would gain the most sales as a result of the 5% increase in the price of widgets) and ask the same question again for this new larger potential market. This continues until they get a “yes” answer to the question. The idea is to arrive at a “relevant market” of products in which a merger could potentially have an anticompetitive effect.¹⁴

¹⁴Note, for example, that a product that has a completely independent demand from all other products, but that is already priced at its monopoly level, would not constitute a relevant market. One potential

In the above example the two firms were both producing the homogeneous product widgets. Sometimes they will be producing imperfect substitutes, say widgets and gidgets (or products sold in somewhat differing geographic areas). The DOJ or FTC will start asking the above question for each of these products separately. The merger is “horizontal” if this leads to a market definition in which the two products are both in the same market.

So far we have assumed that the firms each produce a single product. In many cases, however, they will be multi-product firms. The DOJ or FTC will follow the above procedure for each product they produce.

The general procedure described in the Guidelines has a number of ambiguities. For example, in applying the 5% price increase standard there is a question as to what the “price” is. For example, consider an oil pipeline that buys oil on one end, transports it, and sells it at the other. Is the price the total price charged for the oil at the end, or is it the net price for the transportation provided? Note that if oil is competitively supplied, then the basic economic situation is not affected by whether the pipeline buys oil and sells it to consumers, or charges oil companies for transportation, with the oil companies selling to consumers. Yet, which price is chosen matters for the market definition adopted via the Guidelines procedure.¹⁵ Similarly, the procedure for dealing with the case of differentiated products has the ambiguity that the market definition arrived at starting with one of the products could be different than that arrived at starting with the other. It is in some sense difficult to know how to resolve these ambiguities because the procedure — while intuitive — is not based directly on any explicit model of competition and welfare effects.

problem with this definition is that if a group of firms is currently colluding perfectly, this procedure may allow them to merge, thereby eliminating any possibility that their collusion would break down in the future.

¹⁵In fact, the Guidelines comments on the oil pipeline example, indicating that the price used would be the price of transport. Note that using the total price of oil as the price would have the problem that the pipeline could thwart the test by attaching a \$1,000 dollar bill to its barrels of oil and selling them for \$1,000 more than it would otherwise. Trying to develop a general principle from this example, however, raises the issue of which costs, in general, should be excluded to arrive at the appropriate price. Perhaps the cleanest rule conceptually would be to exclude all costs — that is, to use an increase in the price-cost margin as the basis of the test.

3.2 Calculating Concentration and Concentration Changes

Once the DOJ or FTC has defined the relevant market, the next step is calculating the pre- and post-merger concentration levels. To do so, the DOJ and FTC will include all firms that are currently producing as well as all likely “uncommitted entrants”; i.e., firms that could and would readily and without significant sunk costs supply the market in response to a 5% increase in price. Shares are then calculated for each of these firms, usually on the basis of sales, although sometimes based on production or capacity. Using these shares, say (s_1, \dots, s_N) , the DOJ or FTC will then calculate the following concentration measures:

$$\text{Pre-merger Herfindahl Index: } HI_{pre} = \sum_i (s_i)^2.$$

$$\text{Post-merger Herfindahl Index: } HI_{post} = \sum_i (s_i)^2 - (s_1)^2 - (s_2)^2 + (s_1 + s_2)^2 = \sum_i (s_i)^2 + 2s_1s_2.$$

$$\text{The Change in the Herfindahl Index: } \Delta HI = HI_{post} - HI_{pre} = 2s_1s_2.$$

The levels of these measures place the merger in one of the following categories:

Post-Merger $HI_{post} < 1000$: These mergers are presumed to raise no competitive concerns except in exceptional circumstances.

Post-Merger $HI_{post} > 1000$ and < 1800 : These mergers are unlikely to be challenged if the increase in the Herfindahl Index is less than 100. If it exceeds 100, then the merger “raises significant competitive concerns” subject to consideration of other market factors.

Post-Merger $HI_{post} > 1800$: These mergers are unlikely to be challenged if the change in the Herfindahl Index is less than 50. If it is between 50 and 100, then the merger “raises significant competitive concerns” subject to consideration of other market factors. If it exceeds 100, the merger is presumed to be anti-competitive absent very strong evidence showing otherwise.

Recalling that in a symmetric oligopoly the Herfindahl Index is equal to 10,000 divided by the number of firms in the market, a Herfindahl Index of 1000 corresponds to 10 equal-sized firms; a Herfindahl Index of 1800 corresponds to 5.6 equal-sized firms. A change in the Herfindahl of 100 would be caused by the merger of two firms with a roughly seven percent share; a change of 50 would be caused by the merger of two firms with a five percent share.

3.3 Evaluation of Other Market Factors

The DOJ and FTC's investigation uses the concentration figures discussed above to set presumptions about the merger, but also considers a number of other factors affecting the competitive impact of the merger. These include:

Structural factors affecting the ease of sustaining collusion. These include factors such as homogeneity of products, noisiness of the market, and others that we discussed in the previous chapter. As applied to merger analysis, however, one might wonder whether increases in the ease of sustaining collusion should always raise our concern; after all, one might argue that relatively little competitive harm can come from a merger in a market in which the firms are already easily able to sustain the joint monopoly outcome.

Evidence of market performance. This would involve any empirical evidence showing how the level of concentration in such a market affects competitive outcomes.

The substitution patterns in the market. The DOJ and FTC will ask whether the merging firms are relatively closer substitutes to each other than to other firms in the "market". This is a way of trying to avoid the discarding of important information about substitution patterns that might occur in the process of simply calculating concentration figures.

Substitution patterns between products in and out of the market. The DOJ and FTC will ask whether there is a large degree of differentiation with the products just

“out of the market.” This is in a sense a way of softening the edges of the previous determination of the relevant market; that is, it is a way of making the “in or out” decision regarding certain products less of an all-or-nothing proposition.

Capacity limitations of some firms in the market. Here the aim is to avoid the loss of important information about the competitive constraint provided by the merging firms’ rivals that might occur from a simple calculation of market concentration. If a rival is capacity constrained, we would expect it to be less of a force in constraining any post-merger price increase.

Ease of Entry. Here the DOJ or FTC will consider the degree to which conditions of easy entry might preclude the merger from harming competition. The question they ask is whether, in response to a 5% price increase, entry would occur within 2 years that would drive price down to its pre-merger level. If we are interested in a consumer surplus standard, this test makes sense: in that case, we care only that prices not increase. If we are interested in an aggregate welfare standard, however, then there is some question about how we should think about the ease of entry. To see why, consider the standard two-stage model of entry with sunk costs (as in Mankiw and Whinston [1986]; see also, Mas-Colell, Whinston, and Green [1995], Chapter 12), and for simplicity imagine that competition takes a Cournot form, that firms have identical constant returns to scale technologies, and that the merger creates no improvements in efficiency. In this setting, the result of two firms merging would in the short-run be an elevation in price, and in the longer-run (once entry could occur) would be the entry of exactly one additional firm and a return to the pre-merger price. Thus, in the period after entry occurred, the merger would result in a welfare loss exactly equal to the (flow) cost of the new firm’s cost of entry. It appears then that if the ease of entry is to be considered as a factor in a merger analysis aimed at maximizing aggregate welfare, the motivation for doing so must not be because of any actual entry induced by the merger. One possible motivation is along the lines of Farrell and Shapiro’s analysis.

In particular, the easier is entry, the greater must be the merger-induced improvement in efficiency for the merger to be profitable (in the example above, the merging firms would lose money from their merger if entry occurs quickly). Given this fact, a merger that occurs despite the possibility of rapid entry is more likely to be one that generates large welfare-enhancing efficiencies.¹⁶

3.4 Pro-competitive Justifications

The principal issue here is the consideration of efficiencies. The DOJ and FTC typically adopt a fairly high hurdle for claimed efficiencies, because it is relatively easy for firms to claim that efficiencies will be generated by the merger, and relatively hard for antitrust enforcers to evaluate the likelihood that these efficiencies will be realized. As I have already noted in Chapter 1, the weight given to these efficiencies depends on the welfare standard adopted by the agencies. The 1997 revisions to the DOJ/FTC Guidelines adopt the position that the efficiencies must be sufficient to keep price from increasing for an anticompetitive merger to be approved (hence, reductions in fixed costs do not help gain approval for a merger). This amounts to adopting a consumer surplus standard for horizontal mergers. In contrast, until recent court decisions, Canada's Competition Act appeared to adopt an aggregate welfare perspective by asking whether the efficiency gains outweigh any reduction in consumer surplus coming from higher prices. In either case, the efficiencies that are counted must be efficiencies that could not be realized by less restrictive means, such as through individual investments of the firms, through joint production agreements, or through a merger that included some limited divestitures. Finally, one concern in mergers that claim significant operating efficiencies (say through reductions in manpower or capital) is whether these reductions alter the quality of the products produced by the firms. For example, in a recent merger of two Canadian propane companies having roughly a 70% share of the Canadian market, the merging companies proposed to consolidate their local branches, reducing

¹⁶One paper that considers some issues related to entry and its role in horizontal merger analysis is Werden and Froeb [1998].

trucks, drivers, and service people. These would be valid efficiencies if the quality of their customer service did not suffer, but if these savings represent merely a move along an existing quality-cost frontier, they would not be valid efficiencies from an antitrust standpoint.

4 Econometric Approaches to Answering the Guidelines' Questions

There are two principal areas in applying the DOJ/FTC Guidelines in which econometric analysis has been employed. These are in the process of defining the relevant market and in providing evidence about the effects of increased concentration on prices.

4.1 Defining the Relevant Market

Suppose that we have some collection of substitute products (goods $1, \dots, N$) which include the products of the merging firms. To answer the Guidelines' market definition question we want to study the profitability of a 5% price increase were some subset of the firms to merge, taking the prices of other firms as fixed (at their current levels). We can do this if we know the demand functions for the merging products, the cost functions for the merging products, and the current prices of all N products.

