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Chapter 56

UNILATERAL COMPETITIVE EFFECTS OF HORIZONTAL MERGERS II: AUCTIONS AND BARGAINING

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Horizontal mergers give rise to unilateral anticompetitive effects if they cause the merged firm to act less intensely competitive than the merging firms, while nonmerging rivals do not alter their competitive strategies. This chapter describes the economic theory underlying unilateral competitive effects from mergers when prices are set through an auction or bargaining process. In the auction context, this chapter also describes the quantitative application of this theory in predicting the unilateral price effects of proposed mergers.

1. Introduction

The previous chapter explained that unilateral merger effects arise in many oligopoly models, which vary with the nature of the competitive process. This chapter considers the unilateral effects of mergers in the particular context of auctions and bargaining.[1] Bidders in an auction model interact in accord with strict rules dictated by the auctioneer. Auction models specify the competitive process in detail, and different bidding rules give rise to different models. In this way, auction models contrast with the Cournot and Bertrand models presented in the previous chapter, which characterize outcomes of a competitive process without detailing the process itself. Bargaining is modeled in two quite different ways: Axiomatic bargaining models, like the Cournot and Bertrand models, merely characterize the outcomes of a competitive process; strategic bargaining models, like auction models, specify in detail how bargainers interact, and variations in the nature of that interaction are likely to affect the bargain they strike.

* Antitrust Division, U.S. Department of Justice, and Vanderbilt University, respectively. The views expressed herein are not purported to represent those of the U.S. Department of Justice.

1. For a more detailed and far more technical treatment of this material, see Gregory J. Werden & Luke M. Froeb, *Unilateral Competitive Effects of Horizontal Mergers*, *in* HANDBOOK OF ANTITRUST ECONOMICS (Paolo Buccirossi ed., 2008). For brief summaries of 11 merger analyses by the federal enforcement agencies employing models discussed in this chapter, see U.S. DEP'T OF JUSTICE & FEDERAL TRADE COMM'N, COMMENTARY ON THE HORIZONTAL MERGER GUIDELINES 31-36 (2006) [hereinafter MERGER GUIDELINES COMMENTARY], *available at* http://www.usdoj.gov/atr/public/guidelines/215247.pdf.

2. Mergers in auction models

2.1. Auction formats and bidder values

William Vickery initially formalized the analysis of competition in a bidding setting.[2] Significant elaboration was provided by others,[3] and over the years, the economic literature on auctions grew vast as economists studied every form of auction observed in the real world or conceived by academic theorists.[4]

The form of auction principally discussed here is the English auction. This may be the most familiar form of auction, because English auctions are commonly used to sell art, antiques, and collectibles. When the auctioneer sells items to bidders in an English auction, the level of bids ascends and bidding is open: Bidders shout out their bids or communicate them in some other manner to both the auctioneer and rival bidders. The auction continues as long as the bidding is advanced, and the selling price is the final bid.[5] Auctions also are used in procurement, with the auctioneer buying from one or more of the bidders. An English procurement auction proceeds much like an English selling auction, except that the level of bids descends.

A Dutch auction is organized much like an English auction, except that the level of bids moves in the opposite direction. When the auctioneer sells items to bidders in a Dutch auction, the level of bids descends: The auctioneer announces prices in a decreasing sequence, and the auction ends immediately when any bidder signals agreement to pay the announced price.

In sealed-bid auctions, bidders submit their bids to the auctioneer in confidence. Procurement auctions often have a sealed-bid format. In a first-price sealed-bid procurement auction, the selling price is the amount of the lowest bid. In a second-price sealed-bid procurement auction, the selling price is the amount of the second-lowest bid. Sealed bids may be published after the auction, but no bidder is aware of other bids during the auction.

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2. *See* William Vickery, *Auctions and Bidding Games*, *in* RECENT ADVANCES IN GAME THEORY 15 (Oskar Morgenstern & Albert W. Tucker eds., 1962); William Vickrey, *Counterspeculation, Auctions, and Competitive Sealed Tenders*, 16 J. FINANCE 8 (1961). This work earned Vickery the 1996 Nobel Memorial Prize in Economics.
3. Particularly notable is Paul R. Milgrom & Robert J. Weber, *A Theory of Auctions and Competitive Bidding*, 50 ECONOMETRICA 1089 (1982).
4. For a basic introduction to auctions, see R. PRESTON MCAFEE, COMPETITIVE SOLUTIONS: THE STRATEGISTS TOOLKIT ch. 12 (2002). For an accessible survey of literature's basic insights, see Paul Milgrom, *Auctions and Bidding: A Primer*, J. ECON. PERSP., Summer 1989, at 3. For more comprehensive surveys, see Paul Klemperer, *Auction Theory*, which appears as Chapter 23 in this book; R. Preston McAfee & John McMillan, *Auctions and Bidding*, 25 J. ECON. LITERATURE 699 (1987); and Vernon L. Smith, *Auctions*, *in* 1 THE NEW PALGRAVE: A DICTIONARY OF ECONOMICS 138 (John Eatwell et al. eds., 1987).
5. At auction houses, like Christie's or Sotheby's, as well as countless less well known establishments, the winner pays a "buyer's premium" over the final bid, or "hammer price." The buyer's premium goes to the auction house, while the hammer price goes to the consignee of the item auctioned. At Christie's and Sotheby's U.S. auctions, the buyer's premium generally is 20% of the hammer price.

