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Alive and Clicking: Collusion Theories in Merger Analysis at the Federal Trade Commission

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ALIVE AND CLICKING: COLLUSION THEORIES IN MERGER ANALYSIS AT THE FEDERAL TRADE COMMISSION

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ABSTRACT:

This paper explores the use of collusion theories in merger analysis at the U.S. Federal Trade Commission (“FTC”). The 1992 Merger Guidelines (“Guidelines”) focused more on unilateral effects concerns, relegating collusion analysis to a second-tier theory. That said, both structural and behavioral conditions conducive to establishing or maintaining an arrangement to restrict competition were listed in the Guidelines to structure collusion analysis. This paper undertakes a systematic review of 75 merger decisions to identify the conditions that increase the likelihood of a collusion finding. Standard structural concerns are readily identified, while behavioral factors defy characterization. The results of the analysis also support a Folk Theorem in which structural concerns are validated with some type of performance evidence. Further work finds that allegations of maverick conduct add little to the analysis, while the Bush administration appears to have been slightly more likely to identify a collusion problem than the Clinton administration.

I. INTRODUCTION

The 1992 revision of the *Merger Guidelines*¹ accepted the burden to move beyond a structural checklist and tell a logical story that links a competitive effect of concern to the consummation

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¹ U.S. Department of Justice and Federal Trade Commission, *Horizontal Merger Guidelines*, ANTITRUST TRADE REG. REPORT 1559 (1992).

of a proposed merger.² Two lines of analysis were given, one based on a traditional collusion theory (re-branded as “coordinated interaction”) and the other tied to anticompetitive activity that the merged firm could undertake independently (“unilateral effects”). This evolution was inevitable in light of the continual decline in the breadth of the *Philadelphia National Bank* (“PNB”) structural presumption.³ In 1990, the appellate court in *Baker Hughes* concluded that the PNB presumption could be offset with evidence on a wide range of pro-competitive considerations.⁴ Once the respondent presented some evidence compatible with a pro-competitive outcome for the merger, the plaintiff had to prove a likely competitive concern stemming from the merger. Thus, to prevail on the merits, the plaintiff needed evidence. To structure this evidence, it needed a story.

A careful review of Guidelines-based enforcement would conclude that the new unilateral effects theory defined the enforcer’s leading story

A careful review of Guidelines-based enforcement would conclude that the new unilateral effects theory defined the enforcer’s leading story.⁵ For a unilateral effects theory, the government only had to introduce evidence on a unique similarity for the merged firm’s products, given a limited number of rivals. If this information was lacking, simple market share evidence could establish a presumption. In effect, unilateral effects might end up as nothing more than a structuralist model underpinned with a veneer of economic authority.⁶ Collusion analysis was demoted to a second-tier theory, as that analysis was

² Paul Denis, *Advances of the 1992 Horizontal Merger Guidelines in the Analysis of Competitive Effect*, 38(3) ANTITRUST BULL. 479-515 (1993).

³ *U.S. v. Philadelphia National Bank*, 374 U.S. 321 (1963). For a useful commentary on the decline of the Philadelphia National Bank presumption, see Jonathan Baker, *Mavericks, Mergers, and Exclusion: Proving Coordinated Effects Under the Antitrust Laws*, 77 NYU L. REV. 135-201 (2002).

⁴ *U.S. v. Baker Hughes Inc.*, 731 F.Supp. 3 (D.D.C. 1990), *aff’d* 908 F.2d 981 (D.C. Cir. 1990).

⁵ See, e.g., Robert Lande & James Langenfeld, *The Evolution of Federal Merger Policy*, 11(2) ANTITRUST 5-9 (1997); or Jonathan Baker, *Why Did the Antitrust Agencies Embrace Unilateral Effects?*, 12(1) GEO. MASON L. REV. 31-37 (2003).

⁶ See, e.g., Robert D. Willig, *Merger Analysis, Industrial Organization Theory and Merger Guidelines*, in BROOKINGS PAPERS: MICROECONOMICS 281-332 (Brookings Institution, 1991); or Gregory J. Werden & Luke M. Froeb, *The Effects of Mergers in Differentiated Products Industries: Logit Demand and Merger Policy*, 10(2) J.L. ECON. & ORG. 407-26 (2004). These models link structure to performance by assuming away a wide range of real-world complications. The models may be appropriate in special case situations, but fall short of general models of the competitive process. For example, the models require the producing firm to post price, rather than negotiate on terms of trade. Likewise, the models presume the firms are locked into a specific product portfolio. For a critical overview, see Malcolm B. Coate, *Efficiencies in Merger Analysis: An Institutionalist View*, 13 GEO. MASON SUP. CT. ECON. REV. 189-240 (2005).

generally qualitative, often discussing factors summarized in Posner (1976) and (2001).⁷ While the maverick model had long been mentioned as a viable empirical structure for the coordinated interaction analysis, the bulk of the Guidelines focused on generic models of coordination. Without a clear model of collusion, it was hard to know when one had “enough” evidence.

With roughly 15 years of experience under the 1992 *Merger Guidelines*, it is possible to study the implementation of the coordinated interaction policy with a systematic review of the relevant enforcement decisions undertaken for a set of mergers filed between 1993 and 2005. By limiting the study to coordinated interaction cases, it is possible to build on a 2007 paper by Davies, Olczak, and Coles, and use the enforcement decisions to create a model of coordinated interaction.⁸ As long as the investigations with easy entry are deleted from the sample, the enforcement decision and the conclusion on the ease of collusion are the same. A number of structural variables are readily available to build a Posnerian model of collusion. Moreover, the structural model can be supplemented with a performance-based effects variable to test the importance of evidence related to various explicit or implicit natural experiments. If the natural experiment evidence matters, then theoretical analysis of ease of collusion may take a back seat to natural experiments in predicting merger effects. Finally, the model can be expanded to (1) determine if claims of maverick status are relevant and (2) identify any political influence on the analysis.

Overall, the results are broadly compatible with Posner’s structural theory and support the importance of natural experiment evidence. A small positive effect for the Bush administration is identified, but no pure maverick effect appears to exist. In court, natural experiment evidence should assist a plaintiff in meeting its burden of proof, a task that has been difficult in recent unilateral effects cases.⁹ Section II of this paper provides an introduction to early oligopoly (collusion) theory, with a specific focus on Stigler’s contribution. It also introduces concepts from modern game theory. Section III presents an overview of the impact of economics on the *Merger Guidelines*. A review of the FTC’s case files highlights the role of natural experiment evidence in the enforcement process. The basic modeling is presented in section IV, with the statistical results in section V. Section VI concludes.

⁷ RICHARD A. POSNER, *ANTITRUST LAW: AN ECONOMIC PERSPECTIVE* (1976) (2nd ed. 2001).

⁸ Stephen Davies et al., *Tacit Collusion, Firm Asymmetries and Numbers: Evidence from EC Merger Cases* (unpublished manuscript) (2007).

⁹ See, e.g., *U.S. v. Sungard* 172 F. Supp. 2d 172 (D.D.C. 2001); or *U.S. v. Oracle*, 331 F. Supp. 2d 1098 (N.D. Cal. 2004).

II. ECONOMICS OF OLIGOPOLISTIC COLLUSION

Oligopoly has a long history, predating the formalization of economics. Schumpeter traced the term “oligopoly” to Saint Thomas Moore’s 1516 book, *Utopia*.¹⁰ Cournot structured the oligopoly concept by postulating firms simply assumed their rivals would hold output fixed, regardless of what the firm in question did.¹¹ This assumption allowed market equilibrium to be computed at a price between the monopoly and competitive level. Chamberlin linked the oligopoly market equilibrium to “recognized mutual dependence.”¹² After first touching on the Cournot and Bertrand structures, Chamberlin posited oligopolists would assume their actions affect the responses of their rivals and that they take that conclusion into account in setting price. When this interdependence was completely recognized, profit-maximization behavior generated a monopoly outcome.¹³ Uncertainty could generate less perfect recognition and thus lower prices, although this tacit coordination would generally allow oligopolistic (collusive) firms to raise price well above the competitive level. Market concentration, on its own, seemed problematic. Stigler’s model of collusion showed how market interactions were really much more complex, with a wide range of factors affecting the likelihood of collusion. Modern game theory formalized the basic Stigler insights.¹⁴ These developments are discussed below.

