



**DIRECTORATE FOR FINANCIAL AND ENTERPRISE AFFAIRS
COMPETITION COMMITTEE**

**DAF/COMP/WD(2006)77
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ROUNDTABLE ON COMPETITION IN BIDDING MARKETS

-- Note by the US Department of Justice and the US Federal Trade Commission --

This note is jointly submitted by the US Department of Justice and the US Federal Trade Commission to the Competition Committee FOR DISCUSSION at its forthcoming meeting to be held on 18-19 October 2006.

JT03215847

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QUANTITATIVE APPROACHES TO COMPETITIVE EFFECTS IN BID MARKET MERGER INVESTIGATIONS

1. Introduction

1. In analysing proposed mergers, it is common for the economist to treat the competitive process as one where firms set a single price to all potential trading partners. In many cases, however, it is more appropriate in evaluating the merger's potential effect on competition to treat the competitive process as one involving individual bids, with the bids depending on the circumstances of each bidding opportunity. This paper is about "bid markets," and more specifically about quantitative economic approaches to evaluating proposed mergers in such markets.

2. One of the more straightforward "bid market" mergers to analyse, where (absent entry) competitive effects are likely, is when the merging parties are clearly the two lowest-cost providers of a relevant product, and the costs of the next-best competitor (if one exists) are significantly higher. For such cases, the presence or absence of competitive rivalry that exists only between the merging parties is easy to determine.

3. Real world mergers, however, typically are not so clear as these categories suggest. Merger partners may compete against one another for some customers, but not for others, and third parties may offer close substitutes for some types of customers, but not others.

4. A bid market argument, frequently made by advocates for a merger, is that there cannot be any anticompetitive effect unless a merger involves the two most dominant firms. The logic follows that of homogenous good Bertrand (price setting) competition. That is, consumers care only about price so that in equilibrium the lowest-cost provider wins the auction (or market) at a price that matches (or is slightly below) the cost of the second most efficient firm/bidder. As long as a merger does not bring together the auction winner (the most efficient firm) and the price setter (the second most efficient firm), there can be no competitive effects. Namely, the merger does not alter the identity of the winner (still the most efficient firm), or the equilibrium price (still at or slightly below the cost of the second most efficient firm).

5. The logic of this argument is simple and correct, but should be applied cautiously. Key assumptions, often left unstated by merger advocates, are that all costs are known by all bidders, and that these costs do not vary across bidding events. With variation in costs, a merger will generate competitive effects (price increases) whenever there is some chance that the merging bidders will have the two lowest costs. This is easy to see for open outcry auctions—when the merging bidders do happen to have the lowest costs, price is set not by the second most efficient firm (now part of the merged firm) but by the third most efficient firm. If the second and third most efficient firms have different costs, the merger generates a price increase in all such auctions. For sealed bid auctions in settings with uncertainty about rival bidder's costs, the argument is slightly subtler. A firm that sets its bid to maximise its expected return optimally trades off earning a high margin (submitting a bid much larger than its costs) against winning with high probability (submitting a low bid that is likely to win). Following a merger, the probability that the merged firm wins with each bid level that it contemplates using increases because the merging firms no longer compete against one another. The merged firm takes this into account when it re-optimises its bid, resulting in a higher (less competitive) bid.

6. Another key assumption in the simple bid market argument introduced above is that consumers care only about price. If products are differentiated, so that buyers select a best alternative based on product attributes in addition to price, then mergers that include a “small” firm (in terms of observed market share) can generate adverse competitive effects if the merging firms’ products have similar characteristics. This is directly analogous to differentiated products Bertrand competition, and is subject equally to the possible caveat that firms may be able to “reposition” by, in the case of bid markets, changing the product characteristics in what they offer to buyers. With differentiated products in non-bid markets, we often find competitive effects for mergers that do not include the two most dominant firms, and we should not be immediately convinced by arguments similar to the one introduced above.