Real world auctions often are variations on the canonical forms described here. The auctions used by eBay and other online auction houses are a variation on second-price auctions. Bidders do not submit bids as such, but rather submit maximum bids, and the computer that hosts the auction then does the bidding. At any time during the auction, the current high bid is "one increment" above the second-highest maximum bid so far submitted. Bidders can increase their maximum bids at any time. Online auctions generally also have a pre-set ending time for an auction, and the winning bid is one increment above the second-highest maximum bid at the time the auction ends.

Bidding strategies vary with the format of the auction. In a second-price sealed-bid selling auction, the "dominant strategy" for each bidder is to bid for an item precisely the value placed on the item. This strategy dominates all others in the sense that it is optimal no matter what strategy other bidders adopt. Bidding more than the value placed on the item risks paying more than it is valued, and bidding less than the value placed on the item risks losing the item to another bidder when it could have been acquired for less than the value placed on it. In contrast, bidding the value placed on an item assures that any successful bid produces a gain, because the sale price is not the amount actually bid, but rather the second-highest bid.

English auctions also have a dominant strategy, which is essentially the same as in second-price sealed-bid auctions: Each bidder continues bidding as long as the value placed on an item exceeds the current high bid, or until all rivals have dropped out of the bidding. Consider, for example, four bidders, labeled 1 through 4, who value an item at $10, $20, $30, and $40. The auctioneer may open the bidding at $10, which any of the four may bid, and bidder 1 then drops out. As the bidding proceeds, bidder 2 drops out at $20, and bidder 3 drops out at $30. When bidder 3 drops out, the auction is over, and bidder 4 wins the auction without having to bid up to the level of the value placed on the item. The precise winning bid depends on the auction rule that specifies the minimum increment by which each new bid must exceed the current high bid. If that increment were $1, the winning bid in this example would be $31. To simplify the exposition below, the minimum increment is assumed to be infinitesimally small.

In a first-price sealed-bid auction used to sell items to the bidders, bidding the value placed on an item is a "dominated strategy." Bidding the full value placed on an item makes breaking even the best possible outcome, whereas a financial gain is possible with a somewhat lower bid. The more a bidder shades a bid below the value placed on an item, the greater the gain if the bid wins, but the lower the probability that the bid does win. Hence, bids are formulated by trading off a reduced likelihood of winning against a larger payoff from winning. Bids in a Dutch auction are precisely the same as in a first-price sealed-bid auction.

Despite the difference in bidding strategies in the different auction formats, the Revenue Equivalence Theorem states that, under certain conditions, the auctioneer can expect the same return in all of the formats.[6] The Theorem does not hold,

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6. *See* Milgrom, *supra* note 4, at 6-11; John G. Riley & William F. Samuelson, *Optimal Auctions*, 71 AM. ECON. REV. 381 (1981).

however, with important differences among bidders, in which case there is no robust comparison across auction formats.[7]

Apart from auction formats, another important feature that distinguishes among auction models is the nature of the values bidders place on the item auctioned. In some models, bidders have "private values," while in others, they have "common values." Private values do not depend on how much rival bidders value an item, while common values do. In real world selling auctions, values are most apt to be private when bidder do not anticipate reselling the item and value it on the basis of their own idiosyncratic tastes. Values are most apt to be common when bidders do anticipate reselling the item and value it on the basis of what it is expected to bring in the resale market. In some auctions, values are neither purely private nor purely common; for example, bidders' values in the auction for a Van Gogh depend on both their idiosyncratic tastes and their expectations about future resale.

Common values generally are not known with certainty; rather, bidders independently estimate value and bid on the basis of their estimates. Although values are common, different bidders generally have different information and arrive at different value estimates. With multiple bidders estimating value with error, the highest of the estimates is quite likely to exceed the true value. Thus, if all bidders simply bid their estimates, the winner would be the bidder with the highest estimate, and that estimate typically would exceed the true value. This phenomenon is known as the "winner's curse," and to avoid the winner's curse, it is necessary to bid somewhat less than the estimated value of an item.

The effects of mergers in common values auctions are less well understood. Reducing the number of active bidders has the obvious anticompetitive effect, but merging two bidders also serves to pool their information, which can lead to a more confident value estimate, producing a smaller adjustment to avoid the winner's curse, and possibly a higher bid. The latest research indicates that the anticompetitive effect normally dominates the information pooling effect.[8] To avoid complications from common values, this chapter considers only purely private values.

As noted above, this chapter also concentrates on a single auction format—the English auction—within which the effect of a merger is particularly straightforward. The analysis is presented initially in the context of an auctioneer selling to competing bidders, but nothing of importance changes if the auctioneer instead procures an item from the bidders. The effects of mergers in sealed-bid auctions are much more computationally complex than the effects of mergers in English auctions and are only briefly mentioned below.

