

# Measuring Anticompetitive Effects of Mergers When Buyer Power Is Concentrated

R. Preston McAfee,\* Kenneth Hendricks,\*\* Joshua M. Fried,\*\* Michael A. Williams,\*\*\*\* & Melanie Stallings Williams\*\*\*\*\*

## 1. Introduction

Little more than twenty years ago, when the number three and six retailers in the Los Angeles grocery market attempted to merge into the region's number two ranked competitor, the response from the Department of Justice and the Supreme Court was swift.<sup>1</sup> In interpreting the Clayton Act, the high court struck down the proposed merger, noting that this type of merger was evidence of "exactly the threatening trend toward concentration which Congress wanted to halt."<sup>2</sup> That the proposed merger would have resulted in a consolidation of only 7.5% of the market was nonetheless alarming.<sup>3</sup> In fact, the Supreme Court concluded that the long and constant trend toward fewer competitors was "exactly the sort of trend which Congress, with power to do so, declared must be arrested."<sup>4</sup> So offensive was the proposed merger that the Supreme Court did not simply reverse the district court, but directed the court to order its divestiture "without delay."<sup>5</sup>

What a difference twenty-three years make. In 1999, Exxon and Mobil, the number one and two producers of domestic oil respectively, announced plans to effectuate a merger without a

---

\*Murray S. Johnson Chair of Economics, University of Texas at Austin. B.A. (Economics) *summa cum laude*, *Phi Beta Kappa*, 1976, Purdue University; M.S. (Mathematics), 1978, Purdue University; M.S. (Economics), 1978, Purdue University; Ph.D. (Economics), 1980, Purdue University.

\*\*Professor of Economics, University of British Columbia. B.A. (Economics), 1977, University of British Columbia; M.A. (Economics), 1977, University of British Columbia; Ph.D. (Economics), 1982, University of Wisconsin at Madison.

\*\*\*Associate, Weil, Gotshal & Manges, LLP, New York. B.A. (Spanish with high honors and Economics), 1991, Rutgers University; J.D. *magna cum laude*, 1995, Pepperdine University School of Law; M.B.A. with College Honors and University Distinction, 1999, California State University, Northridge.

\*\*\*\*Principal, PM Industrial Economics, Inc., San Francisco. B.A. (Economics), 1976, University of California, Santa Barbara; Ph.D. (Economics), 1982, University of Chicago.

\*\*\*\*\*Professor of Business Law & Director of Graduate Programs, College of Business Administration & Economics, California State University, Northridge. B.A., 1977, University of California, Santa Cruz; J.D., 1981, Boston University School of Law.

<sup>1</sup>See *United States v. Vons Grocery Co.*, 384 U.S. 270, 272 (1966).

<sup>2</sup>See *id.* at 277.

<sup>3</sup>See *id.* at 272.

<sup>4</sup>See *id.* at 278.

<sup>5</sup>*Id.* at 279 (quoting *United States v. El Paso Gas Co.*, 376 U.S. 651, 662 (1964)).

challenge from the Department of Justice.<sup>6</sup>

This period of relative inactivity in antitrust enforcement has occurred at the same time as, and has perhaps been a partial cause of, the enormous rise in the rate of mergers and acquisitions. There has been an expansion of merger activity at rates that dwarf those of the “go-go ’80s.”<sup>7</sup> The rate of mergers and acquisitions has increased for five consecutive years, now constituting more than two trillion dollars in transactions annually in the United States alone.<sup>8</sup> During this period, antitrust enforcement has, tellingly, been almost dormant. It has been more than twenty years since the U.S. Supreme Court has heard a merger case. While considerable newsplay has been given to the Microsoft case, this case is the exception that proves the rule of government inactivity in antitrust enforcement. What accounts for such a dramatic dropoff in antitrust activity?

Antitrust laws came about from the basic notion that big is bad. Justice Brandeis, writing in *Standard Oil*, judged bigness a “curse” that justified court-ordered breakups.<sup>9</sup> In arguing for his proposed antitrust legislation in 1890, Senator Sherman threatened that communism or socialism could result from a popular backlash against the power of concentrated industries.<sup>10</sup> The recent evolution away from this notion occurred when economists began to analyze the effects of mergers and to conclude that, often, the result of consolidations was to increase efficiencies and thereby reduce consumer costs. This doctrine, developed in the Chicago school of legal-economic analysis, reached its zenith in Robert Bork’s 1978 book *The Antitrust Paradox*. In particular, Bork wrote that the dangers of a vertical merger—one in which a retailer, for example, acquires its supplier—were exaggerated. Instead, “efficiency necessarily benefits consumers by lowering the costs of goods and services . . . whether the business unit is a competitor or a monopolist.”<sup>11</sup> Far from assuming that monopolies were bad, the Bork view was that consolidation was, of itself, largely irrelevant; instead the necessary analysis depended on a merger’s effect on consumers.<sup>12</sup>

However, despite the more sophisticated evolution in antitrust analysis it was observed that profits tended to be higher in concentrated industries. This suggested that there was, at best, pricing power or, at worst, some element of collusion when there were clear market leaders. Judicial rulings, however, did not go beyond the most basic tools of economic analysis.

## 2. Economic Tools of Analysis: The Cournot Model/HHI Index

The economic tools of antitrust analysis have developed rapidly in sophistication during the

<sup>6</sup>Their merger is a particularly striking symbol to antitrust scholars, marking as it does the reunification of the two most important spin-offs of Standard Oil (the dominant holding company Standard Oil of New Jersey, now “Exxon,” and its keystone New York subsidiary, Standard Oil of New York, now “Mobil”) 88 years after they were forcibly broken up in the seminal case of *Standard Oil v. U.S.*, 222 U.S. 1 (1911).