7. The challenges to building an effective unilateral effects case against a proposed merger in a bid market resemble those found in non-bid market settings. One needs to establish (1) that the merging parties frequently are the two most effective competitors, and (2) that in such cases, the next best alternative is significantly less preferred than the merging parties.¹ Consider the following illustrative example. There are four firms (numbered 1, 2, 3, 4), and four consumer segments (labelled A, B, C, D). All firms have zero marginal costs (*e.g.* the product is a license to use existing software), but their products are differentiated. Suppose that consumer valuations are as in the chart below, and are common knowledge.

	A	B	C	D
Population share	45%	45%	5%	5%
v_1	1000	600	500	500
v_2	600	1000	500	500
v_3	900	899	550	400
v_4	700	900	400	550
No merger	1 wins, $p = 100$	2 wins, $p = 100$	3 wins, $p = 50$	4 wins, $p = 50$
1-2 merger	no change	no change	no change	no change
1-3 merger	1 wins, $p = 300$	no change	no change	no change
2-4 merger	no change	2 wins, $p = 101$	no change	no change

8. So for example, an A consumer values firm 1’s product at 1000, and its next most preferred product is firm 3’s (valued at 900). The “No merger” row reports the equilibrium outcome of open outcry auctions for each consumer segment. Firm 1 wins bids for A consumers because it offers the most desired product, and sets its price to make the buyer just indifferent between firm 1 and the next best alternative (firm 3). Since firm 3’s product generates 100 less in value to the consumer, firm 1 submits this difference as its bid and wins the auction. This example illustrates the following points:

1. Despite having a combined 90% share of consumers, a merger of firms 1 and 2 generates no competitive effects because these firms are never the two most preferred alternatives. When one of them is most preferred, firm 3 or 4 is second best. There is no head-to-head competition between firms 1 and 2.

¹ In addition, one needs to establish that entry and/or product repositioning by other firms is difficult, and to take account of any cognisable, merger-specific efficiencies.

2. Following a merger of firms 1 and 3, the price paid by A consumers rises from 100 to 300. While firm 1's product is still most preferred, the merged firm does not submit a separate bid for firm 2's product, so post-merger the best alternative to firm 1 for the consumer is firm 4 (whose product is worth 200 less to the consumer than firm 3's product).
3. Following a merger of firms 1 and 3, the price paid by C consumers does not change, even though the merging parties can be considered the two best alternatives. This follows because the next best alternative to the merging parties is as desirable as the second best alternative. That is, pre-merger firm 3 won the auction and could charge 50 because the next best alternative (firms 2 and 3) was worth 50 less to the consumer. Post-merger, the next best alternative (firm 2) is still worth 50 less to the consumer, so the merged firm cannot raise price.²

9. The kind of analysis set forth in this paper could apply to a variety of settings. For example, in the market for financial management software used by firms, customers typically go through a long process to identify best solutions and negotiate terms. Salespeople may need to submit to a supervisor a discount approval form, which would include information about other potential sellers for a particular buyer's business, before offering a discount to that buyer. Given that discounts are frequently provided to individual customers based on the presence of competing offers, these markets can be thought of as bid markets.

10. Another example is the market for "school milk" – fluid milk that is packaged and sold via contract to school districts. School milk is an undifferentiated product, and buyers care only about price. The main features that differentiate bidders are their physical location, and their volume of other dairy business in/near a given school district. Dairies located near a school district have lower transportation costs, and therefore are likely to be more effective competitors. Furthermore, dairies that deliver to commercial customers near a school district typically will have lower costs because they can add a school district's milk to a delivery truck route that is already in the neighbourhood. On the buyer side, school districts differ in size (volume of milk consumed), as well as in the distance required to serve all of the district's schools.

11. The remaining sections of this paper discuss various quantitative approaches that can be used in investigations of proposed mergers in bid market settings.