For specificity, consider the first step in the Guidelines' analysis, the question of whether the merging firms would together find a 5% price increase to be profitable (the analysis for subsequent broader sets of products is similar). To answer the Guidelines' question, we must first estimate the demand functions for the products produced by the merging firms. The simplest case to consider arises when the merging firms produce identical products, say widgets, which are differentiated from the products of all other firms. In this case, we need only estimate the demand function for widgets, which is given by some function $x(p, q, y, \varepsilon)$, where p is the price of widgets, q is a vector of prices of substitute products, y is a vector of exogenous demand shifters (e.g., income, weather, etc.), and ε represents (random) factors not observable by the econometrician. For example, a constant elasticity demand function

(with one substitute product and one demand shifter) would yield the estimating equation

$$\ln(x_i) = \beta_0 + \beta_1 \ln(p_i) + \beta_2 \ln(q_i) + \beta_3 \ln(y_i) + \varepsilon_i, \quad (15)$$

where i may indicate observations on different markets in a cross-section of markets or on different time periods in a series of observations on the same market.¹⁷ Several standard issues arise in the estimation of equation (15). First, as always in econometric work, careful testing for an appropriate specification is critical. Second, it is important to appropriately control for the endogeneity of prices: the price of widgets p is almost certain to be correlated with ε because factors that shift the demand for widgets but are unobserved to the econometrician will, under all but a limited set of circumstances, affect the equilibrium price of widgets.¹⁸ The most common direction for the bias induced by a failure to properly instrument in estimating equation (15) would be toward an under-estimate of the elasticity of demand because positive shocks to demand are likely to be positively correlated with p .¹⁹ Observe, however, that if we were to estimate instead the inverse demand function

$$\ln(p_i) = \bar{\beta}_0 + \bar{\beta}_1 \ln(x_i) + \bar{\beta}_2 \ln(q_i) + \bar{\beta}_3 \ln(y_i) + \varepsilon_i, \quad (16)$$

then since the equilibrium quantity x is also likely to be positively correlated with ε , we would expect to get an underestimate of the *inverse* demand elasticity – that is, an *over-estimate* of the demand elasticity. (Indeed, the difference between these two estimates of the demand elasticity is one specification test for endogeneity.) This observation leads to what might, in a tongue-in-cheek manner, be called the *Iron Law of Consulting*: “Estimate inverse demand functions if you work for the defendants, and ordinary demand functions if you work for the plaintiffs.” What is needed to properly estimate either form are good cost-side instruments for the endogenous price/quantity variables; that is, variables that can be expected to be correlated with price/quantity but not with demand shocks.

¹⁷More generally, such an equation could be estimated on a panel data set of many markets observed over time.

¹⁸This correlation would not be present, for example, if the firms have constant marginal costs and engage in Bertrand pricing prior to the merger.

¹⁹Our discussion in the text takes the price of substitutes q as exogenous. However, this price may also be correlated with ε and need to be instrumented.

Matters can become considerably more complicated when the product set being considered includes differentiated products. If the number of products in the set is small, then we can simply expand the estimation procedure outlined above by estimating a system of demand functions together. For example, suppose that one merging firm produces widgets and the other produces gadgets, and that there is a single substitute product. Then, in the constant elasticity case, we could estimate the system

$$\ln(x_{wi}) = \beta_{10} + \beta_{11} \ln(p_{wi}) + \beta_{12} \ln(p_{gi}) + \beta_{13} \ln(q_i) + \beta_{14} \ln(y_i) + \varepsilon_{1i}, \quad (17)$$

$$\ln(x_{gi}) = \beta_{20} + \beta_{21} \ln(p_{gi}) + \beta_{22} \ln(p_{wi}) + \beta_{23} \ln(q_i) + \beta_{24} \ln(y_i) + \varepsilon_{2i}. \quad (18)$$

The main difficulty involved is finding enough good instruments to separately identify the effects of the prices p_w and p_g . Usually one will need some cost variables that affect one product and not the other (or at least that differ in their effects on the costs of the two products).

As the number of products in the set of products being considered expands, however, estimation of such a demand system will become infeasible because the data will not be rich enough to permit separate estimation of all of the relevant own and cross demand elasticities between the products (which increase in the square of the number of products). In the past, this was dealt with by aggregating the products into subgroups (e.g., premium tuna, middle-line tuna, and private label tuna in a merger of tuna producers) and limiting the estimation to the study of the demand for these groups (the prices used would be some sort of price indices for the groups). Recently, however, there has been a great deal of progress in the econometric estimation of demand systems for differentiated products. The key to these methods is to impose some restrictions that limit the number of parameters that need to be estimated, while not doing violence to the data.

Two primary methods have been advanced in the literature to date. One, developed by Berry, Levinsohn, and Pakes [1995] (see also Berry [1994]), models the demand for the various products as being a function of some underlying characteristics. For example, in the

automobile industry that is the focus of their study, cars' attributes include length, weight, horsepower, and various other amenities. Letting the vector of attributes for car j be a_j , the net surplus for consumer i of buying car j when its price is p_j is taken to be the function

$$u_{ij} = a_j \cdot \beta_i - \alpha_i p_j + \xi_j + \varepsilon_{ij}, \quad (19)$$

where β_i is a parameter vector representing consumer i 's weights on the various attributes, α_i is consumer i 's marginal utility of income, ξ_j is a random quality component for car j (common across consumers) that is unobserved by the econometrician, and ε_{ij} is a random consumer/car-specific shock that is unobserved by the econometrician and is independent across consumers and cars. The parameters β_i and α_i may be taken to be common across consumers, may be modeled as having a common mean and a consumer-specific random element, or (if the data is available) may be modeled as a function of demographic characteristics of the consumer.²⁰ The consumer is then assumed to make a choice among discrete consumption alternatives, whose number is equal to the number of products in the market. Berry, Levinsohn, and Pakes [1995], Berry [1994], and Nevo [2000a, 2000b, 2001] discuss in detail the estimation of this demand model including issues of instrumentation and computation. The key benefit of this approach arises in the limitation of the number of parameters to be estimated because of the assumption that the value of each product in the market can be tied to a limited number of characteristics. The potential danger, of course, is that this restriction will not match the data well. For example, one model that is nested within (19) is the traditional logit model (take β_i and α_i to be common across consumers, assume that $\xi_j \equiv 0$, and take ε_{ij} to have an extreme value distribution). This model has the well-known Independence of Irrelevant Alternatives (IIA) property, which implies that if the price of a good increases, all consumers who switch to other goods do so in proportion to these goods market shares.²¹ This assumption is usually at odds with actual substitution patterns. For

²⁰If individual-level demographic and purchase data are available, then the parameters in (19) can be estimated at an individual level; otherwise, the population distribution of demographic variables can be used with aggregate data, as in Nevo [2001].

²¹To see this, recall that in the Logit model, the demand of good k given price vector p and M consumers

example, it is common for two products with similar market shares to have quite distinct sets of close substitutes. For example, Berry, Levinsohn, and Pakes discuss the example of a Yugo and a Mercedes (two cars) having similar market shares, but quite different cross-elasticities of demand with a BMW. If the price of a BMW were to increase, it is likely that the Mercedes' share would be much more affected than the share of the Yugo.²²

The second method is the multi-stage budgeting procedure introduced by Hausman, Leonard, and Zona [1994] (see also Hausman [1996]). In this method, the products in a market are grouped on *a priori* grounds into subgroups. For example, in the beer market that these authors study, they group beers into the categories of premium beers, popular price beers, and light beers. They then estimate demand at three levels. First, they estimate the demand within each of these three categories as a functions of the prices of the within-category beers and the total expenditure on the category, much as in equations (17) and (18). Next, they estimate the expenditure allocation among the three categories as a function of total expenditures on beers and price indices for the three categories. Finally they estimate a demand function for expenditure on beer as a function of an overall beer price index. In this method, the grouping of products into groups (and the separability and other assumptions on the structure of demand that make the multi-stage budgeting approach valid) restricts the number of parameters that need to be estimated. This allows for a very flexible estimation of the substitution parameters within groups and in the higher level estimations. On the other hand, the method does impose some strong restrictions on substitution between products in the different (*a priori* specified) groups: for example, substitution patterns toward products in one group (say, premium beers) are independent of which product in another group (say,

is

$$x_i(p) = M \frac{e^{a_k \cdot \beta - \alpha p_k}}{\sum_j e^{a_j \cdot \beta - \alpha p_j}},$$

so the ratio of the demands for any two goods j and k is independent of the prices of all other goods.

²²The fact that two products with the same market shares have the same cross-elasticity of demand with any third product in fact follows from the additive iid error structure of the Logit model [which implies that they must have the same value of $(a_j \cdot \beta - \alpha p_j)$], not the extreme value assumption. The extreme value assumption implies, however, the stronger IIA property mentioned in the text.

popular price beers) has experienced a price increase.

There has to date been very little work evaluating the relative merits of these two approaches. The one such study that I am aware of is Nevo [1997] who compares the two methods in a study of the ready-to-eat cereal industry. In that particular case, he finds that the Berry, Levinsohn, and Pakes characteristics approach works best, but it is hard to know at this point how the two methods compare more generally.

Estimation of cost functions has a longer history. One problem with the cost side, however, tends to be a lack of the needed data.²³ (The output and price data needed for demand estimation tends to be more readily available.) Absent the ability to directly estimate firms' cost functions, we can still get an approximation of marginal costs if we are willing to assume something about firms' behavior. For example, suppose that we assume that firms are playing a static Nash (differentiated product) pricing equilibrium before the merger. Then we can use the fact that the firms' prices satisfy the first-order conditions

$$(p_i - c'_i(x_i(p))) \frac{\partial x_i(p_i, p_{-i})}{\partial p_i} + x_i(p) = 0 \text{ for } i = 1, \dots, N \quad (20)$$

to derive that

$$c'_i(x_i(p)) = p_i + \frac{\partial x_i(p_i, p_{-i})}{\partial p_i} \#_{-1} x_i(p) \text{ for } i = 1, \dots, N. \quad (21)$$

We can then use this information to answer the Guideline's market definition question if we are willing to assume that marginal costs are approximately constant in the relevant range. (This can be done as well with multi-product firms using a somewhat more complicated equation.²⁴)

The econometric tools to estimate demands and costs, particularly in an industry with extensive product differentiation, are fairly recent. Moreover, time is often short in these investigations. As a result, a number of simpler techniques have often been applied to try

²³There are also potential issues of endogeneity and selection; see, for example, Olley and Pakes [1996] for a discussion in the context of estimating firms' production functions.

²⁴Alternatively, given a behavioral assumption, we can try to econometrically infer costs by estimating the firms' supply relations as discussed in Bresnahan [1989].

to answer the Guidelines' market definition question. The simplest of these involve a review of company documents and industry marketing studies, and informally asking customers about their likelihood of switching products in response to price changes. These methods, of course, are likely to produce at best a rough sense of the degree of substitution between products.²⁵

Two other methods include examining price correlations among a set of products and, for cases in which the issue is geographic market definition, looking at patterns of transshipment. Both of these have serious potential flaws, however.

To consider the use of price correlations, for example, imagine that we have two cities, A and B, that are located a distance of 100 miles apart. City B has a competitive widget industry that produces widgets at a cost per unit of c_B . There is a single widget producer in city A who has a cost per unit of c_A . These costs are random. The demand at each location i is $x_i(p) = \alpha_i - p$ and there is a cost t of transporting a widget between the cities.