2.2. Mergers in private values English auctions

When the auctioneer sells an item to bidders with private values, the bidder placing the highest value on the item wins the auction, and the winning bid is the

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7. *See* Eric S. Maskin & John C. Riley, *Asymmetric Auctions*, 67 REV. ECON. STUD. 413 (2000).
8. *See* Vlad Mares & Mikhael Shor, *Industry Concentration in Common Value Auctions: Theory and Evidence*, 35 ECON. THEORY 37 (2008). The information-pooling effect, however, can dominate. *See* Jeremy Bulow & Paul Klemperer, *Prices and the Winner's Curse*, 33 RAND J. ECON. 1 (2002).

maximum of the values placed on the item by the losing bidders. Adding or subtracting a bidder in a private values English auction affects the outcome of the auction if, and only if, it alters the second-highest value. Consider again the example above with bidders labeled 1 through 4, who value an item at $10, $20, $30, and $40. With many additional bidders just like bidders 1, 2, or 3 participating in the auction, bidder 4 would still win the auction and the winning bid would still be $30, but the presence of an additional bidder valuing the item at $35 would raise the winning bid to $35. If bidders 1 and 2 did not participate in the auction, bidder 4 would still win, and the winning bid would still be $30. But if bidder 3 or bidder 4 did not participate, the winning bid would fall to $20.

In modeling a private values auction, each bidder is assumed to draw a value from a statistical distribution attaching probabilities to possible values. If $F(v)$ is the distribution of a random variable representing a bidder's private value v, $F(v_0)$ is the probability that v is less than some particular value v_0. Since probabilities fall between zero and one, $F(v_0)$ is bounded by zero and one.

As a merger in the auction context generally is modeled, each merging bidder continues to take a separate draw from the value distribution, but the merged firm makes a single bid. A merger modeled in this manner affects the winning bid in a private values English auction if, and only if, the merging bidders draw the highest and second-highest values. In the simple numerical example, merging the bidders with the values of $30 and $40 reduces the winning bid to $20, while all other mergers have no effect.[9]

If bidders compete in many separate private values English auctions, the average effect of a merger is the frequency with which the merging bidders draw the two highest values, multiplied by the difference between the second- and third-highest values when they do. Both quantities depend on the distribution of private values, which plays a role comparable to that of consumer preferences in the differentiated products Bertrand model considered in the previous chapter. In that model, a key determinant of the unilateral competitive effects of a merger is the frequency with which either of two products combined by a merger is a consumer's second choice when the other is that consumer's first choice. In an English auction model, a key determinant of the unilateral competitive effects of a merger is the frequency with which either merging firm draws the second-highest value when the other draws the highest value.

The effects of mergers in private values English auctions are similar to the effects of mergers in Bertrand industries detailed in the previous chapter, but there are significant differences. A merger in an industry employing English auctions has no effect in many, probably most, of the auctions for particular items, because the merging bidders do not place the two highest values on many items. Nevertheless, a merger may have a substantial effect on the winning bid for the particular items on which the merging bidders do place the two highest values, and the average effect of a merger may be comparable to that in a Bertrand industry. English auctions also are efficient in

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9. While mergers in some oligopoly models may be unprofitable for the merging firms, that is not so in an auction model. *See* George J. Mailath & Peter Zemsky, *Collusion in Second Price Auctions with Heterogeneous Bidders,* 3 GAMES & ECON. BEHAV. 467 (1991).

the sense the auction allocates an item to the bidder placing the highest value on it, and mergers do not change this.[10] The unilateral exercise of market power following a merger merely transfers wealth from the auctioneer to the bidders by altering the winning bid. In a Bertrand industry, however, the unilateral exercise of market power following a merger entails raising prices to all customers, which causes some marginal customers to cease purchasing the products of the merging firms. That causes a reduction the total consumption of the merging firms' products, which produces a reduction in consumer welfare exceeding the gain to the merged firm and its rivals.

2.3. Mergers with power-related distributions

In modeling the competitive effects of mergers, it is critical to incorporate differences among competitors. Even if all bidders in an auction were the same before a merger, they no longer would be afterward, and some bidders generally are "stronger" than others and win auctions more frequently. Auction theory makes incorporating bidder differences entirely feasible, but it may create considerable mathematical complexity.[11] A useful way to avoid that complexity is to model differences as if they were generated by bidders taking different numbers of draws from a common distribution, with the maximum among the draws taken being the value placed on an item. This makes it possible to make use of the convenient properties of "power-related" value distributions.[12]

The distributions $F_1(v)$ and $F_2(v)$ are power related if there is a positive number r such that $F_1(v) = [F_2(v)]^r$, for all v. A family of power-related distributions consists of all the distributions that can be derived by raising some base distribution, $F(v)$, to some positive power r. It makes no difference which distribution in a power-related family is taken to be the base distribution, and it is convenient to let the base distribution be the distribution of the maximum private value across all bidders. With that normalization, the distribution of the private value of bidder i is the distribution of the maximum value raised to the power δ_i, the probability that bidder i draws the maximum value and wins the auction.

With the introduction of a bit more notation, it is possible to state several important results that hold for all families of power-related distributions[13] and allow

10. This is not necessarily true if the auctioneer employs a "reserve." When the auctioneer sells items to the bidders, an item is not sold if no bid exceeds the reserve. By using a reserve, an auctioneer may prevent the adverse price effect from a merger, but the auctioneer is nevertheless made worse off because of the increase in the probability of no sale being made. *See* Keith Waehrer & Martin K. Perry, *The Effects of Mergers in Open-Auction Markets*, 38 RAND J. ECON. 287 (2003).

