Chapter 36

ANTITRUST POLICY TOWARD HORIZONTAL MERGERS[1]

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[1] This chapter draws on material in Chapter 3 of Whinston (2006).

Handbook of Industrial Organization, Volume 3
Edited by M. Armstrong and R. Porter

DOI: 10.1016/S1573-448X(06)03036-6

Abstract

Recently there has been a notable increase in interest in antitrust law in much of the world. This chapter discusses antitrust policy toward horizontal mergers, the area of antitrust that has seen some of the most dramatic improvements in both economic tools and the application of economics in enforcement practice. The chapter discusses theoretical considerations, merger laws and enforcement practices, econometric methods for analyzing prospective horizontal mergers, and evidence concerning the ex post effects of actual horizontal mergers.

Keywords

Horizontal mergers, Mergers, Market power, Price effects, Unilateral effects, Coordinated effects, Efficiencies, Merger guidelines, Antitrust, Merger simulation

JEL classification: L10, L13, L40, L41

1. Introduction

The last thirty years have witnessed a dramatic movement in much of the world toward unregulated markets, and away from both state ownership (in the former Eastern Block, in South and Central America, and elsewhere) and state regulation (in North America and many European countries). Not coincidentally, they have also witnessed, especially recently, a notable increase of interest in antitrust law.

Antitrust laws (known as "competition" laws outside the United States) regulate economic activity. These laws' operation, however, differs in important ways from what is traditionally referred to as "regulation". Regulation tends to be industry-specific and to involve the direct setting of prices, product characteristics, or entry, usually after regular and elaborate hearings. By contrast, antitrust law tends to apply broadly, and focuses on maintaining basic rules of competition that enable the competitive interaction among firms to produce desirable outcomes. Investigations and intervention are exceptional events, that arise when those basic rules may have been violated.

Antitrust laws can roughly be divided into two types: those concerned with "collusion" (broadly defined) and those concerned with "exclusion". The former category focuses on ways in which competitors may be able to reduce the level of competition among themselves. Its main concerns are price fixing (cartels) and horizontal mergers. The latter category focuses on ways in which a dominant firm may reduce competition by excluding its rivals from the marketplace, either fully, or by more partially reducing their competitiveness. It focuses on practices such as predatory pricing, exclusive dealing, and tying.

In this chapter, I discuss antitrust policy toward horizontal mergers. Of all the areas of antitrust, this is the one that has seen the most dramatic improvement in recent years in both economic tools and the application of economics in enforcement practice.

I begin in Section 2 by discussing the key theoretical issues that arise in evaluating proposed horizontal mergers. Central to those considerations is the fact that while horizontal mergers may reduce firms' incentives for competitive pricing, they can also create important efficiencies. In Section 3, I provide an overview of merger laws and enforcement practices, with a particular focus on antitrust agency enforcement guidelines. The development of those guidelines in many countries has led to a substantial improvement in the application of economic principles to merger enforcement practices. In Section 4, I discuss ways in which econometric evidence can be used to answer some of the key questions that arise in these guidelines. In Section 5, I instead look at empirical techniques that seek to move beyond the guidelines' frameworks for evaluating prospective mergers. One of those methods, merger simulation, represents a particularly promising direction for enforcement practice. In Section 6, I discuss what we know about the effects of actual mergers. While enforcement focuses on analyzing prospective mergers, surprisingly little work has examined the impact of consummated mergers ex post, a critical step for improving enforcement practice. Here I discuss what is known about both price effects and efficiencies. Finally, I end the chapter in Section 7 with some concluding remarks on future directions in the analysis of horizontal mergers.

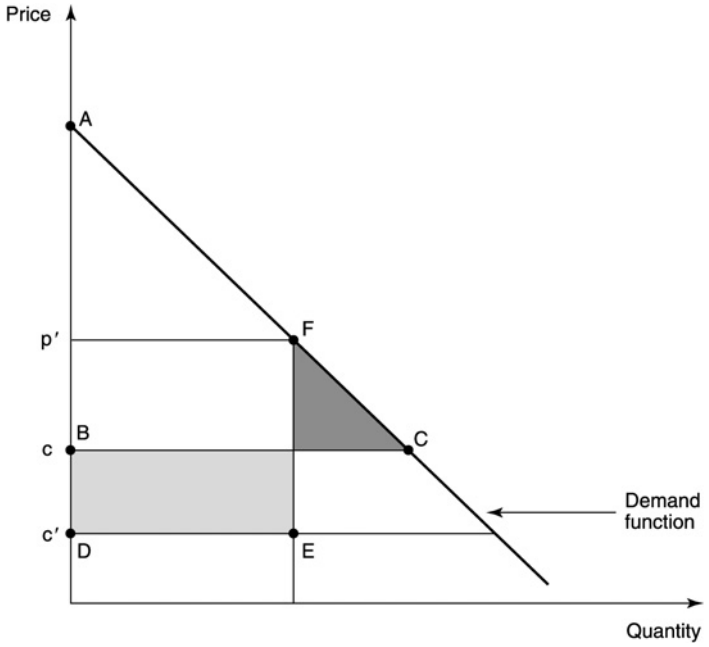

Figure 36.1. The Williamson tradeoff.

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.[2] This "Williamson trade-off" is illustrated in Figure 36.1.

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'.[3] Aggregate social surplus before the merger is given by area ABC, while aggregate surplus after the merger is given by area ADEF. Which is larger involves a comparison

[2] At that time, concern over the fate of small (and often inefficient) businesses frequently led the courts to use merger-related efficiencies as evidence *against* a proposed merger.

[3] We assume here that these costs represent true social costs. Reductions in the marginal cost of production due, say, to 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.

between the area of the shaded triangle, which is equal to the deadweight loss from the post-merger supracompetitive pricing, and the area of the shaded rectangle, which is equal to the merger-induced cost savings. If there is no improvement in costs, then the area of the rectangle will be zero and the merger reduces aggregate surplus; if there is no increase in price, then the area of the triangle will be zero, and the merger increases aggregate surplus. 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 limiting case 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 involves the assumption that the pre-merger price is competitive; i.e., equal to marginal cost. If, instead, the pre-merger price p exceeds the pre-merger marginal cost c then we would no longer be comparing a triangle to a rectangle, but rather a trapezoid to a rectangle (see Figure 36.2) and "rectangles are not bigger than trapezoids"; that is, even for small changes, both effects are of first-order.[4] 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 arising from a horizontal merger is entirely absent from the Williamson analysis, namely the welfare changes arising from shifts of production across firms that have differing marginal costs; so-called, "production reshuffling". We will explore this point in some detail shortly.

Third, the Williamson analysis takes the appropriate welfare standard to be maximization of aggregate surplus. But, as we will discuss in more detail in Section 3, a question about distribution arises with the application of antitrust policy. Although many analyses of mergers in the economics literature focus on an aggregate surplus standard, enforcement practice in most countries (including the U.S. and the E.U.) is closest to a consumer surplus standard.[5] 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.

[4] Specifically, the welfare loss caused by a small reduction in output is equal to the price–cost margin.

[5] On this point, see also the discussion in Baker (1999a).

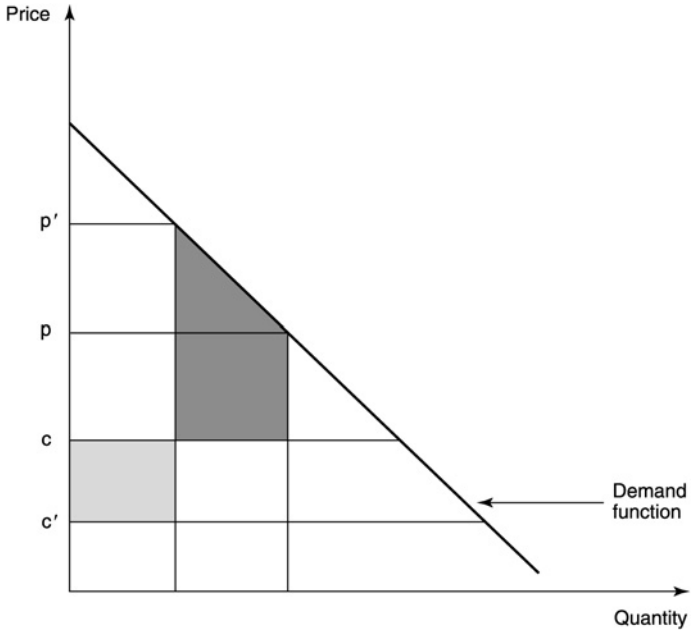

Figure 36.2. The Williamson tradeoff when the pre-merger price exceeds marginal cost.

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 those choices may be affected by the change in market structure brought about by a merger. We will return to this point later in this section.

2.2. *Static ("unilateral") effects of mergers*

Careful consideration of these issues requires a more complete model of market competition. The simplest class of models in which we can formally analyze the effects of horizontal mergers are static oligopoly models. The general presumption in such models is that, absent efficiencies, prices will rise following a merger. The reason for this presumption is that, holding rival prices or outputs fixed, a merger between sellers of substitute goods will lead them to internalize the negative externality that more aggressive pricing or output choices has on the merger partner.[6]

[6] Throughout I focus on mergers of sellers. The same principles apply to mergers of buyers, who have an incentive to reduce demand to lower prices. In some cases, firms that are vertically integrated participate in the market as both buyers and sellers. For a discussion of that case, see Hendricks and McAfee (2000).

Translating this price-increasing effect into an increase in equilibrium prices requires some further "regularity" assumptions. For example, we will see shortly that, absent efficiency improvements, a merger raises price under fairly weak regularity conditions in the Cournot model of simultaneous quantity choices among producers of a homogeneous good. In differentiated price competition models, matters are a little more complicated. The internalization caused by the merger (the fact that some of the sales lost due to a product's price increase are captured by other products now owned by the merged firm) implies that the merged firm will have an incentive to raise the price of any one of its products holding fixed the prices of all of its other products and the prices of rivals.[7] To insure that all prices in the market rise it is sufficient to know that – holding rival prices fixed at any levels – the merger causes the merged firm to raise all of its prices, and that best responses are "upward sloping" (strategic complements). The latter condition implies that the merged firm's price increases lead rivals to increase their prices, which in turn causes the merged firm to further increase its own prices, and so on. These two conditions will hold, for example, if the pricing game is supermodular.[8]

What are the welfare effects of a merger that does generate efficiencies? Farrell and Shapiro (1990) provide such an analysis for the special case in which competition takes a Cournot form. [For related analyses, see Levin (1990) and McAfee and Williams (1992).] They investigate two principal questions: First, under what conditions are cost improvements sufficiently great for a merger to reduce price? As noted earlier, this is the key question when one adopts a consumer surplus standard. Second, can the fact that proposed mergers are profitable for the merging parties be used to help identify mergers that increase aggregate surplus? In particular, one difficult aspect of evaluating the aggregate welfare impact of a merger involves assessing the size of any cost efficiencies. The merging parties always have an incentive to overstate these efficiencies to help gain regulatory approval (or placate shareholders), and these prospective claims are hard for an antitrust authority to verify. But since only the merging parties realize these efficiency gains, it might be possible to develop a *sufficient* condition for a merger to enhance aggregate surplus that does not require investigation of claimed efficiencies by asking when the merger has a positive net effect on parties other than the merging firms.

[7] The share of the lost sales of product A that are captured by product B when A's price increases is known as the *diversion ratio* from product A to product B.

[8] With constant unit costs, a *sufficient* condition for supermodularity with multiproduct firms is that the demand function for each product j satisfies $\partial D_j(p_1, \ldots, p_N)/\partial p_k \partial p_r \geqslant 0$ for all product prices p_k and p_r. This sufficient condition is satisfied in the case of linear demands, but in few other standard models. For example, it is not satisfied in the Logit model. With single product firms, one can sometimes establish instead supermodularity of the log-transformed game [see, for example, Vives (1999) and Milgrom and Roberts (1990)]. That is the case, for example, for the single-product Logit model. Unfortunately, this method does not extend to the case of multiproduct firms. Deneckere and Davidson (1985) provide conditions that imply that a merger increases all prices with symmetrically differentiated products. As a general matter, it appears relatively easy to get non-increasing best responses in the type of random coefficient models that are often used in merger simulations (see Section 5.1). For example, if a rival's price increase causes relatively poor consumers to shift to a firm's product, the firm's optimal price may well fall.

Consider the first question: When does price decrease as a result of a merger in a Cournot industry? 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 pre-merger outputs satisfy $\hat{x}_1 \geqslant \hat{x}_2 > 0$. Following Farrell and Shapiro, we assume that the equilibrium aggregate output increases if and only if, given the pre-merger aggregate output of non-merging firms $\hat{X}_{-12}$, the merger causes the merging firms to want to increase their joint output. The following two assumptions are sufficient (although not necessary) for this property to hold[9]:

(A1) The industry inverse demand function $P(\cdot)$ satisfies $P'(X) + P''(X)X < 0$ for all aggregate output levels X.

(A2) $c_i''(x_i) > P'(X)$ for all output levels x_i and X having $x_i \leqslant X$, and for all i.

Letting $\hat{X}$ be the aggregate pre-merger output in the market, the pre-merger Cournot first-order conditions for these two firms are

$$P'(\hat{X})\hat{x}_1 + P(\hat{X}) - c_1'(\hat{x}_1) = 0, \tag{1}$$

$$P'(\hat{X})\hat{x}_2 + P(\hat{X}) - c_2'(\hat{x}_2) = 0. \tag{2}$$

[9] Formally, (A1) and (A2) have the following implications:

(i) Each firm i's profit maximization problem, given the joint output of its rivals X_{-i}, is strictly concave and therefore has a unique solution. Moreover, letting $b_i(X_{-i})$ denote firm i's best-response function, $b_i(\cdot)$ is non-increasing and $b_i'(X_{-i}) \in (-1, 0)$ at all X_{-i} such that $b_i(X_{-i}) > 0$.

(ii) The equilibrium aggregate output is unique. To see this, define each firm i's *aggregate output best-response function* as $\lambda_i(X) = \{x_i\colon\ x_i = b_i(X - x_i)\}$. For a given level of aggregate output X, this function gives the output level for firm i that is consistent with X if firm i is playing a best response to its rivals' joint output. By observation (i), this output level is unique, is non-increasing in X, and is strictly decreasing in X wherever $\lambda_i(X) > 0$. The equilibrium aggregate output is then the unique solution to $\sum_i \lambda_i(X) = X$.

(iii) For any set of firms I, define its *equilibrium best-response function*

$$b_I^e(X_{-I}) \equiv \left\{ \sum_{i \in I} x_i\colon\ x_i = b_i(X_{I/\{i\}} + X_{-I}) \text{ for all } i \in I \right\}.$$

This gives, conditional on X_{-I}, the (unique) aggregate output for firms in set I that results if all of the firms in set I are playing best responses. It is the solution to $\sum_{i \in I} \lambda_i(X_I + X_{-I}) = X_I$. From this, one can see that $b_I^e(\cdot)$ is non-increasing and $b_I^{e\prime}(X_{-I}) \in (-1, 0)$ whenever $b_I^e(X_{-I}) > 0$, just like the individual best-response functions.

(iv) The pre-merger equilibrium joint outputs of the merging and non-merging firms $(\hat{X}_{12}, \hat{X}_{-12})$ are the unique solution to

$$b_{12}^e(\hat{X}_{-12}) = \hat{X}_{12}, \qquad b_{-12}^e(\hat{X}_{12}) = \hat{X}_{-12}.$$

The post-merger equilibrium joint outputs $(\overline{X}_{12}, \overline{X}_{-12})$ are the unique solution to

$$b_M(\overline{X}_{-12}) = \overline{X}_{12}, \qquad b_{-12}^e(\overline{X}_{12}) = \overline{X}_{-12},$$

where $b_M(\cdot)$ is the best-response function of the merged firm. Given the properties of these best-response functions noted in observation (iii), aggregate output increases after the merger if and only if $b_M(\hat{X}_{-12}) > b_{12}^e(\hat{X}_{-12})$.