A. Chicago Analysis

Stigler’s 1964 analysis represented a huge innovation in collusion (oligopoly) theory as the model detailed various conditions that made interdependent pricing more or less likely. After making the initial point that product homogeneity plays an important role in the development of a collusive pricing scheme, Stigler advanced the idea that cartel participants can track changes in sales patterns to detect (and thus deter) competitive pricing in the marketplace. Stigler’s model suggests that detection of competitive conduct is easiest when information on prices and sales is readily available. It is also possible to infer competitive conduct from the totality

¹⁰ JOSEPH SCHUMPETER, *HISTORY OF ECONOMIC ANALYSIS* (1954); and THOMAS MOORE, *UTOPIA* (1516). Thomas Moore was sainted as he died a martyr for the Catholic Church in 1535. Reading a few pages of the English translation of the book, *Utopia*, clearly suggests that the book has little to do with neoclassical economic theory. Adam Smith’s position as the first modern economist appears secure.

¹¹ AUGUSTIN COURNOT, *RESEARCHES INTO THE MATHEMATICAL PRINCIPLES OF THE THEORY OF WEALTH* (1838) (Eng. trans. 1971).

¹² EDWARD CHAMBERLIN, *THE THEORY OF MONOPOLISTIC COMPETITION* (1933).

¹³ *Id.* at 54.

¹⁴ George Stigler, *A Theory of Oligopoly*, 72(1) J. POL. ECON. 44-61 (1964).

Game theory offers a mathematical characterization for the oligopolistic interactions among firms

of the evidence. Such an inference is more likely when the number of buyers served by each competitor is relatively large (numerous customers switching leads to inference of discount pricing, even though little market share is lost), the market is relatively stable (buyers grow or shrink slowly, so they are

less likely to switch suppliers for reasons unrelated to discounts), and the industry is relatively static (few new buyers exist to disrupt historical business relationships). If competitive conduct is readily identified, it is less likely to occur.

Stigler's theory clearly identified the two considerations associated with coordinated interaction concerns. First, the incumbents must be able to converge to a joint course of conduct to elevate price above the competitive level. Second, the incumbents require a mechanism to detect (and then punish) deviations from the arrangement to increase the probability that all participants abide by the chosen course of conduct. Understanding the structure of the firms, the fundamentals of the market transaction, and the information available to competitors is shown to be necessary to model the ease of collusion. Finally, the model retains a dynamic flavor as conditions that upset the collusive equilibrium (e.g., entry, growth, and innovation) are thought to make persistence of non-competitive pricing less likely. These core ideas are repeated in more modern characterizations of the collusion problem.

B. Post-Chicago Game Theoretic Analysis

Game theory offers a mathematical characterization for the oligopolistic interactions among firms.¹⁵ Before providing an overview, it is necessary to introduce the models through which game theory represents the competitive process. The standard competitive baseline for both homogenous and differentiated goods is the one-shot Nash-Bertrand price-setting game. In a homogeneous market, with comparable cost conditions, the perfectly competitive equilibrium is generated as firms simply cannot raise price above the marginal cost, while in a differentiated goods market, firms unilaterally price above marginal costs to cover the fixed costs associated with the differentiation. Supra-normal profits are eliminated by entry.¹⁶ The Cournot

¹⁵ Carl Shapiro, *Theories of Oligopolistic Behavior*, in *HANDBOOK OF INDUSTRIAL ORGANIZATION* (Schmalensee & Willig, eds. 1989); and DENNIS CARLTON & JEFFREY PERLOFF, *MODERN INDUSTRIAL ORGANIZATION* (2000).

¹⁶ Mergers that fall short of monopoly may have no effect for the homogeneous goods market, but may allow a material price increase for a differentiated good. This non-cooperative price increase for differentiated goods markets represents the core of the unilateral effects concern introduced in the 1992 *Merger Guidelines*, although more detailed analysis must ensure (1) the model actually represents reality, (2) the price effect is material, and (3) repositioning of other rivals is unable to offset the price increase.

regime represents a secondary structure relevant to situations in which the firms (with homogenous goods) compete by setting output levels. Under these conditions, firms would restrict output below the competitive level and force price up. Again, entry could eliminate the supra-normal profits.¹⁷

Game theory illustrates just how difficult collusion is to prove

The possibility for collusion is usually modeled through the use of punishment strategies integrated into infinitely repeated games (“supergames”) in which oligopolists compete in period after period. Technically, the strategies remain noncooperative as each firm unilaterally chooses to implement the punishment tactics. However, the interactive process implicit in the supergame represents almost a textbook characterization of tacit collusion (or mutual dependence recognized), so economists cannot help but characterize these non-cooperative games as collusive. Supergames allow for an infinite number of equilibriums, and lead to the Folk Theorem of Oligopoly: collusive equilibriums are sustainable for some set of parameters. Of course, competitive equilibriums are also possible, leading to another characterization of the Folk Theorem: competitive equilibriums are sustainable for some set of parameters. While economists could add complexities to try to eliminate the plethora of equilibriums, the problem remains that games could also be restructured to generate any desired theoretical equilibrium.¹⁸ Game theory illustrates just how difficult collusion is to prove.

Game theoretical analysis remains useful, because the models highlight the discount rate that links the periods of the supergame together. Minimal discounting of the next period’s returns (which implies rapid reactions to precompetitive price reductions) makes less than competitive equilibriums more viable. In effect, the ability of the collusive suppliers to respond quickly to competition means precompetitive behavior is less likely. While it is well understood that this speed of adjustment is related to the ability to quickly detect competitive conduct in a “spot” market, it is less obvious how to model speed of detection when customer-supplier commitments are relevant. If a firm can establish a long-term relationship with a large customer by cheating on

¹⁷ Mergers may generate price effects in Cournot games, although the model would rarely be useful, as most firms set price and not output. Without some institutional restriction on output expansion to match a rival’s action, the Cournot structure is not viable. The Cournot game may be more useful as a collusion model, assuming some exogenous agreement on the “rules of the game” has created the artificial incentive for firms to hold output fixed. Given an agreement to fix output via the Cournot structure, a merger would tend to make the market less competitive. See Malcolm Coate & Mark Williams, *Generalized Critical Loss for Market Definition*, 22 RESEARCH IN L. & ECON. 41-58, note 4 (2007).

¹⁸ For an analysis of the problems with real world applications of Post-Chicago economics, see Malcolm Coate & Jeffrey Fischer, *Daubert, Science, and Modern Game Theory: Implications for Merger Analysis* (unpublished manuscript) (September 2008), available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1268386.

a cartel, then it may be impossible for its rivals to respond quickly even if the competitive conduct can be detected immediately. In effect, cheating on the collusion may allow the independent firm to lock up new business for a long period of time (this implies the need to use a high discount rate in the mathematical model). Understanding how market processes work should enable an analysis of the extent of vertical customer-supplier relationships. While game theory leaves a role for structural checklists, it significantly increases the level of detail required to undertake competitive analysis.

III. APPLICATION OF ECONOMICS TO MERGER ANALYSIS

Over the years, economic theory has generated a number of insights for the merger review process. The 1968 *Guidelines* focused enforcement on very small changes in market share, but noted that a more detailed analysis should be undertaken when share appeared to be a poor predictor of competitive effect. More aggressive enforcement was warranted when the target firm was likely to be a disruptive force in the market (this “disruptive force” concept was later remarketed as the “maverick” firm). The 1982 *Guidelines* added a set of “other factors” relevant to oligopoly analysis.¹⁹ Structure, conduct, and performance considerations were all mentioned and the discussion generally tracked Posner’s oligopoly checklist. The 1992 *Guidelines* presented a more complex economic analysis that separated the discussion associated with reaching an agreement from the commentary on policing an agreement. The importance of a sophisticated understanding of information structures, along with knowledge of the basic institutional mechanisms of a market, was also stressed. However, the importance of performance evidence was limited to a comment on explicit price-fixing and a couple of footnotes.²⁰

As the foundation for the 1982 *Guidelines*, Posner’s checklist is addressed in sub-section A, while the 1992 *Guidelines* material is discussed in more detail in sub-section B. A final sub-section, which focuses on performance evidence, is included to introduce the “Folk Theorem of Merger Enforcement.” This concept, implicit in the staff applications of the *Guidelines*, suggests that structural collusion models should be tested with exogenous evidence.

¹⁹ See U.S. Department of Justice, *Merger Guidelines*, ANTITRUST TRADE REG. REPORT 1069 (1982); and U.S. Department of Justice, *Merger Guidelines*, 2 Trade Reg. Report (CHH) ¶ 4510 (1982).