Imagine, first, that the transport cost is infinite, so that the markets are in fact completely distinct. Then the price in market A will be $p_A^m = (\alpha_A + c_A)/2$ and the correlation between the prices in market A and market B will be

$$\frac{\text{cov}(p_A, c_B)}{\text{var}(p_A)\text{var}(c_B)} = \frac{\frac{1}{2}\text{cov}(\alpha_A, c_B) + \frac{1}{2}\text{cov}(c_A, c_B)}{\text{var}(p_A)\text{var}(c_B)} \quad (22)$$

If, for example, α_A is fixed and $c_A = c_B \equiv c$, then the correlation will equal 1 (perfect correlation) even though the markets are completely distinct. (This is just the case of a common causal factor, in this case the level of marginal cost.)

Suppose instead that t is random, that for all of its realizations $(c_B + t) < \frac{1}{2}$, and that $\alpha_A = 1$ and $c_A = c_B \equiv c$. In this case, the price in market B fully constrains the price in market A so that $p_A = c + t$. If t and c are independently distributed, then the correlation between the prices in the two markets is

$$\frac{\text{cov}(c + t, c)}{\text{var}(c) + \text{var}(t)} = \frac{\text{var}(c)}{\text{var}(c) + \text{var}(t)} \quad (23)$$

²⁵ More formal consumer survey methods can also be used; see, for example, the discussion in Baker and Rubinfeld [1999].

Hence, if $\text{var}(c)$ is small, the correlation between the prices will be nearly zero, despite the fact that market A is fully constrained by the competitive industry in market B. On the other hand, if the variance of t is instead small, then the correlation will be close to 1. Yet — and this illustrates the problem — which of $\text{var}(c)$ or $\text{var}(t)$ is small has no bearing on the underlying competitive situation.

A problem with looking at transshipments is also illustrated by this last case since no transshipments take place in equilibrium despite the fact that market A is fully constrained by market B.

4.2 Evidence on the Effects of Increasing Concentration on Prices

In the consideration of “other factors”, one type of evidence that is often presented by one or both sides in horizontal merger cases is evidence of the effects of concentration on prices. These studies typically follow the “Structure-Conduct-Performance” paradigm of regressing a measure of performance — in this case price — on one or more measures of concentration and other control variables.²⁶ A typical regression seeking to explain the price in a cross-section of markets $i = 1, \dots, I$ might look like

$$p_i = \beta_0 + w_i \cdot \beta_1 + y_i \cdot \beta_2 + CR_i \cdot \beta_3 + \varepsilon_i, \quad (24)$$

where w_i are variables affecting costs, y_i are variables affecting demand, and CR_i are measures of the level of concentration (the variables might be in logs, and both linear and nonlinear terms might be included). In the most standard treatment, these variables are all treated as exogenous causal determinants of prices in a market. As such, and given the mix of demand and cost variables included in the regression, it has become common to refer to them as “reduced form” estimations (see, for example, Baker and Rubinfeld [1999]), with the intention of distinguishing them from “structural estimation” of demand and supply relationships.

²⁶The use of price in structure-conduct-performance studies was most forcefully advocated by Weiss [1990].

Regressions such as these have seen wide application in horizontal merger cases; indeed, they are the most commonly used econometric technique employed in current merger cases. In the Federal Trade Commission's challenge of the Staples/Office Depot merger, for example, this type of regression was used by both the Commission and the defendants.²⁷ In that merger the focus was on whether these office "superstores" should be considered as a distinct market (or "submarket") or whether these stores should be viewed as a small part of a much larger office supply market. The parties used this type of regression to examine the determinants of Staples' prices in a city.²⁸ In that case, the concentration measures included both a measure of general concentration in the office supply market and measures of whether there were office supply superstores within the same Metropolitan Statistical Areas and within given radiuses of the particular Staples store.

As another example, when the Union Pacific (UP) sought to acquire the Southern Pacific (SP) railroad in 1996 shortly after the merger of the Burlington Northern (BN) and the Sante Fe (SF) railroads, many railroad routes west of the Mississippi River would go from being served by 3 firms to being served by 2 firms in the event of the merger, and some would go from 2 firms to 1 firm. The merging parties claimed that SP was a "weak" railroad, and that it did not have much of a competitive effect on UP in any market in which BN/SF was already present. To bolster this claim, the merging parties conducted this type of study of UP's prices, where the concentration variables included separate dummy variables indicating exactly which competitors UP faced in a particular market.²⁹

Although these regressions have provided useful evidence in a wide range of cases, they can suffer from at least two serious problems. The first has to do with *omitted variables*. Omitted variables is of course a potential problem in any regression analysis, but it bears special mention here. Firms typically have many "assets" that affect their competitive po-

²⁷For an interesting discussion of the use of econometric evidence in the case, see Baker [1999b].

²⁸The data was actually a panel of stores over time, rather than just a single cross-section or time series as in equation (24).

²⁹The case was presented before the Surface Transportation Board, which has jurisdiction over railroad mergers.

sition in a market and it is unusual for an analyst to have measures of all of the important ones, or even most. As a result, the included measure(s) of concentration can end up capturing the effects of these omitted factors. One might hope that this would not matter; perhaps the concentration variable(s) can serve as a useful aggregate proxy for these factors? Unfortunately, it seems like this will often not be the case. To take an example, consider the UP/SP example. One factor that is probably important for the determination of prices on a route is the level of aggregate capacity available on that route (such as tracks, sidings, and yards); higher capacity is likely to lead to lower prices, all else equal. In the pre-merger data, this aggregate capacity level is likely to be correlated with the number and identity of competitors on a route. For example, aggregate capacity is probably larger when more firms are present. Hence, in a regression that includes the number of firms on a route, but not capacity, some of the effect that is attributed to an increase in concentration is likely to be due instead to the fact that across the population of markets, higher concentration is correlated with lower capacity levels. But in a merger, while the number of firms will decrease on many routes, the level of capacity on these routes may well remain unchanged (at least in the short-run). If so, the regression would predict too large an elevation in price following the merger.

The second problem has to do with *endogeneity* of some of the explanatory variables. In fact, (24) is *not* a true reduced form, since the level of concentration is surely endogenous.³⁰ A true reduced form would include only the underlying exogenous factors influencing market outcomes. Indeed, in many ways equation (24) is closer to estimation of a supply relation, in the sense discussed in Bresnahan [1989]. To see this, consider the case in which demand takes the constant elasticity form $X(p) = Ap^{-\eta}$, all firms are identical with constant unit costs of c , and firms play a static Cournot equilibrium. Then we can write an active firm's

³⁰Often some of the other right hand side variables are as well. For example, in studies of airline pricing, it is common to include the load factor on a route — the share of available seats that are sold — as a right-hand side variable affecting costs.

first-order condition as

$$p = c - P'(X)x_i = c + \frac{s_i}{\eta}p = c + \frac{H}{\eta}p \quad (25)$$

where $P(\cdot)$ is the inverse demand function and s_i is firm i 's market share which, given symmetry, equals the Herfindahl index H . As in Bresnahan [1989], we can nest this model and perfect competition by introducing a conduct parameter θ and rewriting (25) as

$$p = c + \theta \frac{H}{\eta} p.$$

Thus,

$$p = \frac{\bar{A}}{\eta - \theta H} c, \quad (26)$$

where the term in parentheses represents the proportional “mark-up” of price over marginal cost. Taking logarithms, we can write (26) as

$$\ln(p) = \ln(c) + \ln(\eta) - \ln(\eta - \theta H). \quad (27)$$

Supposing that marginal cost takes the form $c = \bar{c}e^\varepsilon$ where \bar{c} is observable (or a function of observable variables) and ε is an unobservable cost component, (27) becomes

$$\ln(p) = \ln(\bar{c}) + \ln(\eta) - \ln(\eta - \theta H) + \varepsilon, \quad (28)$$

which has a form very close to (24) (the only difference is the interaction between the concentration variable H and the demand variable η). In fact, using the first-order Taylor expansion that $\ln(x) \approx x - 1$, we can approximate (28) by

$$p = \bar{c} + \theta H + \varepsilon, \quad (29)$$

which takes exactly the linear form often used in these studies. Here H is endogeneous; possible instruments for it include the “market size” variable A , and measures of the cost of entry, both of which affect the level of concentration while arguably being uncorrelated with ε . For more general demand and cost structures, or cases with asymmetric firms, the true supply relation will not take a form so close to (24), but (24) might be viewed as a loose

approximation to the supply relation. The sense in which it is a “reduced form” approach is then really only that those who run such regressions do not attempt to relate their estimates back to any underlying structural model.

5 Breaking the Market Definition Mold

In this section, I discuss three techniques for evaluating the likely effects of a merger on competition that do not follow the approach suggested in the Guidelines. These are merger simulation, residual demand estimation, and the event study approach.

5.1 Merger Simulation

If we are really going the route of estimating demand and cost functions to answer the Guidelines’ questions, one might wonder why we don’t just examine the price effects of the merger directly using these estimated structural parameters. That is, once we estimate a structural model of the industry using pre-merger data, we can *simulate* the effects of the merger. Conceptually, doing so is simple: given demand and cost functions for the various products in the market and an assumption about the behavior of the firms (existing studies typically examine a static simultaneous price choice game), one can solve numerically for the equilibrium prices that will emerge from the post-merger market structure. For example, if firms 1 and 2 in a three-firm industry merge, the equilibrium prices (p_1^*, p_2^*, p_3^*) in a static simultaneous price choice game will be such that after the merger (p_1^*, p_2^*) maximizes the merged firm’s profit given p_3^* (the notation follows that in Section 4.1),

$$(p_1^*, p_2^*) = \arg \max_{p_1, p_2} \times_{i=1,2} [p_i x_i(p_1, p_2, p_3^*, q, y) - c_i(x_i(p_1, p_2, p_3^*, q, y))],$$

while p_3^* maximizes the profit of the third firm given (p_1^*, p_2^*) ,

$$p_3^* = \arg \max_{p_3} p_3 x_3(p_1^*, p_2^*, p_3, q, y) - c_3(x_3(p_1^*, p_2^*, p_3, q, y)).$$

Given explicit functional forms for the demand and cost functions, fixed point algorithms (or, in some cases, explicit solutions using linear algebra), can be used to find the post-merger

equilibrium prices. (More detailed discussions of the method can be found in Hausman, Leonard, and Zona [1994], Nevo [2000b], and Werden and Froeb [1994].) With the recent advances in estimating structural models, this approach is gaining increasing attention.

There are, however, two important caveats regarding this method. First, a critical part of the simulation exercise involves the choice of the post-merger behavioral model of the industry. An obvious response is to try to estimate this behavior using pre-merger data, a technique that has a long history in the empirical industrial organization literature (see, for example, Bresnahan [1987, 1989] and Porter [1983]).³¹ One serious concern, however, is that the firms' behavior may *change* as a result of the merger. For example, the reduction in the number of firms could cause an industry to go from a static equilibrium outcome (say, Bertrand or Cournot) to a more cooperative tacitly collusive regime. In principal, this too may be something that we can estimate if we have a sample of markets with varying structural characteristics. But, to date, those attempting to conduct merger simulations have not done so.