Adding these two conditions together, we have

$$P'(\hat{X})(\hat{x}_1 + \hat{x}_2) + 2P(\hat{X}) - c_1'(\hat{x}_1) - c_2'(\hat{x}_2) = 0. \tag{3}$$

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 [which is also implied by (A1) and (A2)], its best response to $\hat{X}_{-12}$ is greater than the sum of the two firms' pre-merger outputs $\hat{x}_1 + \hat{x}_2$ if and only if

$$P'(\hat{X})(\hat{x}_1 + \hat{x}_2) + P(\hat{X}) - c_M'(\hat{x}_1 + \hat{x}_2) > 0, \tag{4}$$

or, equivalently [using (3)], if

$$c_2'(\hat{x}_2) - c_M'(\hat{x}_1 + \hat{x}_2) > P(\hat{X}) - c_1'(\hat{x}_1). \tag{5}$$

Since $c_1'(\hat{x}_1) \leqslant c_2'(\hat{x}_2) < P(\hat{X})$ [this follows from the pre-merger first-order conditions (1) and (2) and the fact that $\hat{x}_1 \geqslant \hat{x}_2 > 0$], this can happen only if

$$c_M'(\hat{x}_1 + \hat{x}_2) < c_1'(\hat{x}_1). \tag{6}$$

Condition (6) is a stringent requirement. It says 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. To better understand this condition, suppose that the merged firm has the *same* marginal cost as the more efficient merger partner (at the pre-merger output levels) and think about each of their incentives to increase output marginally. A marginal increase in output has the same incremental cost and is also sold at the same price for the two firms. However, the accompanying reduction in the market price is more costly for the merged firm than it would be for the more efficient merger partner because the merged firm sells more. Since the more efficient merger partner did not find it worthwhile to further increase its output before the merger, neither will the merged firm. Hence, for the merged firm to increase its output above the pre-merger level, it must have a lower marginal cost than the more efficient merger partner.

From condition (6), we can see that some kinds of mergers can *never* reduce price. First, as is no surprise, a merger that reduces fixed, but not marginal, costs cannot lower price. For example, imagine that before the merger each of the merging firms has cost function $c(x) = F + cx$, while the cost function of the merged firm is $c_M(x) = F_M + cx$, where $F_M < 2F$. By (6), this merger cannot reduce price.

More interesting, however, a merger that involves "no synergies" – that is, whose only efficiencies involve a reallocation of output across the firms so that

$$c_M(x) = \min_{x_1', x_2'} \left[c_1(x_1') + c_2(x_2')\right] \quad \text{s.t.} \quad x_1' + x_2' = x, \tag{7}$$

also will not result in a lower price. To see why, consider the simple case where the merging firms have increasing marginal costs. If, after the merger, both merger partners' plants remain in operation, efficient production involves equating the marginal costs of

the two firms. This 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. If, on the other hand, one of the merger partner's plants is shut down after the merger to save on fixed costs, then the other plant will be producing more than its pre-merger level. Since marginal costs are increasing, (6) once again cannot hold. More generally, Farrell and Shapiro show that a merger that involves no synergies must raise price whenever (A1) and (A2) hold.[10]

Let us now turn to the second question by supposing that the merger does increase price. Under what circumstances does it nevertheless increase aggregate surplus? 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 $\mathrm{d}X < 0$. Let $\mathrm{d}x_i$ and $\mathrm{d}p$ be the corresponding changes in firm i's output (for $i \notin I$) and the price.

The key step in Farrell and Shapiro's analysis is their use of the presumption that proposed mergers are profitable for the merging firms.[11] If this is so, then we can derive a *sufficient condition* for the merger to increase aggregate surplus based on the *external effect* of the merger on non-participants; that is, on consumers and the non-merging firms. Specifically, the welfare of non-participants is given by

$$E = \int_{P(X)}^{\infty} x(s)\,\mathrm{d}s + \sum_{i\notin I}\bigl[P(X)x_i - c_i(x_i)\bigr]. \tag{8}$$

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

[10] A proof of this result goes as follows: Given the pre-merger aggregate output of firm 1 and firm 2's rivals, $\hat{X}_{-12}$, let $(\bar{x}_1, \bar{x}_2)$ denote the merged firm's best response. Also, let $b_i(\cdot)$ be the pre-merger best-response function of firm i for $i = 1, 2$. Observe, first, that after the merger we must have $\bar{x}_1 \leqslant b_1(\bar{x}_2 + \hat{X}_{-12})$ and $\bar{x}_2 \leqslant b_2(\bar{x}_1 + \hat{X}_{-12})$. (Formally, this can be established using a simple revealed preference argument; intuitively, the merged firm reduces both of its plants' outputs below their unmerged best responses since it internalizes the externality that each plant's output has on its other plant.) Now suppose, contrary to our hypothesis, that $\bar{x}_1 + \bar{x}_2 > \hat{x}_1 + \hat{x}_2$. Clearly $\bar{x}_i > \hat{x}_i$ for either $i = 1$ or $i = 2$; without loss of generality, suppose that $\bar{x}_2 > \hat{x}_2$. Then

$$\bar{x}_1 \leqslant b_1(\bar{x}_2 + \hat{X}_{-12}) < b_1(\hat{x}_2 + \hat{X}_{-12}) = \hat{x}_1.$$

But, $\bar{x}_1 < \hat{x}_1$ implies that

$$\bar{x}_1 + \bar{x}_2 \leqslant \bar{x}_1 + b_2(\bar{x}_1 + \hat{X}_{-12}) < \hat{x}_1 + b_2(\hat{x}_1 + \hat{X}_{-12}) = \hat{x}_1 + \hat{x}_2,$$

a contradiction.

Spector (2003) shows that if one adds the assumption that the merger is profitable (as we do below when considering effects on aggregate surplus), then price cannot fall after a merger that involves no synergies even if entry occurs after the merger.

[11] Note 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)].

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, $\mathrm{d}X_I < 0$, along with the accompanying differential changes in the outputs of rivals, $\mathrm{d}x_i$ for $i \notin I$. These changes $\mathrm{d}x_i$ arise as the non-merging firms adjust their optimal outputs given the reduction in the merged firms' output $\mathrm{d}X_I < 0$. Under Farrell and Shapiro's assumptions, these changes reduce the overall output in the market: $\mathrm{d}X = \mathrm{d}X_I + \sum_{i \notin I} \mathrm{d}x_i < 0$. Totally differentiating (8) we see that their effect on E is

$$\mathrm{d}E = -\hat{X} P'(\hat{X})\,\mathrm{d}X + \sum_{i \notin I} \hat{x}_i P'(\hat{X})\,\mathrm{d}X + \sum_{i \notin I} \big[P(\hat{X}) - c_i'(\hat{x}_i)\big]\,\mathrm{d}x_i. \tag{9}$$

The first two terms in (9) 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 $\hat{X}$, while the latter is proportional to the non-merging firms' total sales $\sum_{i \notin I} \hat{x}_i$. The third term in (9) is the change in the non-merging firms' profits 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

$$\begin{aligned}
\mathrm{d}E &= -\hat{X}_I P'(\hat{X})\,\mathrm{d}X + \sum_{i \notin I} \big[-P'(\hat{X})\hat{x}_i\big]\,\mathrm{d}x_i \\
&= -P'(\hat{X})\,\mathrm{d}X \left[\hat{X}_I + \sum_{i \notin I} \hat{x}_i \left(\frac{\mathrm{d}x_i}{\mathrm{d}X}\right)\right] \\
&= -P'(\hat{X})\hat{X}\,\mathrm{d}X \left[s_I + \sum_{i \notin I} s_i \left(\frac{\mathrm{d}x_i}{\mathrm{d}X}\right)\right],
\end{aligned} \tag{10}$$

where s_i is firm i's pre-merger market share (s_I is the collective market share of the firms in set I), and $\frac{\mathrm{d}x_i}{\mathrm{d}X}$ is the (differential) change in non-merging firm i's output when industry output changes marginally.[12] Thus, $\mathrm{d}E \geqslant 0$ if and only if

$$s_I \leqslant -\sum_{i \notin I} s_i \left(\frac{\mathrm{d}x_i}{\mathrm{d}X}\right). \tag{11}$$

Farrell and Shapiro establish (sufficient) conditions under which signing this differential effect at the pre-merger point is sufficient for signing the global effect.[13] Note one very important aspect of condition (11): it establishes that a merger is welfare-enhancing

[12] $\frac{\mathrm{d}x_i}{\mathrm{d}X}$ is equal to $\lambda_i'(\hat{X})$, the derivative of firm i's aggregate output best-response function (see footnote 9). We get $\frac{\mathrm{d}x_i}{\mathrm{d}X}$ from implicitly differentiating the expression $P'(X)x_i + P(X) - c_i'(x_i) = 0$. Note that $\frac{\mathrm{d}x_i}{\mathrm{d}X} = (\frac{\mathrm{d}x_i}{\mathrm{d}X_{-i}})/(1 + \frac{\mathrm{d}x_i}{\mathrm{d}X_{-i}})$, where $\mathrm{d}X_{-i} \equiv \sum_{j \neq i} \mathrm{d}x_j$ and $\frac{\mathrm{d}x_i}{\mathrm{d}X_{-i}}$ is the slope of firm i's best-response function $b_i'(X_{-i})$.

[13] In particular, this is so if $[P''(\cdot), P'''(\cdot), c_i''(\cdot), -c_i'''(\cdot)] \geqslant 0$.

without the need to quantify the efficiencies created by the merger since the sign of the external effect is purely a function of pre-merger market shares and the non-merging firms' reactions to the merging firms' output reduction.

As one example, consider a situation with a (weakly) concave inverse demand function $[P''(\cdot) \leqslant 0]$ and constant returns to scale for the non-merging firms. We then have $\frac{\mathrm{d}x_i}{\mathrm{d}X} = -[1 + P''(X)x_i/P'(X)] \leqslant -1$ for all i, and so the external effect $\mathrm{d}E$ is non-negative when

$$s_I \leqslant \sum_{i \notin I} s_i \left(1 + \frac{P''(X)x_i}{P'(X)}\right) = (1 - s_I) + \frac{P''(X)X}{P'(X)} \sum_{i \notin I} (s_i)^2$$

or

$$s_I \leqslant \frac{1}{2}\left\{1 + \frac{P''(X)X}{P'(X)} \sum_{i \notin I} (s_i)^2\right\}. \tag{12}$$

Since, $P''(\cdot) \leqslant 0$, this condition holds whenever the merging firms have a share below $\frac{1}{2}$.[14]

As another example consider a situation with the linear inverse demand function $P(X) = a - X$ in which the cost function for a firm with k units of capital is $c(x, k) = \frac{1}{2}(x^2/k)$. (A merger of two 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 non-negative if

$$s_I \leqslant \left(\frac{1}{\varepsilon}\right) \sum_{i \notin I} (s_i)^2; \tag{13}$$

that is, if the share of the merging firms is less than an elasticity-adjusted Herfindahl–Hirschman index 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 and the non-merging firms are large. 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 non-merging firms increases. Since in the Cournot model larger firms have lower marginal costs in equilibrium [this follows from (1) and (2)], the effect of this reshuffling of production on non-merging firms' profits is more positive when the non-merging firms are large. It is also noteworthy that the external effect is more likely to be positive when the shares of the non-merging firms are more concentrated.[15]

[14] If the inverse demand function is linear, then $\mathrm{d}E$ is also negative whenever $s_I > 1/2$.

[15] Note that when a merger will instead *lower* price, $\mathrm{d}E$ is positive when the reverse of condition (11) holds. In that case, a merger is more likely to have a positive external effect when the merging firms are large

Conditions (12) and (13) are simple conditions that require only readily available data on pre-merger outputs and information on the market demand function. Indeed, when demand is linear, checking condition (12) requires information only on market shares [and condition (12) necessarily holds whenever $s_I \leqslant 1/2$].[16] However, the precise forms of these tests are very special and depend on having a great deal of a priori information about the underlying demand and cost functions. For more general demand and cost specifications, condition (11) requires that we also know the slopes of the non-merging firms' best-response functions [in order to know $(\frac{\mathrm{d}x_i}{\mathrm{d}X})$]. These slopes are significantly more difficult to discern than are pre-merger 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 proposed mergers are privately profitable. To the extent that agency problems may lead managers to "empire build" to the detriment of firm value, this assumption may be inappropriate.[17]

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 represent transfers from other stakeholders in the firm [Shleifer and Summers (1988)], this assumption would be inappropriate.

Third, Farrell and Shapiro use the assumption that the merger is profitable in only a limited way. By asking when the external effect is positive, they provide a sufficient condition for a merger to increase aggregate surplus that requires no consideration at all of efficiencies. More generally, an antitrust authority that cannot verify claimed efficiencies directly might use the fact that a merger is profitable to update its beliefs about the extent of likely efficiencies. It could then ask whether the merger results in an increase in expected aggregate surplus given this updated belief.

Fourth, the Farrell and Shapiro analysis is based on the strong assumption that market competition takes a form that is described well by the Cournot model, both before and after the merger. Many other forms of price/output competition are possible, and – as mentioned when discussing the Williamson trade-off – important elements of competition may occur along dimensions other than price/quantity. There has been no work that I am aware of extending the Farrell and Shapiro approach to other forms of market

and the non-merging firms are small (and hence, not very efficient). In fact, Levin (1990) shows that (in an environment with constant returns to scale) if the most efficient non-merged firm is less efficient than the merged firm and price falls following the merger, then the merger necessarily increases aggregate surplus.

[16] Although they bear some superficial resemblance to the concentration tests that appear in the DOJ/FTC Merger Guidelines (see Section 3), conditions (12) and (13) 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.

[17] In 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 not concern itself with stopping mergers based on unresolved agency problems within the merging firms.

interaction. The papers that formally study the effect of horizontal mergers on price and welfare in other competitive settings [e.g., Deneckere and Davidson (1985) and some of the papers discussed in Section 2.3] all assume that there are no efficiencies generated by the merger.[18]

Finally, there is some evidence that the efficiency consequences of production reshuffling that Farrell and Shapiro's analysis 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 breakup of AT&T in 1984, both of which facilitated new entry into a market that essentially had been a (Western Electric) monopoly. They document that productivity 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.[19]

2.3. Mergers in a dynamic world

One of the notable aspects of the Farrell and Shapiro model is its static nature. A number of interesting and important issues arise when one thinks of mergers in a more dynamic context. Many of these issues have received only limited attention.

2.3.1. Repeated interaction ("coordinated effects")

In Farrell and Shapiro's Cournot model, mergers necessarily raise price [under regularity conditions (A1) and (A2)] in the absence of any merger-induced efficiencies. This need not be true when firms interact repeatedly and tacit (or even explicit) collusion is a possibility. (In antitrust lingo, a merger's effects on tacit collusion are referred to as "coordinated effects", in contrast to the "unilateral effects" the merger has on static pricing incentives.) In such cases, as Davidson and Deneckere (1984) note, mergers can be a double-edged sword: they reduce the merging firms' direct incentives for cheating on tacit agreements, but they may also raise firms' profits when collusion breaks down, and thus indirectly increase the temptation to cheat, especially for non-merging firms. Because of these effects, a merger that generates no efficiencies can potentially lead all prices in a market to fall.

Analyzing the effects of a merger on firms' abilities to sustain collusion typically requires a model in which firms can be asymmetric.[20] Several recent papers have stud-

[18] One exception is Gowrisankaran (1999) who allows for a merger-specific "synergy" (effectively, a reduction in fixed costs) in his computational model of endogenous mergers.

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

[20] An exception is when a merger combines firms with the same constant returns to scale technology as in Salant, Switzer and Reynolds (1983).

ied such models. Compte, Jenny and Rey (2002), for example, consider the effects of horizontal mergers in a repeated Bertrand model with firms having differing capacity constraints; Vasconcelos (2005) examines a repeated Cournot game in which firms' cost functions $c(x, k)$ depend both on their output x and capital k (a merger of firms i and j leads to a merged firm with capital $k_i + k_j$); Kuhn (2004) explores a model of repeated price setting with symmetrically differentiated products in which a merger joins the product lines of the merging firms. These papers focus on classes of equilibria in which each firm's profit along any equilibrium path (either collusive or punishment) is a constant share of aggregate profit. This simplifies the analysis of equilibria since the set of subgame perfect equilibrium values for the firms is one-dimensional. (Moreover, all firms agree on what is the "best" equilibrium within this class.)