11. Recent research has developed numerical methods for solving arbitrary asymmetric private values auction models. *See* Wayne-Roy Gale & Jean François Richard, Numerical Solutions of Asymmetric First Price Independent Private Values Auctions (July 24, 2006) (unpublished University of Pittsburgh Working Paper). These methods can be applied to mergers.

12. For analyses of the effects of mergers in auctions using power-related distributions, see Luke Froeb & Steven Tschantz, *Mergers Among Bidders with Correlated Values, in* MEASURING MARKET POWER 31 (Daniel J. Slottje ed., 2002); Waehrer & Perry, *supra* note 10.

13. *See* Luke Froeb, Steven Tschantz & Philip Crooke, Second-Price Auctions with Power-Related Distributions (Vanderbilt University, Working Paper, 2001), http://www.mba.vanderbilt.edu/luke.froeb/papers/prdist.pdf.

simple quantitative predictions of the effects of mergers in English auctions. Let $F(v)$ be the distribution of the maximum private value across all bidders, and let $\mu(r)$ be the mean, or expected value, of the variable with the distribution $[F(v)]^r$. Thus, with δ_i defined as in the last paragraph, $\mu(1)$ is the mean of the maximum private value over all bidders, and $\mu(1-\delta_i)$ the mean of the maximum private value over all bidders other than *i*. In this notation, the expected value of bidder *i*'s winning bids is

$$\mu(1) - [\mu(1) - \mu(1-\delta_i)]/\delta_i$$

and the expected value of bidder *i*'s profit, i.e., its winning probability times the expected value of the difference between its private value and its winning bid, is

$$\mu(1) - \mu(1-\delta_i) \equiv h(\delta_i)$$

These results have the intuitive implication that more-successful bidders, with higher winning bid probabilities, have lower expected winning bids and earn higher expected profits.

These results also are easily used to derive the effects of a merger. For the firm formed by merging bidders *i* and *j*, the probability of winning is simply $\delta_i + \delta_j$, so the merged firm's expected winning bid and its expected profit can be computed directly from the above results. The total expected profits of all bidders is the sum of the $h(\cdot)$ functions for all bidders, which the merger increases by $h(\delta_i + \delta_j) - h(\delta_i) - h(\delta_j)$. English auctions are efficient in the sense that the bidder drawing the highest private value wins, so all of this increase accrues to the merged firm and its gain precisely equals the auctioneer's loss.[14]

2.4. Mergers in procurement and sealed-bid auctions

Nothing important in the foregoing analysis changes when it is adapted to procurement auctions. Bidders in procurement auctions generally are modeled as drawing the cost of serving a particular customer from a distribution of possible costs. The results derived for power-related distributions are easily adapted by replacing the private value distributions with cost distributions, and by replacing the maximum private value by the minimum cost. Cost distributions $F_1(c)$ and $F_2(c)$ are power related if there exists a positive *r* such that $F_1(c) = 1 - [1 - F_2(c)]^r$, for all *c*. If bidders in a procurement auction draw their costs from power-related cost distributions, the $h(\cdot)$ functions is exactly the same as before.

The effect of a cost reduction in an English procurement auction differs from its effect in many other oligopoly models. In other models, a reduction in marginal cost causes the merged firm to lower price or increase output. In a Bertrand industry for example, a reduction in the marginal cost of one of the merging brands is passed through to some extent through a lower price.[15] In procurement auctions, a reduction

14. The foregoing presumes there is no reserve. *See* note 10 *supra*.
15. *See* Luke M. Froeb, Steven Tschantz & Gregory J. Werden, *Pass-Through Rates and the Price Effects of Mergers*, 23 INT'L J. INDUS. ORG. 793 (2005); Gregory J. Werden, Luke M. Froeb & Steven Tschantz, *The Effects of Merger Efficiencies on Consumers of Differentiated Products*, 1 EUR. COMPETITION J. 245 (2005).

in marginal cost similarly causes the merged firm to lower its bids, but when the merged firm wins the auction, the winning bid is not the merged firm's cost, but rather that of the second-lowest bidder. A marginal-cost reduction affects the winning bid if it causes the merged firm to be the low-cost supplier when it otherwise would not have been. A marginal-cost reduction also affects the winning bid if the merged firm has the second-lowest cost and therefore sets the winning bid in the auction, which is lower because the merged firm's bid is lower.

Things change more significantly when the auction format is changed to a first-price, sealed-bid auction. Unfortunately, there are few general results for sealed-bid auctions when there are significant differences among bidders.[16] Numerical analysis using the logit model presented in the next section finds that, given the merging firms' premerger winning bid shares, the price effects of mergers in a sealed-bid auction are almost perfectly predicted by taking 85 percent of the price effect predicted by the corresponding English auction model.[17]

2.5. Applying auction theory to proposed mergers

In the economic literature, simple $h(\cdot)$ functions have been derived for certain families of power-related value distributions.[18] In one of these families, the maximum value among all bidders is uniformly distributed over the interval (*a, b*), and

$$h(\delta_i) = \delta_j\,(b - a)/(4 - 2\delta_j)$$

This function is exactly the same for a procurement auction with costs uniformly distributed over the interval (*a, b*), and it is a simple matter to apply this function to a proposed merger.