Second, it is important to recall that pricing is likely to be only one of several important variables that may be affected by a merger. Entry, long-run investments in capacity, and R&D are among the variables that may be significantly affected by a merger. Indeed, welfare — whether consumer welfare or aggregate welfare — may in the long-run be more affected by these other variables than by pricing. Unfortunately, as we noted earlier, the empirical industrial organization literature is really only at the very beginning of getting a handle on these important issues.

In recent work, Peters [2003] evaluates the performance of these simulation methods by examining how well they would have predicted the actual price changes that followed six airline mergers in the 1980s. The standard merger simulation technique, in which price changes arise from changes in ownership structure (given an estimated demand structure and inferred marginal costs) produces the price changes shown in the column labeled “Ownership

³¹Alternatively, one could simply compare the actual premerger prices with those predicted under various behavioral assumptions, as in Nevo [2000b].

Change” in Table 3.1.³² The actual changes, in contrast, are in the last column, labeled “Actual $\% \Delta p$ ” in the table. While the merger simulation captures an important element of the price change, it is clear that it predicts the price changes resulting from the various mergers imperfectly. For example, the US Air-Piedmont merger (US-PI) is predicted to lead to a smaller price increase than either the NW-RC or TW-OZ mergers, but the reverse actually happened.

Component Effects of Average % Relative Price Change in Overlap Markets						
	#	Ownership Change	Observed Changes	Change in μ	Change in c	Actual $\% \Delta p$
NW-RC	78	19.8	-1.4	0.9	-10.1	7.2
TW-OZ	50	20.8	-2.2	-0.8	-1.0	16.0
CO-PE	67	6.4	0.7	0.2	20.5	29.4
DL-WA	11	7.6	-1.5	-0.5	6.0	11.8
AA-OC	2	4.7	-3.6	-1.8	7.6	6.5
US-PI	60	12.7	2.0	-1.9	6.7	20.3

Table 3.1: Simulated and Actual Price Changes From Airline Mergers (Peters [2003])

Peters next asks how much of this discrepancy can be accounted for by other observed changes that occurred following the merger, such as changes in flight frequency or entry, by including these changes in the post-merger simulation. The column labeled “Observed Changes” in Table 3.1 reports the answer. As can be seen there, these observed changes account for little of the difference.³³

Given this negative answer, Peters then looks to see whether changes in unobserved product attributes (such as firm reputation or quality, denoted by μ in the table) or in marginal costs (denoted by c in the table) can explain the difference. The changes in unobserved product attributes can be inferred using the pre-merger estimated demand coefficients by solving for the levels of these unobserved attributes that reconcile the post-merger quantities purchased with the post-merger prices. Given the inferred post-merger unobserved product

³²See Peters [2003] for a discussion of how different assumption about the demand structure affect these conclusions.

³³It should be noted, however, that Peters looks only at the year following consummation of the merger. These changes may be more significant over a longer period.

attributes, Peters can solve for the Nash equilibrium prices that would obtain were product attributes to have changed in this way, assuming that marginal costs remained unchanged. (Observe that since the post-merger attributes are obtained entirely from the demand side, these computed equilibrium prices need not equal the actual observed prices.) As can be seen in the column labeled “Change in μ ,” this accounts for little of the difference between predicted and actual prices.

Finally, Peters can infer a change in marginal cost, by calculating the levels of marginal costs that would make the computed Nash equilibrium prices equal to the actual post-merger prices. (This is done by including all of the previous changes, including the inferred changes in unobserved product attributes μ , and solving for marginal costs from the Nash equilibrium pricing first-order conditions, as discussed earlier in the chapter.) The price change reported in the column labeled “Change in c ” reports the size of the price change if these marginal cost changes are included in the simulation, omitting the product attribute changes. As can be seen in the table, the changes due to changes in c represent a large portion of the discrepancy between the initial simulation and the actual price changes.

It should be noted, however (as Peters does), that an alternative interpretation of these results is that it was firm conduct rather than marginal costs that changed post-merger. For example, this seems most clear in the case of the CO-PE merger, where the acquired airline was suffering serious financial difficulty prior to the merger. In this case, prices undoubtedly increased not because of a true marginal cost change, but rather because of a change in the previously distressed firm’s behavior. Changes in behavior may have occurred in the other mergers as well. At the very least, however, Peters’ study suggests directions that are likely to be fruitful in improving prospective analyses of mergers.

It seems clear that as our techniques for estimating structural models get better, merger simulation will become an increasingly important tool in the analysis of mergers. How quickly this happens, however, and the degree to which it supplants other techniques, remains to be seen.

5.2 Residual Demand Estimation

Another technique that does not follow the Guidelines' path, but that also avoids a full-blown structural estimation, is the residual demand function approach developed by Baker and Bresnahan [1985]. Specifically, Baker and Bresnahan propose a way to determine the increase in market power from a merger that involves separately estimating neither the cross-price elasticities of demand between the merging firms' and rivals' products nor rivals' behavioral reactions. As Baker and Bresnahan put it:

...evaluating the effect of a merger between two firms with $n - 2$ other competitors would seem to require the estimation of at least n^2 parameters (all of the price elasticities of demand), a formidable task.... That extremely difficult task is unnecessary, however. The necessary information is contained in the slopes of the two single-firm (residual) demand curves before the merger, and the extent to which the merged firm will face a steeper demand curve.... The key to the procedures is that the effects of all other firms in the industry are summed together. ... This reduces the dimensionality of the problem to manageable size; rather than an n -firm demand system, we estimate a two-firm residual demand system. [p.59]

To understand the Baker and Bresnahan idea, it helps to start by thinking about the residual demand function faced by a single firm (i.e., its demand curve taking into account rivals' reactions), as in Baker and Bresnahan [1988]. Specifically, consider an industry with N single-product firms and suppose that the inverse demand function for firm 1 is given by

$$p_1 = P_1(x_1, x_{-1}, z), \quad (30)$$

where x_1 is firm 1's output level, x_{-1} is an $(N - 1)$ -vector of output levels for firm 1's rivals, and z are demand shifters. To derive the residual inverse demand function facing firm 1, Baker and Bresnahan posit that the equilibrium relation between the vector x_{-1} and x_1 given

the demand variables z and the cost variables w_{-1} affecting firms $2, \dots, N$ can be denoted by

$$x_{-1} = B_{-1}(x_1, z, w_{-1}). \quad (31)$$

For example, imagine for simplicity that there are two firms in the industry ($N = 2$). If equilibrium output levels are determined by either a static simultaneous-choice quantity game or by a Stackleberg game in which firm 1 is the leader, then (31) is simply firm 2's best-response function. Substituting for x_{-1} in (30) we can then write firm 1's residual inverse demand function as

$$p_1 = P_1(x_1, B_{-1}(x_1, z, w_{-1}), z) \equiv R_1(x_1, z, w_{-1}). \quad (32)$$

For example, in the simple case in which z and w_{-1} are both scalar variables, we might estimate this in the simple constant elasticity form:

$$\ln(p_{1i}) = \gamma_0 + \gamma_1 \ln(x_{1i}) + \gamma_2 \ln(z_i) + \gamma_3 \ln(w_{-1,i}) + \varepsilon_i. \quad (33)$$

Baker and Bresnahan would then look to the estimate of γ_1 , the quantity elasticity of the residual inverse demand function, as a measure of the firm's market power.³⁴

Note that since x_1 will typically be correlated with ε , we will require an instrument for x_1 . Moreover, since the rivals' cost variables w_{-1} are already in the estimating equation (33), this will need to be a cost variable that affects *only* firm 1, say w_1 . Figure 3.3 depicts the idea of what identifies the residual demand function $R_1(\cdot)$. Imagine that firms other than firm 1 produce a homogeneous product, that firm 1's product is differentiated, and that the N firms compete by simultaneously choosing quantities. By holding the demand variable z and the cost variables w_{-1} for firm 1's rivals fixed, the estimating equation (33) effectively holds the aggregate best-response function of the rivals fixed, which is labeled as $\bar{B}_{-1}(\cdot)$ in Figure 3.3.³⁵ A shift in the cost variable for firm 1 from w_1 to $w'_1 < w_1$ shifts firm 1's best-response function outward as depicted in Figure 3.3. This increases x_1 and reduces the

³⁴A similar derivation to that above can be done to derive instead a residual ordinary (rather than inverse) demand function.

³⁵That is, the function $\bar{B}_{-1}(\cdot)$ is the sum of the quantities in the vector function $B_{-1}(\cdot)$.

Figure 3.3: The Idea Behind the Baker-Bresnahan
Residual Demand Function Estimation

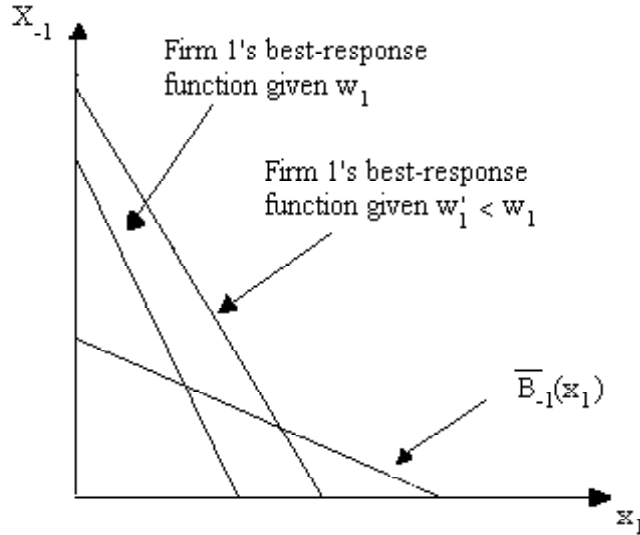


Figure 3:

sum of the rivals' outputs. What the slope of the residual demand function captures is the ratio of the resulting change in firm 1's price to the change in its quantity.³⁶

Two potential problems with this approach should be noted. First, the "equilibrium relation" between firm 1's output x_1 and its rivals' outputs x_{-1} may not take the form in (31). For example, if there are two firms ($N = 2$) and outputs are determined via a Stackleberg game with *firm 2* as the leader, then firm 2's output will depend on all of the variables that affect firm 1's best-response function (i.e., including w_1), not just on (x_1, z, w_2) .

Second, unless firm 1 is *actually* a Stackleberg leader, the output chosen by firm 1 in equilibrium will *not* be the solution to $\max_{x_1} [R_1(x_1, z, w_{-1}) - c_1]x_1$. For example, if outputs are actually determined in a simultaneous (Cournot) quantity choice game, the residual

³⁶For example, if rivals act competitively and have constant returns to scale, then $\bar{B}_{-1}(\cdot)$ will be a line with slope -1, and the coefficient γ_1 estimated in equation (33) will be zero since any decrease in firm 1's output will be met by a unit-for-unit increase in the rivals' output.

demand function derived from this procedure will not have any direct correspondence to the actual price-cost margins in the market.