²⁰ The 1992 *Merger Guidelines* note that market conditions are likely to be conducive to coordinated interaction when firms in the market have (1) engaged in express collusion and (2) salient characteristics of the market have not changed. Implicit performance evidence may also be addressed. See, e.g., § 2.1 (focuses on consumer harm) and note 22 (mentions the use of normal course of business documents) of the *Guidelines*.

A. The 1982 *Guidelines* and Posner's Checklist

Richard Posner created a classic checklist of characteristics associated with oligopolistic interdependence as part of his ambitious attempt to expand the reach of the antitrust laws to encompass tacit collusion.²¹ These structural conditions are listed below.²²

- **High market share:** The Herfindahl statistic (defined by the sum of the square of the market shares held by the firms in the market) is a generally accepted proxy for impact of market share on the probability of less than competitive conduct. While higher values for the Herfindahl statistic tend to increase the likelihood and duration of competitive problems, the magnitude of the effect must be evaluated on the basis of industry-specific evidence. High values of the Herfindahl are correlated with relatively few significant competitors (firms required to participate in the cartel), but the Herfindahl is able to proxy the relative size of the firms.
- **No fringe:** Fringe firms are price takers and thus unlikely to participate in any arrangements to raise price. Collusion is more likely to evolve or persist, the smaller the fringe (and the more limited its ability to expand output).
- **Inelastic demand at competitive price:** The market elasticity measures the loss of sales associated with customers substituting away from the market. If a price increase leads to a small reduction in output (inelastic demand), then the significant firms need only to

²¹ In contrast to most scholars who consider pure tacit collusion to be legal (due to the lack of an agreement), Posner looked at the effects of the tacit collusion (usually higher prices) and found price-fixing. He proposed a more aggressive style of analysis in which the pricing in a less than competitive manner would be illegal. See Posner (1976), *supra* note 7. To promote this outcome, Posner listed a number of factors that make markets relatively more susceptible to tacit collusion and introduced conduct and performance factors that were potentially compatible with collusion. While this style of price-fixing analysis never had much support, it became the standard for merger analysis in the 1980s.

²² Two conditions (local markets and cooperative practices) are not listed here, because they seem more related to reaching an illegal price-fixing agreement than coordinated interaction. Posner also added one characteristic of conduct (antitrust record) to his list of conditions favorable to collusion and four examples of problematic conduct (exchange of price information, industry-wide resale price maintenance, base point pricing, and exclusionary conduct) as examples of economic evidence of less than competitive behavior. These conduct considerations were also mentioned in the 1982 *Guidelines*, along with the 1968 *Guidelines*' concept of the disruptive firm. Finally, Posner's analysis included a list of performance conditions suggestive of less than competitive behavior. Evidence associated with current less than competitive performance is useful to test the implications of the structural analysis.

reduce their production slightly to force price up. Thus, coordinated interaction is more likely to occur.

- Entry takes a long time: Collusion to restrict competition is more likely to evolve and persist when entry takes a long time, as the potential returns to less than competitive behavior are higher.
- Buying side of market is unconcentrated: Arrangements to restrict competition are more likely to persist when the buyer side of the market is relatively atomistic. Large buyers may be able to threaten the stability of a cartel by shifting significant purchases to suppliers willing to price competitively.
- Standardized product: Firms generally find it easier to agree on the terms of coordination and ensure all significant rivals participate in the arrangement when the product is standardized. Also, standardization makes it easier to detect deviations from any collusive agreement.
- Non-durable product: Non-durable goods are not relevant for market competition in future periods, because customers cannot invest in maintenance to extend the life of the good. Thus, markets with nondurable goods are more likely to suffer from collusion than markets with durable goods.
- Principal firms sell at same level of distribution: Coordination interaction is simpler to establish and maintain when it is operationalized at one vertical level.
- Similar cost structures and production processes: Some form of collusion is more likely to evolve and persist when all the significant competitors share the same cost structure and technology.
- Demand is static or declining: Firms are more likely to sustain a policy of less than competitive behavior when the market is static or declining, because the oligopolists do not have to deal with a constant flow of new customers and products into the market.
- Prices can change quickly: The ability to adjust price in a timely manner makes punishment strategies more effective and hence tends to make coordinated interaction more successful.

²³ The 1982 *Guidelines* generalize this point to focus on the supplier's ability to obtain detailed information on prices, outputs, or specific transactions. Sealed bidding is simply one example in which good information is available.

- Sealed bidding: The use of sealed bidding makes it easier to identify competitive pricing, as the winning bid must be published. As secret price discounts are impossible, collusion is more likely to be sustained over time.²³

The fundamental problem with a structural Posnerian merger analysis is the lack of a general theoretical analysis to facilitate the evaluation of the relevant factors. Empirical information on the structural factors can be tabulated and some broad-based observations derived, but balancing the impact of the factors to evaluate the likely competitive effect of a merger is purely subjective.²⁴ Moreover, it is unclear how to work the structural effect of the merger into the analysis. As Scheffman and Coleman note, checklists “are too crude to provide much assistance in determining whether a coordinated interaction theory is relevant.”²⁵

In its defense, Posner’s collusion presentation moves beyond structure and includes market performance evidence. Generalizing Posner’s price-fixing analysis to address merger enforcement would therefore trigger a search for performance evidence compatible with the structural competitive concern. Hence, a complete Posnerian study of a merger in an oligopolistic industry could generate useful results, as the implications of the structural analysis would be validated with performance evidence.

B. The 1992 Merger Guidelines Characterization

The 1992 *Merger Guidelines* address the limitation of the structural analysis first by sub-dividing the coordinated interaction issue into its constituent parts (predicting (1) whether a post-merger arrangement is likely to evolve and (2) if that arrangement is likely to persist), and then by insisting that the analysis provides an explanation of how prices could be elevated above the competitive level. By concentrating on the need to tell a story, the revised *Guidelines* are better able to focus the analysis on the relevant informational and institutional structures in the market. While informational issues underlie a number of the Posnerian conditions, the *Guidelines* stress the importance of information as a stand-alone structural characteristic. The institutional details of the competitive process within a market must also be evaluated to determine if

²⁴ The standard Posnerian checklist could be used to conclude a merger is not likely to enhance collusive pricing if the review identified few factors suggestive of concern. Alternatively, if enough assumptions are made, then a mathematical model could be parameterized and used to estimate the price effects of a merger. See, e.g., Janusz Ordover et al., *Herfindahl Concentration and Mergers*, 95 HARV. L. REV. 1857-73 (1982).

²⁵ David Scheffman & Mary Coleman, *Quantitative Analysis of Potential Competitive Effects from a Merger*, 12(2) GEO. MASON L. REV. 319-69, 327 (2003).

However, a more detailed collusion model could suggest price agreements are less likely to form in static markets, because the potential profit from collusion is lower

post-merger collusion is likely. For example, generic information on the business conditions facing rivals may increase the probability of some form of agreement, while the availability of information on specific transactions or individual prices and output levels may make the detection of price discounting more likely, all else equal. On the other hand, customer-supplier relationships might moot the importance of information, because once the customer switches, the new vertical relationship is established. This relationship may possibly be immune to short-run offers of discounts.

This relationship may possibly be immune to short-run offers of discounts.

The basic Posnerian considerations generally point in the same direction for the two 1992 *Guidelines* questions.²⁶ For example, high market share is considered to make an agreement on price more likely to occur, because fewer firms need to be involved in the understanding. Likewise, an agreement is easier to monitor and police when it is only necessary to follow the actions of a few competitors. Arguments can also be made that certain conditions support one oligopoly task, while making the other less likely. Either effect could dominate, given specific market conditions. For example, Stigler's model shows agreements are easier to monitor in a static market. However, a more detailed collusion model could suggest price agreements are less likely to form in static markets, because the potential profit from collusion is lower.

A few of Posner's factors are generalized by the *Guidelines*. Posner considers collusion more likely when demand is static or declining. The *Guidelines* expand this concept to address any dynamic change in the market. Maintaining a collusive agreement is simply more difficult when market conditions (e.g., demand curves, cost conditions, or innovation) are changing rapidly. Second, Posner observes collusion is more likely when prices can change rapidly. The *Guidelines* also generalize this issue to focus on the characteristics of the typical transaction. The speed associated with changing any detail in the representative transaction could also affect the ease of collusion.