<sup>7</sup>See, e.g., Geoffrey Colvin, *The Year of the Mega Merger*, FORTUNE, Jan. 11, 1999, at 61 (“Even the Roaring 80’s seem modest next to current deal values.”).

<sup>8</sup>In 1998, mergers and acquisitions resulted in \$2.4 trillion in announced activity, while 1999 reported \$2.2 trillion in the first three quarters alone. See *Why This Merger Wave Is Different*, BUS. WK., Oct. 18, 1999, at 234.

<sup>9</sup>Standard Oil, 221 U.S. 1 (1911).

<sup>10</sup>“You must heed [the voter’s] appeal or be ready for the socialist, the communist, and the nihilist.” 21 CONG. REC. 2460 (1890).

<sup>11</sup>ROBERT BORK, *THE ANTITRUST PARADOX* 7-8 (1978).

<sup>12</sup>See *id.*

past thirty years. One of the first instruments used in this period to measure market concentration in the context of mergers was a computation of the aggregate percentage of market share for sales held by a given number of firms. These concentration ratios were used to measure the relative control of the applicable market by a specific number of firms. This measure proved so popular that the Department of Justice promulgated the use of concentration ratios of the four leading firms in their 1968 Merger Guidelines.<sup>13</sup>

Eventually, concentration ratios were abandoned in favor of a more comprehensive measure, the Hirschman Hirfendal Index (HHI), which included the market share of all firms in the market rather than merely the top two or four firms. For more than a decade, the HHI has been the dominant mechanism employed by economists, judges, and the Department of Justice in measuring market concentration.<sup>14</sup> The HHI is computed by summing the squares of the each firm's percentage market share.<sup>15</sup> For example, in a given market which contains five firms that hold 40%, 30%, 15%, 10%, and 5% of the market, the HHI would be  $(40)^2 + (30)^2 + (15)^2 + (10)^2 + (5)^2$ , or 2,850. The post-merger index is then compared to the pre-merger HHI. Thus, in the above example, if the first two firms were to merge, thereby reconfiguring the respective market shares to 70%, 15%, 10%, and 5%, the post-merger HHI would be 5,250, or 2,400 points higher than the pre-merger HHI. In this example, the Department of Justice would presume that the merger is likely to create, enhance or facilitate the exercise of market power by looking at the activity only from the perspective of the seven participants.<sup>16</sup>

Due to its simplicity, and the belief that the HHI and the corresponding differential between pre- and post-merger indexes was a superior method of measuring anticompetitive behavior, courts quickly endorsed the HHI index as the applicable test for determining market concentration.<sup>17</sup> The application of the HHI in subsequent cases was relatively straightforward. Courts would ascertain the relevant product and geographic markets and then determine whether the post-merger HHI determination of market concentration indicated that the proposed merger was violative of antitrust laws.<sup>18</sup> Concentration ratios and the HHI are based wholly on the assumption that only sellers, and not buyers, influence price. But problems emerge when courts premise their analysis and conclusions regarding antitrust violations on the assumption that buyers have no market power or ability to influence price. These measurements do not yield accurate proxies for the anticompetitive effects of integration in cases where both buyers and sellers have market power. Even if the HHI indicated a high degree of market concentration, courts would often look to other, nonquantitative factors to determine whether the proposed merger would violate the relevant antitrust laws without

<sup>13</sup>See U.S. DEPT. OF JUSTICE, MERGER GUIDELINES (1968).

<sup>14</sup>The Department of Justice specifically adopted the HHI when it promulgated its 1992 guidelines. U.S. DEPT. OF JUSTICE, HORIZONTAL MERGER GUIDELINES § 1.5 (1992). Under the DOJ's guidelines, a post-merger HHI below 1000 is regarded as "unconcentrated," a post-merger HHI between 1000 and 1800 is considered "moderately concentrated," and a post-merger HHI over 1800 is regarded as "highly concentrated." *See id.*

<sup>15</sup>*See id.*

<sup>16</sup>*See id.*

<sup>17</sup>*See, e.g.,* Rothery Storage & Van Co. v. Atlas Van Lines, Inc., 792 F.2d 210 (D.C. Cir. 1986); United States v. Loew's, Inc., 882 F.2d 29 (2d Cir 1989); A.A. Poultry Farms, Inc. v. Rose Acre Farms, Inc., 881 F.2d 1396 (7th Cir. 1989).

<sup>18</sup>*See* United States v. Calmar Inc., 612 F. Supp. 1298, 1300-01 (D. N.J. 1985) (describing the method courts use to analyze whether a merger violates the Clayton Act).

assigning the same mathematical value to such variables as they would with the HHI.<sup>19</sup>

The HHI index, then, allowed the infusion of some form of economic analysis. But while valuable in gauging the concentration of seller power, it basically stopped there. In a fashion reminiscent of the Brandeis “big is bad” model, relying entirely on the HHI required, as an assumption, that when sellers controlled large portions of the market there were, per se, anticompetitive effects. While this is often true, it is overly simplistic. It assumes that the power of sellers is determinative; that is, that when sellers have concentrated power it creates monopolistic power. However, it ignores the circumstances that might concentrate power in buyers, thereby alleviating some or all of the anticompetitive effects of concentrated seller power. Specifically, when buyers have power, sellers would not have the unilateral power to raise prices. Two examples of times when buyers have concentrated power include (1) when the buyers themselves are concentrated, and (2) when a market has been vertically integrated. In each of these circumstances, the HHI index gives an incomplete or misleading analysis of the monopolistic effects of a merger or acquisition. For both instances, we review the relevant case law, the shortcomings of the Cournot/HHI analysis, and propose an extension of the HHI formula designed to give a more realistic view of a merger’s economic effects on buyers.

a. *The Failure of the HHI to Consider Buyer Power*

The HHI and corresponding analysis on which it is premised assumes that buyers in a given market are dispersed and exert no power over price. However, certain markets contain a high concentration of buyers who are able to influence prices. If, for example, two defense industry companies sought to merge and this merger would create an alarmingly high HHI, it would presumptively be blocked under the current DOJ guidelines. However, if there is a single buyer for all of the products, namely the Department of Defense, is it realistic to say that the proposed merger will harm the buyer? Certainly the Department of Defense has significant power to set product specifications and pricing because they act as a monopolistic buyer.