Suppose that each of the merging firms has a winning bid probability over recent years of 1/3. A bit of arithmetic yields $h(1/3) = (b - a)/10$, and if the average profit per auction for each of the merging firms had been \$10, it follows that $(b - a) = \$100$. The winning bid probability of the merged firm is just the sum of the winning bid probabilities of the merging firms, so the average profit per auction for the merged firm is $h(2/3) = (b - a)/4 = \$25$. Each of the merging firms had earned an average of \$10 per auction, so the merger generates an additional \$5 per auction in profit. If there are 30 auctions per year, the merged firm can be expected to win 20 of them, yielding an annual gain to the merged firm, and loss to the auctioneer, of \$100.

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16. For numerical analyses of mergers in sealed-bid auctions, see Robert C. Marshall, Michael J. Meurer, Jean-Francois Richard & Walter Stromquist, *Numerical Analysis of Asymmetric First Price Auctions*, 7 GAMES & ECON. BEHAV. 193 (1994); Serdar Dalkir, John Logan & Robert T. Masson, *Mergers in Symmetric and Asymmetric Noncooperative Auction Markets*: *The Effects on Prices and Efficiency*, 18 INT'L J. INDUS. ORG. 383 (2000).
17. *See* Steven Tschantz, Philip Crooke & Luke Froeb, *Mergers in Sealed Versus Oral Auctions*, 7 INT'L J. ECON. BUS. 201 (2000).
18. *See* Froeb et al., *supra* note 13. With sufficient bid data, it is possible to avoid strong assumptions about the cost or value distributions, by applying techniques that have been developed for econometric estimation of auction models. *See* Susan Athey & Philip A. Haile, *Identification of Standard Auction Models*, 70 ECONOMETRICA 2107 (2002).

Another useful family of power-related distributions is constructed by assuming the private value or cost distributions have the same form as the random component of utility in the logit model discussed in the previous chapter. Defining σ as the standard deviation of the value or cost distribution, and π as the ratio of the circumference of a circle to its diameter (approximately 3.14),

$$h(\delta_j) = -\sigma(\sqrt{6}/\pi)\log(1-\delta_j).$$

Note that $\log(1-\delta_i)$ is negative, so this function is positive and increases with increases in the standard deviation of the value or cost distribution. That is true because a higher variance causes a greater expected spread between the two highest values, or the two lowest costs. The effect of a merger of bidders *i* and *j* on expected profits is

$$-\sigma(\sqrt{6}/\pi)[\log(1-\delta_i-\delta_j)-\log(1-\delta_i)-\log(1-\delta_j)]$$

A higher standard deviation for the value or cost distribution causes a greater effect from the merger because it causes a greater expected spread between the second- and third-highest private values, or the second- and third-lowest costs. Using this family of power-related distributions, it is also straightforward to generate quantitative predictions for proposed mergers. For example, if a firm with a 50 percent winning probability has an average profit from winning of 5, the implied standard deviation of the value distribution is easily calculated to be 9.25, and the expression immediately above can be used to compute the effect of the merger of any two bidders identified only by their winning bid probabilities.

In some auction models, it has been observed that substantial price effects from mergers leaving at least two bidders require an implausibly high variance in the underlying value or cost distribution.[19] This does not suggest that auctions are inherently an especially competitive process; rather, it suggests only that in certain auction settings, there is little differentiation, so the internalization of competition between the merging firms has little impact.

2.6. *The* Horizontal Merger Guidelines *and merger cases*

Auction models are explicitly mentioned in the *Horizontal Merger Guidelines*,[20] and the federal enforcement agencies have used auction models in analyzing

19. *See, e.g.*, Lance Brannman & Luke M. Froeb, *Mergers, Cartels, Set-Asides, and Bidding Preferences in Asymmetric Oral Auctions*, 83 REV. ECON. & STAT. 283, 287 (2000).

20. U.S. DEP'T OF JUSTICE & FEDERAL TRADE COMM'N, HORIZONTAL MERGER GUIDELINES § 2.21 n.21 (1992) (with Apr. 8, 1997 revisions to Section 4 on efficiencies), *reprinted in* 4 Trade Reg. Rep. (CCH) ¶ 13,104:

> [S]ellers may formally bid against one another for the business of a buyer, or each buyer may elicit individual price quotes from multiple sellers. A seller may find it relatively inexpensive to meet the demands of particular buyers or types of buyers, and relatively expensive to meet others' demands. Competition, again, may be localized: sellers compete more directly with those rivals having similar relative advantages in serving particular buyers or buyer groups. For example, in open outcry auctions, price is determined by the cost of the second lowest cost seller. A merger involving the first and second lowest-cost sellers could cause prices to rise to the constraining level of the next lowest-cost seller.

proposed mergers,[21] but *Oracle* is the only court decision that explicitly refers to an auction model.[22] One of the government's experts, R. Preston McAfee, used an auction model to generate a quantitative estimate of the proposed merger's likely price effects.[23] He modeled competition among vendors of highly complex business software as an English procurement auction. His model predicted price increases of 5 to 11 percent for one market affected by the merger and 13 to 30 percent for another.