2. Frequency Analysis

12. Perhaps the most important step in developing a case to challenge a proposed merger among "bid market firms" is to establish that the merger partners actually compete against one another. One initial approach is to examine a large number, or all, sales of a relevant product and calculate how frequently the merging parties face each other. Such information, for example, can take the form of bids submitted to buyers that employ an auction (*e.g.* school districts purchasing milk), or party documents requesting approval to improve an offer to a buyer that is negotiating with several suppliers (*e.g.* software salespersons completing a discount approval form before offering a lower price to a prospective customer).

13. Advocates for a merger may respond to this approach by arguing that the analysis should include not just firms that actually submitted bids, but also some other firms that could have submitted bids, but

² This point is also illustrated by the "2-4 merger" row. Only B consumers are harmed, but the magnitude of the price increase is small (price rises from 100 to 101) because the third best alternative (firm 3) is a pretty close substitute for the second best alternative (firm 4).

chose not to.³ Suppose, for example, that geographic distance to a consumer is a key factor in determining the competitiveness of a supplier. If one observes variation in bid participation that does not follow geographic patterns—*e.g.* firm 1 does not bid for customer A, but does submit bids to customers located in a geographic ring surrounding customer A—then perhaps firm 1 should be included as a competitor for customer A. Data that describes several procurements for a given customer can help counter this argument. That is, data demonstrating that firm 1 never bids for customer A provides additional support for the conclusion that firm 1 should not be included as a market participant for customer A.⁴

14. The Federal Trade Commission used Frequency Analysis in a recent case involving bidding in four markets, field-erected LNG storage tanks, field-erected LPG storage tanks, field-erected LIN/LOX tanks, and field-erected thermal vacuum chambers. In all four markets, the two merging firms, Chicago Bridge and Iron (CBI) and Pitt-Des Moines (PDM), won the majority of the bids from 1990 to 2001, the time of the acquisition: In the field-erected LNG storage tank market, CBI and PDM won all of the bids between 1990 and 2001. The Commission noted that both customer opinion and the parties' own documents indicated that CBI and PDM were the two strongest competitors in the four markets. While the parties argued that other firms (especially large foreign construction companies) could easily enter these markets, the Commission found that various entry barriers would prevent such firms from restoring the competition lost from the merger.

15. In examining the merger of BP Amoco with ARCo, the Federal Trade Commission examined the market for bidding for new oil development tracts on both state and Federal lands in the Alaska North Slope oil fields. The Commission reviewed the bidding history for a ten-year period and found that BP Amoco and ARCo were the two highest bidders in 71 percent of the auctions in the year prior to the merger's announcement and that they had been the highest bidders in a majority of auctions for the earlier years. Bids were lower in auctions where only one of the two bid. The Commission argued that the two companies possessed unique geological knowledge and extensive infrastructure from having pioneered the oil field and that no other competitor would be able to replace the competition lost by the two firms merging. The Commission's complaint was resolved by a consent decree in which the firm's agreed to sell ARCo's Alaskan interests to Phillips Petroleum.

3. Regressions

16. While the frequency analysis described above may be informative about the rivalry between merging parties, it can be criticised for not establishing the magnitude of any anticompetitive price effects. If each bidding competition were to include a third party whose product is an extremely close substitute to at least one of the merging parties, then, all else equal, the merger is unlikely to generate substantial anticompetitive price effects. One approach to quantifying the size of price effects is to use linear regression to estimate prices paid (or discounts offered) as a function of which firms submit bids and buyer characteristics.

17. Before discussing specific regressions, a brief discussion about data is warranted. For buyers that use a sealed bid auction, information about all bidders often will be available. At a basic level, studying the

³ This is analogous to the argument in markets with posted prices that an attempt to exercise market power (by raising price or submitting higher bids) will invite entry by firms that currently have no sales (or who have not submitted bids).