Nor is the second scenario described above farfetched. The seven largest refiners of California gasoline, for example, account for 95% of the production of gasoline sold in that state.<sup>20</sup> At the same time, however, the seven largest *buyers* of refined gasoline constitute 95% of retail sales.<sup>21</sup> Thus, the wholesale California gasoline market consists of large sellers and large buyers. If a buyer in the retail market were to merge with a seller in the refinery market, what would be the effect on the competitiveness of the refinery market? Clearly, the answer does not lie in the HHI because that index speaks only to the relative anticompetitiveness of the post-merger market by taking into account a particular market’s concentration. As there has been no merger in the refinery market, the HHI would not change and would not indicate any anticompetitive behavior because the market concentration has not changed. Yet *something* has changed, because in this instance the buyer in the refinery market is able to influence the price of refined gasoline by virtue of its vertical integration with the refiners. Thus, in both “concentrated buyers” scenarios, the HHI model provides an unsuitable quantification of anticompetitive effects from vertical integration.

The failure of the HHI model to work in cases where buyers are concentrated is an issue that has been confronted by U.S. courts. For example, in *United States v. Calmar, Inc.*,<sup>22</sup> the United States

<sup>19</sup>See *id.* at 1307 (listing six mitigating factors used to determine the relevant market in addition to the quantitative HHI value).

<sup>20</sup>KEITH LEFFLER & BARRY PULLIAM, PRELIMINARY REPORT TO THE ATTORNEY GENERAL REGARDING CALIFORNIA GASOLINE PRICES chart 7 (Nov. 22, 1999), at <http://caag.state.ca.us/piu/gasstudy/gasstudy.htm>

<sup>21</sup>*Id.* at chart 8.

<sup>22</sup>612 F. Supp. 1298 (D. N.J. 1985).

sought to enjoin a merger of Calmar, which controlled 60% of the product market of regular sprayers<sup>23</sup> and 58% of the product market of regular dispensers,<sup>24</sup> with Realex, which controlled 23% and 21% of the same two markets respectively.<sup>25</sup> The complaint also alleged that the regular sprayer market contained three participants with an HHI of approximately 4,400 while the regular dispenser market had 5 participants with an HHI of approximately 4,000.<sup>26</sup> The proposed merger between the number one and two leaders in the regular sprayer and regular dispenser market would create a post-merger HHI of more than 7,100 and 6,400 respectively.<sup>27</sup> Notwithstanding these presumptively anticompetitive HHI results, the court looked to other nonquantitative factors, such as the ease of entry into each product market, as a basis for denying a preliminary injunction barring the merger.<sup>28</sup> Interestingly, one such factor the court alluded to was the existence of some buyer power. Significantly, for the purposes of this article's analysis, the court examined the ability of a user to manufacture the pump dispensers themselves.<sup>29</sup> Thus, the court, without assigning a value to buyer power to use in conjunction with the HHI, noted its existence in the relevant product markets while simultaneously applying the HHI. The presence of buyer power, which the court used with other factors to mitigate the HHI's conclusion that the merger was anticompetitive, is precisely the variable that this Essay proposes to treat systematically in creating and applying a model to measure concentration in markets where buyer power influences price.

*b. The Failure of the HHI to Consider Buyer Concentration Resulting From Vertical Integration*

Buyer power, like seller power, is concentrated when a company has been vertically integrated, as illustrated in the gasoline refinery example discussed above. However, the HHI is unable to yield an accurate result in assessing the anticompetitive effects of a vertical merger. For example, what effect will there be when a manufacturer of a product acquires a retailer of that same product? If an application of the HHI would show that there is no unduly high score in either the manufacturing or retail market, can we conclude that there is no monopolistic effect? Not necessarily; the “invisibility” of such a merger, however, may explain the lack of antitrust enforcement in the area. It has been more than eighteen years since the Department of Justice has blocked a vertical integration merger, and this suggests, at least, that we should look beyond the classic HHI analysis in order to

<sup>23</sup>The Government's complaint defined regular sprayers as “a plastic pump with a spray head that, when fully depressed, dispenses approximately one cubic centimeter of liquid from a container in the form of a dense, ‘wet’ spray of large particles.” *Id.* at 1300.

<sup>24</sup>The Government's complaint defined regular dispensers as “a plastic pump with a spout that, when fully depressed, dispenses a steady stream of approximately one to two cubic centimeters of viscous liquid from a container.” *Id.*

<sup>25</sup>*Id.*

<sup>26</sup>*Id.*

<sup>27</sup>*Id.*

<sup>28</sup>*Id.* at 1307 (noting of the relevant market that “it is so fluid and volatile both from the perspective of the product user and from the perspective of the product supplier, that it is unlikely that any firm, no matter how great its market share may be at any given time, could exercise market power very long”).

<sup>29</sup>*Id.* (“There are alternative ways that a user can obtain pump dispensers—from various existing suppliers, by manufacturing them themselves, by assisting or joining with a new supplier to commence production.”).

determine if these mergers have any anticompetitive effects.