The *Oracle* decision did not comment on the general relevance of auction models to unilateral effects analysis nor on the specific relevance of an auction model to that case. It is perilous to read much into silence, but the court seemed open to the use of auction models. Ultimately, the court rejected the predictions of McAfee's model on the sole basis that the assumed winning bid shares were based on "unreliable data."[24] The court held that a far greater range of products should have been included in the analysis.[25]

3. Mergers in bargaining models

3.1. Bargaining models and bargaining outcomes[26]

One prototypical bargaining scenario involves two parties, A and B, splitting a pie, and a model can be constructed by specifying how the bargaining proceeds. Suppose A and B make alternating offers, with A going first. A and B strike a bargain if either accepts the other's offer, and if no offer is accepted within three rounds, the pie becomes inedible, and neither party gets any. The outcome of the bargaining is determined by "backward induction"—starting with the last round and working back to the first. In round three, A offers B nothing, because that is all B

21. For brief discussions of six fairly recent mergers to which the federal enforcement agencies applied an auction model, see MERGER GUIDELINES COMMENTARY, *supra* note 1, at 31-34. *See also* United States v. Suiza Foods Corp., 1999-2 Trade Cas. (CCH) ¶ 72,645, at 85,790 (E.D. Ky. 1999) (competitive impact statement) (explaining that the merger would reduce the number of bidders for school milk contracts, so the "remaining bidders will bid less aggressively"); Jonathan B. Baker, *Unilateral Competitive Effects Theories in Merger Analysis*, ANTITRUST, Spring 1997, at 21, 25 (explaining the FTC's analysis of the merger of Turner and Time-Warner, which led to restructuring of the deal, in terms of an auction model). In other cases, there was no clear reliance on auction theory, although the industry explicitly relied on auctions to trade. *See, e.g.*, FTC v. Alliant Techsystems, 808 F. Supp. 9, 14-17, 21 (D.D.C. 1992) (ammunition for tanks); United States v. United Tote, 768 F. Supp. 1064, 1066-68, 1071 (D. Del. 1991) (totalizers for race tracks); United States v. Baker Hughes, Inc., 731 F. Supp. 3, 8-9 (D.D.C.) (mining equipment), *aff'd*, 908 F.2d 981 (D.C. Cir. 1990).
22. United States v. Oracle, 331 F. Supp. 2d 1098, 1169-70, 1172 (N.D. Cal. 2004).
23. *Id.* at 1169-70.
24. *Id.* at 1170.
25. *Id.* at 1158-61.
26. For an accessible presentation of bargaining theory, see, e.g., SAMUEL BOWELS, MICROECONOMICS: BEHAVIOR, INSTITUTIONS, AND EVOLUTION 167-83 (2004). For more technical treatments, see MARTIN J. OSBORNE & ARIEL RUBINSTEIN, BARGAINING AND MARKETS (1990), and John C. Harsanyi, *Bargaining, in* 1 THE NEW PALGRAVE: A DICTIONARY OF ECONOMICS 190 (John Eatwell et al. eds., 1987).

can get by rejecting the offer. In round two, A rejects B's offer if it is less than the whole pie, because A can get the whole pie by waiting until round three. In round one, A offers B nothing, and B accepts, knowing that nothing can be gained by prolonging bargaining.

The foregoing is a strategic bargaining model. Such models have much in common with auction models in their attention to detail about the process, yet they stand in sharp contrast with auction models because neither party plays the role of the auctioneer by dictating rules and committing to deal only according to those rules. Like many strategic bargaining models, the solution is highly sensitive to the order of play and number of rounds, and this sensitivity can be discomforting because real world bargaining normally has no fixed number of rounds nor a designated party to make the first offer.

John F. Nash, Jr., posited axioms for reasonable solutions to the bargaining game that eliminate sensitivity to arbitrary conditions such as which party goes first.[27] Nash's axiomatic bargaining theory resembles the Cournot and Bertrand models in that it abstracts completely from the process of bargaining. Nash demonstrated that a bargaining outcome satisfying his axioms maximizes the product of the gains the two parties derive from reaching a bargain. In most cases, the result is that each player gets half of the total incremental gains to both players from striking a bargain.

Nash hypothesized that his axiomatic solution was the outcome of some strategic bargaining model, and a major step toward confirming Nash's hypothesis was taken by analyzing the scenario of splitting a pie when the parties make alternating offers and the value of the pie diminishes with each round. In this scenario, the player making the first offer is able to bargain for more than half of the pie because its value diminishes between that first offer and any counter by other party, but the outcome is close to the even split of Nash's axiomatic solution.[28] Further analysis demonstrated that the outcome of this bargaining scenario converges to Nash's axiomatic solution as the time period between offers becomes very small.[29]

3.2. The effects of mergers on bargaining outcomes

The Nash bargaining solution provides intuition as to how a merger may affect the outcome of bargaining, and one possibility is no effect at all. Suppose A bargains with C over splitting a pie, and B bargains with C over splitting a second pie. The merger of A and B has no effect on splitting either pie because it has no effect on the gain to any of the three from striking a bargain. This conclusion holds because A and B are not really in competition. With two separate pies involved, there is no way in which C can play A and B off against each other.