²⁶ Three of Posner's characteristics are not explicitly mentioned in the *Guidelines'* competitive effects section, but remain relevant to the overall analysis. Inelasticity of demand is not noted, although the factor is important in the market definition analysis. Likewise, the relevance of ease of entry for the likelihood of coordinated interaction is not explained, although it is obviously covered in the entry section. Finally, the durable nature of the good is not highlighted as relevant to collusion, but is touched on in the entry discussion.

²⁷ In a recent commentary, Dick (2003) suggested that the *Guidelines'* analysis should focus on two questions to address this concern. First, what constrains the suppliers' pre-merger incentive or ability to coordinate their actions? In effect, the merger review must discover what drives the pre-merger pricing decisions. This understanding leads to the second question: How will the proposed merger change the existing constraints on competition? This approach would also link the *Guidelines'* analysis to a specific economic theory. See Andrew Dick, *Coordinated Interaction: Pre-merger Constraints and Post-merger Effects*, 12(1) GEO. MASON L. REV. 65-88 (2003).

While the *Guidelines*' structure offers insight into the issue of collusion, it must link the analytical structure to the merger in question to be useful for antitrust policy.²⁷ In the overview to the coordinated interaction section, the *Guidelines* state: "A merger may diminish competition by enabling the firms selling in the relevant market more likely, more successfully, or more completely to engage in coordinated interaction that harms consumers."²⁸ The term "more likely" implies the merger causes some type of regime shift in which the merger changes the market from competitive to collusive (the maverick model explicitly mentioned in the *Guidelines*' text is simply an example of a regime-shift model) and the phrase "more completely" suggests that some type of structuralist model is relevant (as the market is currently less than competitive, and the merger worsens the situation). "More successfully" implies some effect on the durability of the coordinated interaction process (regime shift becomes more likely to persist given the fixed probability it will occur or the structuralist effect becomes more long-lasting).

Coate & Ulrick discuss three styles of coordinated interaction analysis (maverick, general regime shift, and structuralism) that are found in FTC staff analysis.²⁹ Maverick analysis applies when one of the merging parties has a relatively unique and significant incentive to deviate from the terms of the collusive consensus. Under certain conditions, the maverick firm ensures that the market remains competitive and its loss through merger leads to some form of collusion. In the standard maverick theory, facts are used to identify and prove the specific characteristics of the maverick and its loss is then considered likely to trigger collusion.³⁰ Mathematical precision is possible if the compatible oligopolists are considered to act in a

²⁸ See 1992 *Merger Guidelines*, at § 2.1.

²⁹ See Malcolm Coate & Shawn Ulrick, *Influential Evidence in Merger Enforcement at the Federal Trade Commission*, in *ISSUES IN COMPETITION LAW & POLICY* (W.D. Collins, ed. 2008). The three theories are also mentioned in Malcolm Coate, *Economic Models in Merger Analysis: A Case Study of the Merger Guidelines*, 2(1) *REV. L. & ECON.* 53-84 (2006). Moreover, Scheffman & Coleman (2003), *supra* note 25, at 328-29, without benefit of the systematic review of the files, define three comparable theories (evidence of existing effective coordinated interaction, removal of a maverick, and removal of other impediments to coordination).

³⁰ Baker & Shapiro (2007) also posit a more generic maverick model to be applied when specific facts are not available. This model simply assumes that the merger partners have a significant probability of being the maverick when the number of significant competitors is small. Thus, the merger is likely to lead to the loss of this hypothetical maverick. This second "theory" simply appeals to structuralism, as specific facts supporting the maverick hypothesis are not required. See Jonathan Baker & Carl Shapiro, *Reinvigorating Horizontal Merger Enforcement* (unpublished manuscript) (June 2007), available at <http://faculty.haas.berkeley.edu/shapiro/mergerpolicy.pdf>.

³¹ The analysis could start with the classic Landes & Posner (1981) model and generalize the monopolist to represent the set of collusive firms and the fringe to include the maverick. The model would be calibrated to generate a competitive equilibrium when the maverick prices as a fringe firm. See William Landes & Richard Posner, *Market Power in Antitrust Cases*, 94(5) *HARV. L. REV.* 937-96 (1981).

less than competitive manner, but coordinated pricing is not profitable in light of the competition from the maverick firm (in combination with the fringe entities). Parameterizing a complex model should allow the calculation of a competitive equilibrium.³¹ Then the analyst could adjust the model to transform the maverick from an independent competitor to a cartel participant and compute the merger-related price increase. Baker (2002) and Baker & Shapiro (2007) appear to advance the maverick model as the only relevant model of collusion for antitrust policy.³²

The staff also considers a general “regime-shift” model in which the pre-merger structure gives rise to a competitive outcome, while the post-merger structure is conducive to some form of collusion. Modeling the regime shift is limited only by the imagination of the merger analyst. For example, mergers that created or enhanced the power of a leading firm could be problematic as price leadership could facilitate both establishing and policing an agreement. Moreover, the concern with the leadership would be heightened if the leader actively supported conduct (e.g., product standardization or information exchanges) that appeared to reduce the costs of coordinated interaction. Mergers may also create more symmetry in the market. When few rivals exist, increasing the product, marketing, distribution, and cost symmetries in the market could make a collusive equilibrium more likely. Concerns would be enhanced when market structures ensure that rivals understand their mutual interdependence. More generic models of competition could also give rise to collusive concerns when the number of firms in the market is reduced. These regime shift models can also be quantified by modeling the shift from competition to some form of collusion.³³

Structuralism is also anticipated in the *Guidelines*, as the pre-merger structure could support a small collusive surcharge, while the post-merger structure could enable a higher collusive price. Structural evidence may suggest that at least weak coordinated interaction is likely pre-merger. Post-merger, the structure will become much more compatible with less than competitive behavior and the market price may rise. While theorists consider Cournot to represent unilateral behavior, the single shot Cournot game could be used to give a mathematical veneer to a structural coordinated interaction model, as prices rise with a reduction in the number of independent competitors, holding costs constant. The analyst need only parameterize the model for the current market conditions and compute the effect associated with deleting a rival. Interested analysts could generalize the simple model to allow for fringe competition, differentiation, or cost asymmetries.

³² See Baker (2002), *supra* note 3; and Jonathan Baker & Carl Shapiro, *supra* note 30.

³³ Fisher et al. (1988), for example, used a Cournot structure for the collusive regime, while a Bertrand structure illustrated the pre-merger competition. See Alan Fisher et al., *Price Effects of Horizontal Mergers*, 77 CAL. L. REV. 777-827 (1988).

Building a theoretical foundation for coordinated effects concerns appears to move the analysis beyond the checklist stage and creates a road map for economic analysis. The analyst can review the record of the investigation and collect evidence to parameterize the relevant theory in much the same way as unilateral effects analysis. Scheffman & Coleman detail a number of studies that can be undertaken as part of the analysis.³⁴ Facts must determine which of the many oligopoly theories are appropriate for the specific merger. In effect, this analysis can appeal to the timeless Friedman commentary on methodology in economics.³⁵ The analyst can infer the market behaves “as if” competition follows a model of collusion whenever the collusion model generates testable implications for competition in the particular market that are not falsified by the evidence. If multiple models survive the testing process, the choice between the models is based on a balancing of simplicity and fruitfulness considerations. Mathematical derivation from stylized facts may be helpful, but it is not necessary. In the next subsection, details on how this testing process appears to have played out are given.

Building a theoretical foundation for coordinated effects concerns appears to move the analysis beyond the checklist stage and creates a road map for economic analysis

C. Folk Theorem of Merger Enforcement

In reviewing FTC enforcement activity, it is clear that the *Guidelines*' analyses define testable hypotheses for the competitive effects of mergers.³⁶ The structural analysis explains the effect of the merger-related change in structure on the competitive environment. Competitive concerns are raised when the merger is likely to generate an adverse effect on consumers in a relevant market. While the bulk of the coordinated effects analyses remain qualitative, mathematical

³⁴ See Scheffman & Coleman (2003), *supra* note 25.

³⁵ MILTON FRIEDMAN, *ESSAYS IN POSITIVE ECONOMICS* 3-43 (1953).