Baker and Bresnahan's procedure for evaluating a merger expands on this idea. Imagine, for simplicity, an industry in which initially there are three firms and suppose that firms 1 and 2 will merge, and that firm 3 will remain independent (the idea extends to any number of independent firms as above). Now suppose that the inverse demand functions for firms 1 and 2 are

$$p_1 = P_1(x_1, x_2, x_3, z) \quad (34)$$

and

$$p_2 = P_2(x_1, x_2, x_3, z). \quad (35)$$

As before, suppose that firm 3's best-response function is

$$x_3 = B_3(x_1, x_2, z, w_3). \quad (36)$$

Substituting as before we can write:

$$p_1 = R_1(x_1, x_2, z, w_3) \quad (37)$$

$$p_2 = R_2(x_1, x_2, z, w_3). \quad (38)$$

Equations (37) and (38) give the residual inverse demands faced by the merged firms 1 and 2 taking into account firm 3's reactions to their price choices. Given estimates of these equations, Baker and Bresnahan propose evaluating the merger by computing the percentage price increase caused for each of the merging firms by a 1% reduction in *both* of their outputs, and comparing this to the two merging firms' single-firm residual inverse demand elasticities (as derived above); if these elasticities are much greater in the former case, they conclude that the merger increases market power.

Unfortunately, this method for evaluating post-merger market power suffers from the same two problems as in the single firm case. Moreover, a new problem emerges with the

method Baker and Bresnahan use to compare pre- and post-merger market power: since both of the merging firms could not have been Stackleberg leaders prior to the merger, the single firm residual inverse demand elasticities are clearly not directly related to pre-merger mark-ups.³⁷

5.3 The Event Study Approach

Our third non-Guidelines empirical technique for examining the effect of a merger aims to do so without *any* kind of structural estimation. The simple idea, originally due to Eckbo [1983] and Stillman [1983], is as follows: A merger that will raise the prices charged by the merging firms is good for rivals, while one that will lower these prices is bad for them. Hence, we should be able to distinguish these two cases by looking at rivals' stock price reactions to the merger announcement and any subsequent enforcement actions. (Eckbo and Stillman looked at these reactions for a number of mergers and found no positive effects on rivals, and therefore concluded that most mergers are not anticompetitive.)

Although a very simple technique (it uses the very standard event study method), it has a number of potential pitfalls. The first has to do with the power of the test. McAfee and Williams [1988], for example, examined what they argue was an “obviously anticompetitive merger” and found no evidence of statistically significant positive stock price reactions by rivals. They argue that the problem is that the rivals may be large firms with highly variable stock returns so that the power of test may be low; i.e., we shouldn't take observing no statistically significant reaction in rivals' stock prices to mean that the merger will not raise prices.

Another issue has to do with what the literature calls “precedent effects.” If a merger is announced, this may convey information about market (or regulatory) conditions more generally. For example, consider the announcement of an efficiency-enhancing merger. This

³⁷In the special case in which the merged firm will act as a Stackleberg leader, we can however use the estimates of (37) and (38) to derive the post-merger prices by solving $\max_{x_1, x_2} \sum_{i=1,2} [R_i(x_1, x_2, z, w_3) - c_i]x_i$ for the merged firm's optimal quantities (x_1^*, x_2^*) and then computing $p_1^* = R_1(x_1^*, x_2^*, z, w_3)$ and $p_2^* = R_2(x_1^*, x_2^*, z, w_3)$.

announcement may indicate not only that the merged firms' costs will fall, but also that the other firms in the industry are likely to follow their example by merging themselves. Typically, the resulting reduction in all firms' costs will lead to both lower prices and higher profits. Thus, the informational content of this announcement — what it says about likely future mergers and their effects — will lead rivals' stock prices to *increase* upon announcement of this price-reducing merger.³⁸

In the other direction, there is a possibility that a merger that increases the size of a firm could also increase the likelihood of anticompetitive exclusionary behavior. For example, in a “deep pocket” model of predation in which the size of a firm's asset holdings affects its ability to predate on rivals (e.g., Benoit [1984], Bolton and Scharfstein [1990]), a merger might increase the likelihood that rivals are preyed upon. This could lead to negative returns for rival stock values from announcement of a price-increasing merger.

These interpretational difficulties can be substantially avoided by looking instead at *customer* stock prices as is done by Mullins, Mullins, and Mullins [1995]. Doing so allows one to look directly at the stock market's expectation of the changes in price (as well as any non-price dimensions of net surplus such as quality) that will be produced by the merger. Mullins, Mullins, and Mullins study the United States Steel (USS) dissolution suit that was filed in 1911. They begin by identifying 13 potentially significant events in the history of the case, and then narrow their focus down to five events by restricting attention to those events which caused a statistically significant movement in USS's stock price. The five events are described in Table 3.2, which also indicates with a (+) or a (-) whether the event is associated with an increase or a decrease in the probability of dissolution.

³⁸In principal, we can try to distinguish between anticompetitive and precedent effects by looking for differential stock price responses among rivals: competitive effects should be felt more strongly by rivals that compete more closely with the merging firms. In this way, Prager [1992] finds evidence of precedent effects in her study of the 1901 merger between Great Northern Railway and the Northern Pacific Railway. One caveat, however, is that the precedent effect may in some cases also be more relevant for these same firms.

Variable		Description
<i>USSRUMOR</i>	(+)	Wall Street reacts to rumors that U.S. Steel will voluntarily dissolve and the following day the <i>New York Times</i> reports that U.S. Steel and the Department of Justice (DOJ) are negotiating the voluntary dissolution. Neither the DOJ nor U.S. Steel comments on these reports initially. September 20–21, 1911
<i>USSDEN</i>	(-)	U.S. Steel announces that it is not contemplating dissolution and believes that it is not guilty of antitrust violations. September 26, 1911
<i>DISSUIT</i>	(+)	The DOJ files the dissolution suit against U.S. Steel. On the same day, U.S. Steel officially announces that it will cancel the Great Northern lease and lower the freight rates on iron ore as had been previously reported. October 26, 1911
<i>SCTREARG</i>	(-)	The Supreme Court orders reargument in several large antitrust cases before it, including the U.S. Steel case. May 21, 1917
<i>SCTDEC</i>	(-)	The Supreme Court affirms the district court decision in U.S. Steel's favor. March 1, 1920

Table 3.2: Mullins, Mullins, and Mullins [1995] Event Descriptions

They then examine the effects of these events on the stock market values of four sets of firms: steel industry rivals, railroads, the Great Northern Railway, and street railway companies. Examining steel industry rivals follows the Eckbo-Stillman method.³⁹ Railroads and street rail companies, in contrast, were both customers of USS, in that they bought significant quantities of steel.⁴⁰ The event responses for these groups to the five events are shown in Table 3.3, which also shows the response of USS to each event.⁴¹ As can be seen in the table, the responses of steel industry rivals are generally insignificant. The railroad stocks, however, respond in a statistically and economically significant way to these events, and in a direction that suggests that dissolution of USS would lower steel prices. Indeed, since steel represented only 10% of railroad costs, the 2% value reduction that railroads felt in response to the *USSRUMOR* event would correspond to a 20% reduction in the expected cost of steel if the probability of the merger went from 0 to 1 as a result of this news, and even more otherwise.

³⁹The set of steel rivals excludes the Great Northern Railway which had a complicated relationship with USS due to USS's lease of the Great Northern Railway's iron ore holdings. Mullins, Mullins, and Mullins examine the effects of the events on the Great Northern Railway separately, which I do not report here.

⁴⁰The railroads were both customers and suppliers to USS, since a great deal of steel was shipped by rail. Mullins, Mullins, and Mullins argue that the effects on both suppliers and customers should be similar in this case because there is evidence that no secret rebates were granted off of the existing regulated rail rates, and so the effect of the merger on both suppliers and customers should be a function only of the change in the output of steel.

⁴¹Street rail stock prices were available only toward the end of the sample period.

Event	STEEL RIVALS	RAILROADS	STREET RAILS
USSRUMOR	.00374 (.1782)	.02033 (3.0246)	
USSDEN	.00903 (.4316)	-.01320 (-1.9742)	
DISSUIT	-.03532 (-1.6874)	.01260 (1.8828)	
SCTREARG	.06233 (1.7707)	-.01860 (-.7394)	
SCTDEC	.04260 (1.3366)	-.02858 (-1.7453)	-.02551 (-.3533)

t-statistics are in parentheses.

Table 3.3: Average Estimated Event Responses in Mullins, Mullins, and Mullins [1995]

While Mullins, Mullins, and Mullins found significant effects on customers, it should be noted that finding no statistically significant customer stock price response to a merger's announcement may not indicate the absence of a price effect: If customers are themselves producers, any price increases may be fully passed on to final consumers. In addition, as noted in the McAfee-Williams critique, the power of such a test may be low.

Of course, this entire method assumes that stock market participants have an accurate forecast of the competitive effects of the merger. Moreover, in the typical merger investigation, the antitrust agencies would be able to ask directly the opinions of a wide range of industry and stock market participants, and so the additional information gained by this method may not be that great.

6 Examining the Results of Actual Mergers

All of the foregoing discussion has focused on a *prospective* analysis of horizontal mergers. It is natural to ask, however, what we know, looking *retrospectively*, about their *actual* effects. Such analyses can be useful for at least two reasons. First, they can guide our priors about the likelihood of mergers being anticompetitive or efficiency-enhancing (ideally, as a

function of their characteristics). Second, we can use this information to assess how well various methods of prospective merger analysis perform, as in the Peters [2003] paper that we discussed in Section 5.1.

Unfortunately, the economics literature contains remarkably little of this kind of analysis. In the remainder of the chapter, I discuss the few studies that have looked at either price or efficiency effects in actual mergers (none look at both). This is clearly an area where we could use more research.⁴²

6.1 Price Effects

A small number of studies have analyzed the effects of actual mergers on prices. Many of these have focused on the airline industry, where a number of high-profile mergers occurred in the mid-1980s and price data is publicly available because of data reporting regulations. Borenstein [1990] studies the effects of the mergers of Northwest Airlines (NW) with Republic Airlines (RC) and Trans World Airlines (TW) with Ozark Airlines (OZ) in 1985/1986. In both cases, the merging airlines had their major hub at the same airport: Minneapolis served as the hub for both NW and RC; St. Louis was the hub for TW and OZ.⁴³ Both mergers began in 1985 with final agreements reached in the first quarter of 1986, and received regulatory approval (from the Department of Transportation) in the third quarter of 1986. Table 3.4 shows the average prices before and after the mergers for four categories of markets, defined by whether both merging firms operated before the merger and by whether they faced any competition before the merger (“other firms”). The “relative prices” columns record for the third quarters of 1985, 1986, and 1987 the average over markets in the respective category of the percentage difference between the average price for the merging firms in that market and the average price for a set of markets of a similar distance. The “average change” over

⁴²To the extent that this limited amount of work is due to a lack of data, one way to enhance our knowledge (or at least that of the DOJ and FTC) may be for the enforcement agencies to require parties to approved (or partially approved) mergers to provide the agencies with information for some period of time after their merger.