For example, in the Compte, Jenny and Rey paper, market demand is $Q(p) = 1$ if $p \leqslant 1$ and 0 if $p > 1$. Each firm i has capacity k_i and can produce output at zero cost up to capacity. There are N firms, with $k_1 \leqslant \cdots \leqslant k_N$ and $K \equiv \sum_j k_j \geqslant 1$. The firms play a repeated simultaneous price choice game. In such a game, if any collusion is possible, it is possible to sustain perfect collusion in every period (a price of 1). Compte, Jenny and Rey therefore focus on characterizing the lowest discount factor δ at which collusion is feasible.

There are two cases to consider in their model. First, if $K_{-N} \equiv \sum_{j \neq N} k_j \geqslant 1$, then any set of $N - 1$ firms has enough capacity to supply all of demand. In that case, the static Nash equilibrium yields profits of zero to all firms, and represents the worst possible punishment for a deviation. Collusion is then feasible if and only if

$$\hat{\pi}_i(1) \leqslant \frac{\alpha_i \pi(1)}{1 - \delta} \quad \text{for all } i,$$

where $\hat{\pi}_i(1) = \min\{k_i, 1\} \equiv \hat{k}_i$ is firm i's profit from an optimal deviation when all other firms charge a price of 1 ($\hat{k}_i$ is firm i's "effective" capacity), α_i is firm i's market share, and $\pi(1) = 1$ is the aggregate profit in each period when all firms charge a price of 1. Substituting these values and dividing by α_i, collusion is feasible if and only if

$$\max_i \frac{\hat{k}_i}{\alpha_i} \leqslant \frac{1}{1 - \delta}.$$

Thus, the firm that constrains collusion is the firm with the largest ratio of effective capacity to market share. Collusion is easiest to sustain when this ratio is the same for all firms, that is, when each firm i's market share is equal to its share of effective capacity: $\alpha_i = \hat{k}_i / \hat{K}$, where $\hat{K} = \sum_i \hat{k}_i$. Hence, the lowest discount factor at which collusion is feasible is

$$\underline{\delta} = \frac{\hat{K} - 1}{\hat{K}}. \tag{14}$$

Condition (14) tells us that when $K_{-N} \geqslant 1$, so that punishments for deviation always lead to a payoff of zero, mergers can never harm the prospects for collusion (note that a merger can never increase $\hat{K}$). Moreover, a merger of firms i and j who both have

strictly positive capacities will make collusion easier whenever they can supply the entire market after the merger ($k_i + k_j > 1$).

In the second case, $K_{-N} < 1$, so there is no longer a zero-profit static Nash equilibrium. Determining when collusion is feasible then requires that we also determine the worst possible punishment. Following techniques in Abreu (1986), these worst punishments involve a "stick-and-carrot" structure. Specifically, the best and worst equilibria, which involve per period discounted aggregate profits of $\bar{v}$ and $\underline{v}$, have the following structures: If any collusion is possible, the best equilibrium involves the firms all charging price $\bar{p} = 1$ in every period if no deviation has occurred in the previous period (so $\bar{v} = 1$), and reverting to the worst equilibrium if a deviation has occurred. The worst equilibrium involves all firms charging some price $\underline{p} < 1$ for one period. If no firm deviates, they then revert to the best equilibrium; if, instead, some firm deviates, the worst punishment is restarted.[21] In this case, collusion is sustainable if and only if there is a punishment value $\underline{v}$ such that for all i,

$$(\hat{k}_i - \alpha_i) \leqslant \left(\frac{\delta}{1-\delta}\right)\alpha_i(1-\underline{v}), \tag{15}$$

$$\max\{1 - K_{-i}, 0\} \leqslant \alpha_i \underline{v}. \tag{16}$$

Condition (15) is the condition needed for firm i not to deviate from the collusive price $\bar{p} = 1$ (the best deviation involves selling $\hat{k}_i$ units at a price slightly below 1). It says that the gain from a one-period deviation $(\hat{k}_i - \alpha_i)$ is less than the present discounted value of the loss from reverting to the worst equilibrium in the next period. Condition (16) is the condition needed for firm i not to deviate from the punishment price $\underline{p}$ (the best deviation involves charging a price $p = 1$ and selling $\max\{1-K_{-i}, 0\}$ units). It says that the payoff in the first period of deviating must be less than the firm's per period payoff in the worst equilibrium. Since deviation leads to a restarting of the worst equilibrium, this insures that a deviation is not profitable. Dividing by α_i and looking for the firms for which these constraints are tightest, we see that collusion is possible if and only if

$$\max_i\left(\frac{\hat{k}_i}{\alpha_i}\right) - 1 \leqslant \left(\frac{\delta}{1-\delta}\right)(1-\underline{v}), \tag{17}$$

$$\max_i\left(\frac{\max\{1 - K_{-i}, 0\}}{\alpha_i}\right) \leqslant \underline{v}. \tag{18}$$

Note that the firm that imposes a constraint on collusion at the collusive price $\bar{p} = 1$ may be different than the firm that imposes the constraint at the punishment price $\underline{p}$. Putting conditions (17) and (18) together tells us that collusion is feasible if and only if

$$\left(\frac{\delta}{1-\delta}\right) \geqslant \frac{\max_i(\frac{\hat{k}_i}{\alpha_i}) - 1}{1 - \max_i(\frac{\max\{1-K_{-i},0\}}{\alpha_i})}. \tag{19}$$

[21] If there is a lower bound on prices (such as $\underline{p} \geqslant 0$), then the punishment period may need to last more than one period.

Collusion is easiest at the market shares $(\alpha_1, \ldots, \alpha_N)$ that minimize the right-hand side of (19). The numerator, reflecting incentives to deviate from the collusive price, is minimized when shares are proportional to effective capacities, as before. The denominator, reflecting incentives to deviate from the punishment price, is minimized when shares are proportional to each firm's minimax payoff, $\max\{1 - K_{-i}, 0\}$. Compte, Jenny and Rey show that the collusive incentives dominate, so that collusion is easiest when shares are again proportional to effective capacities. This makes the numerator on the right-hand side of (19) equal $(\hat{K} - 1)$. The denominator, on the other hand, equals $[1 - (1 - K_{-N})\hat{K}/\hat{k}_N]$, which reflects the fact that with shares proportional to effective capacities, it is the largest firm that has the highest incentive to deviate from the punishment.[22] This implies (using the fact that $K_{-N} + \hat{k}_N = \hat{K}$ when $K_{-N} < 1$) that the lowest discount factor at which collusion is feasible is

$$\underline{\delta} = \frac{\hat{k}_N}{\hat{K}}. \tag{20}$$

Condition (20) has a striking implication: when $K_{-N} < 1$, only mergers that involve the largest firm matter for the ease of sustaining collusion (since no other mergers change $\hat{K}$ when $K_{-N} < 1$) and any merger that causes the largest firm to grow larger starting from an initial size at which it is unable to serve the entire market makes collusion *harder* (by raising $\hat{k}_N$ and possibly lowering $\hat{K}$). The reason is that it is the largest firm that constrains the ability to punish when shares are proportional to effective capacities. Indeed, the value of the worst punishment is $\underline{v} = \hat{K}(1 - K_{-N})/\hat{k}_N$. For example, when the largest firm approaches having nearly all of the industry capacity, so that $\hat{k}_N \to \hat{K}$ and $(1 - K_{-N}) \to 1$, it becomes impossible to punish deviations from collusion ($\underline{v} \to 1$).

The fact that asymmetry, and thus mergers involving the largest firm, can harm collusion arises as well in the papers by Vasconcelos (2005) and Kuhn (2004). As in Compte, Jenny and Rey, the reason is the punishment effect: the largest firm often has the greatest incentive to deviate in a punishment phase. Intuitively, it bears the largest cost from the punishment.

While these papers have significantly increased our understanding of the factors affecting collusion with asymmetric firms, the restricted classes of equilibria they analyze could give misleading results. For example, an optimal collusive scheme might involve different shares for a firm in collusive and punishment phases, or even different prices for different firms within a given period. In general, one must also confront the issue of how firms select which equilibrium to play among the various feasible collusive equilibria. The last section of Kuhn (2004) uses computational techniques to look at the

[22] To see this formally, substitute $\alpha_i = \hat{k}_i/\hat{K}$ into the denominator of (19) and observe that for any $i \neq N$, $\max\{1 - K_{-N}, 0\}/\hat{k}_N \geqslant \max\{1 - K_{-i}, 0\}/\hat{k}_i$ if $K_{-i} \geqslant 1$, while if $K_{-i} < 1$ then

$$\frac{\max\{1 - K_{-N}, 0\}}{\hat{k}_N} = \frac{1 - K_{-N}}{\hat{k}_N} \geqslant \frac{1 - K_{-N}}{k_N} \geqslant \frac{1 - K_{-i}}{k_i} = \frac{\max\{1 - K_{-i}, 0\}}{\hat{k}_i}$$

(the second weak inequality follows because $K > 1$).

effect of mergers when firms use Nash bargaining to select from among the full set of collusive equilibria in a linear version of his model. More work in this direction, both analytical and computational, would be useful.

2.3.2. Durable goods

The Farrell and Shapiro analysis focuses on non-durable goods. Many mergers, however, occur in durable goods industries. Two issues arise when merging firms operate in a durable goods market. First, consumers' abilities to delay their purchases in anticipation of future price reductions affect the ability to exercise market power. As emphasized by Coase (1972), this may mitigate – sometimes completely – the ability of a durable good monopolist to earn positive profits. On the other hand, consumers' abilities to delay their purchases may make tacit collusion among durable good oligopolists *easier* by reducing the sales enjoyed by a deviating seller. This occurs because consumers who anticipate that a price war is about to break out will delay their purchases. Indeed, Gul (1987) and Ausubel and Deneckere (1987) show that in some cases durable good oligopolists may be able to sustain a higher price than can a durable good monopolist.

The second issue concerns the welfare costs of horizontal mergers that do increase market power. Carlton and Gertner (1989) point out that used goods may constrain the pricing of even a monopolist whose market power is not otherwise constrained by the factors noted by Coase. Indeed, when new goods depreciate in quantity but not in quality (so that used goods may be combined to yield equivalent consumption value to new goods) and the market is initially at a competitive steady state, even a newly-formed monopolist will not be able to raise price above the competitive level until the current stock of used goods depreciates. If it depreciates slowly, or if entry is likely to occur before too long, then even a merger to monopoly will have small welfare effects. In contrast, Gerstle and Waldman (2004) show that when used goods are of lower quality than new ones and consumers differ in their willingness to pay for high quality, a newly-formed monopolist will be able to raise price right away, and that welfare losses are larger than in the setting studied by Carlton and Gertner.

2.3.3. Entry

In most market settings, merging firms need to worry about the possibility of new entry following their merger. This can affect both the set of proposed mergers and their welfare consequences.

The possibility of post-merger entry reduces the set of profitable mergers. It also affects the average characteristics of profitable mergers. Werden and Froeb (1998), for example, in an exploratory study of mergers and entry, observe that mergers that lead to entry are rarely profitable in the absence of efficiency improvements. Thus, the set of profitable mergers when entry is possible is likely to be more heavily weighted toward mergers that reduce costs.

Consider now how the possibility of entry affects the welfare evaluation of mergers. If we are interested in a consumer surplus standard, the possibility of new entry increases the likelihood that a given merger will lower price. If we are interested in an aggregate surplus standard, however, the possibility of entry need not make a given merger more attractive. 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, ch. 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 short-run result of two firms merging is an elevation in price, while the long-run effect (once entry can occur) is the entry of exactly one additional firm and a return to the pre-merger price. However, in this setting, we know that entry incentives are generally excessive [see Mankiw and Whinston (1986)]: too many firms enter the industry in a free-entry equilibrium. This implies that the merger's effect on aggregate surplus is *worse* when entry is possible than when it is not.

We will see shortly (in Section 3.1.3) that easy entry conditions tend to make antitrust agencies more receptive to a merger. If the goal is to maximize aggregate surplus, would such a presumption make sense given the above observation? One reason it might is related to Farrell and Shapiro's idea of conditioning on a proposed merger being profitable. In particular, if easier entry causes profitable mergers to involve, on average, greater efficiencies, then mergers that are proposed in markets with easy entry may nonetheless be more likely to increase aggregate surplus (and consumer surplus too).

2.3.4. Endogenous mergers

There is a fairly large literature that tries to endogenize the set of mergers that will occur in a market in the absence of any antitrust constraint [see, for example, Mackay (1984), Kamien and Zang (1990), Bloch (1996), Yi (1997), Gowrisankaran and Holmes (2004)]. One key observation in this literature is that an unregulated merger process may stop far short of full monopolization. The reason is a "hold-out" problem: if potential acquirees anticipate that the acquirer will be purchasing other firms, thereby raising the market price, they may insist on such a high price for their own firm as to make their acquisition unprofitable. Indeed, in some cases, this may mean that no mergers occur at all.[23]

This literature has some potentially important implications for Farrell and Shapiro's analysis of the welfare effects of proposed horizontal mergers. For example, observe that when Farrell and Shapiro assume that a proposed merger is profitable for the merging parties they do this under the assumption that this merger is the only merger that can happen. In a dynamic context in which other mergers may follow the currently proposed merger (or, may occur if it is *not* consummated), what it means for a merger to be

[23] This point is also related to the literature on contracting with externalities [e.g., Segal (1999)].

"profitable" is that the merger must increase the sum of the two firms' values. This is not the same as saying that the merger is profitable in the absence of other mergers. Moreover, the external effect of the merger may differ markedly from Farrell and Shapiro's calculation of the change in E. For example, it may include changes in the amounts that non-merging firms are paid later when they themselves are acquired.

This literature also suggests that there may be some subtle effects from a change in an antitrust authority's rules for blocking mergers. Such a change may have not only a direct effect on the set of consummated mergers through a change in treatment when a given merger is proposed, but may also change the set of permissible mergers that are actually proposed.

2.3.5. Other competitive variables

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 as through changes in prices/outputs. Some progress on these issues 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 effects. Further work along these lines can be found in Gowrisankaran (1999), who also attempts to endogenize the merger process itself. Some consideration of non-price variables has recently been introduced into merger analyses through the concept of "innovation markets" [Gilbert and Sunshine (1995)].

2.3.6. Multimarket contact

Finally, in a dynamic world in which tacit collusion is possible, a merger may affect pricing in a market not only by changing within-market concentration, but also by changing the extent to which multiproduct firms compete against one another in multiple markets. Bernheim and Whinston (1990), for example, show theoretically that, in some cases, multimarket contact can improve firms' abilities to sustain high prices by pooling the incentive constraints that limit tacit collusion. Some evidence of multimarket contact effects is provided by Phillips and Mason (1992) and Evans and Kessides (1994). The latter study provides evidence that the price increases that arose from a series of horizontal mergers in the U.S. airline industry in the 1980s were to a significant degree due to multimarket contact effects.

3. Merger laws and enforcement

Merger laws and enforcement developed at very different times in different countries. Antitrust scrutiny of horizontal mergers started before 1900 in the U.S., but much later

in most other countries. For instance, mergers were first subject to review in the United Kingdom in 1965, in Germany in 1973, in Australia in 1974, and in Israel in the late 1980s. The E.U. did not have a merger control law until 1990. Yet, despite this fact, in recent years there has been a striking convergence in merger laws and enforcement around the globe toward a model in which mergers are evaluated prospectively for their potential competitive harms according to fairly similar standards. In many – although not all – respects, this convergence has been toward the U.S. model of merger review. In this section, I begin by reviewing that approach. I next describe merger control in the E.U. I then discuss some of the main areas of differences in other countries, with a particular focus on one important area of difference, the choice of a welfare standard. Finally, I look briefly at enforcement experience in the U.S. and the E.U.

3.1. U.S. merger laws and the DOJ/FTC guidelines

Horizontal mergers were first regulated in the United States with passage of the Sherman Act in 1890. Section 1 of the Sherman Act states that "Every contract, combination in the form of trust or otherwise, or conspiracy, in restraint of trade or commerce among the several states, or with foreign nations, is hereby declared illegal…". This vague prohibition authorized the U.S. courts to develop a common law of antitrust to fulfill the statute's intent, and the courts soon used it to rule some horizontal mergers (particularly among railroads) illegal. (The U.S. courts also applied Section 1 of the Sherman Act to price fixing, exclusive contracts, and other anticompetitive "agreements".)