³⁶ Scheffman et al. (2003) note that evidence on customer concerns and hot documents have always been used to support inference of coordinated interaction in the modern Guidelines era. Natural experiments were also noted as relevant to the study of likely competitive effects. See David Scheffman et al., *Twenty Years of Merger Guidelines Enforcement at the FTC: An Economic Perspective*, 71(1) ANTITRUST L.J. 277-331, 304 (2003). The FTC-DOJ merger commentaries also detail situations in which evidence is used to support inferences of less than competitive behavior stemming from a merger. See U.S. Federal Trade Commission & U.S. Department of Justice, *Commentary on the Horizontal Merger Guidelines* (2006), at 22-23, available at <http://www.ftc.gov/os/2006/03/CommentaryontheHorizontalMergerGuidelinesMarch2006.pdf>. See also Malcolm Coate, *Empirical Analysis of Merger Enforcement under the 1992 Merger Guidelines*, 27 REV. INDUS. ORG. 279-301 (2005); and Coate & Ulrick (2008), *supra* note 29.

collusion models can be designed to predict less than competitive outcomes that can then be balanced against efficiencies. Any type of economic analysis actually generates a testable hypothesis for the effect of the merger.

From reviewing the case files, it is clear that a “Folk Theorem of Merger Enforcement” exists. Simply put, this theorem observes that whenever pre-merger evidence suggests a causal relationship between structure and performance exists, then a merger materially affecting structure is likely to substantially lessen competition. Theory is needed to give context to the evidence and evidence is needed to test the implications of the theory. As Friedman observes, economic science is hypothesis testing. Of course, testing does not guarantee success in court, because the defendants might also advance a validated economic theory suggestive of continued competition. The legal process sorts out the valid evidence and reaches a decision on the merits.

In another article, three types of evidence used by FTC staff for “testing” coordinated interaction theories are discussed.³⁷ In the best case scenario, evidence of natural experiments is found in which a structural change, comparable to the merger in question, generated anti-competitive effects. This evidence is likely to be more available for the very explicit theories of concern (maverick and structuralist), because the search for evidence can be focused. Natural experiment evidence may also be inferred from evidence on hot document or customer complaints. In this instance, the idea is that the hot document or customer complaint is based on a firm’s or customer’s recollection of a natural experiment (or series of natural experiments), that leads to the conclusion memorialized in the specific evidence. The reviews of the FTC analyses show some form of evidence is regularly found in the investigations, although actual evidence is not a necessary condition for an enforcement action.³⁸ In the next section, econometric analysis checks for the link between natural experiment evidence and coordinated interaction findings.

³⁷ Coate (2005), *id.* It is also possible to consider natural experiment evidence that supports a pro-competitive theory of the merger. Initial analysis shows this pro-competitive evidence variable does not have a significant effect on the enforcement decision.

³⁸ In addition to explicit or implicit natural experiments, it is possible to test theories of competitive concern with general economic evidence. The anticompetitive effects associated with merger to monopoly are the best example of such an analysis, because economic science has systematically found monopolies behave in a less than competitive manner. The structure-conduct-performance model also provided the scientific basis for merger enforcement until the general version of the theory was falsified. See Coate & Fischer (2008), *supra* note 18. A recent study by Kovacic et al. (2005) suggests that mergers to duopoly are problematic, at least in homogeneous (chemical) industries. See William Kovacic et al., Lessons for Competition Policy from the Vitamins Cartel (unpublished manuscript) (Sep. 2005), available at <http://ssrn.com/abstract=818744>.

IV. AN ENFORCEMENT MODEL FOR COORDINATED INTERACTION

The background on economic theory will serve to structure the search for an empirical model of coordinated interaction. Statistical analysis should highlight relationships between structural characteristics and FTC enforcement policy (this paper's proxy for a collusion concern), as well as identify the impact of the natural experiment effects evidence or any other explanatory variable. One limitation must be discussed. The 1992 *Guidelines* propose a case-specific study of coordinated interaction, with the analyst required to obtain data on information structures and institutional realities. This style of analysis is not easily quantified and thus must be left out of this study. However, this search for informational structures and institutional realities is (1) based on structural considerations and (2) would be expected to affect the collection of effects evidence. Thus, the formal *Guidelines* style of analysis may be implicit in the modeling. In the following two subsections, the data collection process is reviewed first, followed by a discussion of model specification.

A. Data On Collusion Analysis in Merger Enforcement

The merger enforcement decision at the FTC has been studied in a number of recent papers³⁹ While these papers estimate the probability of a merger challenge, the basic data can also be used to evaluate the likelihood of a subsidiary finding that the merger makes collusion “more likely, more successful, or more complete.” This subsidiary finding will drive the enforcement decision if (1) coordinated interaction is the appropriate theory, (2) barriers to entry are present, and (3) efficiencies are integrated into the analysis to account for the overall effect (if any) of cost savings. Thus, to transform a dataset focused on the enforcement decision into a dataset addressing the likelihood of coordinated interaction, it is only necessary to delete all the unilateral effects cases, remove the matters in which ease of entry is dispositive on the issue of competitive concern, and incorporate evidence on efficiencies into the model. Of course, such an analysis is only able to identify the interpretation of coordinated interaction that appears in FTC enforcement decisions. To the extent the agency's interpretation is not

³⁹ See Mats Bergman et al., Comparing Merger Policies: the European Union versus the United States (unpublished manuscript) (March 2007), available at <http://ssrn.com/abstract=975102>; Malcolm Coate & Shawn Ulrick, *Transparency at the Federal Trade Commission: The Horizontal Merger Review Process*, 73(2) ANTITRUST L.J. 531-570 (2006); and Coate (2005), *supra* note 36. For an overview of all the recent papers using FTC data, see Malcolm Coate, An Overview of Transparency at the Federal Trade Commission: Generalities and Innovations in Merger Analysis (unpublished manuscript) (September 2008), available at <http://ssrn.com/abstract=1111687>.

consistent with an economic evaluation of the coordinated interaction concerns, the analysis may draw incorrect conclusions.⁴⁰

The data collection process started with the 166 merger investigations identified in Bergman et al. exhibiting between one and three markets potentially affected by the merger and added twenty-one new matters reviewed in 2004 and 2005 to the dataset.⁴¹ The 108 unilateral effects cases were deleted to focus purely on the collusion investigations. A further 19 files were deleted as the staff attorneys concluded entry was easy. This left a total of 60 collusion cases. To increase the sample, additional markets associated with the 187 matters were coded, whenever (1) the theory of concern was oligopoly and (2) the legal staff found barriers to entry. By looking at every market studied in the 187 investigations, it was possible to increase the sample to 76 investigations. One case had to be deleted, because the decision to close was intertwined with the failing-firm analysis. This left a sample of 75 collusion merger investigations undertaken during the 1993 to 2005 period.

Figure 1 defines the structural and evidence variables collected from the FTC files and provides the ranges and summary statistics.⁴² In addition to the standard information on the Herfindahl (HHI), the detailed review of the files identified the number of firms in the market with an ability to materially affect the outcome of the competitive process (defined as significant rivals and measured prior to the merger) as well as raw market share data. This share information allowed the calculation of two additional explanatory variables: fringe share and leadership ratio. The fringe variable was computed by summing the shares attributed to the significant rivals and then subtracting that number from one. It ranged from 0 to over 40 percent. The leadership proxy was calculated by dividing the share of the leading firm by the share of the second largest firm in the market. This variable ranged from one (for numbers equivalent situations in which no firm leads the market) to over five. It was calculated for the post-merger environment to incorporate the change in structure caused by the merger.

Five binary variables were coded to capture insights associated with market structure. A homogeneous goods index was derived based on a staff finding of relative similarity for the products in the market.⁴³ If the staff reported the specific good was customized to the buyer's

⁴⁰ Of course, the study would remain useful as an evaluation of the internal review structure even if it could be shown that some enforcement decisions were not consistent with standard economic theory.

⁴¹ See Bergman et al. (2007), *supra* note 39.

⁴² The raw structural information (market concentration, theories of concern, and product homogeneity) are based on the attorney analyses. More complex variables (not necessarily addressed in every attorney memo) are based on findings by either attorneys or economists.

⁴³ See Coate (2006), *supra* note 29.