⁴³NW and RC accounted for 42% and 37% respectively of enplanements at Minneapolis; TW and OZ accounted for 57% and 25% of enplanements at St Louis.

1985-87 is the average over markets in the respective category of the percentage difference between the 1987 “relative price” in the market and the 1985 “relative price.”⁴⁴

	Other Firms	Mkts	Relative Prices ^a			Av. Change ^a
			1985	1986	1987	1985-87
NW & RC	Yes	16	3.1 (2.8)	0.2 (4.5)	10.1 ^d (5.9)	6.7 (4.3)
NW or RC	Yes	41	14.3 ^b (2.6)	21.2 ^b (3.5)	19.9 ^b (2.8)	6.0 ^c (2.6)
NW & RC	No	11	15.2 ^d (8.2)	32.1 ^b (10.3)	37.8 ^b (7.5)	22.5 ^b (5.2)
NW or RC	No	16	27.0 ^b (6.7)	36.6 ^b (9.5)	39.4 ^b (7.1)	12.0 ^c (5.5)
Total		84	14.7 ^b (2.3)	21.5 ^b (3.3)	24.1 ^b (2.7)	9.5 ^b (2.1)
TWA & OZ	Yes	19	-1.3 (6.1)	-2.7 (4.0)	3.2 (4.6)	4.6 (7.5)
TWA or OZ	Yes	29	10.5 ^c (4.0)	4.7 (4.2)	5.7 (4.4)	-3.0 (3.1)
TWA & OZ	No	9	39.6 ^b (7.5)	55.5 ^b (13.2)	27.4 ^b (2.4)	-5.8 (6.4)
TWA or OZ	No	10	56.0 ^b (12.0)	61.4 ^b (11.8)	33.5 ^b (8.1)	-12.3 ^c (4.0)
Total		67	17.8 ^b (4.0)	17.9 ^b (4.6)	12.1 ^b (3.0)	-0.0 (3.5)

^aShown in percent.

^bSignificant at 1 percent level (two-tailed test).

^cSignificant at 5 percent level (two-tailed test).

^dSignificant at 10 percent level (two-tailed test).

Table 3.4: Merging Airlines’ Price Changes at Their Primary Hubs (Borenstein [1990])

The results in Table 3.3 reveal very different experiences following the two mergers. Prices increased following the NW/RC merger, but not following the TW/OZ merger. Looking at the different categories in the NW/RC merger, (relative) prices increased by 22.5% on average in markets which were NW and RC duopolies prior to the merger.⁴⁵ It is also noteworthy that prices increased as well on routes in which NW and RC did not compete prior to the

⁴⁴Note that this average price change is therefore not equal to the change in the average relative prices reported in the relative price columns.

⁴⁵Peters [2003], however, reports somewhat different price changes for these same mergers. In his data, prices increased 7.2 percent and 16.0 in the NW/RC and TW/OZ mergers, respectively, in markets that were initially served by both merging firms. (Across the six mergers Peters studies, prices increased between 6 and 30 percent in such markets.) Peters reports that they increased 11.0 percent and 19.5 percent, respectively, in markets where these firms faced no pre-merger competition. The reason for the differences from Borenstein’s results is unclear.

merger. This could reflect a price-constraining effect of potential entry prior to the merger, increased market power arising from domination of the hub airport after the merger, or in the case of markets in which they faced competitors, the effects of increased levels of multimarket contact with competitor airlines. Borenstein also notes that the prices of other airlines on these routes displayed a pattern very similar to the pattern seen for the merging firms in Table 3.4.

Kim and Singal [1993] expand on Borenstein's analysis by examining the price changes resulting from 14 airline mergers that occurred from 1985 to 1988. Table 3.5 depicts the average of the changes in the relative prices for routes served by the merging firms compared to all other routes of similar distance. The table is divided horizontally into three sections: The first "full period" section looks at the change in prices from one quarter before the first bid of the acquirer to one quarter after consummation of the merger; the second "announcement period" section looks at changes from one quarter before the first bid of the acquirer to one quarter after this bid; the third "completion period" section looks at changes from one quarter before consummation to one quarter after. The table is also divided into two sections vertically. The left section looks at the merging firms' price changes, while the right section looks at rivals' price changes on the routes served by the merging firms. Within each of these sections, price changes are computed separately depending upon whether one of the merging firms was financially distressed prior to the merger.

Variable	Merging firms			Rival firms		
	All mergers	Mergers between normal firms	Mergers with a failing firm	All mergers	Mergers between normal firms	Mergers with a failing firm
<i>Full period:</i>						
Sample size	11,629	8,511	3,118	8,109	5,578	2,531
Relative fares, beginning	0.9602** (0.8238**)	1.0325** (0.8982**)	0.7626** (0.6883**)	0.9140** (0.8645**)	0.9745** (0.9218**)	0.7807** (0.7588**)
Relative fares, ending	1.0159** (0.8850**)	1.0529** (0.9309**)	0.9148** (0.8015**)	0.9831** (0.9287**)	1.0085 (0.9472**)	0.9272** (0.8944**)
Relative fare changes: Lfarechg (percentage)	9.44** (9.75**)	3.25** (3.76**)	26.35** (20.66**)	12.17** (11.20**)	5.94** (4.42**)	25.90** (23.71**)
<i>Announcement Period:</i>						
Sample size	7,214	5,832	1,382	4,891	3,730	1,161
Relative fares, beginning	0.9792** (0.8575**)	0.9855** (0.8636**)	0.9530** (0.8376**)	0.9444** (0.8945**)	0.9499** (0.9093**)	0.9268** (0.8487**)
Relative fares, ending	1.0070** (0.8947**)	1.0754** (0.9440**)	0.8228** (0.7337**)	0.9807** (0.9208**)	1.0345** (0.9634**)	0.8076** (0.7882**)
Relative fare changes: Lfarechg (percentage)	-5.54** (3.81**)	11.32** (10.38**)	-18.85** (-17.66**)	5.06** (3.77**)	12.64** (9.73**)	-19.28** (-14.80**)
<i>Completion Period:</i>						
Sample size	7,557	6,140	1,417	5,304	4,105	1,199
Relative fares, beginning	0.9874** (0.8657**)	1.048** (0.9273**)	0.7247** (0.6526**)	0.9496** (0.8938**)	1.0201** (0.9507**)	0.7081** (0.7046**)
Relative fares, ending	0.9640** (0.8683**)	0.9652** (0.8724**)	0.9590** (0.8541**)	0.9764** (0.9286**)	0.9776** (0.9286**)	0.9725** (0.9332**)
Relative fare changes: Lfarechg (percentage)	0.21 (3.31**)	-9.00** (-6.81**)	40.11** (38.36**)	6.10** (7.19**)	-5.36** (-3.72**)	45.34** (43.24**)

Notes: Relative fare is the ratio of the fare on the sample route to the weighted average fare in the control group. The relative fares are measured at the start and end of each observation period. Lfarechg is the mean of the differences between the sample and control routes in the natural logs of the ratio of fares at the end to the beginning of each period. All numbers not in parentheses represent unweighted means of the variable. All numbers in parentheses are means weighted by the number of passengers on each route. For relative fares, statistical significance is tested using the *t* statistic with reference to a mean of 1.00, and for Lfarechg the significance is with reference to a mean of zero.

**Statistically significant at the 1-percent level (two-tailed test).

Table 3.5: Changes in Relative Fares of Merging and Rival Firms (Kim and Singal [1993])

Looking at price changes for the merging firms, we see that relative prices rose by an average of 3.25% over the full sample period in mergers involving firms that were not financially distressed. They rose substantially more (26.25%) in mergers involving a financially distressed firm. The announcement period and completion period changes are interesting as well. One might expect market power effects to be felt prior to the actual merger (as the management teams spend time together), while merger-related efficiencies would occur only after completion. For mergers involving “normal firms” we indeed see that prices rise in the announcement period, and fall – although not as much – in the completion period.⁴⁶ (The

⁴⁶It is perhaps a little surprising, however, that substantial efficiencies would be realized so soon after completion. Moreover, there is some evidence (Kole and Lehn [2000]) that these mergers may have led to

patterns for mergers involving a failing firm are more puzzling.) Price changes for rival firms again follow very similar patterns. Kim and Singal also examine through regression analysis the relationship between the change in relative fares and the change in the Herfindahl Index. Consistent with the efficiency interpretation just given, they find that for mergers involving “normal firms”, the size of the price elevation during the announcement period is highly correlated with the change in concentration induced by the merger, while the fall in prices during the completion period is unrelated to this change.

Finally, Kim and Singal break the merging firms’ routes into four categories depending upon whether the route involves a common hub airport for the merging firms (if so, it is a “Hub” route) and whether the merging firms both served the route prior to the merger (if so, it is an “overlap” market). Table 3.6 depicts their results for the full period. Notably for mergers involving normal firms, prices fall on “Hub only” routes and they have no change on Hub/Overlap routes. (Moreover, Singal and Kim show that these price reductions come entirely during the completion period.) These changes strongly suggest the presence of merger-related efficiency benefits. “Overlap Only” markets show a price change like that seen in Table 3.5 for the full sample. Finally, note that routes that are neither a hub route nor an overlap route also experience price increases that are of this magnitude. These may reveal the effect of increased multimarket contact.⁴⁷

increases rather than decreases in marginal costs.

⁴⁷Evans and Kessides [1994] perform a “structure-conduct-performance”-style study of the relation between airline prices and both concentration and multimarket contact during this period and find positive and economically significant price effects from both factors. Their findings also provide indirect evidence on the effects of the airline mergers during this period, because most of the changes in concentration and multimarket contact in their sample were attributable to mergers.

$$Lfarchg_i = \alpha + \beta_1 \text{Normal}_i \times Lhhichg_i + \beta_2 \text{Fail}_i \times Lhhichg_i + \varepsilon_i$$

Period and subsample	Mean Lfarchg, percentage [sample size]		Mean Lhhichg, percentage [sample size]		Regression coefficient (t statistic)				R^2_{adj}
	Merger between normal firms	Merger with a failing firm	Merger between normal firms	Merger with a failing firm	Constant	Normal \times Lhhichg	Fail \times Lhhichg		
<i>A. Merging Firms:</i>									
Full period									
Hub/Overlap	-0.33 [193]	48.91** [180]	36.35** [193]	20.13** [180]	0.3174 (9.00)	-0.4891 (-6.69)	0.0920 (1.00)	0.101	
Hub Only	-11.01** [291]	40.23** [331]	1.89 [291]	5.81** [331]	0.1604 (6.99)	-0.0461 (-0.45)	0.0837 (0.72)	-0.002	
Overlap Only	3.92** [1,205]	40.12** [566]	22.49** [1,205]	19.92** [566]	0.1535 (11.89)	-0.1370 (-4.56)	0.3512 (5.28)	0.044	
Neither	3.84** [6,822]	18.28** [2,041]	0.84** [6,822]	4.02** [2,041]	0.0690 (16.59)	0.1945 (12.12)	0.1548 (3.38)	0.016	

Table 3.6: Relative Fare Changes for Four Categories of Routes (Kim and Singal [1993])

Peters [2003], which was largely focused on evaluating merger simulation techniques (see Section 5.1), documents as well the service changes and entry events that followed six of these mergers. Peters shows that flight frequency tended to decrease in markets that were initially served by both merging firms, and increase in markets that were initially served by only one of the merging firms. The mergers also led to entry, although these changes in the number of rivals were only statistically significant for three of the mergers.