The vagueness of the Sherman Act's prohibitions, however, resulted in pressure for further legislation, leading in 1914 to passage of the Clayton and Federal Trade Commission Acts. The Clayton Act more specifically prohibits certain practices including, in its Section 7, mergers where "the effect of such acquisition may be substantially to lessen competition, or tend to create a monopoly" in any line of commerce. The Federal Trade Commission Act created the Federal Trade Commission (FTC) as a specialist agency to enforce the antitrust laws. The central substantive provision guiding the FTC's enforcement actions is Section 5 of the Act which states that "Unfair methods of competition in or affecting commerce… are hereby declared illegal". The U.S. courts interpret Section 5 as applying to anything that is a Sherman Act or Clayton Act violation.[24]

Three types of sanctions can be imposed in U.S. antitrust cases: criminal penalties, equitable relief, and monetary damages. Sherman Act offenses are felonies, and the Department of Justice (DOJ), but not the FTC, can seek criminal penalties for them. (Violations of the Clayton Act and FTC Act are not crimes.) In practice, however, criminal penalties are sought only for overt price fixing and are not relevant for horizontal merger enforcement.

[24] The courts also interpret Section 5 of the FTC Act as applying as well to somewhat "lesser" acts that violate the "spirit" of the Sherman and Clayton Acts. That broader interpretation seems not to matter, however, in the area of merger enforcement. The FTC also applies Section 5 to consumer protection issues, such as misleading advertising and fraud.

Equitable relief entails undoing a wrong that has occurred, or preventing future harm, for example, by requiring divestiture of a merger that has already been consummated or by preventing firms from merging in the first place. In practice, nearly all antitrust remedies in horizontal merger cases involve equitable relief.

Both the DOJ and private parties can sue in the federal courts for equitable relief for violations of either the Sherman or Clayton Acts. The result of such a proceeding, should the plaintiff prevail, is a court issued *decree*. (Often, however, settlement negotiations result instead in a *consent decree* prior to a court decision in a case.[25])

The FTC can also seek equitable relief. Here the procedure is somewhat different and involves a quasi-judicial administrative proceeding within the agency in front of what is known as an "administrative law judge", in which the FTC staff and the accused firms present evidence. The administrative law judge then issues an opinion, which is then reviewed by the Commission, consisting of five commissioners appointed by the President for seven-year terms. The Commission can approve or change (in any way) the administrative law judge's decision, and is then empowered to issue a "cease and desist" order if it finds that violations have occurred. Like lower court rulings for DOJ or private party suits, these cease and desist orders can be appealed by the firms to the appellate courts. In practice, however, the FTC merger review process often involves a court hearing much earlier than that, since for mergers that it has concerns about which have not yet been consummated the FTC nearly always seeks a preliminary injunction in federal court to prevent the parties from merging until after its internal proceeding is completed.

Finally, private parties who prove in court that they were injured due to Sherman and Clayton Act offenses can recover treble damages. In addition to providing a means for compensating parties injured by antitrust violations, these penalties help to create an additional army of private enforcers of the antitrust laws (moreover, an army that is perhaps more aware of when violations are occurring than are the governmental enforcement agencies). Treble damages rarely arise from horizontal mergers, however, because merger notification requirements (discussed next) mean that most illegal mergers are now blocked before they are consummated.

Since the Hart–Scott–Rodino Act of 1976, parties to mergers that exceed certain size thresholds must notify the DOJ and FTC of their intention to merge. Currently, notification is required if the acquired company exceeds $212.3 million in assets, or if the acquired company exceeds $53.1 million in assets and the annual sales or assets of the larger of the acquirer and acquired firms exceeds $106.2 million and of the smaller exceeds $10.7 million. The parties must then wait 30 days before consummating their merger (15 days if it is a cash tender offer). Prior to that time limit, the agencies can

[25] One important issue that I do not discuss is the crafting of effective remedies. A report by the FTC [Federal Trade Commission (1999)] studies factors that have led divestitures to be more or less effective as a merger remedy. Recently, the European Commission has also completed such a study [European Commission (2005)].

issue a request for additional information. Once the parties have complied with this so-called "second request", an additional 30-day waiting period begins (15 days for a cash tender offer) to give the agencies time to object to the merger before it is consummated. In practice, there is a great deal of flexibility in the duration of the second request phase because it depends on when compliance is deemed to be complete. In fact, since at this point in the process the parties are usually eager to appear cooperative in the hope of persuading the agencies to their point of view, they will often agree to delay the date of official compliance, or agree to delay merging for more than 30 days after they have complied.

The agencies tend to divide their review of notified horizontal mergers by industry to take advantage of industry-specific expertise. One somewhat odd feature of this division of responsibility between the two agencies is that different procedures apply to the two agencies' reviews of mergers, with the DOJ's need to go to court contrasting with the FTC's ability to conduct its own quasi-judicial administrative proceeding within the agency. This difference is tempered in practice, though, by the fact that both agencies need to go to federal court to obtain a preliminary injunction.

In addition to these federal antitrust statutes, state attorney generals can also use their individual states' antitrust laws to attack a merger that affects commerce in their state. Indeed, nothing in principle prevents a state's attorney general from doing so even after the DOJ or FTC has approved a merger.

The DOJ and FTC have periodically issued guidelines outlining the method they would follow for evaluating horizontal mergers. The most recent *Horizontal Merger Guidelines* were issued jointly in 1992, with a revision to the section on efficiencies in 1997.[26] The *Guidelines* first took a form resembling their present one in the early 1980s. The changes to the *Guidelines* introduced at that time dramatically increased the level of economic sophistication in horizontal merger review. The *Guidelines* have also greatly influenced the approach toward merger review adopted by antitrust authorities in other countries.

In practice, the approach followed by the DOJ and FTC in their merger reviews has an enormous effect on the set of mergers that are actually consummated. Antitrust cases are extremely expensive and often long affairs. As a result, once the DOJ or FTC announce that they will seek to block a merger, few firms decide to incur the costs and time required to fight in court. (Nearly all of the remaining mergers are dropped or settled if the agencies win a preliminary injunction in court.)

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.

[26] A copy of the Guidelines can be found at: http://www.usdoj.gov/atr/public/guidelines/horiz_book/hmg1.html and http://www.ftc.gov/bc/docs/horizmer.htm.

3.1.1. Market definition

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

> Would a hypothetical profit-maximizing monopolist of widgets impose at least 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 increase in price" (the "SSNIP test") is usually taken to be 5% of the pre-merger price. If the answer to this question is yes, then widgets is the relevant market. If the answer is no, then the agencies add the next closest substitute product (the product that would gain the most sales as a result of a 5% increase in the price of widgets) and ask the question again for this new larger potential market. This process continues until the answer to the question is yes. The idea is to arrive at a "relevant market" of products in which a merger potentially could have an anticompetitive effect.[27]

In this 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 imperfectly overlapping geographic areas). The DOJ and FTC will start by asking the same 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 merging firms each produce a single product. In many cases, however, they will be multi-product firms. The DOJ and FTC will follow the same procedure for each product they produce.

The market definition procedure described in the *Guidelines* makes a number of seemingly arbitrary choices to resolve potential ambiguities (and in some cases leaves these ambiguities unresolved). For example, consider the 5% price increase test. If an oil pipeline 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 supplied competitively, 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 delivered oil to consumers. Yet, which price is chosen matters for the *Guidelines*' market definition procedure. The *Guidelines* explicitly discusses this example, and opts for the net price of transportation. In contrast, in discussing retail mergers, the *Guidelines* opt for looking at the increase

[27] One thorny issue is what to do if widget producers are successfully colluding (tacitly) before the merger. Applying the SSNIP test directly, one would conclude that widgets is not the relevant market. This might be appropriate if one expects collusion to continue forever, in which case a merger cannot make matters worse in widgets. But if that collusion might at some point break down, a merger would prevent those price decreases from happening. In response to this concern, the *Guidelines* state that if it appears that firms are currently colluding, then the relevant comparison price for the SSNIP test would be a "competitive" price.

in retail prices, rather than the (implicit) net price of retail services. As another example, should the test be that the hypothetical monopolist raises price on all products by at least 5%, or that it does so for at least one of them? Here the *Guidelines* require that at least one price including one of the products of the merging parties increase by at least this amount. It is in some sense difficult to know what is the "right" way to resolve these (and other) ambiguities, because the *Guidelines*' procedure – while intuitive – is not based directly on any explicit model of competition and welfare effects.

3.1.2. Calculating concentration and concentration changes

Once the DOJ or FTC has defined the relevant market, the next step is to calculate the pre- and post-merger concentration levels. To do so, the DOJ and FTC will include all firms that are producing currently 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. Pre-merger shares are then calculated for each of these firms, usually on the basis of sales, although sometimes based on production, capacity (or, more generally, asset ownership), or (when uncommitted entrant responses are important) likely sales shares in response to a hypothetical 5% price increase. Using these pre-merger shares, say $(s_1, \ldots, s_N)$, the DOJ and FTC then calculate the following concentration measures:

Pre-merger Herfindahl–Hirschman index: $\text{HHI}_{\text{pre}} = \sum_i (s_i)^2$.

Post-merger Herfindahl–Hirschman index: $\text{HHI}_{\text{post}} = \sum_i (s_i)^2 - (s_1)^2 - (s_2)^2 + (s_1 + s_2)^2 = \sum_i (s_i)^2 + 2s_1 s_2$.

The change in the Herfindahl–Hirschman index: $\Delta\text{HHI} = \text{HHI}_{\text{post}} - \text{HHI}_{\text{pre}} = 2s_1 s_2$.

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

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

$HHI_{post} > 1000$ and < 1800: These mergers are unlikely to be challenged if the change in the Herfindahl–Hirschman index is less than 100. If it exceeds 100, then the merger "potentially raises significant competitive concerns", depending on consideration of other market factors.

$HHI_{post} > 1800$: These mergers are unlikely to be challenged if the change in the Herfindahl–Hirschman index is less than 50. If it is between 50 and 100, then the merger "potentially raises significant competitive concerns", depending on consideration of other market factors. If the change exceeds 100, it is presumed that the merger is likely to be anti-competitive without evidence showing otherwise.

Recalling that in a symmetric oligopoly the Herfindahl–Hirschman index is equal to 10,000 divided by the number of firms in the market, an index of 1000 corresponds to 10 equal-sized firms; an index of 1800 corresponds to 5.6 equal-sized firms. A change of 100 in the Herfindahl–Hirschman index would be caused by the merger of two firms with roughly a 7% share; a change of 50 would be caused by the merger of two firms with a 5% share.

The Guidelines therefore establish "safe harbors" for merging firms (i.e., cases in which a challenge is declared to be "unlikely") as well as some initial presumptions of anticompetitive harm. Actual enforcement practice has been more lenient than these numbers may suggest. This is due, in part, to the DOJ and FTC's consideration of other market factors and pro-competitive justifications, to which we now turn.

3.1.3. Evaluation of other market factors

Calculation of pre-merger concentration and its change due to the merger is only the starting point of the DOJ and FTC's investigations. After calculating these concentration figures, the DOJ and FTC consider a number of other factors affecting the likely competitive impact of the merger. These include:

Structural factors affecting the ease of sustaining collusion (tacit or explicit). These include factors such as homogeneity of products, noisiness of the market, and others that influence the ease of sustaining collusion [see, for example, Hay and Kelley (1974) and Whinston (2006, ch. 2)]. Generally, the DOJ and FTC are more concerned about mergers in markets in which tacit or explicit collusion is easier to sustain. One might wonder, however, whether mergers in markets in which collusion is easier should necessarily be of greater concern. After all, relatively little competitive harm can come from a merger in a market in which it is already easily for the firms to sustain the joint monopoly outcome. Put differently, the relevant question is the extent to which the merger is likely to increase prices. Market conditions that make collusion easier in general need not make the price effect of a merger larger.

Evidence of market performance. Although not explicitly mentioned in the *Guidelines*, the DOJ and FTC often consider empirical evidence showing how the level of concentration in such a market affects competitive outcomes in assessing the likely competitive effects of a merger. We will discuss this type of evidence further in Section 4.2.

Substitution patterns in the market. The DOJ and FTC will ask whether the merging firms are closer substitutes to each other than to other firms in the market. This is a way to avoid discarding important information about substitution patterns, as might occur by simply calculating concentration figures. In markets with product differentiation (and unit demands), a merger changes pricing incentives when the products of the merging firms are the first and second choices, at prevailing prices, of a significant share of customers. The agencies will look to demand estimates, marketing studies, business documents, and other evidence to determine the extent to which this is true.[28]

[28] The *Guidelines* also state that the agencies "will presume that a significant share of sales in the market are accounted for by consumers who regard the products of the merging firms as their first and second choices" when the merger falls outside of the safe-harbor regions described above and the merging firms have a combined share of at least 35 percent.

Substitution patterns between products in and out of the market. The DOJ and FTC will ask whether there is a large degree of differentiation between the products just "in" and 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. To the extent that there are not close substitutes outside the market, there is a greater potential for the exercise of market power.

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, one would expect it to be less of a force in constraining any post-merger price increase. Also, as discussed in Section 2.3.1, capacity constraints can affect the degree to which a merger facilitates tacit or explicit collusive pricing.

Ease of entry. Here the DOJ and FTC will consider the degree to which entry involving sunk costs might preclude anticompetitive effects arising from the merger. (Recall that "uncommitted" entrants, who have insignificant sunk costs, are included in calculating market shares.) The question they ask is whether, in response to a 5% price increase, entry would be likely to occur within 2 years that would drive price down to its pre-merger level. As discussed in Section 2.3.3, this makes sense with a consumer surplus welfare standard, but there is a question about how the ease of entry should affect merger analysis if the goal is to instead maximize aggregate surplus.

3.1.4. 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 a merger, and relatively hard for antitrust enforcers to evaluate the likelihood that those efficiencies will be realized. How efficiencies should be factored into the analysis of a merger depends on the welfare standard adopted by the agencies. The 1997 revisions to the DOJ/FTC *Guidelines*, while somewhat ambiguous, suggest that the efficiencies need to be sufficient to keep consumer surplus from decreasing for a merger to be approved.[29] With such a consumer surplus

[29] The *Guidelines* state that "The Agency will not challenge a merger if cognizable efficiencies are of a character and magnitude such that the merger is not likely to be anticompetitive in any relevant market. To make the requisite determination, the Agency considers whether cognizable efficiencies likely would be sufficient to reverse the merger's potential to harm consumers in the relevant market, e.g., by preventing price increases in that market". Note, however, that this test is stated as a sufficient condition for approving a merger, not as a necessary one. This ambiguity may seem a bit odd, but is probably deliberate. The agencies have some prosecutorial discretion, and can approve mergers that the courts might block. While the courts' standard is not totally clear either, it surely leans more toward a consumer surplus standard than is the preference of the economists at the agencies. In addition, there may be some difference in the standards applied by the DOJ and the FTC, with the FTC more inclined toward a consumer surplus standard than the DOJ. (Since the

standard, for example, reductions in the merging firms' fixed costs do not help a merger gain approval; only reductions in marginal costs matter.

Regardless of whether a consumer or aggregate surplus standard is followed, the efficiencies that are counted must be efficiencies that could not be realized easily by less restrictive means, such as through individual investments of the firms, through joint production agreements, or through a merger that includes some limited divestitures.

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 overall Canadian market, the merging companies proposed consolidating their local branches, reducing 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 instead a move along an existing quality–cost frontier, they would not be valid efficiencies from an antitrust standpoint.

3.2. Merger control in the E.U.

While merger control began in the E.U. only in 1990, today the E.U. has a highly developed merger control policy that often represents a critical hurdle for large companies who wish to merge. Merger review in the E.U. is handled by the European Commission, and the investigative process by the Competition Directorate General ("DG Comp") within the Commission. In 2004, the E.U. adopted a new merger control regulation (the "ECMR"; Regulation 139/2004) that changed somewhat the substantive test applied to merger review, and also made some procedural and investigative reforms.[30] At the same time, the Commission published merger review guidelines and adopted some internal institutional changes designed to improve its decision-making.[31,32] The current E.U. policy resembles the U.S. approach in many respects, although with some significant differences.

E.U. merger policy applies to all mergers involving companies whose sales surpass certain size thresholds. Specifically, a merger between two firms has a "community dimension" if the combined entity has at least 5 billion Euros in worldwide sales and

agencies tend to specialize in reviewing mergers in different industries, this would have the effect of applying somewhat different standards in different industries.) On this issue, see also Werden (1997).