FIGURE 1 Overview of the Explanatory Variables

Variable	Definition	Range	Mean Enforced	Mean Closed
Herfindahl (HHI)	Herfindahl Index computed by summing the square of market share held by each firm in the post-merger market	1437-7008	3727*	2990
Significant Rivals	Number of pre-merger "significant" rivals in market affected by merger	3/10	4.02*	5.85
Fringe Share	Market share held by firms not considered significant in the analysis.	0/43.6	9.20*	12.3
Share Ratio	Ratio of share of largest post-merger firm to share of second largest entity	1/5.8	1.91	1.76
Homogenous Good	Indicator variable for homogeneous goods finding in attorney data	0/1	.521	.370
Buyer Sophistication	Indicator variable to identify cases in which buyer power was found by either attorneys or economists	0/1	.188*	.370
Inelastic Demand	Indicator variables for market in the hospital, oil, or drug industry	0/1	.417	.370
Vertical Issues	Indicator variable to identify cases in which vertical aspects of merger were considered by attorneys or economists	0/1	.125*	.370
Efficiencies	Indicator variable for efficiency finding by either attorneys or economists	0/1	.438*	.741
Evidence	Index of anti-competitive findings associated with customer complaints, hot documents or historical natural experiments by either attorneys or economists; 0 implies no such findings, 3 means all three factors reported.	0-3	1.17*	.407
Maverick Firms	Indicator variable for Maverick firm finding in the attorney files	0/1	.270	.111
Administration (Bush)	Indicator variable for control of FTC by Chairman appointed after June 2001	0/1	.333	.185
Cases	Number of matters reviewed		48	27

*The sample mean for the enforced cases is significantly different from the mean for closed cases.

specification, this was also coded as homogenous when the bulk of the firms in the market were able to meet consumer demand on relatively equal terms. Buyer sophistication signaled a staff observation that customers had some ability to negotiate with their suppliers.⁴⁴ Having a large buyer implied sophistication, but no clear buyer share cutoff existed. The vertical variable identified mergers in which the staff investigation identified some vertical relationship affected by the merger.⁴⁵ For example, if a large upstream firm with a horizontal presence in a downstream market bought a competitor, the vertical relationship would be found. A fourth variable attempts to proxy the elasticity of demand with information on the industry involved in the merger.⁴⁶ Finally, an efficiency index was assembled.⁴⁷ It takes on the value one whenever either the attorneys or economists report evidence of merger-specific efficiencies. As the FTC often stops short of formally endorsing the efficiency claims, language suggestive of merger-specific savings was taken as relevant.⁴⁸ Figure 1 reports that the enforced matters were statistically likely to exhibit different findings for sophistication, vertical issues, and efficiencies.

Performance evidence associated with natural experiments was also collected.⁴⁹ Simply put, each file was reviewed for hot documents, validated customer complaints, and economic effects compatible with the theory of concern. The evidence on hot documents and customer concern was relatively easy to obtain from the files.⁵⁰ FTC staff generally highlighted these “legal” findings and explained their importance relative to the rest of the information in the file. Thus, it was possible to separate the relevant from the irrelevant information.⁵¹ The economic effect variable required more creativity, because economic facts must be interpreted in light of a theory of concern. In this instance, the analysis first identified the theory of concern at the core of the investigation and then evaluated any natural experiment supportive of the predictions of that theory. For example,

⁴³ See Coate (2006), *supra* note 29.

⁴⁴ Buyer sophistication was borrowed from Coate & Ulrick (2008), *supra* note 29. In effect, the variable flagged markets in which the staff recognized that the institutional arrangements associated with market competition allow complex bilateral negotiations.

⁴⁵ The vertical variable is lifted from Bergman et al. (2007), *supra* note 39.

⁴⁶ Hospital, oil, and drug industry matters are assumed to exhibit relatively inelastic demand.

⁴⁷ See Coate (2005), *supra* note 36.

⁴⁸ The level of verification memorialized in the file varied from case to case, thus conclusory language was used to code the index.

⁴⁹ See Coate (2005), *supra* note 36.

⁵⁰ This is detailed in Coate & Ulrick (2006), *supra* note 39.

⁵¹ Customers complain about all sorts of things, sometimes related to the likely competitive effect of the merger on competition and other times linked to the effect of the merger on their business. FTC staff reviews identify the complaints associated with a loss of competition. Likewise, a range of documents can be identified as “hot.” The review only flags the claims when the document links an adverse effect on competition to the consummation of the merger.

FIGURE 2 Types of Collusion Investigations with Barriers to Entry^a
(percentage in parenthesis is enforcement rate)

Market Conditions	Matters	Homogeneous Sophisticated	Homogeneous Not Sophisticated	Not Homogeneous
One Merger Partner is Industry Leader	36 (66.7%)	6 (50%)	13 (92.3%)	17 (52.9%)
Together Merged Firm Becomes Industry Leader	22 (63.6%)	0 (NA)	10 (70.0%)	12 (58.3%)
Together Merged Firm Becomes Second Firm	8 (62.5%)	1 (0%)	0 (NA)	7 (71.4%)
Number Equivalent Analysis	5 (60.0%)	0 (NA)	3 (100%)	2 (0%)
Together Merged Firm Becomes Third Firm	4 (50.0%)	1 (0%)	1 (0%)	2 (100%)
Total	75 (64.0%)	8 (37.5%)	27 (81.5%)	40 (57.5%)

^aNumber of Cases for each structural regime listed in Figure.

economic evidence that the acquired firm had behaved as a maverick in the past and protected competition would be considered supportive of the implications of a maverick theory of violation.⁵²

Two other variables (“maverick” and “administration”) were recovered from the files. The maverick variable flags the cases in which the staff simply reported a claim of maverick status for one of the merging parties, but failed to present natural experiment evidence supportive of the maverick model. Thus, this indicator flags the cases in which the investigation identified unsubstantiated allegations of maverick status. The second variable, administration, identified the cases filed after June 2001. These matters were all decided under a chairman appointed by U.S. President George W. Bush.

Figure 2 presents some initial information on the data. As a first analysis, the shares of all of the significant competitors were identified and analyzed. The first row summarizes results

⁵² Posner’s list of performance characteristics could be useful to show the market is currently performing in a less than competitive manner, a result supportive of a structural model of concern. See *Posner (1976), supra* note 7.

for 36 matters in which one of the two merging firms holds the largest share in the market. By definition, these firms would obtain an even larger lead on their rivals if the merger was consummated. However, it is important to note that the merger would not allow the new firm to dominate the market, because that concern would have triggered a unilateral effects analysis. The second row focuses on transactions in which a larger leading firm was created by the merger. Here, another 22 matters are flagged, although in some matters, the post-merger share would barely exceed that of the previous market leader. The next row provides information for mergers that create a larger number two firm. Only eight cases are found. The fourth row reports on five numbers-equivalent cases. In these matters, the staff weights all the significant competitors equally; hence, a merger would reduce the number of players by one, but have no other effect on structure. The last row counts the mergers that create stronger number three competitors, where a total of four cases are noted.

In theory, structural analysis should differ for each type of case, probably leading to significant differences in enforcement probabilities. In fact, this does not occur as the enforcement rates vary only slightly (50 percent to 66.7 percent) over the sample. The rest of figure explores this result, disaggregating the cases by a combination of homogeneous goods and buyer sophistication status. Although the sample of homogeneous goods with sophisticated buyers is small, these matters show relatively low enforcement (37.5 percent), especially when compared to the rate associated with homogeneous goods with unsophisticated buyers (significantly higher at 81.5 percent). Moreover, the homogeneous goods markets without sophisticated buyers are statistically more likely to end in enforcement action than the differentiated goods.⁵³ In light of these complex interrelationships in the data, econometric analysis is required to sort out the regularities in the data.

B. Modeling Merger Enforcement

In theory, it would be desirable to separately model what appear to be the FTC's three collusion theories (maverick, regime shift, and structuralist). However, this approach is precluded by data limitations. Instead, it is necessary to aggregate all the data together and explore two general models, one that focuses purely on structural considerations and the other that adds an evidence variable to the analysis. If evidence matters, then the variable would take on a significant positive sign. If the structural variables also matter, then they will retain their statistical significance (and signs). Within this approach, it is possible to model market concentration in more detail, investigate the scope of customer sophistication, and explore the impact of the

⁵³ Interestingly, buyer sophistication does not appear to affect enforcement probability in the differentiated goods sample.

maverick theory. Finally, it is possible to see if the Bush administration changed the decision-making process for coordinated interaction investigations.

The basic structural model focuses on a concentration index (e.g., the Herfindahl index) and five control variables (homogeneous good, buyer sophistication, inelastic demand, vertical considerations, and merger-related efficiencies). The market share data available in the files allows the analysis to move beyond the Herfindahl index and explore market structure in more detail. Three variables are considered. First, the number of significant competitors is included, because the coordinated interaction would require cooperation from all significant players. Second, the size of the fringe could matter, because a substantial fringe might be able to undermine the collusion. Third, the potential for leadership might be important, because a relatively large firm could set the terms for coordination. Leadership is defined as the post-merger ratio of the share of the leading firm to its largest competitor. These three variables are used to replace the Herfindahl index in some of the specifications.