Banking is another industry in which firms are required to provide the government with data on their operations. Prager and Hannan [1998] study the price effects of mergers in the banking industry for the period January 1992 through June 1994. They examine the change in deposit rates for three types of deposits, NOW accounts (interest bearing checking accounts), MMDA accounts (personal money market deposit accounts⁴⁸), and 3MOCD accounts (three-month certificates of deposit). Hannan and Prager separately examine the effects of “substantial horizontal mergers” for which the Herfindahl Index in the effected

⁴⁸These have restricted check-writing privileges.

market increases by at least 200 points to a post-merger value of at least 1800, and “less substantial mergers”, for which the Herfindahl increases by at least 100 points to a post merger value of at least 1400 and which were not “substantial mergers”. Their price data are monthly observations on deposit interest rates from October 1991 through August 1994, while their estimating equation takes the form

$$ratchg_{it} = \alpha + \sum_{t=2}^{\times} \delta_t I_t + \sum_{n=-12}^{\times 12} \beta_n SM_{int} + \sum_{n=-12}^{\times 12} \gamma_n LSM_{int} + \varepsilon_{it},$$

where $ratchg_{it} = \ln(rate_{it}/rate_{i,t-1})$ and $rate_{it}$ is bank i 's deposit rate in period t , I_t is a dummy variable taking value 1 in period t and 0 otherwise, SM_{int} is a dummy variable taking value 1 if bank i was exposed to a substantial horizontal merger in period $t+n$, and LSM_{int} is a dummy variable taking value 1 if bank i was exposed to a less substantial horizontal merger in period $t+n$.⁴⁹ The results from this estimation can be seen in Table 3.7, where the merger exposure effects are presented in three aggregates: the premerger period ($n = -12$ to $n = 0$), the post merger period ($n = 1$ to $n = +12$), and the total period.

⁴⁹In fact, matters are somewhat more complicated than this, because the pricing data are at the bank level, not the market (SMSA) level. Hence, the merger exposure variables are actually weighted averages (by deposits) of the exposures that a given bank i has in the various markets in which it operates.

OLS WITH ROBUST STANDARD ERRORS ¹ DEPENDENT VARIABLE: richg_{it}									
	NOW			MMDA			3MOCD		
	Coeff.	t-stat	prob > t	Coeff.	t-stat	prob > t	Coeff.	t-stat	prob > t
PREMERGER EFFECT									
Substantial mergers	-0.0865	-1.431	0.159	-0.0139	-0.429	0.670	0.0023	0.129	0.898
Lesser mergers	0.0585	2.050	0.046	-0.0081	-0.459	0.648	0.0148	0.877	0.385
POST MERGER EFFECT									
Substantial mergers	-0.0882	-2.348	0.023	-0.0765	-4.349	0.000	-0.0178	-0.687	0.495
Lesser mergers	0.0368	1.326	0.191	0.0042	0.135	0.893	0.0443	1.689	0.098
TOTAL EFFECT									
Substantial mergers	-0.1747	-2.413	0.020	-0.0905	-2.317	0.025	-0.0155	-0.450	0.655
Lesser mergers	0.0953	2.422	0.019	-0.0038	-0.109	0.913	0.0590	1.728	0.091
# of obs.		13313			13498			12972	
# of banks		435			443			433	
Ave. obs. per bank		30.60			30.47			29.96	
Regression R ²		0.0896			0.1409			0.3586	

¹ Each regression includes 33 month indicators and 25 weighted merger indicators ($I(i, t-m)$ for $m=2$ to 34 and $I(\text{bank } i \text{ 'exposed' to merger in month } t-m)$ for $m=-12, \dots, 0, \dots, 12$). Coefficients for these variables are not reported in order to conserve space.

² The estimation technique employed here allows for the possibility of error correlation across observations within the same state.

Table 3.7: Price Effects of “Substantial” and “Less than Substantial” Bank Mergers
(Prager and Hannan [1998])

The results indicate that substantial mergers reduce the rates that banks in a market offer. This effect is largest for NOW accounts (approximately a 17% reduction in rates), for which customers arguably have the strongest attachment to local banks, and least for three-month CD's (less than 2% reduction in rates, and not statistically significant). Notably, however, Prager and Hannan find that less substantial mergers increase rates paid in the market. One possible interpretation of this difference is that these mergers involve efficiencies (which allow banks, absent other effects, to increase their rates), but the effects of these efficiencies on prices are more than offset by an increase in market power for substantial mergers. Finally, although the results in Table 3.7 do not distinguish between the price changes for merging firms and their rivals, Prager and Hannan find that these two groups had very similar price

effects, paralleling the Borenstein and Kim and Singal findings on this point.⁵⁰

6.2 Efficiencies

Just as with price effects, remarkably little has been done examining the effects of horizontal mergers on productive efficiency, at least given the issue's importance. Most of the work examining the efficiency effects of mergers has examined mergers in general, rather than focusing on horizontal mergers. In general, the effects need not be the same. On the one hand, there may be greater potential for synergies when the merging firms are in the same industry; on the other hand, since horizontal mergers may increase market power, even efficiency decreasing horizontal mergers may be profitable for merging firms.⁵¹

Work examining mergers in general has generally found that there is a great deal of heterogeneity in merger outcomes. Some mergers turn out well, others very badly.⁵² As well, the average effects are sensitive both to the time period examined and the particular sample of mergers studied. Perhaps the best known study of post-merger performance is Ravenscraft and Scherer [1987], who document using the FTC's Line of Business data (collected for just three years from 1974-76) a dramatic decline in post-merger profitability of acquired lines of business, which generally were highly successful prior to acquisition. Ravenscraft and Scherer's sample, however, consisted largely of acquisitions from the conglomerate merger wave of the 1960s. Two different studies have examined data from the years following this conglomerate merger wave, Lichtenberg and Siegel [1987] and McGuckin and Nguyen [1995]. Lichtenberg and Siegel examine the effect of ownership changes on statistically estimated plant-level total factor productivity using the Census Bureau's Longitudinal Establishment

⁵⁰In one other study, Barton and Sherman [1984] document the price changes that occurred following the 1976 and 1979 acquisitions of two competitors by a manufacturer of two types of duplicating microfilm. They provide evidence consistent with price increases following the merger. The data they use comes as a result of a 1981 FTC antitrust suit seeking to reverse the acquisitions.

⁵¹One reason for greater synergies may simply be that the managers of the acquiring firm are more likely to understand the business of the acquired firm; see, for example, Kaplan, Mitchell, and Wruck [2000].

⁵²This is also consistent with the event study analysis of stock price returns, which finds wide variation in how the market evaluates announced mergers. At the same time, as the case studies in Kaplan [2000] document, a merger's performance may end up very different from the market's initial forecast.

Data (LED) file for the years 1972 to 1981. (Total factor productivity is determined in much of their work as the residual from estimation of a Cobb-Douglas production function.) As can be seen in Table 3.8, in contrast to the Ravenscraft and Scherer findings, they find that acquired plants were less productive than industry averages prior to acquisition, but had productivity increases that brought them almost up to the industry average afterwards. This may reflect the un-doing of Ravenscraft and Scherer's inefficient conglomerate mergers.

Year	Level of productivity (residual) ^a	Year	Level of productivity (residual) ^a
$t-7$	-2.6 (4.00)	$t+1$	-2.9 (6.06)
$t-6$	-3.0 (5.06)	$t+2$	-2.7 (6.00)
$t-5$	-3.4 (6.50)	$t+3$	-2.5 (4.97)
$t-4$	-3.3 (6.77)	$t+4$	-1.9 (3.52)
$t-3$	-3.3 (7.40)	$t+5$	-1.9 (3.23)
$t-2$	-3.6 (8.71)	$t+6$	-1.8 (2.57)
$t-1$	-3.7 (9.59)	$t+7$	-1.2 (1.16)
t	-3.9 (9.10)		

Sources: Authors' calculations.

a. t -statistics to test H_0 : difference equals 0 in parentheses.

Table 3.8: Differences in Mean Levels of Productivity between Plants Changing Ownership in Year t and Plants Not Changing Ownership (Lichtenberg and Siegel [1987])

The LED database, however, contains primarily large plants. McGuckin and Nguyen [1995] study the same question using instead the Census Bureau's Longitudinal Research Database (LRD) for the years 1977-1987. They restrict attention to mergers occurring between 1977-1982 and focus on the food manufacturing industry (SIC 20). This sample includes many more small plants than in Lichtenberg and Siegel's analysis. It also includes plants that operated during only part of the sample period (an "unbalanced panel"), while Lichtenberg and Siegel used a balanced panel (a balanced panel may worsen selection biases). However, most of their analysis uses labor productivity (the average product of labor relative

to the industry average product) instead of a measure of total factor productivity. In contrast to Lichtenberg and Siegel, they find that acquired plants tend on average to have above-average productivity prior to acquisition, although they find that this is not true when they restrict attention to large plants like those studied by Lichtenberg and Siegel. Like Lichtenberg and Siegel, they find post-merger productivity improvements.

Unfortunately, neither of these studies deals with endogeneity or selection issues when estimating productivity, which we know (see, Olley and Pakes [1996]) can seriously bias productivity estimates. Moreover, the latter study, as we have noted, bases its findings on labor productivity, rather than total factor productivity, which can reflect shifts in input mixes. In addition, neither of these studies considers separately the effects of horizontal mergers. In fact, we would ideally like to know how horizontal mergers affect productivity *conditional* on their structural attributes (e.g., potential for increasing market power), since these attributes affect which mergers managers pursue.⁵³

One study that examines horizontal mergers explicitly is Pesendorfer [1998], who studies a horizontal merger wave in the paper industry in the mid 1980s. Rather than estimating productivity directly, Pesendorfer tries to infer pre and post-merger productivity using the firms' capacity choices. (Much as we discussed in Sections 4.1 and 5.1, he infers marginal costs from the Cournot-like first-order conditions for capacity choice.) This is an interesting idea, but is not entirely convincing in this application for several reasons. First, the investment first-order conditions he uses are entirely static, while investment choices are likely to be affected by dynamic considerations. Second, the procedure relies on an assumed investment cost function (this might not be necessary if one uses a panel). Finally, one cannot distinguish whether the changes in marginal cost he derives reflect shifts of the plant's marginal cost function or movements along an unchanging function.