[30] These reforms involved the referral process described below and also increased the Commission's powers to compel production of information.

[31] The old and new merger regulations, the Commission's guidelines, and other related documents can be found at http://europa.eu.int/comm/competition/mergers/legislation/regulation/#regulation. For an introduction to E.U. merger review and the new ECMR, see Parisi (2005). For a discussion of E.U. merger policy prior to these changes, see Motta (2004).

[32] The internal institutional reforms were designed to improve decision-making by, for example, creating a new chief economist position and forming an internal review panel, distinct from the investigating team, for each merger investigation.

if each firm has sales of at least 250 million Euros in the E.U., unless each merging firm has more than two-thirds of its E.U. sales in the same Member State.[33] If these thresholds are not met, the merger still has a community dimension if (i) the combined entity has sales of more than 2.5 billion Euros worldwide and more than 100 million Euros in sales in at least three Member States, and if (ii) each of the merging parties has at least 100 million Euros in sales in the E.U. and at least 25 million Euros in sales in each of at least three of the member states considered under (i), unless each merging party has more than two-thirds of its sales in the E.U. in the same Member State. When these thresholds are met, the parties must notify the European Commission of their merger and await approval before consummating their merger. The Commission then has exclusive jurisdiction over the case. These notification and jurisdiction rules contrast with the U.S. process in two respects. First, notification and jurisdiction coincide in the E.U. (every merger to which E.U. law applies must be notified). In contrast, in the U.S., the FTC and DOJ need not be notified of mergers that are smaller than the Hart–Scott–Rodino thresholds, even though these mergers are still subject to the U.S. antitrust laws (there are no size thresholds that limit application of the U.S. laws). Second, in the U.S., individual states' Attorney Generals may attempt to block a merger under their state's laws at the same time that the DOJ or FTC is reviewing the merger under the U.S. antitrust laws.

When these size criteria are not met, the merger is handled by the individual national competition authorities. However, the regulation also includes a "referral" process, whereby Member States may request that the European Commission handle review of a notified merger. In addition, in advance of notification, the merging firms may request referral to the Commission if they would otherwise have to notify the competition authorities in at least three individual Member States. In this case, if none of the Member States objects, the merger is deemed to have a community dimension and the Commission has exclusive jurisdiction over its review. There are also provisions for partial or complete referrals of merger reviews from the Commission to individual Member States who may have either a particular interest or particular expertise in the review of a merger.

The basic review procedure resembles in broad outline that at the FTC, in that the Commission investigates a proposed merger, holds an internal hearing, and reaches a decision. There are a few important differences though. First, the review procedure in the E.U. is subject to much stricter time deadlines than is review in the U.S. The procedure involves two phases. The Commission has 25 working days to either approve a notified merger or, if it has serious doubts, open a "Phase II" investigation.[34] If it does open such an investigation, it has 90 more working days to reach a decision. This deadline can be extended by up to 20 days with the parties' consent, but – unlike in the U.S. – not by more than this.[35] If the Commission fails to reach a decision by this deadline,

[33] These size thresholds, and those in the next sentence, exclude value-added taxes.

[34] This deadline is extended to 35 working days if the parties submit proposed conditions for their merger (such as limited divestitures) or if there was a referral request.

[35] The total period can be extended to 105 working days if conditions are offered.

the merger is deemed to have been approved. Second, unlike in the U.S., the parties have the right to access the Commission's investigative file during the Phase II review process. In the U.S., any such access comes only as part of the usual discovery process should the merger end up in court. Third, the E.U. has the power to block a merger on its own. Courts become involved only if someone appeals the Commission's decision.[36] This contrasts with the U.S. situation in which even the FTC must go to court to get a preliminary injunction. As a result, the U.S. courts play a decisive role in merger review with greater frequency than in the E.U. Historically, the appeals process in Europe has been very slow, often taking a number of years, so that few merging parties have appealed Commission decisions in the hopes of still merging.[37] Starting in 2000, however, a new expedited appeals process was instituted which may end up altering the extent of court review in the E.U.[38]

Until recently, the substantive test for reviewing mergers in the E.U. was focused on the notion of "dominance". In the E.U.'s original merger regulation, mergers were "incompatible with the common market", and hence could be prohibited, when the merger would "create or strengthen a dominant position as a result of which effective competition would be significantly impeded in all or a substantial part of the European Union". Dominance is

> . . . a situation where one or more undertakings wield economic power which would enable them to prevent effective competition from being maintained in the relevant market by giving them the opportunity to act to a considerable extent independently of their competitors, their customers, and, ultimately, of consumers.

For a single firm, a market share of over 50% is presumptively "dominant", while a share between 40–50% will often be. (In a few cases, a share below 40% has been held to be dominant.) Under the original merger regulation, the concept of dominance was used to get at both unilateral and coordinated effects. First, a merger creating a single dominant firm could be illegal because of its creation of market power leading to unilateral effects. In addition, through the concept of "collective dominance", the regulation could be used to block mergers that were likely to lead to significant coordinated effects. However, it was unclear whether the original regulation could be used to attack mergers that were likely to give rise to unilateral effects without creating a dominant firm. (For example, a merger of the second and third largest firms in an industry in which the three largest firms have shares of 40, 15, and 15 percent.)

The substantive test in the new ECMR makes clear that the regulation applies to such situations. The new test prohibits mergers that would

[36] These appeals go first to the Court of First Instance, and then to the European Court of Justice. Unlike in the U.S., where only the merging parties can appeal a decision blocking a merger, third parties have standing to appeal Commission decisions in the E.U. (both those blocking and allowing the merger).

[37] In some cases, parties have instead appealed just to reverse the Commission's finding that they are dominant, so as not to be subject to heightened antitrust scrutiny in the future (an example is the appeal of the Commission's ruling in the 2001 GE-Honeywell case).

[38] In the other direction, as noted earlier, in Europe third parties have standing to appeal Commission decisions. In the U.S., only the merging parties have this right.

> significantly impede effective competition, in particular as a result of the creation or strengthening of a dominant position, in the common market or a substantial part of it.

The new language makes illegal all mergers that "significantly impede effective competition", paralleling the U.S. "substantial lessening of competition" test, while still retaining the existing jurisprudence of "dominance" based rulings.[39]

The Commission's new merger guidelines (combined with its 1997 market definition notice) describe its approach to implementing this test.[40] They parallel the U.S. *Guidelines* closely, including in their approach toward efficiencies. Nonetheless, there are some differences. Reflecting the dominance-based aspects of the ECMR, the Commission's guidelines contain a greater emphasis on the merged firm's market share than do the U.S. *Guidelines*. A combined share above 40% is likely to meet the criteria for being dominant. In the other direction, a combined share below 25% is presumed not to significantly impede effective competition, except in cases of collective dominance. The Commission guidelines also state HHI criteria that set initial presumptions about a merger (although there is language stating that these are not "presumptions"). The Commission is unlikely to have concerns with mergers in which the post-merger HHI is below 1000. It is also unlikely to have concerns with mergers in which the post-merger HHI is between 1000 and 2000 and the change in the HHI is below 250, or in which the post-merger HHI is above 2000 and the change in the HHI is below 150, except in exceptional cases where other factors mitigate these presumptions. These cutoffs are more lenient than those in the U.S. *Guidelines*, although perhaps not more lenient than the actual practice of the U.S. agencies. Also, while stated only as safe-harbor regions, when viewed as also delineating the set of mergers over which the Commission *may* have concerns, these thresholds are clearly stricter than the old dominance test of 40%. (The post-merger HHI in a market in which there is a firm with a 45 percent share, for example, cannot be lower than 2000.[41])

Three other differences from the U.S. *Guidelines* are that (i) supply substitution is formally included in the market definition step, while in the U.S. it is considered only later in the calculation of shares and concentration, (ii) the presence of buyer power is stated explicitly as a factor that may mitigate any increase in market power among sellers in a market due to a merger, and (iii) the possibility of foreclosure is explicitly considered in the E.U. guidelines, while it is not mentioned in the U.S. *Guidelines*.[42]

[39] As the preamble to the new ECMR puts it, the notion of a significant impediment to competition extends "beyond the concept of dominance, only to the anti-competitive effects of a concentration resulting from non-coordinated behavior of undertakings which would not have a dominant position on the market concerned".

[40] The market definition notice is at http://europa.eu.int/comm/competition/antitrust/relevma_en.html.

[41] Kuhn (2002) argues that this tightening of the standard for legality motivated many of those who favored the change in the substantive test.

[42] For a discussion of the issue of foreclosure, see the chapter by Rey and Tirole in this volume. The U.S. also has vertical guidelines that can apply to a merger that involves vertical issues. In practice, though, the European Commission has been more open to considering foreclosure issues in merger cases than have the U.S. agencies.

Despite these differences, the test for legality of a merger under the new ECMR and the Commission's merger guidelines is now close to that in the U.S.

3.3. Differences across other countries

The pattern in other countries as well has been toward a substantial convergence in antitrust law and enforcement towards the U.S. focus on whether a merger causes a "substantial lessening of competition" and the framework of the U.S. *Horizontal Merger Guidelines*. Nonetheless, as in the case of the E.U., there are still some significant areas of difference across countries. These include notification requirements, methods of adjudication, and the formal legal test in the laws themselves, as well as elements of different countries' antitrust authorities' procedures for evaluating mergers such as market definition tests, thresholds of presumption (e.g., safe harbors), and the consideration given to the "other factors" listed (and other factors not listed) in the U.S. *Guidelines*.

One of the most significant ways in which most countries differ from the U.S. model is in the formal process of adjudication. Few countries have anything resembling the odd mix of procedures in the U.S. In some cases, such as the E.U. procedure discussed above, the procedure resembles the FTC proceedings, in which a specialist agency analyzes the facts and renders a decision, which can then be appealed to a court. In other countries, such as Canada, the specialist agency must bring a case to a separate tribunal. Nearly always, however, this tribunal specializes in antitrust matters, unlike the U.S. situation in which the DOJ and the FTC (for preliminary injunctions) bring merger cases in federal courts that hear many types of cases.

A second important difference concerns the formal welfare standards embodied in different countries' laws. The differences in standards show up most clearly in how they consider efficiencies (although, as I noted above, they should probably also affect the consideration of entry). As we have seen, the U.S. is closest to applying a consumer welfare criterion to mergers, so that efficiencies are a defense only to the extent that they are likely to prevent price increases (or, more generally, prevent any reduction in consumer surplus). The E.U. adopts this same criterion. Australia, however, considers the change in aggregate surplus as part of a "public benefits" test for determining whether to allow mergers that are expected to raise price (it also considers other factors, such as effects on exports). New Zealand also considers a merger's effects on aggregate surplus. Until the recent *Superior Propane* case, Canada had a very explicit aggregate surplus standard. Now, however, Canada applies a "balancing weights" approach, in which the Competition Tribunal is supposed to apply weights to consumer and producer surplus that reflect the "social" weight to be accorded to transfers between consumers and shareholders. These weights may differ from one merger to another, reflecting, for example, the relative wealth of consumers and shareholders in a particular merger.

3.3.1. Theoretical perspectives on the welfare standard for merger review

It is striking that while most economists would regard maximization of aggregate surplus as the natural standard for merger review, most merger reviews around the world

actually apply something close to a consumer surplus standard. Distributional concerns could, of course, lead to something close to a consumer surplus standard. The economics literature also contains some analyses that suggest economic reasons why even a society interested in aggregate surplus might prefer to commit its antitrust authority to a consumer surplus standard.

Besanko and Spulber (1993) provided the first such argument. They study a setting in which the merging parties know more about the efficiency improvement generated by their merger than does the antitrust authority. Specifically, suppose that the merging firms observe the merger's "type" θ, where θ is drawn from set $[\underline{\theta}, \bar{\theta}] \subset \mathbb{R}$ according to distribution $F(\cdot)$, but the antitrust authority does not.[43] A merger of type θ results in a change in the joint profit of the merging firms equal to $\Delta\pi(\theta)$, a change in consumer surplus equal to $\Delta CS(\theta)$, and a change in aggregate surplus equal to $\Delta S(\theta) = \Delta\pi(\theta) + \Delta CS(\theta)$. Higher θ mergers are more efficient, so that these functions are all increasing in θ. The cost of proposing a merger is $k > 0$. [This cost is not included in $\Delta S(\theta)$ and $\Delta\pi(\theta)$.] Since only profitable mergers will ever be proprosed, we can restrict attention to mergers with $\Delta\pi(\theta) \geqslant k$.

The merger review game proceeds as follows: First, after observing θ, the merging firms decide whether to propose their merger. Then, the antitrust authority chooses a probability α that the merger is approved.

As a starting point, suppose that the antitrust authority uses an aggregate surplus standard in making its decision. To focus on the interesting case, suppose that there is some uncertainty at the time of the antitrust authority's decision about whether the merger increases aggregate surplus. Specifically, suppose that $E[S(\theta)] < 0$ so that on average the merger lowers aggregate surplus, while $S(\bar{\theta}) > 0$ so that the most efficient merger would raise aggregate surplus. Consider equilibria in which the approval probability is positive: $\alpha^* > 0$.[44] Any such equilibrium has a cut-off structure: if the probability of approval is α, the proposed mergers are those with types $\theta \geqslant \hat{\theta}(\alpha)$, where $\alpha \cdot \Delta\pi(\hat{\theta}(\alpha)) = k$. It also must have a probability of approval below 1 ($\alpha^* < 1$) since if approval was certain all merger types would be proposed, which would instead lead the agency to reject all mergers (recall that $E[\Delta S(\theta)] < 0$). Since $\alpha^* \in (0, 1)$, the antitrust authority must be *indifferent* about approving the merger given the set of merger types that are actually proposed in the equilibrium. That is, if α^S is the approval probability and θ^S is the cut-off type we must have

$$E\left[\Delta S(\theta) \mid \theta \geqslant \theta^S\right] = 0 \tag{21}$$

and

$$\theta^S = \hat{\theta}\left(\alpha^S\right). \tag{22}$$

[43] One can think of the type θ as representing the informational asymmetry that persists after the agency conducts its merger review.

[44] There is always also an equilibrium in which the agency approves no mergers ($\alpha^* = 0$) and no mergers are ever proposed. I ignore this equilibrium in what follows.

Condition (21) has a startling implication: merger activity in this situation *must reduce* aggregate surplus since proposed mergers on net generate no improvement in aggregate surplus, but incur proposal costs. Even banning all merger activity would be better.

In contrast, consider what happens if the agency commits to evaluating mergers based on a consumer surplus standard. In that case, an approval probability α^{CS} and cut-off type θ^{CS} is an equilibrium if

$$E\left[\Delta CS(\theta) \mid \theta \geqslant \theta^{CS}\right] = 0$$

and

$$\theta^{CS} = \hat{\theta}\left(\alpha^{CS}\right). \tag{23}$$

In any such equilibrium, merger activity must increase aggregate surplus since that change equals

$$\begin{aligned}
&\left[1 - F\left(\theta^{CS}\right)\right]\left\{\alpha^{CS} E\left[\Delta S(\theta) \mid \theta \geqslant \theta^{CS}\right] - k\right\} \\
&\quad = \left[1 - F\left(\theta^{CS}\right)\right]\left\{\alpha^{CS} E\left[\Delta CS(\theta) \mid \theta \geqslant \theta^{CS}\right] + \alpha^{CS} E\left[\Delta \pi(\theta) \mid \theta \geqslant \theta^{CS}\right] - k\right\} \\
&\quad > \left[1 - F\left(\theta^{CS}\right)\right]\left[\alpha^{CS} \Delta \pi\left(\theta^{CS}\right) - k\right] \\
&\quad = 0.
\end{aligned}$$

Thus, here, a commitment to a consumer surplus standard actually increases aggregate surplus.

A few caveats are in order, however. First, a consumer surplus standard does not always improve things. In particular, for mergers whose effect on aggregate surplus is necessarily positive [because $S(\underline{\theta}) > k$], the equilibrium of the merger game when the agency uses a aggregate surplus standard maximizes aggregate surplus by approving all mergers, while the equilibrium when the agency uses instead a consumer surplus standard will reject some mergers whenever $E[\Delta CS(\theta)] < 0$. Second, when there is uncertainty about the effect of a merger on aggregate surplus, a better outcome than that generated by a consumer surplus standard can be achieved using merger filing fees. These can implement the same set of proposed mergers as the consumer surplus standard, but without the cost of rejecting good (high θ) mergers with positive probability.