As with buyer power resulting from a concentration of buyers, courts have been aware of the issue of buyer power resulting from vertical integration. Again, there has been no analytical tool to quantify its effects. One of the seminal cases delineating the applicable standards for violations of the Clayton Act, *Brown Shoe v. United States*,<sup>30</sup> required the Court to confront the issue of vertical integration. In *Brown Shoe*, the Supreme Court stated that a prerequisite for finding a violation of the Clayton Act was the determination that competition would be substantially lessened in the relevant product and geographic markets.<sup>31</sup> The Supreme Court noted that the market share that companies would acquire by merging is among the most important factors that must be considered in ascertaining the probable effects of the merger in the relevant market.<sup>32</sup> It accordingly held that while the proposed merger would result in a company with a market concentration of only two percent, the results of the vertical integration of a retailer acquiring a manufacturer were violative of the law.<sup>33</sup>

In another case in which the concentration of buyer power was relevant, the district court in *Marathon Oil Co. v. Mobil Corp.*,<sup>34</sup> granted a preliminary injunction prohibiting Mobil Corporation, the fourth largest seller of domestic motor gasoline, from acquiring Marathon Oil Company, which ranked twelfth in domestic gasoline sales.<sup>35</sup> In determining whether the proposed acquisition would violate section 7 of the Clayton Act,<sup>36</sup> the Court first concluded that the relevant product market was motor gasoline and then turned its attention toward defining the relevant geographic market.<sup>37</sup> While the court did not ascertain the particular geographic market, it nonetheless concluded that the market was “something less than nationwide” due to the existence of price differentials.<sup>38</sup> The court then determined that the four-firm concentration ratios in the states of Illinois, Indiana, Michigan, Ohio,

<sup>30</sup>370 U.S. 294 (1962).

<sup>31</sup>*Id.* at 324 (citing *United States v. E.I. du Pont de Nemours & Co.*, 353 U.S. 589, for the proposition that “[d]etermination of the relevant market is a necessary predicate to a finding of a violation of the Clayton Act because the threatened monopoly must be one which will substantially lessen competition ‘within the area of effective competition’”).

<sup>32</sup>*Id.* at 343.

<sup>33</sup>*See id.* at 345-46 (asserting that the Court “cannot avoid the mandate of Congress that tendencies towards concentration in industry are to be curbed in their incipency”).

<sup>34</sup>530 F. Supp. 315 (N.D. Ohio 1981).

<sup>35</sup>*Id.* at 317-18.

<sup>36</sup>15 U.S.C. §§ 12-27 (1994). The Clayton Act provides in relevant part:

No person engaged in commerce or in any activity affecting commerce shall acquire, directly or indirectly, the whole or any part of the stock or other share capital and no person subject to the jurisdiction of the Federal Trade Commission shall acquire the whole or any part of the assets of another person engaged in commerce or in any activity affecting commerce, where in any line of commerce or in any activity affecting commerce in any section of the country, the effect of such acquisition may be substantially to lessen competition, or to tend to create a monopoly.

15 U.S.C. § 18.

<sup>37</sup>*Marathon Oil*, 530 F. Supp. at 320-21 (noting that because there was no dispute between the parties that motor gasoline was the relevant product market, the “crucial question presented for resolution is whether the relevant geographic market is nationwide or something less”).

<sup>38</sup>*Id.* at 322.

Tennessee and Wisconsin, combined with the substantial barriers to entry in the gasoline market, showed a probability that Marathon would succeed at trial in proving that the proposed acquisition would violate the Clayton Act by lessening competition in the affected areas.<sup>39</sup> The court's analysis, which was largely premised on *Brown Shoe* and its progeny, proceeded from the traditional assumption that buyers lack the power to affect prices.<sup>40</sup> In many cases, this assumption may in fact be accurate because buyers are largely dispersed and unconcentrated. However, missing from the court's analysis in this case was a quantification or estimation of the anticompetitive effects of the merger in the wholesale gasoline market. In 1981, Mobil and Marathon were the seventh and ninth largest domestic refiners respectively.<sup>41</sup> Thus, a proposed merger would affect not simply the retail market with its dispersed buyers to which the court devoted its analysis, but also to the more concentrated refinery and wholesale markets. Marathon and Mobil were wholesale buyers in the sense that they bought refined oil from refiners, and sellers due to the fact that they numbered among the refiners who sold the gasoline to the wholesalers. They could exert buyer power by producing the refined oil themselves due to their vertical integration, unlike the buyers at the retail level. The small number of buyers would facilitate the ability to focus their concerted efforts to further exert influence on the selling price. The unresolved question is how to evaluate mergers, or more generally the exercise of market power by sellers, in markets in which buyers can influence the market price. We turn to this question in the next section.

### 3. The Theory

This section presents our approach to measuring market power in vertically related markets where concentration is present on both sides of the intermediate market and on the seller side of the downstream market. We start with a general discussion of our approach. We then consider several significant and intuitive special cases, leading to a description of the general formula and its broad conclusions. Finally, we apply our approach to the merger of the gasoline refining and retailing assets in California of Exxon Corporation and Mobil Corporation. Our theory suggests that the combination of refining assets will raise gasoline prices in California by one percent, but the combination of the retailing assets will have a negligible effect, in spite of the relatively larger retailing presence of the two firms.

In order to describe the theory, we must first describe the environment to which the theory applies. Consider, for example, gasoline refining and retailing as upstream and downstream markets, respectively. Refiners produce bulk gasoline (the intermediate good), which they either market themselves, or sell to others to market. The upstream (refining) firms have a cost of production that depends on their capacity, which is essentially the size of their refinery.<sup>42</sup> Capacity is not viewed as a fixed quantity but a supply function describing the cost of producing output. Increasing the capacity reduces the cost of additional production.<sup>43</sup> The downstream (retailing) firms buy wholesale gasoline and then sell it to final consumers. These firms will also have retailing costs that depend on the size of their capacity. Retailing capacity is closely related to the number of retailing outlets, but also includes location—one prominent location might be worth two obscure locations. The elements of

<sup>39</sup>*Id.* at 326. The combined market share of a Marathon-Mobil merger would control 17.8% of the Illinois market, 17.13% of the Indiana market, 20.44% of the Michigan market, 16.70% of the Ohio market, 10.44% of the Tennessee market, and 17.44% of the Wisconsin market. *Id.* at 323.