⁴ Another potential complicating factor is that sellers may improve offers for a collection of products and services that extends beyond the relevant products of a merger investigation. That is, while the competition authorities may be potentially concerned about product *x*, one of the merging parties may be offering discounts to a customer looking to purchase (*x*, *y*, *z*). In such cases, should the competition authority infer that the discount was due solely, or only partly, to competition for the sale of *x*?

identities of the two lowest bidders, as well as the difference of the second and third lowest bids should indicate (1) whether the merging parties compete against one another, and (2) whether the next best competitor is a close substitute.

18. Frequently, however, buyers do not employ a formal auction process to solicit bids from competing suppliers. That is, a buyer may simultaneously negotiate with multiple sellers, playing them off of one another in order to obtain the best price. In such settings, the data gathered by competition authorities typically will not include information about every competitor's "best and final offer". So for example, a buyer may play firms 1 and 2 off of one another to obtain the best price, but not engage firm 3. Such a buyer may suffer if firms 1 and 2 were to merge, but the data available to the competition authority may be uninformative about whether an alternative supplier exists, or how close a substitute that alternative may be.⁵

19. Let us now turn to a couple of linear regression specifications (among a large number of possibilities) for the proposed merger of two firms that we will (unimaginatively) label firm 1 and firm 2. Suppose that buyers do not employ sealed bid auctions, but simultaneously negotiate with multiple suppliers in order to obtain the best price. Given this manner of selling, firm 1 requires salespersons to justify offering price concessions on a standard form. As part of its merger review, the competition authority has obtained all such completed forms as part in its document/data request.

20. One specification tries to explain the final percentage discount off of list price that firm 1 makes to one of its customers as a function of which other firms participate, and characteristics of the product(s) being purchased⁶:

$$\text{Discount} = b_2 \text{ FIRM2} + b_3 \text{ FIRM3} + b_4 \text{ FIRM4} + \text{product characteristics}$$

Here the *FIRM* terms are dummy variables that indicate whether one of firm 1's rivals appeared on the discount approval form, that is, if firm 2 was mentioned then *FIRM2* = 1, otherwise *FIRM2* = 0. If the discount is expressed in percentage terms, then the *b2* coefficient can be interpreted as the typical additional discount that firm 1 offers when it competes against firm 2.

21. What should the analyst infer from the estimated coefficients of such regressions? Is the magnitude of *b2* a measure of competitive effects for the merger of firms 1 and 2? Or, like the frequency analysis above, is this just additional evidence that the merging parties compete against one another? The answer depends on what information one believes is contained in the discount approval forms.

22. One view is that discount approval forms include the names of all rivals that are (or could be) serious competitors for the sale in question. Provided that the predicted price increase does not induce entry, the magnitude of *b2* may be a reasonable, or even conservative, predicted price effect. Post-merger,

⁵ An analogy can be drawn to open outcry auctions. Imagine sitting among the bidders at an auction house during a fine art sale. One may be able to observe which bidders improve the price for a painting, as well as how the price changes during the auction. Presumably, the final price is at a level that the second strongest bidder is just indifferent to winning or losing. It is unlikely, however, that an auction observer will always be able to ascertain the price at which the third strongest bidder dropped out. In merger reviews, the competition authority may be able to assemble documents and data that provide some information about how a bid evolved, but for similar reasons may not have precise information about the third best alternative.

⁶ If one were able to include all relevant product characteristics as variables on the right hand side of the equation one might, as an alternative to using the size of the discount, use price level as the dependent variable.

each competition would include the same set of bidders minus firm 2.⁷ If firms do not alter their bidding or negotiating strategies, then a merger of firms 1 and 2 is equivalent to having the firm 2 dummy variable switch from “1” to “0” while all other explanatory variables remain at their pre-merger levels. Thus the coefficient on *FIRM2* is a measure of competitive effects.⁸ One should expect an even larger price effect, to the degree that the merger induces firms to bid or negotiate less aggressively.