Two more recent papers of this type are Neven and Roller (2002) and Lyons (2002). Neven and Roller (2002) study a model of lobbying [along the lines of Grossman and Helpman (1994) and Bernheim and Whinston (1986)] in which firms (both the merging firms and competitors) can attempt to influence the antitrust authority but consumers are unable to do so. The antitrust authority cares both about its mandated goal and the firms' "influence" payments (these may be thought of as the implicit promises of future employment, etc.). Intuitively, if lobbying is efficient (so that a dollar payment is worth a dollar to the authority), an authority with a consumer surplus mandate will end up maximizing aggregate surplus because it will maximize the sum of consumer surplus and influence payments, and those influence payments will reflect firms' profitabilities

Table 36.1
Recent merger enforcement experience in the U.S. and E.U.

	U.S.			E.U.		
Year	Transactions	Blocked	Modified	Transactions	Blocked	Modified
1997	3702	19	39	172	1	9
1998	4728	25	57	235	2	16
1999	4642	22	54	292	1	27
2000	4926	26	53	345	2	40
2001	2376	8	46	335	5	23
2002	1187	12	21	279	0	15
2003	1014	18	17	212	0	17
Total	22,575	130	287	1870	11	147

Sources: U.S. data are from the FTC/DOJ annual reports to Congress ("Merger Enforcement" section), available at http://www.ftc.gov/bc/hsr/hsrinfopub.html. E.U. data are from http://europa.eu.int/comm/competition/mergers/cases/stats.html.

from merger approval.[45] Lyons (2002), on the other hand, notes that firms can choose which mergers to propose and can be expected to propose the most profitable merger among those that will be allowed. Restricting the set of allowed mergers through a consumer surplus standard can in some cases lead firms to propose mergers that increase aggregate surplus by more than the mergers they would choose under an aggregate surplus standard.

3.4. Enforcement experience

Table 36.1 summarizes enforcement experience in the U.S. and E.U. from 1997 through 2003.

The U.S. agencies handled more than ten times as many cases as did the E.U. during this period. This is no doubt due in large part to the substantially lower notification thresholds in U.S. law than in the E.U. merger regulations. The number of notified transactions reached its high in both the U.S. and E.U. in the year 2000, with the drop after that much more precipitous in the U.S. than in the E.U. Over the 1997–2003 period 0.6% of notified transactions (130 out of 22,575) were blocked by the U.S. agencies, and another 1.3% (287 out of 22,575) were approved subject to conditions that modified the original proposed merger (e.g., through partial divestitures). In the E.U., notified transactions were about as likely as in the U.S. to be blocked (0.6%), but much more

[45] Neven and Roller actually focus on cases in which both lobbying and the ability to monitor the antitrust authority's adherence to its mandated goal are imperfect.

likely to be modified (7.9%).[46] This could reflect a difference between the merger review approaches of the U.S. agencies and the European Commission, but is also likely to reflect the fact that the mergers handled by the European Commission are, on average, much larger than those handled by the U.S. agencies because of the different notification thresholds.

In the U.S., the number of blocked or modified mergers as a percentage of notified mergers rose slightly in 2001–2003 relative to 1997–2000, going from 1.6% to 2.0%. Whether this was because of a change in the type of mergers being pursued, the change from the Clinton to the Bush administration (not likely), or the fact that the agencies' personnel were handling fewer cases is not clear. In contrast, this percentage fell from 9.4% in 1997–2000 to 7.3% in 2001–2003 in the E.U.[47]

4. Econometric approaches to answering the *Guidelines*' questions

There are two principal areas in which econometric analysis has been employed in applying the DOJ/FTC *Guidelines* and similar guidelines in other countries. These are in defining the relevant market and in providing evidence about the effects of increased concentration on prices. In this section, I discuss these methods.

4.1. Defining the relevant market

Suppose that we have a collection of substitute products (goods $1, \ldots, N$) that include the products of the merging firms. To answer the *Guidelines*' market definition question we want to study whether a hypothetical profit-maximizing monopolist of some subset of these products would raise price by at least 5%, taking the prices of other firms as fixed (at their pre-merger levels). We can do this if we know the demand and cost functions for these products, and the pre-merger prices of all N products.

To answer the *Guidelines*' question, we must first estimate the demand functions for these products. The simplest case to consider arises when we are considering a hypothetical monopolist of a single homogeneous product, say widgets, which is differentiated from the products of all other firms. In this case, we only need to 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

[46] The "transactions" columns in Table 36.1 report the number of notified transactions in each year, not the number of decisions reached in each year. The number of decisions in each of these years in the E.U. were: 142 in 1997, 238 in 1998, 270 in 1999, 345 in 2000, 340 in 2001, 273 in 2002, 231 in 2003. Thus, 0.6% of E.U. decisions blocked and 8.0% of E.U decisions modified proposed mergers over this period. The U.S. does not report the total number of decisions in each year (as our earlier discussion indicated, a decision is a less well-defined event in the U.S.).

[47] The number of blocked or modified mergers as a percentage of total decisions in the E.U. fell from 9.8% in 1997–2000 to 7.1% in 2001–2003.

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

$$\ln(x_i) = \beta_0 + \beta_1 \ln(p_i) + \beta_2 \ln(q_i) + \beta_3 \ln(y_i) + \varepsilon_i, \tag{24}$$

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.[48]

Several standard issues arise in the estimation of Equation (24). 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.[49] The most common direction for the bias induced by a failure to properly instrument in estimating Equation (24) would be toward an underestimation of the elasticity of demand because positive shocks to demand are likely to be positively correlated with p.[50] Observe, however, that if we were to estimate instead the inverse demand function

$$\ln(p_i) = \bar{\beta}_0 + \bar{\beta}_1 \ln(x_i) + \bar{\beta}_2 \ln(q_i) + \bar{\beta}_3 \ln(y_i) + \varepsilon_i, \tag{25}$$

then since the equilibrium quantity x is also likely to be positively correlated with ε, we would expect to underestimate the *inverse* demand elasticity – that is, *over-estimate* 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.

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 just outlined by estimating a system of demand functions together. For example, suppose that we are considering a hypothetical monopolist of widgets and gidgets, and that there is a single substitute product. Then, in the constant elasticity case, we could estimate the system

$$\ln(x_{wi}) = \beta_{10} + \beta_{11} \ln(p_{wi}) + \beta_{12} \ln(p_{gi}) + \beta_{13} \ln(q_i) + \beta_{14} \ln(y_i) + \varepsilon_{1i}, \tag{26}$$

$$\ln(x_{gi}) = \beta_{20} + \beta_{21} \ln(p_{gi}) + \beta_{22} \ln(p_{wi}) + \beta_{23} \ln(q_i) + \beta_{24} \ln(y_i) + \varepsilon_{2i}. \tag{27}$$

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

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

[50] The discussion in the text takes the price of the substitute q as exogenous. However, this price may also be correlated with ε and may need to be instrumented.

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

As the number 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-price demand elasticities among 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 a function of some underlying characteristics.[51] 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

$$u_{ij} = a_j \cdot \beta_i - \alpha_i p_j + \xi_j + \varepsilon_{ij}, \tag{28}$$

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 common across consumers, may be modeled as having a common mean and a consumer-specific random element, or (if the data are available) may be modeled as a function of demographic characteristics of the consumer.[52] 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.

[51] Berry, Levinsohn and Pakes build on previous work by Bresnahan (1987), as well as a large literature on discrete choice and product characteristics [see, e.g., McFadden (1981) and the references therein]. For further reading on these methods, see Ackerberg et al. (in press).

[52] If individual-level demographic and purchase data are available, then the parameters in (28) can be estimated at an individual level; otherwise, the population distribution of demographic variables can be used with aggregate data, as in Nevo (2001).

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 its limitation of the number of parameters to be estimated by tying the value of each product 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 Equation (28) 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.[53] This assumption is usually at odds with actual substitution patterns. For example, it is common for two products with similar market shares to have distinct sets of close substitutes. 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's share would be affected much more than the share of the Yugo.[54] A good deal of work in this literature has focused (successfully) on how to estimate versions of this model that have richer substitution patterns than the logit model. For example, by allowing consumers to differ in their β_i coefficients, the model generates more reasonable substitution patterns, since the second choice of a consumer who chooses a BMW (and, hence, is likely to value highly horsepower and luxury) is much more likely to be a Mercedes than a Yugo because the Mercedes's characteristics are more similar to the characteristics of the BMW.

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, beers are grouped 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 function of the prices of the within-category beers and the total expenditure on the category, much as in Equations (26) and (27). Next, they estimate the expenditure allocation among the three categories as a function of total expenditure on beer and price indices for the

[53] To see this, recall that in the logit model, the demand of good k given price vector p and M consumers 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.

[54] The 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 i.i.d. 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.

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 categories (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 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 patterns between products in the different (a priori specified) groups. For example, the substitution toward products in one group (say, premium beers) is independent of which product in another group (say, popular price beers) has experienced a price increase.

To date there has been very little work evaluating the relative merits of these two approaches. One such study 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 (the multi-stage budgeting approach produces negative cross-price elasticities for products like Post's and Kellogg's Raisin Bran cereals that are almost surely substitutes), but it is hard to know at this point how the two methods compare more generally.

The second step in answering the *Guidelines*' market definition question is estimation of firms' cost functions. This can, in principle, be accomplished directly by estimating cost functions, or indirectly by estimating either production functions or factor demand equations. Like estimation of demand, these methods all must confront endogeneity issues; selection issues can also arise.[55] One additional problem with the cost side, however, is often a lack of necessary data. The output and price data needed for demand estimation tend to be more readily available than the cost or input information needed to determine a firm's cost function.

Without the ability to directly estimate firms' cost functions, we can still estimate marginal costs if we are willing to assume something about firms' behavior. For example, suppose we assume that firms are playing a static Nash (differentiated product) pricing equilibrium before the merger and that each firm i produces a single product before the merger.[56] Then we can use the fact that the firms' prices satisfy the first-order conditions

$$\bigl(p_i - c_i'\bigl(x_i(p)\bigr)\bigr)\frac{\partial x_i(p_i, p_{-i})}{\partial p_i} + x_i(p) = 0 \quad \text{for } i = 1, \ldots, N \tag{29}$$

to derive that

$$c_i'\bigl(x_i(p)\bigr) = p_i + \left[\frac{\partial x_i(p_i, p_{-i})}{\partial p_i}\right]^{-1} x_i(p) \quad \text{for } i = 1, \ldots, N. \tag{30}$$

[55] See Olley and Pakes (1996) and Griliches and Mairesse (1995) for discussions of these issues.

[56] The same type of inference can be made with multi-product firms using a somewhat more complicated equation. See Nevo (2001).

This gives us an estimate of firms' marginal costs if we are willing to assume that marginal costs are approximately constant in the relevant range.[57]

Given estimated demand and cost functions for the products controlled by the hypothetical monopolist, and the pre-merger prices of other products, one can compute the hypothetical monopolist's profit-maximizing prices and compare these to the pre-merger prices of these products to answer the *Guidelines*' 5% price increase market definition question.

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 often have been applied to try 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.[58,59]

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 trans-shipment. Both of these have serious potential flaws, however.

To consider the use of price correlations, imagine that we have two cities, A and B, that are located 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

$$\frac{\operatorname{cov}(p_A, c_B)}{\sqrt{\operatorname{var}(p_A)\operatorname{var}(c_B)}} = \frac{\frac{1}{2}\operatorname{cov}(\alpha_A, c_B) + \frac{1}{2}\operatorname{cov}(c_A, c_B)}{\sqrt{\operatorname{var}(p_A)\operatorname{var}(c_B)}}. \tag{31}$$

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 $\alpha_A = 1$ and $c_A = c_B \equiv c$, and that for all realizations of t we have $(c + t) < \frac{1}{2}$. In this case, the price in market B fully constrains

[57] Alternatively, given a behavioral assumption, one can try to econometrically infer costs by jointly estimating demand and the firms' supply relations as discussed in Bresnahan (1989).

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

[59] Rough estimates of the degree to which customers would switch in response to a given price increase and of the firms' price–cost margins can be used to ask whether the price increase would be profitable for the hypothetical monopolist. This is the essence of "critical loss analysis" [Harris and Simons (1989)]. For a critique of common uses of critical loss analysis, focusing on the importance of checking if those rough estimates of customer switching and margins are consistent with the firms' pre-merger behavior, see Katz and Shapiro (2003) and O'Brien and Wickelgren (2003).

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

$$\frac{\operatorname{cov}(c+t,c)}{\sqrt{\operatorname{var}(c)+\operatorname{var}(t)}\sqrt{\operatorname{var}(c)}} = \frac{\operatorname{var}(c)}{\sqrt{\operatorname{var}(c)+\operatorname{var}(t)}\sqrt{\operatorname{var}(c)}}. \tag{32}$$

Hence, if $\operatorname{var}(c)$ 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 – whether it is $\operatorname{var}(c)$ or $\operatorname{var}(t)$ that is small has no bearing on the underlying competitive situation.

A problem with looking at trans-shipments is also illustrated by this last case since no trans-shipments 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

To help determine the likely effects of a proposed merger, the DOJ and FTC (and the merging parties) often examine evidence on the effects of concentration in similar markets. 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.[60] A typical regression seeking to explain the price in a cross-section of markets $i = 1, \ldots, I$ might look like

$$p_i = \beta_0 + w_i \cdot \beta_1 + y_i \cdot \beta_2 + CR_i \cdot \beta_3 + \varepsilon_i, \tag{33}$$

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 non-linear terms might be included). In the most standard treatment, these variables all are 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 the regression results as "reduced form" estimates, with the intention of distinguishing them from "structural" estimates of demand and supply relationships [see, for example, Baker and Rubinfeld (1999)]. Given the results of regression (33), the impact of the merger on price is typically predicted from (33) using pre and post-merger measures of concentration, where post-merger concentration is calculated by assuming that the merged firms' post-merger share is equal to the sum of their pre-merger shares (e.g., that the HHI changes from HHI_{pre} to HHI_{post}).

Regressions such as these have seen wide application in horizontal merger cases. In the FTC's challenge of the Staples/Office Depot merger, for example, this type of regression was used by both the FTC and the defendants.[61] In that merger the focus was on whether these office "superstores" should be considered as a distinct market (or

[60] The use of price in structure–conduct–performance studies was most forcefully advocated by Weiss (1990).

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

"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.[62] In that case, an observation of the dependent variable was the price of a particular Staples store in a particular month; 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 railroad (UP) sought to acquire the Southern Pacific railroad (SP) in 1996 shortly after the merger of the Burlington Northern Railroad (BN) and the Sante Fe Railroad (SF), many railroad routes west of the Mississippi River would go from being served by three firms to being served by two firms in the event of the merger, and some would go from being served by two firms to one firm. The merging parties claimed that SP was a "weak" railroad, and that it did not have a significant 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.[63]

Although this method has provided useful evidence in a wide range of cases, it can suffer from some serious problems. A first problem has to do with the endogeneity of concentration. In fact, (33) is *not* a true reduced form. A true reduced form would include only the underlying exogenous factors influencing market outcomes and not concentration, which is an outcome of the competitive process.[64] Indeed, in many ways Equation (33) 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 first-order condition as

$$p = c - P'(X)x_i = c + \frac{s_i}{\eta}p = c + \frac{H}{\eta}p, \tag{34}$$

where $P(\cdot)$ is the inverse demand function and s_i is firm i's market share which, given symmetry, equals the Herfindahl–Hirschman index, which I denote here by H. As in Bresnahan (1989), we can nest this model and perfect competition by introducing a conduct parameter θ and rewriting (34) as

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

[62] The data were actually a panel of stores over time, rather than just a single cross-section or time series as in Equation (33).

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

[64] Often some of the other right-hand side variables are endogenous 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.