<sup>40</sup>*Id.*

<sup>41</sup>*Id.* at 317-18.

<sup>42</sup>The size of a refinery includes not just the flow-through capacity, but also components, like cokers, that permit the production of additional gasoline instead of low value output like asphalt.

<sup>43</sup>This assumption is generally consistent with the observed supply functions of refineries.

the theory developed to model this industry are (1) upstream (refining) capacity of the firms, (2) downstream (retailing) capacity of the firms, (3) the nature of the upstream production costs, (4) the nature of the downstream (retailing) costs, and (5) the final consumer demand.

The HHI approach to assessing concentration in a market is based on the Cournot model, which assumes that a group of firms sell to a large number of passive (*i.e.*, price-taking) consumers. In the Cournot model, each firm chooses a quantity to produce, and then that quantity is sold at a price determined by equating of the total quantity produced by the firms and market demand. Sellers can unilaterally affect the market price. As a result, they produce less than the efficient amounts, which equate marginal costs to market price. The markup of price over marginal cost is a measure of the seller's market power and, in the Cournot model, is equal to the seller's market share divided by the elasticity of demand.<sup>44</sup> (The elasticity of demand measures the percentage quantity decrease created by a 1% price increase.)<sup>45</sup> Hence, the Cournot model suggests that the HHI measures the amount by which prices are above the competitive level. The model also implies that the larger a firm's market share is, the more it underproduces as a way of increasing the price.

There are two difficulties with using the HHI index as a measure of concentration in either the upstream or downstream markets. First, seller power in the downstream market typically implies buyer power in the upstream market. This presents a significant modeling problem because it is not possible for both sides of the market to choose their quantities independently of the prevailing prices.<sup>46</sup> When buyers demand more than sellers, for example, some mechanism must be present to adjust price and balance supply and demand. Second, the upstream and downstream divisions of a vertically integrated firm are not likely to behave as if they are independent firms. This is the problem of "captive" production, which is the amount that a vertically integrated firm sells in the downstream market. In choosing how much to produce, the upstream division worries about the effect on retail price of its sales in the intermediate market.

Elsewhere, two of the authors of this Article have proposed a generalization of the Cournot model that accommodates the exercise of market power by both buyers and sellers in the upstream market, and the balancing of supply and demand.<sup>47</sup> In other words, sellers offer to supply increasing quantities if buyers will pay higher prices, and buyers state their willingness to pay for different quantities with those quantities demanded increasing as prices fall. This allows the model to capture strategic behavior on the part of buyers.<sup>48</sup> In doing so, buyers are permitted to understate their willingness to pay and similarly, sellers can overstate their actual costs. Thus, both buyers and sellers can misrepresent their true demand and supply; the market balances the reported aggregate demand and aggregate supply, leading to a market price and quantities. Buyers purchase less than they actually desire at the market price as a way of reducing the market price. Sellers underproduce as a way of

<sup>44</sup>Specifically, let  $E$  be the elasticity of demand, and  $s_i$  be the market share of the  $i^{\text{th}}$  firm. Let firm  $i$  have marginal cost  $c_i$ . Then  $\frac{p - c_i}{p} = \frac{s_i}{E}$ . Specifically, let  $E$  be the elasticity of demand, and  $s_i$  be the

market share of the  $i^{\text{th}}$  firm. Let firm  $i$  have marginal cost  $c_i$ . Then  $\sum s_i \frac{p - c_i}{p} = \frac{1}{E} \sum s_i^2$ .

<sup>45</sup>The quantity-weighted average price-cost margin, or Lerner index, equals the sum of squared market shares, or HHI, divided by the demand elasticity.

<sup>46</sup>Whereas, if buyers are assumed to be price "takers," sellers can set quantities unilaterally, and price will adjust automatically to achieve market equilibrium.

<sup>47</sup>KENNETH HENDRICKS & R. PRESTON MCAFEE, MEASURING INDUSTRY CONCENTRATION IN INTERMEDIATE GOODS 00-01 (University of British Columbia Working Paper Series, 2000).

<sup>48</sup>*Id.*

increasing the market price. The larger a firm's share, the more a buyer or seller distorts their behavior away from efficiency.<sup>49</sup>

a. *The Importance of Costs*

Demand elasticity and market shares are not the only determinants of market power; cost elasticities are also important in our model. A seller who restricts supply expects a portion of that supply to be made up by other sellers, since other sellers are represented by increasing supply curves rather than constant quantities, as in the Cournot model. If marginal production costs are approximately constant, sellers have very little incentive to understate their willingness to supply because their rivals are expected to make up most of the reduction. Conversely, if marginal cost curves are quite steep, then the Cournot situation prevails and sellers have a strong incentive to restrict supply. Similarly, a buyer who restricts demand expects that other buyers will make up most of the portion of that demand if retailing cost curves are quite flat and very little of it if they are steep.

Two special cases serve to illustrate this point. Suppose upstream sellers can expand or contract production without any efficiency loss because marginal production costs are approximately constant. Then upstream sellers have no incentive to reduce supply, and the intermediate good market will in fact be fully efficient. The retail price-cost margin will be determined by the HHI of that market and is independent of production shares. The other special case is when sellers in the downstream market can expand or contract sales without any efficiency loss because marginal retailing costs are nearly constant. In that case, the retailing sector is perfectly competitive, only the upstream concentration matters, and the HHI for that market is the correct measure of market power.

b. *Captive Production*

For ease of exposition, we will assume in this section that each firm is vertically integrated and that production and retail cost elasticities are positive. Thus, each firm can misrepresent both its production and its consumption to the marketplace, as a way of distorting market prices in its favor. We consider two special cases: where consumer demand is perfectly elastic, and where consumer demand is perfectly inelastic.