23. Suppose, instead, that a sale to a customer proceeds in a manner similar to an open outcry auction, and that the discount approval forms record only the name of the last remaining rival bidder. That is, while we know the name of the last rival to leave the auction, there may be other bidders that left at an earlier phase. Under this scenario, the *FIRM2* coefficient by itself likely overstates the competitive effect. This is because, without any other change in the identities of firms participating in any given bidding competition, a hypothetical firm 1/firm 2 merger would switch the *FIRM2* variable off (from “1” to “0”) and switch another firm indicator variable on (from “0” to “1”) in many cases.⁹ So for example, if one assumed, perhaps unrealistically, that firm 3 would replace firm 2 on every firm 1/firm 2 competition, then the predicted effect would be a price increase of b_2 (firm 2 leaves the auction) *minus* b_3 (firm 3 “enters”) for a net effect of $b_2 - b_3$.¹⁰ Note that firm 3 has not actually entered the competition—it was there all along—it simply has “entered” the discount approval form to fill the void caused by firm 2’s absence.

24. This discussion illustrates a challenge in developing a case to block a merger when the firms compete in bid markets that are not sealed bid auctions. As discussed in the introduction, assessing competitive effects in such environments requires information about how often the merger partners are the most effective competitors (lowest cost and/or most desirable product), as well as information about how close the next best alternative is. When a buyer plays bidders off of one another as in an open outcry auction, data obtained from the parties may include only the transaction price and the identity of the winning bidder.¹¹ In some cases, there may be additional information about which firms were in the running toward the end of the competition. Another complicating factor is that a buyer’s bid evaluation may include non-price characteristics that are hard for an econometrician, working at a competition agency or elsewhere, to track.

25. Another type of regression, among many, explains price as a function of the number of bidders and buyer characteristics:

$$\text{Price} = \text{number of bidders} + \text{buyer characteristics}$$

⁷ Of course, the merger only has an effect for competitions in which firms 1 and 2 would have been active, absent the merger.

⁸ This approach uses the discount approval forms from firm 1 for customers that ultimately purchased from firm 1. It does not attempt to make specific predictions about discounts offered to customers that ultimately bought from firm 2. Presumably, that would require the use of similar data from firm 2.

⁹ The only instances when another firm dummy variable would not change from 0 to 1 are customers for which the merger is literally a merger to monopoly. For such cases, the discount approval form would list all rivals of firm 1 participating in that competition (*i.e.* just firm 2), and the analysis of the preceding paragraph would apply.

¹⁰ A more reasonable assumption about post-merger bidding behavior may be that rival firms replace firm 2 on the discount approval forms at the same rate that they appear pre-merger (*e.g.* if firm 3 is mentioned on 1/2 of the discount approval forms that do not mention firm 2, then *FIRM3* should change from 0 to 1/2, and similarly for other rival firms).

¹¹ While one may be able to assemble additional bid information from the buyers themselves, such buyers may not retain precise information about the third best alternative. After all, they need only identify the two best alternatives and have them compete against one another to obtain the best price.

This general form is best used when the analyst has reliable information about the number of bidders, and thus is appropriate when buyers employ sealed bid auctions.

26. With respect to the number of bidders, it is often worthwhile to employ a set of dummy variables that indicate the number of bids submitted. Using such a set of dummy variables allows for the second bidder and the third bidder to have different effects on the price. In contrast, a specification that includes the number of bidders in a single variable implicitly assumes that each additional bidder changes the observed price by the same amount. We would expect, however, that the second bidder has a larger impact than the fifth or sixth bidder.¹²

27. Buyer characteristics include factors that affect bidder costs. These may include size of the contract in order to capture possible economies or diseconomies of scale. If geographic distance between buyer and seller is important, distance to the closest potential sellers can also be included.¹³

28. If the data include observations over a period of time in which supplier costs have changed (e.g. input costs, fuel), including a set of time dummy variables can control for such changes.¹⁴

A few comments about this type of regression:

1. Observe that in contrast to the previous specification, bidder identities are not included here. The only manner in which bidder-specific attributes enter is via buyer-specific attributes. The implicit assumption here is that the number of bidders, and not their identities, affects prices. This is valid for settings in which the relevant products are undifferentiated (e.g. milk). In the school milk setting, the distance from a given school district to each of some number of closest dairies could be included in the buyer characteristics. If dairies have significantly different costs, say due to more efficient plant equipment or more fuel-efficient trucks, then this specification may not accurately reflect the competitive environment. An advantage to this approach is that one can use the regression results to predict post-merger price effects in a manner that allows a rival dairy to have different effects across different school districts. This permits one to predict which customers are most likely to suffer an anticompetitive price effect, as well as identify which rivals are most likely to provide competitive discipline on a customer-by-customer basis.
2. If buyer characteristic variables that describe distance have small or insignificant coefficients, this suggests that geographic location may not be important for competition. If this is true, more distant suppliers—ones that currently do not submit bids to buyers located near the merging firms—may be capable of submitting competitive bids if the merged firm were to attempt to exercise market power. This suggests that such distant suppliers might need to be included as market participants.

¹² The econometric literature suggests such a non-linear relationship. See Susan Athey and Philip A. Haile (2002) “Identification of Standard Auction Models,” *Econometrica* for example.

¹³ In the case of school milk, buyer characteristics might include school district size (number of lunches served), distance to some number of closest dairies, and the driving distance required to visit every school in the school district.

¹⁴ School milk auctions typically occur in the late summer of each year. Thus, each dairy likely makes its bidding decisions for all school districts in a given year using the same forecasts about raw milk and fuel costs. Given this, year dummy variables accurately capture potential cost shifters.

3. Specifications that regress price (or discount) on a set of variables that include number of bidders (via a single variable or set of dummy variables) or the identity of participating firms are useful only to the degree that the analyst has controlled for characteristics that affect the desirability of winning the auction. If a specification does not control for important features, then a finding that more bidders generates better prices may be due largely to underlying features of the object for sale rather than to competition. In such cases, predicted price effects will overstate actual effects.

29. Consider the following illustrative example. Suppose that a government uses an auction to sell the right to extract minerals from various parcels of land, and that firms' valuations of such rights depends on characteristics like how hard the ground is (affects drilling costs) and seismographic readings. In addition, assume that the government has set a minimum price for each tract, or that bid preparation is costly, so that bidders do not necessarily participate in every auction. An analyst examining the bid data may find that prices were very high for parcels that had many bidders and therefore conclude that competition between bidders had a large price effect. Armed with this finding, the analyst may recommend blocking a proposed merger. If, however, the seismographic information suggests the presence of an extremely valuable mineral deposit, and the ground is easy to drill, high prices and many bidders may be due, in part or totally, to these attributes of the object for sale rather than to competitive forces.¹⁵ Consider an extreme example: an industry-wide cartel forms and submits a bid above the reserve price only on parcels of land with seismographic data that predicts deposits above a certain expected monetary value. A naïve examination of the results would suggest that sale prices increase when the number of bidders increases (from 0 to 1), so therefore competition (the number of bidders) matters. Yet there is no competition at all in this example. Price differences are driven entirely by underlying characteristics of the objects for sale.¹⁶

30. Applying this general comment to the school milk hypothetical raises the question, "Are there any other school milk contract attributes (besides district size and location attributes) that can significantly affect the contract's value to dairies?" If regressions of the type described above are to be useful for measuring competitive effects, the answer generally should be no. One can also ask the question for our initial specification as used in the software case. There the dependent variable in the regression was percentage discount off of an initial price rather than price paid. To the degree that the software firms' initial prices (before offering any discounts) capture all of the important features of the sales opportunity (e.g. buyer characteristics, including how well the supplier's product works for the buyer), using discounts rather than prices sidesteps this problem of overstated competitive effects. If initial prices fail to account for all such factors, then this type of omitted variables problem may appear.