The five control variables all represent standard structural considerations. First, it is generally considered easier to coordinate price when the product is relatively homogeneous. Therefore, a positive sign is expected for this index. Buyer sophistication tends to make coordinated interaction less likely, as sophisticated buyers are able to negotiate with the various competitors in the market and possibly undermine collusive prices. In this instance, a negative sign is expected. Inelastic demand is generally thought to make collusion more likely as output restrictions needed to support higher prices would be relatively low. A positive sign is likely. The vertical indicator identifies markets in which firms interact at various vertical levels. In general, this observation would suggest that less room exists for collusive behavior. Moreover, the merger supposes a change in this vertical relationship, a change that would tend to reduce vertical transaction costs. These vertical efficiencies also make cartelization less likely. Overall, a finding of vertical ramifications implies a negative relationship with a finding of coordinated interaction.

The final variable addresses efficiency considerations. Findings of efficiencies imply an effect on the cost structure of some of the market competitors. Cost differentials can affect the probability of coordinated interaction in two ways. First, cost differences make it more difficult to coordinate on price, hence collusion is less likely. Second, even if some coordination can occur, the price could be lower. Both considerations point to a negative effect on coordinated interaction. One generalization of the basic model is considered, as customer sophistication is interacted with the homogeneous good variable. Basically, sophistication would be expected to have a much greater effect when the market is homogeneous and customers could more easily pit suppliers against each other and undermine any collusive agreement.

Finally, it is possible to see if the Bush administration changed the decision-making process for coordinated interaction investigations

The structural model is complemented with the evidence index. This variable serves to identify the degree of exogenous support for the relevant theory of coordinated interaction. Logically, the more evidence supporting a competitive concern, the more likely a collusion finding will be made. Hence, a positive coefficient is expected for the evidence variable. The other structural variables may retain their significance, or become statistically indistinguishable from zero, depending on whether evidence supplements or trumps market structure.

Next, an indicator for a claim of maverick status is added to the model. If the maverick status mattered, it would make a finding of collusion more likely whenever a maverick firm is identified.⁵⁴ Note the analysis is only testing for the importance of a maverick allegation, because natural experiment evidence related to a maverick effect is already included in the model through the evidence index.

Finally, an indicator for Bush administration control of the FTC is included in the model. The shift parameter indicates whether the Bush administration revitalized coordinated effects analysis.⁵⁵ This data is unable to determine if the administration was more aggressive overall, because it would require a joint study of entry and coordinated effects analysis.

V. ESTIMATION OF THE MODELS

The statistical analysis is undertaken in a series of twelve probit regressions, presented in Figures 3, 4, and 5.⁵⁶ The discussion in this section will track the visual presentation of the models, although the bulk of the analysis will be focused on the last model in each figure. Examples of the impact of various structures on the probability of a concern will be given.

Figure 3 presents a standard Herfindahl-based model of coordinated interaction.⁵⁷ In all the specifications, the Herfindahl index is positively related to a concern, suggesting market shares matter. In model 3-1, customer sophistication, inelastic demand, and vertical issues also affect the collusion finding, with the expected signs. Efficiencies exhibit the expected negative effect, but tests slightly below conventional levels of statistical significance. A finding of homogeneous goods

⁵⁴ See Baker (2002), *supra* note 3.

⁵⁵ See Darren Tucker & Bilal Sayyed, *The Merger Guidelines Commentary: Practical Guidance and Missed Opportunities*, ANTITRUST SOURCE 1-13, 8 (May 2006).

⁵⁶ Both the continuous and discrete variables are transformed with the natural logarithm function to allow for more nonlinear effects (one is added to the evidence index to enable the transformation). A clustered errors technique is used to address the fact that some mergers are represented by two or three analyses of different markets of concern.

⁵⁷ The change in Herfindahl along with the interaction of the change and the Herfindahl can be included in the model, but proved to be statistically insignificant and thus are not reported.

FIGURE 3 Standard Oligopoly Model^a

	3-1 (Structure)	3-2 (Structure) ^b	3-3 (Evidence)	3-4 (Evidence) ^b
HHI	2.756*** (5.11)	2.864*** (4.32)	2.588*** (4.55)	2.665*** (3.66)
Homogenous Good	.3813 (.92)	1.054** (2.18)	.4563 (1.02)	1.358** (2.13)
Buyer Sophistication or Sophistication *Homogeneous	-1.480*** (-2.85)	-2.10** (-2.51)	-1.452*** (-2.77)	-2.522*** (-2.81)
Inelastic Demand	.8416* (1.91)	.3398 (.83)	1.058** (2.23)	.5889 (1.32)
Vertical Issues	-.9773** (-1.98)	-.5562 (-1.12)	-1.388*** (-3.34)	-1.105*** (-2.57)
Efficiencies	-.5945 (-1.43)	-.7982* (-1.95)	-.6931 (-1.34)	-.9962* (-1.70)
Evidence	-	-	1.253*** (2.86)	1.603*** (2.80)
Constant	-20.97*** (-4.89)	-22.05*** (-4.17)	-20.08*** (-4.51)	-20.94*** (-3.61)
Predictions (percent- age)	80.0	82.7	84.0	86.7
Pseudo-R-square	.4296	.4505	.5015	.5489
Log Pseudo- likelihood	-27.95	-26.93	-24.43	-22.11

a. t-statistic in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%.

b. Buyer sophistication is interacted with homogeneous good index.

increases the chance of enforcement, but the effect is not significant. Looking back at Figure 2, this result is not surprising, because customer sophistication appears to interact with product homogeneity. Re-estimating the model with the buyer sophistication variable interacted with homogeneity (model 3-2) generates the expected effect.⁵⁸ On its own, a homogeneous good facilitates coordinated interaction. However, when customer sophistication is relevant, a competitive problem is less likely, as sophisticated consumers have an ability to protect themselves from collusive overcharges. In this second regression, the other control variables retain their signs, but now only the efficiency variable is statistically different from zero.

The next two regressions (models 3-3 and 3-4) repeat the two initial specifications, but add the evidence variable to the regressions. Here, evidence suggestive of a competitive concern has the expected positive effect on the probability of a coordinated interaction finding. This result serves to confirm the importance of testing structural oligopoly models with natural experiment-related evidence. The structural variables retain their signs and all but one achieves statistical significance in model 3-4.⁵⁹ The final model correctly predicts 87.5 percent of the 48 collusion findings, and 85.2 percent of the 27 no-effect conclusions.

The magnitude of the coefficients cannot be directly compared across the models. Instead, any comparison must evaluate the standard normal function given values for all of the other variables in the model. For example, consider an efficient merger in a homogeneous goods market. Using model 3-2, the probability of a collusion concern moves from 15 to 87 percent, as the Herfindahl increases from 1,400 to 3,000. Switching the focus to model 3-4 generates marginal reductions in the enforcement probability when no evidence is available, but a single finding of evidence causes the probability to jump to a range of 44 to 97 percent. Other information can significantly change these probabilities. Holding the structure and evidence variables at fixed values, the direction of the effect for the five remaining structural variables can be computed by just summing up the relevant coefficients. For example, in the last situation mentioned, findings of buyer power and inelasticity will create a probability of collusion ranging from almost 0 to 87 percent. Overall, it is clear that both structural findings and evidence matters.

Figure 4 repeats the analysis in Figure 3, but replaces the Herfindahl index with three parameters designed to offer a more detailed structural analysis. The count on the number

⁵⁸ An alternative specification in which the buyer sophistication index was interacted with both the homogenous and differentiated good variables was also estimated. The interaction of buyer sophistication and differentiation was not significantly different from zero in any of the models, and it was removed from the model for expositional ease to obtain the specifications presented in the text.

⁵⁹ The five structural indicator variables test jointly significant. (The Chi-square statistics are 19.26, 12.65, for models 3-3 and 3-4, respectively. Both models' results are above the cutoff for five degrees of freedom of 11.07.)