We begin with the perfectly elastic case in which the downstream price,  $r$ , is fixed. In such an environment, each firm will equate its marginal value of consumption to its marginal cost of production. To understand this result, consider a net seller in the intermediate good market, that is, a firm that produces more than it consumes. This firm gains by raising the price in the intermediate good market. The firm can raise the price by reducing its production, which costs the firm the intermediate price  $p$ , minus its marginal production cost  $mc_i$ . Alternatively, the firm can increase the price by consuming more, which costs the firm the price  $p$  minus the marginal value  $mv_i$  of additional consumption which is equal to  $r$  minus the marginal cost of retailing,  $mw_i$ . Thus, firms will be technically efficient. However, their marginal value will not generally equal the price of the intermediate good; indeed, buyers will wish to have a value greater than price (demand reduction to reduce the price), while sellers will wish to have a marginal production cost less than the price (supply reduction to raise the price).

The second significant fact is that the size of the misrepresentation of demand and supply is proportional to the net participation in the marketplace.<sup>50</sup> This is intuitive and closely parallels the

<sup>49</sup>*Id.*

<sup>50</sup>Formally, let  $v_i$  be the marginal value of the  $i^{\text{th}}$  firm,  $c_i$  be the marginal cost. Let  $d_i$  be the demand elasticity and  $O_i$  be the supply elasticity. Let  $s_i$  be the  $i^{\text{th}}$  firm's market share of consumption, and  $F_i$

the share of production. Then 
$$\frac{v_i - p}{p} = \frac{c_i - p}{p} = \frac{s_i - \mathbf{s}_i}{e(1-s_i) + h(1-\mathbf{s}_i)}$$
. The denominator of our formula differs from the Cournot formula because a seller conjectures that, if it reduces its output,

Cournot theory. Large buyers in the intermediate good market reduce their purchases, and increase their production, as a way of reducing the price they pay. The larger are their purchases, the larger is this incentive to suppress demand. Thus, the size of the distortion increases at approximately a linear rate as participation in the intermediate good market increases.

The fact that each firm equates its own marginal value and marginal production cost, along with the fact that these differ from price proportionately to the participation in the intermediate good market, leads to the following conclusion: The average difference between the marginal value of the intermediate good and its marginal cost is approximately proportional to the sum of the squared net market shares. That is, let  $s_i$  be the  $i^{\text{th}}$  firm's share of the total consumption, and  $F_i$  be the share of the total production. Then the difference between the average marginal value, and the average marginal cost, is the sum of squares of  $s_i - F_i$ , divided by an appropriate elasticity that reflects the elasticities for both consumption and production.<sup>51</sup>

We may conclude that, in the case of very elastic downstream demand, captive production has no impact on other market participants. It is correct to measure market power according to the share of the intermediate good market.

The situation is quite different when downstream demand is perfectly inelastic. In this case, market quantities are fixed. The market-clearing condition for the upstream market implies that the intermediate good price is determined by the sellers' reported supply curves and does not depend on the buyers' reported demand curves. Similarly, given  $p$ , the retail price is determined by the buyers' reported demand curves, and not the sellers' reports. This implies that a vertically integrated firm's production and consumption decisions are independent of each other. Hence, it is appropriate to view the upstream and downstream markets as separate markets and ignore the fact that the same firms may be involved in both. Captive production can be ignored without loss: it is only gross production and consumption that matter.

When downstream demand is very inelastic, the final good price will be the intermediate good price plus a markup based on downstream concentration (the sum of the squares of the downstream market shares  $s_i$ ). The upstream markup is determined by the market shares of the upstream producers. As a consequence, the retail price will have a markup over average cost that is an average of the HHI at both the upstream and downstream levels. The weights given the upstream and downstream are the proportion of the retail price attributed to the upstream and downstream sector, respectively.<sup>52</sup> In this

not only do buyers buy less, but other sellers supply more. Thus, the fraction supplied by other sellers,  $1 - \sigma_i$ , and the fraction purchased by other buyers,  $1 - s_i$ , enter the denominator. The Cournot model can be recovered as a special case of the present analysis by assuming sellers don't buy, buyers are small, and the production elasticity is zero. For ease of exposition, we will neglect the denominator differences in the text, but the calculations employ them for accuracy.

<sup>51</sup>Specifically, using the notation of the preceding footnote, the formula is:

$$\frac{1}{p} \sum_i (s_i v'_i - s_i c'_i) = \sum_i \left( \frac{(s_i - F_i)^2}{e(1 - s_i) + h(1 - F_i)} \right)$$

<sup>52</sup>Here is the general formula. Let  $A$  be the inverse of the elasticity of demand. Let  $p$  be the intermediate good price, and  $r$  be the retail price, and  $\theta = p/r$ . Let  $B$  be  $1 - \theta$  divided by the elasticity of retailing costs, and  $C$  be  $\theta$  divided by the elasticity of production cost,  $\eta$ . Then the price-cost margin, or modified herfindahl index (MHI) is given by

$$MHI = \sum_i \left( \frac{BC(s_i - F_i)^2 + ABs_i^2(1 - F_i) + ACs_i^2(1 - s_i)}{A(1 - s_i)(1 - F_i) + B(1 - F_i) + C(1 - s_i)} \right)$$

case, we find that a simple aggregate of the two HHI indices is the appropriate index.

c. *The General Case*

It will be rare to encounter the special cases studied in the previous section. In general, downstream demand is neither perfectly elastic or perfectly inelastic. In such situations, the appropriate assessment of market concentration lies somewhere between the sum of the squared net market shares (neglecting captive production), and the weighted average of the squared gross market shares (including captive production), with the weights determined by the proportion of the final good price created by the intermediate good. Moreover, the more elastic the final good demand is, the less the weight that should be put on the captive production.