¹⁵ More generally, economic theory suggests that in "private value" auctions there will be a clear (although non-linear) positive relationship between price and the number of bidders. However, in common value auctions there may be no such clear relationship. Private value auctions are auctions in which each bidder's valuation of the object would remain unchanged if the bidder observed information about another bidder's valuation of the object. A common value auction is one in which this is not the case. See Susan Athey and Philip A. Haile (2002) "Identification of Standard Auction Models," *Econometrica* and Phillip A. Haile, Han Hong, and Matt Shum (2003): "Nonparametric Tests for Common Values in First-Price Sealed-Bid Auctions," NBER Working Paper 10105.

¹⁶ Of course, a cartel operating in this manner likely would look suspicious to competition authorities. To counter this, cartel members may submit additional phony bids in order to make the bidding appear more competitive. This can further complicate the interpretation of the coefficient on the number of bidders variable as a competitive effect.

4. Other ideas

31. We conclude by briefly discussing some other bid market ideas.

4.1 *Natural experiments*

32. Some cases may include “natural experiments” that can be informative about competitive effects. Imagine, for example, that in a proposed milk merger one of the merging parties had been “debarred” – legally prohibited from bidding for some school milk contracts – for a period of time. Did milk prices fall after the debarred firm re-entered? Imagine that while milk prices have generally increased since the time period of the debarment, the price increase in districts where the debarred firm “re-entered” are smaller in magnitude than the corresponding price changes in school districts that the debarred firm did not re-enter. This suggests that the debarred firm has a competitive effect in school milk markets.

4.2 *Structural approaches.*

33. The quantitative approaches presented here have been reduced form—looking to establish relationships between price and competition without attempting to recover the underlying distribution of firm costs that induces the observed pattern of bids. An alternative is the structural approach that attempts to estimate the underlying cost distribution, as well as the equilibrium bidding strategy (how a firm should bid given its draw from a cost distribution).

34. Although difficult, structural estimation can have some advantages. One of the most difficult issues for quantitative analysis of bidding markets is modelling the determinants of the number of bidders. For example, if unobserved characteristics cause a project to be a simple low cost one, then those characteristics may induce lots of bidders who bid relatively low. That would induce a negative correlation between bid price and number of bidders. However, that negative correlation would not be an appropriate measure of the effect of the number of bidders on competition and indeed would overstate it.

35. One approach to separate out the forces of competition (i.e., having one more potential bidder) from the forces that determine the number of actual bidders (conditional on the number of potential bidders) is structural estimation of underlying cost distributions. There is a small but growing auction literature that has made some progress in successfully estimating the underlying structure under some special assumptions. These types of analyses are on the frontiers of quantitative research.¹⁷

4.3 *Auction simulation.*

36. An alternative method of measuring competitive effects is to assume a flexible form for the cost distributions of firms and calibrate the model to fit pre-merger market shares under the assumption that the firm-specific portions of costs are independently distributed. In sharp contrast to structural approaches, merger simulation in auction settings does not require a great deal of data. Firms that win many bids are assumed to be more efficient on average (draw their costs from a more favourable distribution). If one

¹⁷ Recent examples include Patrick Bajari and Ali Hortacsu (2003), “Winner’s Curse, Reserve Prices and Endogenous Entry: Empirical insights from eBay auctions,” *RAND Journal of Economics*, Unjy Song (2003), “Nonparametric Estimation of an eBay Auction Model with an Unknown Number of Bidders,” unpublished working paper, and Christopher P. Adams (2006), “Estimating Demand from eBay Prices,” unpublished working paper. Methods for non-parametric estimation of auction models using bid data are presented in Susan Athey and Philip A. Haile (2002) “Identification of Standard Auction Models,” *Econometrica*. For a survey, consult Ken Hendricks, and Robert H. Porter, “An Empirical Perspective on Auctions,” forthcoming in *Handbook of Industrial Organization* (Vol. III), edited by Armstrong and Porter, available at: <http://www.csio.econ.northwestern.edu/Papers/2006/CSIO-WP-0078.pdf>.