In many real world situations, the merging firms do compete and can be played off against each other, and in such situations, their merger can have significant

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27. *See* John Nash, *Two-Person Cooperative Games*, 21 ECONOMETRICA 128 (1953); John Nash, *The Bargaining Problem*, 18 ECONOMETRICA 155 (1950).
28. *See* Ariel Rubinstein, *Perfect Equilibrium in a Bargaining Model*, 50 ECONOMETRICA 97 (1982).
29. *See* Ken Binmore, Ariel Rubinstein & Asher Wolinsky, *The Nash Bargaining Solution in Economic Modelling*, 17 RAND J. ECON. 176 (1986).

effects. For example, the merger of two hospitals may allow them to achieve a better bargain if those hospitals are substitutes in the networks of managed care plans. The merger increases the plans' gains from striking a bargain because it means that neither merging hospital will be in the network if no bargain is struck.[30] This was the theory in several government challenges to hospital mergers.[31]

Suppose that a managed care plan can market its network to an employer for $100 if it contains either of two merging hospitals, for $120 if it contains both, and cannot market it at all without one of the hospitals. The gain to the managed care plan from adding either of the hospitals to its network when it already has the other is $20. By threatening each of the merging hospitals with being dropped from the network, the managed care plan can keep the $100 for itself and make the gain from striking a bargain with a second hospital just $20, which the Nash bargaining solution predicts is evenly split. Thus, before the merger each hospital gets $10 for joining the managed care network. Now suppose the hospitals merge and offer both as a package on a take-it-or-leave-it basis. The managed care plan can no longer drop one of the hospitals, and the gain from striking a bargain with the merged hospital is the full $120, which again is evenly split in the Nash bargaining solution. The merged hospital thus can bargain for $60, while the separate merging hospitals could bargain for only a total of $20.

A merger can worsen the bargaining position of the merging firms. This may occur if merging firms bargain with a supplier and the merged firm becomes "pivotal" to the supplier in the sense that the supplier can cover some fixed costs that have not yet been incurred only by striking a bargain with the merged firm. Ironically, the merger reduces the supplier's gain from striking a bargain with the merging firms and allows the supplier to achieve a better bargain. The merged firm covers the supplier's fixed costs because they otherwise would not be incurred and the merged firm would lose the entire gain from making a bargain.[32]

Suppose five national companies own many local monopoly providers of cable television, and each of the five bargains with a content provider over payment for broadcast rights for programming that has not yet been produced.[33] The gain in subscriber revenue to each of the companies from adding this programming is $20,

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30. *See* Gregory Vistnes, *Hospitals, Mergers, and Two-Stage Competition*, 67 ANTITRUST L.J. 671 (2000).

31. United States v. Long Island Jewish Med. Ctr., 983 F. Supp. 121, 130-34, 143 (E.D.N.Y. 1997); United States v. Mercy Health Servs., 902 F. Supp. 968, 972-74, 981 (N.D. Iowa 1995), *vacated as moot*, 107 F.3d 632 (8th Cir. 1997); Evanston Nw. Healthcare Corp., FTC Docket No. 9315, 62-63, http://www.ftc.gov/os/adjpro/d9315/070806opinion.pdf. For brief discussions of five recent mergers to which the federal enforcement agencies applied a bargaining model, see MERGER GUIDELINES COMMENTARY, *supra* note 1, at 34-36. *See also* United States v. Syufy Enters., 903 F.2d 659, 669 (9th Cir. 1990) (government alleged that merger of movie theaters would allow the merged firm to bargain with film distributors for better terms); Baker, *supra* note 21, at 21-22, 24-25 (bargaining model used to explain the FTC's analysis of the effects of the merger of the Rite-Aid and Revco drug store chains).

32. *See* Alexander Raskovich, *Pivotal Buyers and Bargaining Position*, 51 J. INDUS. ECON. 405 (2003).

33. This example is adapted from Raskovich, *id.* at 407-08.

so the Nash bargaining solution is that each cable company pays $10 for the rights. With a cost of producing the programming of $40, the content provider nets $10 by licensing to all five cable companies. If the content provider's negotiations with any one of the cable companies were to break down, the content provider would still break even, so no cable company is pivotal.

The firm formed by the merger of any two of the cable companies would be pivotal because the content provider cannot break even by striking a bargain with all of the other cable companies. If the merged cable company and the content provider strike a bargain, they earn a total of $30—a $40 increase in combined subscriber revenues for the two merged cable systems, plus $30 in revenue from the three other cable companies, less $40 of production costs. The Nash bargaining solution is that each party gets half, requiring the merged cable company to pay a total of $25 for the programming in order to net $15 after accounting for the $40 increase subscriber revenues. Before the merger, each of the merging cable companies paid $10 for the programming, so the merged firm pays $5 more than the two merging firms had paid.

Before the merger, failing to strike a bargain with any one cable company cost the content provider exactly the amount that company would have paid for the programming, but after the merger, failing to strike a bargain with the merged cable company costs the content provider less than the amount the merged company would have paid for the programming. If no bargain is struck with the merged cable company, the programming is not produced and the content provider breaks even. If a bargain is struck, the programming is produced, and the content provider nets $10 less than what the merged cable company pays for the programming (revenue from other cable companies totaling $30, minus the production costs of $40).