Thus, we find support for both sides of the “how to treat captive consumption” debate. When demand is very elastic, net sales and purchases are the relevant focus of analysis; the presence of captive consumption can safely be ignored. When demand is highly inelastic, the market breaks into two separate upstream and downstream markets, and the gross shares in each of these is the relevant focus of analysis. With highly inelastic demand, gross production and consumption are the relevant focus of analysis, and the links between the upstream and downstream firms can be safely ignored.

The significance of concentration depends on cost and demand elasticities. When retail costs or demand is very elastic, little harm can be done to downstream consumers. In the former case, firms have very little incentive to reduce supply and, in the latter case, consumers will not tolerate a price increase. As a consequence, the efficiency of the intermediate good market is the only relevant consideration in a merger, and captive consumption should be ignored. In contrast, when downstream demand is highly inelastic, the efficiency of the intermediate good market has a minimal effect on the final good price, and the efficiency of total production and retailing should be the primary focus of antitrust analysis. These efficiencies depend on the gross, not net, shares. Moreover, we find that the upstream and downstream HHIs should be averaged using weights derived from relative prices.

4. *The Merger of Exxon and Mobil*

The recent merger of Exxon and Mobil presents an opportunity to apply the general version of the approach described in this Article. Both companies are significant refiners and retailers of gasoline in California.<sup>53</sup> The gasoline market in California is isolated from the rest of the country for several reasons. First, there is no pipeline connecting the major refineries in the gulf coast to California.<sup>54</sup> Second, shipping via the Panama Canal is very costly.<sup>55</sup> Third, California requires a reformulated gasoline known as CARB, which is distinct from fuel used in the rest of nation.<sup>56</sup> As a consequence, California CARB gasoline is probably a single market for antitrust purposes and is a reasonable focus of study for assessing the effects of the merger.

<sup>53</sup>See *supra* text accompanying note 6.

<sup>54</sup>ATTORNEY GENERAL’S REPORT ON GASOLINE PRICING IN CALIFORNIA 6 (May 2000), available at <http://caag.state.ca.us/piu/gasstudy/gasstudy2.pdf> [hereinafter ATTORNEY GENERAL’S REPORT].

<sup>55</sup>LEFFLER & PULLIAM, *supra* note 20, at 6, 14.

<sup>56</sup>*Id.* at 2; see also Allen R. Meyerson, *So, How Did Gasoline Prices Get This High?*, N.Y. TIMES, May 1, 1996, at A1.

Table 1 presents estimates of the market shares of the major retailers and wholesalers.<sup>57</sup> It is clear that there is significant concentration in both refining and in retailing. In addition, the wholesale (intermediate) market is also concentrated.<sup>58</sup> Finally, both Exxon and Mobil are significant but not dominant players in both gasoline refining and retailing.

Table 1: Approximate Market Shares, California  
CARB Gasoline

Company	<i>i</i>	Refining Market Share	Retail Market
Chevron	1	26.4 (26.6)	19.2 (19.5)
Tosco	2	21.5 (21.7)	17.8 (18.0)
Equilon	3	16.6 (16.7)	16.0 (16.2)
Arco	4	13.8 (13.9)	20.4 (20.7)
Mobil	5	7.0 (13.3)	9.7 (17.5)
Exxon	6	7.0 (0.0)	8.9 (0.0)
Ultramar	7	5.4 (5.4)	6.8 (6.9)
Paramount	8	2.3 (2.3)	0.0 (0.0)
Kern	9	0.0 (0.0)	0.3 (0.3)
Koch	10	0.0 (0.0)	0.2 (0.2)
Vitol	11	0.0 (0.0)	0.2 (0.2)
Tesoro	12	0.0 (0.0)	0.2 (0.2)
PetroDiamon	13	0.0 (0.0)	0.1 (0.1)
Time	14	0.0 (0.0)	0.1 (0.1)
Glencoe	15	0.0 (0.0)	0.1 (0.1)

In addition to the market shares, the theory requires the specification of

- (i) The retail demand elasticity;
- (ii) The elasticity of the cost of retailing;
- (iii) The elasticity of the cost of production (refining); and
- (iv) The present ratio of the intermediate good price to the final good price.

Of these, the retail demand elasticity and the ratio of the intermediate good to final good prices are the best known. We will measure all prices net of taxes. Since taxes tend to be proportional, this is tantamount to a change in units and will not affect the outcome. In 1998, the average retail price was \$.85,<sup>59</sup> and the average wholesale (“rack”) price was \$.60,<sup>60</sup> giving a 0.7 ratio of intermediate

<sup>57</sup>LEFFLER & PULLIAM, *supra* note 20, at chart 7. Both columns failed to sum to 100% and were slightly adjusted to eliminate rounding error. The data should be viewed as imprecise and more illustrative than definitive.

<sup>58</sup>LEFFLER & PULLIAM, *supra* note 20, at chart 8 The wholesale market is actually larger than one might conclude from Table 1, because firms engage in swaps, which are one-for-one trades to obtain gasoline in the areas they need it.

<sup>59</sup>*Id.* at chart 24. Note figures exclude taxes.