makes an additional assumption about the fraction of the gross value of the product that accrues to the buyer, one can use the fitted model to calculate expected price effects. In the simulation, cost distributions for third parties do not change while the merged firm's costs are now the minimum of firm 1's cost draw and firm 2's cost draw. Since simulation exercises typically rely on small amounts of data (a benefit of this approach), the selection of functional form can have a large effect on the predicted price effects (a drawback of this approach). Given this, analysts should confirm that their predictions are robust across a range of parameter values and/or functional forms.

4.4 *Coordinated effects.*

37. This discussion paper has focused on unilateral effects. Mergers in bid markets can also generate coordinated effects. As in non-bid markets, a challenge to proving this type of harm is establishing that the merger matters. That is, merger-induced coordinated effects require firms not to be colluding pre-merger and becoming able to post-merger, or alternatively, firms that were colluding pre-merger become better colluders post-merger. In other words, does the elimination of an independent bidder make collusion more feasible?

38. Evidence assembled for a coordinated effects case often is qualitative rather than quantitative. One such approach is the "checklist" of market factors conducive to collusion.¹⁸ Shortcomings of this approach are that the factors are neither necessary nor sufficient for collusion to occur, and real world cases generally will have some factors present and other factors absent. For such real-world cases, employing this approach requires subjectively weighting the factors to determine which of them are important for promoting collusion.

39. Following the analysis of repeated games, quantitative approaches to assessing coordinated effects have often focused on whether the critical discount factor required to sustain tacit collusion declines substantially post-merger. For example, with estimates of collusive profits, competitive profits, and cheating profits, one might find that pre-merger, the discount factor δ required to sustain collusion among all market participants must satisfy $\delta \geq .9$, and that following the elimination of one market participant via merger, this constraint is relaxed to $\delta \geq .8$. The interpretation here is that collusion is more likely because post-merger there are more discount factors ($.8 \leq \delta < .9$) that support collusion.¹⁹ Such approaches typically only consider the formation of an industry-wide cartel, and do not attempt to verify whether the oligopolists' discount factors are in the appropriate range.²⁰

40. A complimentary approach is to use merger simulation to focus on the potential gains from collusion in a static game. If collusion would not significantly increase profits pre-merger, but does so post-merger, then one may conclude that market participants have greater incentive to solve the problems associated with forming and maintaining a collusive agreement. This quantitative approach, like others that

¹⁸ One source for this approach is Richard Posner, *Antitrust Law: An Economic Perspective* (2001). See also the discussion in Andrew R. Dick, "Coordinated Interaction: Pre-Merger Constraints and Post-Merger Effects," *George Mason Law Review* 12 (2003).

¹⁹ Of course, if $\delta < .8$, then this type of collusion is infeasible pre- and post- merger, and if $\delta \geq .9$, then the analysis suggests collusion is feasible pre- and post-merger. This method of analysis, then, suggests the possibility of coordinated effects (induced by a merger) only for discount factors satisfying $.8 \leq \delta < .9$. More complicated versions of this mode of analysis compute a specific critical discount factor for each market participant.

²⁰ For a discussion of some of the related literature, as well as a presentation of one such approach in a differentiated product Bertrand setting, consult Pierluigi Sabbatini, "How to simulate the coordinated effect of a merger," *Autorita Garante Della Concorrenza e Del Mercato, Temi e Problemi* volume 12 (2006).

address coordinated effects, does not provide a sharp prediction about when mergers will induce collusion or worsen a collusion problem.²¹

²¹ For one approach, including a discussion of the *Arch Coal* bid market merger investigated by the Federal Trade Commission, consult William E. Kovacic *et al* (2006) “Quantitative Analysis of Coordinated Effects” available: <http://faculty.fuqua.duke.edu/~marx/bio/papers/QACE1.pdf>.