Recent work, most notably Olley and Pakes [1996] (see also Levinsohn and Petrin [2003]),

⁵³ Another thing that affects the mergers that managers pursue is the antitrust policy in effect at any given time. Thus, using information on efficiency effects (or price effects, for that matter) to determine appropriate antitrust policy must recognize this endogeneity.

has greatly improved our abilities in estimating productivity. The examination of the productivity effects of horizontal mergers seems a natural and highly valuable direction for this work to go.

References

- Andrade, G., M. Mitchell, and E. Stafford [2001], "New Evidence and Perspectives on Mergers," *Journal of Economic Perspectives* (15), 103-20.
- Baker, J.B. [1999a], "Developments in Antitrust Economics," *Journal of Economic Perspectives* (13), 181-94.
- Baker, J.B. [1999b], "Econometric Analysis in *FTC v. Staples*," *Journal of Public Policy & Marketing* (18), 11-21.
- Baker, J.B. and D.L. Rubinfeld [1999], "Empirical Methods Used in Antitrust Litigation: Review and Critique," *American Law and Economics Review* (1), 386-435.
- Baker, J.B. and T.F. Bresnahan [1985], "The Gains to Merger or Collusion in Product-Differentiated Industries," *Journal of Industrial Economics* (33), 427-44.
- Baker, J.B. and T.F. Bresnahan [1988], "Estimating the Residual Demand Curve Facing a Single Firm," *International Journal of Industrial Organization* (6), 283-300.
- Barton, D.M. and R. Sherman [1984], "The Price and Profit Effects of Horizontal Merger: A Case Study," *Journal of Industrial Economics* (33), 165-77.
- Benoit, J.-P. [1984], "Financially Constrained Entry in a Game with Incomplete Information," *RAND Journal of Economics* (4), 490-9.
- Berry, S.T. [1994], "Estimating Discrete Choice Models of Product Differentiation," *RAND Journal of Economics* (25), 242-62.
- Berry, S. and A. Pakes [1993], "Some Applications and Limitations of Recent Advances in Empirical Industrial Organization: Merger Analysis," *American Economic Review Papers and Proceedings* (83), 247-52.
- Berry, S. and A. Pakes [1993], "Some Applications and Limitations of Recent Advances in Empirical Industrial Organization: Merger Analysis," *American Economic Review* (83), 247-52.
- Berry, S., J. Levinsohn, and A. Pakes [1995], "Automobile Prices in Market Equilibrium," *Econometrica* (63), 841-90.

- Bolton, P. and D. Scharfstein [1990], "A Theory of Predation Based on Agency Problems in Financial Contracting," *American Economic Review* (80), 93-106.
- Borenstein, S. [1990], "Airline Mergers, Airport Dominance, and Market Power," *American Economic Review* (80), 400-4.
- Bresnahan, T.F. [1987], "Competition and Collusion in the American Automobile Industry: The 1955 Price War," *Journal of Industrial Economics* (35), 457-82.
- Bresnahan, T.F. [1989], "Empirical Methods in Industries with Market Power," in R. Schmalensee and R. Willig, eds., *Handbook of Industrial Organization (Volume II)*, Amsterdam: Elsevier.
- Brock, W. and J. Scheinkman [1985], "Price-Setting Supergames with Capacity Constraints," *Review of Economic Studies* (52), 371-82.
- Carlton, D. and R. Gertner [1989], "Market Power and Mergers in Durable Goods Industries," *Journal of Law and Economics* (32), S203-26.
- Coase, R.H. [1972], "Durability and Monopoly," *Journal of Law and Economics* (15), 143-49.
- Compte, O., F. Jenny, and P. Rey [2002], "Capacity Constraints, Mergers, and Collusion," *European Economic Review* (46), 1-29.
- Eckbo, B.E. [1983], "Horizontal Mergers, Collusion, and Stockholder Wealth," *Journal of Financial Economics* (11), 241-73.
- Evans, W.N. and I.N. Kessides [1994], "Living by the 'Golden Rule': Multimarket Contact in the U.S. Airline Industry," *Quarterly Journal of Economics* (109), 341-66.
- Farrell, J. and C. Shapiro [1990], "Horizontal Mergers: An Equilibrium Analysis," *American Economic Review* (80), 107-26.
- Gowrisankaran, G. [1999], "A Dynamic Model of Endogenous Horizontal Mergers," *RAND Journal of Economics* (30), 56-83.
- Hausman, J.A. [1996], "Valuation of New Goods Under Perfect and Imperfect Competition," in T. Bresnahan and R. Gordon, eds., *The Economics of New Goods*, Studies in Income and Wealth (58), Chicago: National Bureau of Economic Research.
- Hausman, J., G. Leonard, and J.D. Zona [1994], "Competitive Analysis with Differentiated Products," *Annales D'Economie et de Statistique* (34), 159-80.
- Jensen, M.C. and R.S. Ruback [1983], "The Market for Corporate Control: The Scientific Evidence," *Journal of Financial Economics* (11), 5-50.

Kaplan, S.N., ed. [2000], *Mergers and Productivity*, Chicago: University of Chicago Press.

Kaplan, S.N., M.L. Mitchell, and K.H. Wruck [2000], "A Clinical Exploration of Value Creation and Destruction in Acquisitions: Organizational Design, Incentives, and Internal Capital Markets," in S.N. Kaplan, ed., *Mergers and Productivity*, Chicago: University of Chicago Press.

Kole, S. and K. Lehn [2000], "Workforce Integration and the Dissipation of Value in Mergers: The Case of USAir's Acquisition of Piedmont Aviation," in S.N. Kaplan, ed., *Mergers and Productivity*, Chicago: University of Chicago Press.

Kim, E.H. and V. Singal [1993], "Mergers and Market Power: Evidence from the Airline Industry," *American Economic Review* (83), 549-69.

Levinsohn, J. and A. Petrin [2003], "Estimating Production Functions Using Intermediate Inputs to Control for Unobservables," *Review of Economic Studies* (70), 317-41.

Lichtenberg, F.R. and D. Siegel [1987], "Productivity and Changes in Ownership of Manufacturing Plants," *Brooking Papers on Economic Activity: Special Issue on Microeconomics*, Washington, D.C.: The Brookings Institution.

Mankiw, N.G. and M.D. Whinston [1986], "Free Entry and Social Inefficiency," *RAND Journal of Economics* (17), 48-58.

Mas-Colell, A., M.D. Whinston, and J.R. Green [1995], *Microeconomic Theory*, New York: Oxford University Press.

McAfee, R.P. and M.A. Williams [1988], "Can Event Studies Detect Anticompetitive Mergers?," *Economics Letters* (28), 199-203.

McAfee, R.P. and M.A. Williams [1992], "Horizontal Mergers and Antitrust Policy," *Journal of Industrial Economics* (40), 181-6.

McGuckin, R.H. and S.V. Nguyen [1995], "On Productivity and Plant Ownership Change: New Evidence from the Longitudinal Research Database," *RAND Journal of Economics* (26), 257-76.

Mullin, G.L., J.C. Mullin, and W.P. Mullin [1995], "The Competitive Effects of mergers: Stock Market Evidence from the U.S. Steel Dissolution Suit," *RAND Journal of Economics* (26), 314-30.

Nevo, A. [1997], *Demand for Ready-to-Eat Cereal and Its Implications for Price Competition, Merger Analysis, and Valuation of New Goods*, Harvard University Ph.D. Dissertation.

- Nevo, A. [2000a], "A Practitioner's Guide to Estimation of Random Coefficients Logit Models of Demand," *Journal of Economics and Management Strategy* (9), 513-48.
- Nevo, A. [2000b], "Mergers with Differentiated Products: The Case of the Ready-to-Eat Cereal Industry," *RAND Journal of Economics* (31), 395-421.
- Nevo, A. [2001], "Measuring Market Power in the Ready-to-Eat Cereal Industry," *Econometrica* (69), 307-42.
- Olley, G.S. and A. Pakes [1996], "The Dynamics of Productivity in the Telecommunications Equipment Industry," *Econometrica* (64), 1263-98.
- Perry, M.K. and R. Porter [1985], "Oligopoly and the Incentive for Horizontal Merger," *American Economic Review* (75), 219-27.
- Pesendorfer, M. [1998], "Horizontal Mergers in the Paper Industry," NBER Working Paper No. 6751.
- Peters, C. [2003], "Evaluating the Performance of Merger Simulation: Evidence from the U.S. Airline Industry," Northwestern University, Center for the Study of Industrial Organization Working Paper # 32.
- Porter, R.H. [1983], "A Study of Cartel Stability: The Joint Executive Committee, 1880-1886," *Bell Journal of Economics* (14), 301-14.
- Prager, R.A. [1992], "The Effects of Horizontal Mergers on Competition: The Case of the Northern Securities Company," *RAND Journal of Economics* (23), 123-33.
- Prager, R.A. and T.H. Hannan [1998], "Do Substantial Horizontal Mergers Generate Significant Price Effects? Evidence from the Banking Industry," *Journal of Industrial Economics* (46), 433-52.
- Ravenscraft, D.J. and F.M. Scherer [1987], *Mergers, Sell-offs, and Economic Efficiency*, Washington, D.C.: Brookings Institution.
- Salant, S., S. Switzer, and R. Reynolds [1983], "Losses from Horizontal Mergers: The Effect of an Exogenous Change in Industry Structure on Cournot-Equilibrium," *Quarterly Journal of Economics* (98), 185-99.
- Shleifer, A. and L.H. Summers [1988], "Breach of Trust in Hostile Takeovers," in A. Auerbach, ed., *Corporate Takeovers: Causes and Consequences*, Chicago: University of Chicago Press, 33-56.
- Stillman, R. [1983], "Examining Antitrust Policy Towards Horizontal Mergers," *Journal of Financial Economics* (11), 225-40.
- Weiss, L.W., ed. [1990], *Concentration and Price*, Cambridge, MA: MIT Press.

Werden, G. [1990], “Antitrust Policy Toward Horizontal Mergers: A Comment on Farrell and Shapiro,” Department of Justice Economic Analysis Group Discussion Paper No. 90-4.

Werden, G. and L. Froeb [1998], “The Entry-Inducing Effects of Horizontal Mergers: An Exploratory Analysis,” *Journal of Industrial Economics* (46), 525-43.

Werden, G. and L. Froeb [1994], “The Effects of Mergers in Differentiated Products Industries: Logit Demand and Merger Policy,” *Journal of Law, Economics, and Organization* (10), 407-26.

Williamson, O.E. [1968], “Economies as an Antitrust Defense: The Welfare Tradeoffs,” *American Economic Review* (58), 407-26.