<sup>60</sup>*Id.*

to final good price. Retail demand is very inelastic, with estimates ranging from 0.2 to 0.5.<sup>61</sup> We choose 1/3 as representative; this means that a 6% decrease in quantity will lead to an 18% increase in price. Production is also inelastic, at least in the short run, because such a major portion of the production process, the refinery, is difficult to change.<sup>62</sup> We choose a value of 1/2 as representative of the inelastic production process. This means that the last 10% of output costs 20% more than the previous 10%. Ultimately, the elasticity of supply is probably increasing as the refinery nears capacity. However, a refinery that is making a significant amount of diesel and home-heating oil has some ability to produce more gasoline, by losing progressively more of these other products. Finally, the elasticity of the retailing costs is the additional expenditure required to increase retail sales, and we set this elasticity to 5. This means that a ten percent increase in quantity sold would increase the retailing per-unit costs by 2%. It means that essentially the industry has nearly constant costs.

Exxon and Mobil together account for 14% of the refining and 18% of the retailing of gasoline in California, and the two firms had similarly sized operations.<sup>63</sup> We will estimate what the effect of the merger would be on the markup, the quantity produced and sold, and the retail price. We will also consider two possible remedies: a refinery divestiture and a retail divestiture.

Our results are presented in Table 2. Rows correspond to various industry structures. The row labeled Pre-Merger provides calculations for the status quo. The next row reports calculations for the full combination of Exxon and Mobil's assets.<sup>64</sup> The penultimate row provides the estimates with a merger of the retail sectors only, divesting a refinery. (Each party has one refinery.) Finally the last row provides the market performance with a divestiture of the retail assets.

Table 2: Estimated Effects of Merger

<sup>61</sup>*Id.*

<sup>62</sup>ATTORNEY GENERAL'S REPORT, *supra* note 54, at 19.

<sup>63</sup>LEFFLER & PULLIAM, *supra* note 20, at charts 7 and 8.

<sup>64</sup>In contrast to the procedure generally used in merger analysis, we use the market shares and the economic theory to estimate the capacities of the firms. With these capacities, we perform the combination. Then we compute the profit-maximizing behavior of firms, to solve for the equilibrium quantities at both levels of the market. Finally, we compute the various performance indicies. That is, we do not follow the common procedure of assuming that the merging firms will sustain their combined pre-merger market shares. The theory suggests that the merging firms will in fact shrink due to strategic considerations, as a way of manipulating the prices. The forecast of the market shares post-merger is provided, in parentheses, in Table 1. Note that the merged firm does shrink, and the others expand slightly. This is a computationally intensive approach. Moreover, essentially the same outcomes arises from the naïve approach of simply adding the market shares of the merging parties. While the authors prefer the more sophisticated approach of estimating the capacities, the naïve approach seems to work well in this application.

	Price-Cost Margin	Output Efficiency	Quantity Decrease	Price Increase
Pre-Merger	20.0%	94.6%	--	--
Post-Merger	21.3%	94.3%	0.31%	0.94%
Refinery Divestiture	20.1%	94.6%	0.03%	0.09%
Retail Divestiture	21.2%	94.3%	0.30%	0.90%

The first column of figures is the price-cost margin. It provides the percentage of the retail price which represents a markup over the average industry marginal cost. It comes out to 20%, which is reasonable given that California retail prices tend to be in the neighborhood of 20% higher than those prevailing in Texas, adjusting for both taxes and the added expense of producing CARB gasoline.<sup>65</sup> The merger increases the price-cost margin to 21.3%. Virtually all of this increase can be attributed to the merging of the refineries, in spite of the fact that concentration increases by a larger amount in the retail sector. The refineries account for all of the increased profit margins because the retail sector is relatively competitive, due to its elasticity. An attempt to raise prices via the retail sector is thwarted by other firms, which eliminates the profitability of the attempt. In contrast, other firms have a very limited ability to increase output in the face of a quantity decrease by a refiner, and thus increased concentration in refining induces a retail price increase. The size of the price increases, using the pre-merger prices as a base, are given in the last column of Table 2. Even with the full merger, the predicted increase is less than one percent. This strikes us as plausible given the modest market shares of the merging parties.

It turns out that the theory also provides estimates of the quantity reduction relative to full efficiency.<sup>66</sup> We find gasoline sales in California are about ninety-five percent of the fully efficient level. The merger reduces the quantity by about one-third of one percent. With a refinery divestiture, the quantity reduction is less than one-thirtieth of one percent. By contrast, retail divestitures have little effect—a foreseeable corollary to the conclusion that the retail merger itself will have little impact.

## 5. Conclusion

The traditional Cournot/HHI analysis remains a useful tool in antitrust, but is incomplete in cases where buyers have power, that is, when the buyers themselves are concentrated or when a firm has been vertically integrated. In each instance, application of our extended theory allows a more accurate analysis of the monopolistic effects of mergers and acquisitions. While seller concentration is relevant, the power of buyers is relevant also. Likewise, while the HHI is attractive in its simplicity, it fails to accurately predict the monopolistic effects of vertical integration, which depend upon the elasticity of demand. In any event, the HHI “big is bad” analysis seems ready for an overhaul. What is necessary, of course, is for the courts to use the available tools of economic

<sup>65</sup>CARB costs about four cents per gallon more to produce. LEFFLER & PULLIAM, *supra* note 20, at 7; ATTORNEY GENERAL'S REPORT, *supra* note 54, at 5. We do not intend to make an exact comparison, because California prices vary significantly over time, sometimes due to refinery outages. LEFFLER & PULLIAM, *supra* note 20, at 11. Moreover, the cost of delivered crude oil in California is different than that prevailing in Texas. *Id.* at 10. However, the estimates seem in the ballpark of the differences. Texas does appear to be more competitive, due to the large number of refineries and the large number of independent retailers.

<sup>66</sup>The major assumption required is that the three elasticities are approximately constant. The actual computations are relatively difficult. Interestingly, the quantity as a proportion of the fully efficient quantity can be calculated for the Cournot model in a similar way.

analysis to intelligently gauge the risk that a particular merger will create an anticompetitive effect in the marketplace.