Thus,

$$p = \left(\frac{\eta}{\eta - \theta H}\right)c, \tag{35}$$

where the term in parentheses represents the proportional mark-up of price over marginal cost. Taking logarithms, we can write (35) as

$$\ln(p) = \ln(c) + \ln(\eta) - \ln(\eta - \theta H). \tag{36}$$

Suppose that marginal cost takes the form $c = \bar{c}e^{\varepsilon}$, where ε is an unobservable cost component and $\bar{c}$ is either observable or a parameter to be estimated.[65] Then (36) becomes

$$\ln(p) = \ln(\bar{c}) + \ln(\eta) - \ln(\eta - \theta H) + \varepsilon, \tag{37}$$

which has a form very close to (33), the main difference being the interaction between the concentration variable H and the demand coefficient η. Estimating Equation (33) might then be considered a linear approximation to this supply relation.

The problem in estimating (37) is that, because of its endogeneity, H is likely to be correlated with the cost shock ε, causing least-squares estimation to produce inconsistent (i.e., biased) parameter estimates. Specifically, since the number of firms in a market is determined by the profitability of entry, H will be related to the level of costs in the market. To derive consistent parameter estimates in this case we need to find instrumental variables that are correlated with H but not with the unobserved costs ε. Possibilities include the "market size" variable A, and measures of the cost of entry.

Even if we can find such instruments, however, the model we used to derive Equation (37) assumed that firms are symmetric. This is problematic, since (aside from a Cournot industry with identical constant returns to scale firms) either the pre-merger or the post-merger situation is likely to be asymmetric. When we allow for asymmetries, however, a firm's supply relation is unlikely even to take a form like (33), in which rivals' prices or quantities affect the firm's pricing only through a concentration measure like H. If so, (33) will be misspecified.

Another potential problem with using estimates of (33) to predict merger-induced price changes arises because of unobservable strategic choices by firms. For example, firms often will make strategic decisions that affect costs, such as conducting R&D or investing in capacity. These decisions, say k, typically will depend on the degree of competition in a market; that is, in a sample of markets they may be described by some function $k^*(H, \cdot)$. Looking back at Equation (37), if k is unobserved by the econometrician, it will end up in the unobserved term ε. Since $k^*(\cdot)$ depends on H, this induces a correlation between ε and H that cannot readily be instrumented for, because variables that are correlated with H almost always will be correlated with k and hence with ε.

[65] More generally, we could model the cost term $\bar{c}$ as a function of observed variables and parameters.

Thus, even if firms are symmetric and H really is exogenous in our sample of markets, our parameter estimates will be inconsistent.

Is this a problem? One might argue that the answer is no. After all, if H is really exogenous, then the least-squares estimates still tell us the expectation of price conditional on H (and observable demand and cost factors). Since this is what we really want to know – the total effect of a change in H on price, including any effects due to induced changes in k – perhaps we are fine? The problem is that this is true only if the merger will change the strategic choices k in accord with the function $k^*(H, \cdot)$ that holds in the data. This may or may not be the case. For example, $k^*(H, \cdot)$ may reflect the long-run equilibrium choice of k given H, but k may be very different from this in the short and medium run after the merger.

For instance, consider the UP/SP example. One important factor 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 probably is 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 likely results from the fact that, across the sample 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.

Finally, there is also a problem when we turn to using the estimates for predicting the price change due to a merger. The actual post-merger equilibrium level of H is unlikely to equal HHI_{post}, the level calculated by simply assuming that the post-merger share of the merged firms is equal to the sum of their pre-merger shares. Indeed, in the Cournot model we know that (without synergies) H will *not* be equal to HHI_{post}, since the merged firms' combined share will fall. As one simple example, in the case of an N-firm symmetric Cournot industry with constant returns to scale, the post-merger Herfindahl–Hirschman index will be $1/(N-1)$, while $\text{HHI}_{\text{post}} = 2/N$. We can deduce the true merger-induced change in concentration if we have structural estimates of demand and supply relations. But, as we will see in the next section, if we have estimates of these relations we also can use them to directly predict post-merger prices, and so there would not be much point to using (33).

Given the relative ease and widespread use of this method, one might hope that it gives at least approximately correct answers despite these problems. It would be good to know more than we now do about whether this is right.[66]

[66] See Peters (2003) for one look at this question.

5. Breaking the market definition mold

When they were introduced, the *Guidelines* greatly improved the U.S. agencies' analysis of proposed horizontal mergers. At the same time, we have seen that their market definition-based process, while intuitive, is not based on any explicit model of competition and welfare effects. Given this fact, it is natural to ask whether there are other techniques that do not require this type of market definition exercise and examination of concentration changes. In this section, we examine three alternative techniques that economists have proposed for evaluating the likely effects of a merger. These are merger simulation, residual demand estimation, and the event study approach. Of these three, merger simulation seems particularly promising.

5.1. Merger simulation

If we are really going the route of estimating demand and cost functions to answer the *Guidelines*' market definition question (as in Section 4.1), why not 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. Doing so, we also can avoid a costly debate over what should be "in" and "out" of the market.

Conceptually, simulating the price effects of a merger 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-move 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 satisfy (the notation follows that in the discussion of differentiated product demand systems in Section 4.1)

$$\left(p_1^*, p_2^*\right) \quad \text{solves} \quad \max_{p_1, p_2} \sum_{i=1,2} \left[p_i x_i\left(p_1, p_2, p_3^*, q, y\right) - c_i\left(x_i\left(p_1, p_2, p_3^*, q, y\right)\right)\right],$$

and

$$p_3^* \quad \text{solves} \quad \max_{p_3} \; p_3 x_3\left(p_1^*, p_2^*, p_3, q, y\right) - c_3\left(x_2\left(p_1^*, p_2^*, p_3, q, y\right)\right).$$

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 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).] Going one step further, one also can ask how large a marginal cost reduction must arise from the merger to prevent consumer surplus from falling (or, with an aggregate surplus standard, what combinations of fixed and marginal cost reductions are necessary to prevent aggregate surplus from falling). With the recent advances in estimating structural models, this approach is gaining increasing attention.

There are, however, three important caveats regarding this method. First, correct estimation of demand is essential for the quality of any predictions through simulation. Demand estimates will be more reliable when the simulation does not have to rely on out-of-sample extrapolation; that is, when the merger does not cause prices to move outside the range of prior experience.

Second, a critical part of the simulation exercise involves the choice of the post-merger behavioral model of the industry. One can base this behavioral assumption on estimates of 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)].[67] A 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.

Third, as previously discussed, 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 may all be altered significantly by a merger. The empirical industrial organization literature is just beginning to get a handle on these dynamic issues. To date, no actual merger simulation has included them. Nonetheless, dynamics is a very active area of research, and it may not be long before this begins to happen. [For a discussion of a simulation of merger effects in a dynamic model with capacity investments using assumed parameter values see Berry and Pakes (1993).]

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 Table 36.2 in the column labeled "Ownership Change".[68] The actual changes, in contrast, are in the last column of the table, labeled "actual $\%\Delta p$". 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 only imperfectly. For example, the U.S. Air–Piedmont merger (US–PI) is predicted to lead to a smaller price increase than either the Northwest–Republic (NW–RC) or TWA–Ozak (TW–OZ) mergers, but the reverse actually happened.

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

[67] Alternatively, one could simply compare the actual pre-merger prices with those predicted under various behavioral assumptions, as in Nevo (2000b).

[68] See Peters (2003) for a discussion of how different assumptions about the demand structure affect these conclusions.

Table 36.2
Simulated and actual price changes from airline mergers

	Component effects of average percent relative price change in overlap markets					
Merger	# of 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

Source: Peters (2003).

or entry, by including these observed changes in the post-merger simulation. The column labeled "observed changes" in Table 36.2 reports the answer. As can be seen there, these observed changes account for little of the difference.[69]

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 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 unobserved product attributes are obtained entirely from the demand side, these computed equilibrium prices need not equal the actual post-merger 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 using the Nash equilibrium pricing first-order conditions, as in the discussion of econometric approaches to market definition in Section 4.1.) The price change in the column labeled "change in c" reports the size of the change if these marginal cost changes are included in the simulation, omitting the product attribute changes. As can be seen in

[69] It 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.

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 that 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's study suggests directions that are likely to be fruitful in improving prospective analyses of mergers.

It seems clear that as techniques for estimating structural models get better, merger simulation will become an increasingly important tool in the analysis of horizontal mergers. How quickly this happens, however, and the degree to which it supplants other techniques, remains to be seen. My sense is that it is likely that before too long these techniques, and their further refinements, will constitute the core of merger analysis, at least for cases in which data and time limitations are not too severe.

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 cost function parameters. As Baker and Bresnahan (1985, 59) 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.

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 function 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

$$p_1 = P_1(x_1, x_{-1}, z), \tag{38}$$

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 $2, \ldots, N$ can be denoted by

$$x_{-1} = B_{-1}(x_1, z, w_{-1}). \tag{39}$$

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 (39) is simply firm 2's best-response function. Substituting for x_{-1} in (38) we can then write firm 1's residual inverse demand function as

$$p_1 = P_1\big(x_1, B_{-1}(x_1, z, w_{-1}), z\big) \equiv R_1(x_1, z, w_{-1}). \tag{40}$$

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:

$$\ln(p_{1i}) = \gamma_0 + \gamma_1 \ln(x_{1i}) + \gamma_2 \ln(z_i) + \gamma_3 \ln(w_{-1,i}) + \varepsilon_i. \tag{41}$$

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.[70]

Note that since x_1 typically will 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 (41), this will need to be a cost variable that affects *only* firm 1, say w_1. Unfortunately, such an instrument is often hard to find.

Figure 36.3 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 may be differentiated, and that the N firms compete by simultaneously choosing quantities. By holding fixed the demand variable z and the cost variables w_{-1} for firm 1's rivals, the estimating Equation (41) effectively holds fixed the rivals' aggregate best-response function, which is labeled as $\bar{B}_{-1}(\cdot)$ in Figure 36.3.[71] 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 36.3. This increases x_1 from x_1' to x_1'' and reduces the sum of the rivals' joint output X_{-1}. The slope of the residual demand function is then equal to the ratio of the resulting change in firm 1's price to the change in its quantity. For example, if rivals have constant returns to scale and act competitively, and if firm 1's product is not differentiated from its rivals' products, then $\bar{B}_{-1}(\cdot)$ will be a line with slope -1, and the coefficient γ_1 estimated in Equation (41) will be zero since any decrease in firm 1's output will be met by a unit-for-unit increase in its rivals' output.

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

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

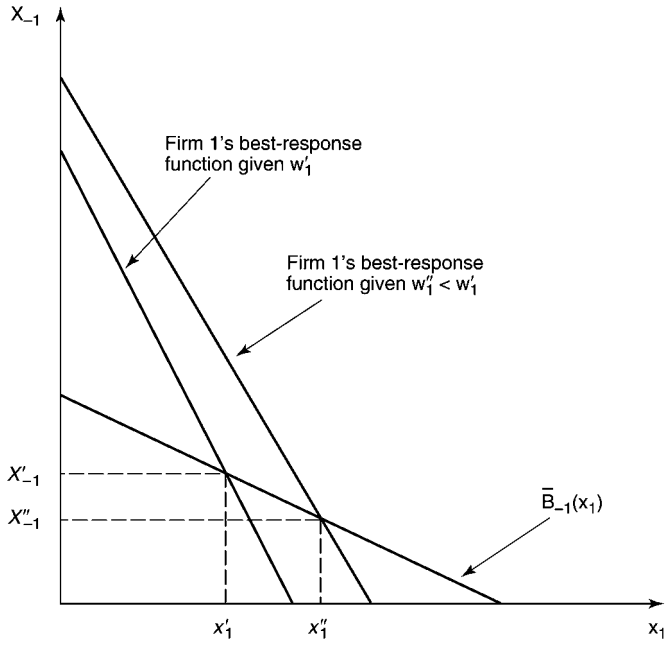

Figure 36.3. The idea behind the Baker–Bresnahan residual demand function estimation.

While clever, there are at least two serious potential problems with this approach in addition to the difficulty of finding suitable instruments. First, the "equilibrium relation" between firm 1's output x_1 and its rivals' outputs x_{-1} may not take the form in (39). 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 actually are determined in a simultaneous (Cournot) quantity choice game, the residual 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 again extends to any number of independent firms). Now suppose that the inverse demand functions for firms 1 and 2 are

$$p_1 = P_1(x_1, x_2, x_3, z) \tag{42}$$

and

$$p_2 = P_2(x_1, x_2, x_3, z). \tag{43}$$

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

$$x_3 = B_3(x_1, x_2, z, w_3). \tag{44}$$

Substituting as before we can write

$$p_1 = R_1(x_1, x_2, z, w_3), \tag{45}$$

$$p_2 = R_2(x_1, x_2, z, w_3). \tag{46}$$

Equations (45) and (46) give the residual inverse demands faced by 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 for each of the merging firms caused 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 problems as in the single-firm case. Moreover, an additional 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 clearly are not directly related to pre-merger mark-ups.[72]

Taken together, these various problems make the residual demand approach less useful than merger simulation.

5.3. *The event study approach*

A third empirical technique that does not follow the *Guidelines*' method, examines the effect of a merger without *any* kind of structural estimation. The simple idea, originating in 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.)

[72] In the special case in which the merged firm will act as a Stackleberg leader, we can however use the estimates of (45) and (46) 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 $p_2^* = R_2(x_1^*, x_2^*, z, w_3)$.

Although a simple technique (it uses the 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, examine what they argue was an "obviously anticompetitive merger" and find 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 the test may be low; i.e., we should not take the lack of statistically significant reactions in rivals' stock prices to mean that the merger will not raise prices.[73]

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 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.[74]

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 merger that would increase price in the long run.

These interpretational difficulties can be substantially avoided by looking instead at *customer* stock prices as done by Mullin, Mullin and Mullin (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 buyer surplus such as quality) arising from the merger. Mullin, Mullin and Mullin study the United States Steel (USS) dissolution suit that was filed in 1911. They begin by identifying thirteen potentially significant events in the history of the case, and then narrow their focus to five events by restricting attention to those events that caused a statistically significant movement in USS's stock price. The five events are described in Table 36.3, which also indicates with a (+) or a (−) whether the event is associated with an increase or a decrease in the probability of dissolution.

[73] Another reason for finding no effects on rivals is that the merger announcement might be anticipated. This can be checked by looking to see if the announcement had any effect on the stock prices of the merging firms.

[74] In 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 in some cases the precedent effect also may be more relevant for these same firms.

Table 36.3
Event descriptions

Variable		Description
USSRUMOR	(+)	Wall Street reacts to rumors that U.S. Steel will voluntarily dissolve and the following day the *New York Times* 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
USSDEN	(−)	U.S. Steel announces that it is not contemplating dissolution and believes that it is not guilty of antitrust violations. September 26, 1911
DISSUIT	(+)	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
SCTREARG	(−)	The Supreme Court orders reargument in several large antitrust cases before it, including the U.S. Steel case. May 21, 1917
SCTDEC	(−)	The Supreme Court affirms the district court decision in U.S. Steel's favor. March 1, 1920

Source: Mullin, Mullin and Mullin (1995).

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.[75] Railroads and street rail companies, in contrast, were both customers of USS, in that they bought significant quantities of steel.[76] The event responses of these groups to the five events are shown in Table 36.4, which also shows the response of USS to each event.[77] As can be seen in the table, the responses of steel industry rivals are generally insignificant. The railroad stocks, however, respond to these events in a statistically and economically significant way, and in a direction that suggests that dissolution of USS would lower steel prices.

Two further points are also worth noting. First, while Mullin, Mullin and Mullin 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

[75] The 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. Mullin, Mullin and Mullin examine the effects of the events on the Great Northern Railway separately, which are not reported here.

[76] The railroads were both customers and suppliers to USS since a great deal of steel was shipped by rail. Mullin, Mullin and Mullin argue that the effects on both suppliers and customers should be in the same direction because they would both depend only on the change in the output of steel.

[77] Street rail stock prices were available only toward the end of the sample period. Note also that Table 5 in their paper, from which the results in Table 36.4 are drawn, also reports the effect of these events on the Great Northern Railway.

Table 36.4
Average estimated event responses

Event	Steel rivals	Railroads	Street rails
USSRUMOR	0.00374	0.02033	
	(0.1782)	(3.0246)	
USSDEN	0.00903	−0.01320	
	(0.4316)	(−1.9742)	
DISSUIT	−0.03532	0.01260	
	(−1.6874)	(1.8828)	
SCTREARG	0.06233	−0.01860	
	(1.7707)	(−0.7394)	
SCTDEC	0.04260	−0.02858	−0.02551
	(1.3366)	(−1.7453)	(−0.3533)

Source: Mullin, Mullin and Mullin (1995).
Note: t-statistics are in parentheses.