An interesting feature of bargaining models is their implications for the pass through of cost reductions. A merger that reduces the marginal cost of supplying a customer, increases the gain to the merged firm from striking a bargain with that customer, which causes marginal-cost reductions to be partially passed through. The cost reductions typically are evenly split in the Nash bargaining solution, yielding a pass-through rate of 50 percent. In contrast to essentially all other oligopoly models, fixed-cost reductions also may be partially passed through in bargaining models, even in the short run. If a customer is large enough that there is a recurring fixed cost associated with its particular account, a merger-related reduction in that fixed cost is shared with the customer, just as a reduction in marginal cost.

4. The "fit" of auction and bargaining models

In *Daubert,* the Supreme Court declared that expert testimony is admissible only if it "is sufficiently tied to the facts of the case that it will aid the jury in resolving a factual dispute," i.e., only if there is a good "fit" between the testimony and the pertinent inquiry.[34] As one court of appeals declared, *Daubert* requires a "thorough analysis of the expert's economic model," which "should not be admitted if it does

34. Daubert v. Merrell Dow Pharms., 509 U.S. 579, 591 (1993) (quoting United States v. Downing, 753 F.2d 1224,1242 (3d Cir. 1985)).

not apply to the specific facts of the case."[35] The same discipline is appropriate outside the courtroom whenever a particular model is given significant weight in the evaluation of the likely competitive effects of a merger.[36]

To fit an industry, a model used to analyze a merger should reflect basic aspects of the competitive landscape. For example, the Cournot and Bertrand models discussed in the previous chapter do not fit an industry in which prices vary significantly across transactions (either because the product is customized to a significant extent or because of price discrimination). An auction or bargaining model, however, can easily reflect the observed price dispersion in the industry, so an auction or bargaining model may fit such an industry.

An auction or bargaining model may fit an industry quite well enough even though it does not perfectly describe the industry. An auction model may be appropriate when the merging firms compete through a process that resembles either open or sealed bidding, even if there is no formal bidding process, and even if competitors' actions are not limited to the submission of bids. In *Oracle* the defendant objected to the use of an auction model on the grounds that the customers were "extremely powerful at bargaining" and the merging sellers did "not simply 'bid' for business" but rather engaged in "negotiations [that were] extensive and prolonged, with the purchaser having complete control over information disclosure."[37] But an auctioneer has just this sort of power and control, and in any event, these objections appear to relate only to the descriptive accuracy of an auction model. Oracle did not explain why these objections provided a basis for questioning the predictive accuracy of an auction model. A model used to predict the effects of a merger must explain for the past what it is expected to predict for the future.[38] If some particular auction model did a good job at explaining the merging firm's bidding in the relevant market, it should not matter whether actual procurement procedures differ from those in the model.

One test of the fit of an auction model is how well it explains the intensity of competition as reflected in the relationship between winning bids and bidders' costs or private values. It should be possible to determine whether bidders' profits are related to their winning probabilities in the manner predicted by the model. If data on costs or values are available, it is also useful to estimate the variance of the cost or value distribution and compare that to the variance inferred from bidder profits. If such data are not available, one may still ask whether the implied variance makes

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35. Concord Boat Corp. v. Brunswick Corp., 207 F.3d 1039, 1055-56 (8th Cir. 2000).

36. *See* Gregory J. Werden, Luke M. Froeb & David T. Scheffman, *A Daubert Discipline for Merger Simulation*, ANTITRUST, Summer 2004, at 89.

37. United States v. Oracle, 331 F. Supp. 2d 1098, 1169-70, 1172 (N.D. Cal. 2004). The defendants evidently would have preferred a bargaining model, but an auction model is apt to fit better than a bargaining model, even if negotiations follow the submission of bids, when the winner is determined by the bidding process alone, or the party accepting the bids dictates the rules under which bidders compete.

38. Empirical evidence indicates that the predictions of auction models comport well with bidding in real world auctions. *See* Patrick Bajari & Lixin Ye, *Deciding Between Competition and Collusion*, 85 REV. ECON. & STAT. 971 (2003); Patrick Bajari & Ali Hortaçsu, *Are Structural Estimates of Auction Models Reasonable? Evidence from Experimental Data*, 113 J. POLIT. ECON. 703 (2005).

sense. If bidders in a procurement setting appear to have very similar costs in different procurements, an auction model may not be able to explain high observed profits.

A critical issue in evaluating the fit of an auction model relates to the manner in which the merger itself is modeled. The discussion above assumes that a merged firm submits a single bid after taking the separate draws from the cost or value distribution the merging firms would have taken. This may be an entirely sensible way to model a merger, for example, because the cost of supplying a customer depends on location, and the merged firm has all of the merging firms' locations. In some cases, however, this may be an unrealistic assumption, although it may be possible to model mergers differently, for example, as just the elimination of one of merging firms.

There is limited experience in modeling mergers with bargaining models, and less can be said about when a bargaining model in general, and any specific bargaining model in particular, is appropriate. Even if a merger clearly alters bargaining power, analysis predicated on Nash's axiomatic bargaining solution is not necessarily appropriate because it may not reflect the specific strategic bargaining game being played in the industry.