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. Second, similar kinds of tests could also be run, looking instead at effects on firms that produce complements to the products of the merging firms.

Any suggestion that an antitrust authority should primarily rely on event–study analyses presumes that stock market participants are able to forecast the competitive effects of mergers more accurately (and faster) than is the agency, perhaps a questionable assumption.[78] Less extreme is the idea that an antitrust authority might use event–study evidence as just one source of information, perhaps as a check on its own internal analysis and any opinions obtained directly from industry and stock market participants.

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 the Peters (2003) paper discussed in Section 5.1 does for merger simulation.

Unfortunately, the economics literature contains remarkably little of this kind of analysis. In the remainder of the chapter, I discuss some studies that have looked at

[78] The studies in Kaplan (2000), for example, illustrate how the stock market's initial reaction to a merger is often a poor forecast of the merger's ultimate profitability.

either price or efficiency effects in actual mergers (none look at both). This is clearly an area that could use more research.[79,80]

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 are 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 and 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.[81] 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 36.5 shows the average "relative prices" before and after the mergers for four categories of markets, defined by whether both merging firms were active competitors in the market before the merger (defined as each firm having at least a 10% market share on the route prior to the merger and shown in the first column of the table) and by whether they faced any competition before the merger (whether there were "other firms" in the market is shown in the second column of the table). 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 (throughout the table, standard errors are in parentheses). The "av. change" over 1985–1987 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".[82]

The results in Table 36.5 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.[83]

[79] Pautler (2003) surveys some articles that I do not discuss here, including studies looking at profitability, stock price reactions, and other effects.

[80] To the extent that the limited amount of work is due to a lack of data, one way to enhance our knowledge (or at least that of the enforcement agencies) 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.

[81] NW 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.

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

[83] Werden, Joskow and Johnson (1991) also look at these two mergers. Using somewhat different techniques from Borenstein, they also find that the NW–RC merger increased prices substantially, while the TW–OZ

Table 36.5
Merging airlines' price changes at their primary hubs

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

Source: Borenstein (1990).
[a]Shown in percent.
[b]Significant at 1-percent level (two-tailed test).
[c]Significant at 5-percent level (two-tailed test).
[d]Significant at 10-percent level (two-tailed test).

It is also noteworthy that prices also increased on routes in which NW and RC did not compete prior to the 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

merger had smaller (but, in their case, still positive) price effects on routes on which the merging firms were active competitors. Peters (2003) also reports price changes for these same mergers in his study of six mergers during this period. His data show instead that prices increased 7.2% and 16% in the NW–RC and TW–OZ mergers, respectively, in markets that were initially served by both merging firms. Peters reports that they increased 11% and 19.5%, respectively, in markets where these firms faced no pre-merger competition.

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 36.5.

Kim and Singal (1993) expand on Borenstein's analysis by examining the price changes resulting from fourteen airline mergers that occurred from 1985 to 1988. Table 36.6 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 (relative) 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 vertically divided into two sections. The left section looks at the merging firms' (relative) price changes, while the right section looks at rivals' (relative) price changes on the routes served by the merging firms. Within each of these sections, (relative) price changes are computed separately, depending on whether one of the merging firms was financially distressed prior to the merger. Descriptions of the variables in Table 36.6 are in the notes to the table.

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.[84] (The patterns for mergers involving a failing firm are more puzzling.) Price changes for rival firms again follow similar patterns. Kim and Singal also examine through regression analysis the relationship between the change in relative fares and the change in the Herfindahl–Hirschman 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 on 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 36.7 depicts their results on (relative) price changes (in percentages) for the full period. Notably for mergers involving

[84] It 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 increases rather than decreases in marginal costs.

Table 36.6
Changes in relative fares of merging and rival firms

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
Full period:						
Sample size	11,629	8511	3118	8109	5578	2531
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 Lfarchg (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*)
Announcement period:						
Sample size	7214	5832	1382	4891	3730	1161
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	1.0270* (0.8947*)	1.0754* (0.9440*)	0.8228* (0.7337*)	0.9807* (0.9208*)	1.0345* (0.9634*)	0.8079* (0.7882*)
Relative fare changes Lfarchg (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*)
Completion period:						
Sample size	7557	6140	1417	5304	4105	1199
Relative fares, beginning	0.9874* (0.8657*)	1.048* (0.9273*)	0.7247* (0.6528*)	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* (0.9296*)	0.9776* (0.9286*)	0.9725* (0.9332*)
Relative fare changes Lfarchg (percentage)	0.21 (3.31*)	−9.00* (−6.82*)	40.11* (38.36*)	6.10* (7.13*)	−5.36* (−3.72*)	45.34* (43.24*)

Source: Kim and Singal (1993).
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. Lfarchg 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 Lfarchg the significance is with reference to a mean of zero.
*Statistically significant at the 1-percent level (two-tailed test).

Table 36.7
Relative fare changes for four categories of routes

Period and subsample	Mean Lfarchg, percentage [sample size]		Mean Lhhichg, percentage [sample size]		Regression coefficient (t statistic)**			
	Merger between normal firms	Merger with a failing firm	Merger between normal firms	Merger with a failing firm	Constant	Normal × Lhhichg	Fail × Lhhichg	R^2_{adj}
Merging firms: 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* [1205]	40.12* [566]	22.49* [1205]	19.92* [566]	0.1535 (11.89)	−0.1370 (−4.56)	0.3512 (5.28)	0.044
Neither	3.84* [6822]	18.28* [2041]	0.84* [6822]	4.02* [2041]	0.0690 (16.59)	0.1945 (12.12)	0.1548 (3.38)	0.016

Source: Kim and Singal (1993).
Notes: Lfarchg is deserbed in Table 36.6. Lhhichg is the difference between the sample and control routes in the natural logs of the ratio of the Herfindahl–Hirschman index at the end to the beginning of each period.
*Statistically significant at the 1-percent level (two-tailed test).
**$\text{Lfarchg}_i = \alpha + \beta_1 \text{Normal}_i \times \text{Lhhichg}_i + \beta_2 \text{Fail}_i \times \text{Lhhichg}_i + \varepsilon_i$.

normal firms, prices fall on "hub only" routes (i.e., non-overlap routes involving a common hub) and they have no change on hub/overlap routes. (Moreover, Kim and Singal 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 36.6 for the full sample. Finally, note that routes that are neither a hub route nor an overlap route also experience price increases of this magnitude. These may reveal the effect of increased multimarket contact.[85]

Peters (2003), which was largely focused on evaluating merger simulation techniques (see Section 5.1), also documents the service changes and entry events that followed six of these mergers. Peters shows that flight frequency tended to decrease in markets that initially were served by both merging firms, and increase in markets that initially were served by only one of the merging firms.[86] The mergers also led to entry, although

[85] Evans and Kessides (1994) perform a structure–conduct–performance-style study of the relationship 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.

[86] Borenstein (1990) and Werden, Joskow and Johnson (1991) report similar changes in service following the NW–RC and TW–OZ mergers.

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 U.S. banking industry from 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 accounts), and 3MOCD accounts (three-month certificates of deposit).[87] Hannan and Prager separately examine the effects of "substantial horizontal mergers" in which the Herfindahl–Hirschman index in the affected market increases by at least 200 points to a post-merger value of at least 1800, and "less substantial mergers", in which the Herfindahl–Hirschman index 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. Their estimating equation takes the form

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

where $\text{ratchg}_{it} = \ln(\text{rate}_{it}/\text{rate}_{i,t-1})$ 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 month $t + n$, and LSM_{int} is a dummy variable taking value 1 if bank i was exposed to a less substantial horizontal merger in month $t + n$.[88] The results from this estimation can be seen in Table 36.8, where the merger exposure effects are presented in three aggregates: the pre-merger period ($n = -12$ to $n = 0$), the post merger period ($n = 1$ to $n = +12$), and the total period.

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, in the absence of 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. Unlike in Kim and Singal (1993), the direction of these effects is the same in the pre and post-merger period. Finally, although the results in Table 36.8 do not distinguish between the price changes for merging firms

[87] MMDA accounts have restricted check-writing privileges.

[88] In 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.

Table 36.8
Price effects of "substantial" and "less than substantial" bank mergers

	NOW			MMDA			3MOCD		
	Coefficient	t-statistics	Probability $> \|t\|$	Coefficient	t-statistics	Probability $> \|t\|$	Coefficient	t-statistics	Probability $> \|t\|$
Pre-merger 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
Number of observations		13,313			13,498			12,972	
Number of banks		435			443			433	
Average observations per bank		30.60			30.47			29.96	
Regression R^2		0.0896			0.1409			0.3586	

Source: Prager and Hannan (1998).

Notes: OLS with robust standard errors[1]; dependent variable: ratchg_{it}. Each regression includes 33 month indicators and 25 weighted merger indicators ($I[t = m]$ for $m = 2$ to 34 and I [bank i "exposed" to merger in month $t-n$], $n = -12, \ldots, 0, \ldots, 12$). Coefficients for these variables are not reported in order to conserve space.

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

and their rivals, Prager and Hannan find that these two groups had similar price effects, paralleling the Borenstein (1990) and Kim and Singal (1993) findings on this point.

In a recent paper, Focarelli and Panetta (2003) study bank mergers in Italy during the years 1990–1998 and their effects on deposit rates. Like Kim and Singal (1993) and Prager and Hannan (1998), they separately look at announcement (which they call "transition") and completion periods. However, they look at a much longer time period after the merger when examining the completion period (for each merger, they consider the effects until the end of their sample), arguing that a long time period may be required to realize efficiencies from merger. Like Kim and Singal they find evidence of market power effects during the announcement/transition period as deposit rates fall during this period. However, they find that in the long run these mergers increased deposit rates. Thus, in this case, the price-reducing effects of merger-related efficiencies seem to have dominated the price-increasing effects of increased market power.

Some recent studies have been done as well in other industries in which price data are available. Hosken and Taylor (2004) study the effects of a 1997 joint venture that combined the refining and retail gas station operations of the Marathon and Ashland oil companies. Specifically, they examine retail and wholesale price changes in Louisville, Kentucky, a city where this merger raised concentration significantly (the wholesale Herfindahl–Hirschman index increased from 1477 to 2263; the retail index increased by over 250, ending up in the 1500–1600 range). They conclude that there is no evidence that the merger caused either wholesale or retail prices to increase.[89] In contrast, Hastings (2004) finds that rivals' prices increased following ARCO's 1997 acquisition (through long-term lease) of 260 stations from Thrifty, an unbranded retailer. Vita and Sacher (2001) document large price increases arising from a 1990 merger between the only two hospitals in the city of Santa Cruz, California. The acquirer in this case was a non-profit hospital. Hospital markets, which also have data publicly available because of regulatory requirements, have also been the subject of some other work evaluating price and service effects of mergers; see Pautler (2003).[90]

There is one important caveat to the interpretations we have been giving to observed price changes in these studies: throughout, we have been assuming that the product remains unchanged. An alternative explanation for price increases or decreases instead may be that the merger led to changes in the quality of the merged firms' products. Thus, rather than market power, price increases may reflect quality improvements; and rather than cost reductions, price decreases may reflect quality degradation. That said, many of the papers we have discussed document patterns that tend to rule out such interpretations of their findings. For example, the price increases during the Kim and

[89] Wholesale prices did increase significantly 15 months after the merger, but the authors argue that this was due to an unrelated supply shock.

[90] In an older 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.

Singal (1993) announcement period are unlikely to come from quality improvements. Likewise, Focarelli and Panetta (2003) explicitly examine and reject the hypothesis that the long-run increases in merging banks' interest rates that they document are due to quality degradation.

In summary, the literature documenting price effects of mergers has shown that mergers can lead to either price increases or decreases, in keeping with the central market power versus efficiency trade-off that we have discussed. There is also some evidence that more substantial mergers are more likely to raise prices. The use of post-merger evidence to evaluate techniques for prospective merger analysis, as in Peters (2003), is unfortunately much more limited.

6.2. *Efficiencies*

Just as with price effects, remarkably little has been done examining the effects of horizontal mergers on productive efficiency. Indeed, here the evidence is even thinner. Most of the work examining the efficiency effects of mergers has examined mergers in general, rather than focusing on horizontal mergers. 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.[91] On the other hand, since horizontal mergers may increase market power, even efficiency decreasing horizontal mergers may be profitable for merging firms.

Work examining mergers in general has typically found that there is a great deal of heterogeneity in merger outcomes. Some mergers turn out well, others very badly.[92] As well, the average effects are sensitive to both 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 1974–1976) 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, largely consisted 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 total factor productivity at the plant-level using the Census Bureau's Longitudinal Establishment Data (LED) for the years 1972–1981. (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 36.9 (where "year t" is the year of the merger), in contrast to the Ravenscraft and

[91] One reason for greater synergies simply may 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).

[92] This 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 stock market's initial forecast.

Table 36.9
Differences in mean levels of productivity between plants changing ownership in year t and plants not changing ownership

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

Source: Lichtenberg and Siegel (1987).
[a] t-statistics to test H_0: difference equals 0 (in parentheses).

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 after the acquisition. This may reflect the undoing of Ravenscraft and Scherer's inefficient conglomerate mergers.

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 and 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 only operated during part of the sample period (an "unbalanced panel"), while Lichtenberg and Siegel used a balanced panel (a balanced panel may worsen selection biases). However, instead of a measure of total factor productivity most of their analysis uses labor productivity (the average product of labor relative to the industry average product), which can be affected by shifts in the mix of inputs. In contrast to Lichtenberg and Siegel, McGuckin and Nguyen find that acquired plants 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 can seriously bias productivity estimates [see Olley and Pakes (1996)]. In addition, neither of these studies considers separately the effects of horizontal mergers. In fact, ideally we would like to know how horizontal mergers affect productivity *conditional* on their structural attributes (e.g., potential for increasing market power).

There have been a few studies looking at efficiency effects of horizontal mergers. Most of these have focused on the banking industry. In general, these studies have found little evidence that, on average, mergers of banks that operate within the same local markets increase those banks' efficiencies. [See, for example, Berger and Humphrey (1992) and Peristiani (1997), as well as the discussion in Pautler (2003).]

A recent study that also examines horizontal mergers explicitly is Pesendorfer (2003), which studies a horizontal merger wave in the paper industry during 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 it is unfortunately not entirely convincing in his application. This is true 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, his procedure relies on an assumed investment cost function (this might not be necessary if one instead has panel data). 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.

In summary, the evidence on the efficiency effects of horizontal mergers provides little guidance at this point. There is reason, however, to be hopeful that we will learn more soon. Recent work, most notably Olley and Pakes (1996), has greatly improved our ability to estimate productivity [see also Levinsohn and Petrin (2003)]. The examination of the productivity effects of horizontal mergers seems a natural (and highly valuable) direction for this work to go.

7. Conclusion

A great deal of progress has been made in recent years in our ability to analyze prospective mergers. A better theoretical understanding of the trade-off between market power and efficiencies, the development of merger simulation techniques, some initial steps towards understanding a range of dynamic issues, and a few investigations of the effects of actual mergers have all been significant steps forward. At the same time, as the discussion has made clear, there are a number of important and interesting areas that clearly need further research. Continued theoretical work on mergers in dynamic settings, incorporation of non-price variables and changing firm behavior into merger simulation techniques, further evidence on the price and efficiency effects of mergers (particularly conditional on a merger's attributes), and additional work using ex post

merger experiences to evaluate methods for prospective merger analysis are all high priorities.

Acknowledgements

I thank Mark Armstrong, Jonathan Baker, Michael Black, Patrick Bolton, Dennis Carlton, Richard Caves, Luke Froeb, Neil Gandal, Ken Heyer, Kai-Uwe Kuhn, Aviv Nevo, Volker Nocke, Ariel Pakes, John Parisi, Paul Pautler, Craig Peters, Robert Porter, Simon Priddis, Patrick Rey, Tom Ross, Spencer Waller, Greg Werden, and Abe Wickelgren for their comments, help, and suggestions. Fan Zhang provided excellent research assistance. I also thank the NSF, the Searle Foundation, and the Toulouse Network for Information Technology for their financial support.

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