FIGURE 4 Complex Oligopoly Model^a

	4-1 (Structure)	4-2 (Structure)^b	4-3 (Evidence)	4-4 (Evidence)^b
Significant Rivals	-4.320*** (-3.83)	-5.787*** (-5.29)	-4.857*** (-3.70)	-8.100*** (-3.92)
Share Ratio	.5422 (1.62)	.5529 (1.57)	.7673** (1.96)	.9379** (2.01)
Fringe	-.3339 (-1.58)	-.0890 (-.44)	-.4607* (-1.95)	-.2319 (-.65)
Homogenous Good	.6109 (1.34)	1.939*** (3.46)	.6445 (1.30)	3.209*** (3.29)
Buyer Sophistication or Sophistication *Homogeneous	-1.547*** (-2.77)	-3.227*** (-3.48)	-1.893*** (-2.90)	-5.488*** (-3.77)
Inelastic Demand	1.002* (1.93)	1.222** (2.12)	1.352** (2.50)	1.953** (2.29)
Vertical Issues	-1.321** (-2.28)	-1.109* (-1.74)	-1.959*** (-3.47)	-2.295*** (-3.53)
Efficiencies	-.5485 (-1.32)	-.7694 (-1.54)	-.9883* (-1.95)	-1.867** (-2.51)
Evidence	-	-	1.661*** (3.14)	2.773*** (2.80)
Constant	7.075*** (4.10)	8.362*** (4.95)	7.532*** (3.69)	11.30*** (3.56)
Predictions	81.33	84.0	85.33	89.3
Pseudo-R-square	.4735	.5530	.5670	.6902
Pseudo Log-likelihood	-25.80	-21.91	-21.21	-15.18

a. t-statistic in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%.

b. Buyer sophistication is interacted with homogeneous good index.

of significant competitors is inversely related to the likelihood of coordinated interaction in all the specifications. The ratio of the share of the leading firm to its closest competitor takes on the expected positive sign, but its significance level is marginal in the first two specifications. Fringe share is significant in only one specification.⁶⁰ It is possible to nest the models in Figures 3 and 4 by adding the Herfindahl index to the Figure 4 specification.⁶¹ In the (unreported) regressions, the Herfindahl index never becomes statistically significant, while the joint hypothesis setting the coefficients of three new concentration variables to zero cannot be rejected for the first two specifications. Thus, it is impossible to distinguish between the first two sets of share-based parameters. Once the evidence variable is added, it is possible to conclude that, when taken together, significant rivals, ratio of shares of leading firms, and fringe share are statistically different from zero.⁶² Thus, when data is available, the user has a reason to prefer models 4-3 and 4-4 over models 3-3 and 3-4.

Adding the evidence variable in models 4-3 and 4-4 increases the level of significance of the other control variables. The results for buyer sophistication match those found in Figure 3, in which the sophistication effect is basically focused in homogeneous goods industries. Elasticity and vertical ramifications remain significant in the new specifications, while the pure efficiency effect becomes significant. Thus, in all the specifications, the structural variables remain important when the model is generalized to address explicit or implicit natural experiment evidence.⁶³ Model 4-4 correctly predicts 91.7 percent of the findings of collusion and 85.2 percent of the no-effect matters.

Predictions for the probability of a collusion finding would generate similar results to those discussed above, although now the structural parameters would focus on significant competitors: the leadership share ratio and fringe share. As noted above, models 4-3 and 4-4 appear preferable to the simple Herfindahl models 3-3 and 3-4. Of course, for any

⁶⁰ Interacting fringe share with product homogeneity does not improve the results. Possibly fringe firms face expansion constraints in the real world, or customers require partnership relationships with their core suppliers even when the good is homogeneous. Thus, industry-specific facts may limit the importance of the fringe.

⁶¹ As the three new structural variables explain 84 percent of the variance in the Herfindahl, multicollinearity may limit the results of the testing.

⁶² The Chi-square statistics needed to reject a zero effect for rivals, share ratio and fringe share are 14.4 and 13.86 for models 4-3 and 4-4, respectively. Both are greater than the relevant Chi-square cutoff of 7.81. For models 4-1 and 4-2, the test statistics are insignificant, at 4.56 and 4.51, respectively.

⁶³ Given that the t-statistics already highlight the significance of the five structural indicator variables, it is not surprising that the joint Chi-square test also generates highly significant results (17.7 for model 4-3 and 19.22 for model 4-4).

particular merger, it is straightforward to compute a fitted value for any probit equation and use the standard normal function to generate the probability of a collusion finding that ranges from zero to one. While the models in Figure 4 do a better job of predicting than those in Figure 3, the difference is small (1 to 2.5 percentage points). A more sophisticated analysis would look at each prediction. The review of the fitted probabilities shows the more complex model (model 4-4) predicts the correct outcome within ten percentage points of the actual outcome (over 90 percent for concern and under 10 percent for no concern) in 69.3 percent of the cases. In contrast, the standard Herfindahl model (model 3-4) only achieves this success in 52 percent of the transactions. Overall, the more detailed model appears to perform better, although the model requires a complex understanding of market structure. Without access to all the market share data, the complex model cannot be used.

Figure 5 explores two special considerations, one that turns out interesting and one that does not. The models in model 3-4 and 4-4 were recycled into Figure 5, with models 5-1 and 5-3 focus on maverick firm findings, while models 5-2 and 5-4 search for a change in understanding of oligopoly associated with the Bush administration.⁶⁴

The maverick results are anticlimactic, as the index associated with maverick-based analysis is insignificant (although the coefficient takes on the expected positive sign). The results on the other variables are robust, suggesting that exclusion of this effect does not impact the analysis. While maverick-based analysis remains a theory of collusion and finding natural experiment evidence on real-life maverick behavior would generally support a competitive concern, speculation on maverick status adds nothing to the likelihood of a coordinated interaction finding. These statistical conclusions are not compatible with the Baker-Shapiro hypothesis that the maverick model is the single theory of collusive oligopoly.

The results associated with the Bush administration variable are much more interesting. In model 5-2, the dummy variable exhibits a positive effect and the test statistic approaches conventional levels of significance. While the coefficients on the other variable jump around a little, the results do not strongly support inclusion of the administration effect. In contrast, model 5-4 identifies a significant administration effect, suggesting that the Bush enforcers were more likely to infer coordinated interaction. While the magnitude of the coefficient is smaller than those associated with the other binary variables, the effect is still substantial. Adding this

⁶⁴ For the 1993-2005 sample, the Bush administration investigated 45.9 percent of their cases with a collusion theory, while the earlier administrations studied 41.8 percent of their cases with collusion analysis. The similarity in these two figures suggests the Bush administration did not systematically reclassify matters from unilateral to collusion.

FIGURE 5 Oligopoly Model with Maverick or Administration Variables^a

	5-1 (Maverick)	5-2 (Admin)	5-3 (Maverick)	5-4 (Admin)
HHI	2.630*** (3.61)	2.521*** (3.58)		
Significant Rivals			-7.943*** (-3.90)	-8.535*** (-4.13)
Share Ratio			.9416** (2.00)	1.134** (2.38)
Fringe			-.2420 (-.65)	-.04312 (-.16)
Homogenous Good	1.376** (2.09)	1.283* (1.84)	3.170*** (3.23)	3.398*** (3.40)
Sophistication *Homogeneous	-2.519*** (-2.77)	-2.763*** (-2.98)	-5.414*** (-3.73)	-6.588*** (-3.97)
Inelastic Demand	.6989 (1.43)	.7376 (1.48)	1.938** (2.31)	2.877*** (3.07)
Vertical Issues	-1.104*** (-2.60)	-1.544*** (-2.98)	-2.258*** (-3.46)	-3.012*** (-3.74)
Efficiencies	-.9937* (-1.71)	-.7700 (-1.33)	-1.843** (-2.48)	-1.844** (-2.41)
Evidence	1.668*** (2.79)	1.773*** (2.84)	2.773*** (2.72)	3.098*** (2.94)
Maverick Firms	.7195 (1.00)	-	.3225 (.38)	-
Administration	-	.9384 (1.62)	-	1.446** (2.04)
Constant	-20.80*** (-3.55)	-20.18*** (-3.53)	11.02*** (3.42)	10.69*** (3.90)
Predictions	84.0	82.7	88.0	89.3
Pseudo-R-square	.5572	.5741	.6911	.7265
Pseudo Log-likelihood	-21.70	-20.87	-15.14	-13.41

a. t-statistic in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%.

variable allows the model to explain 93.8 percent of the collusion findings and 88.9 percent of the matters in which the theory was rejected.

Further analysis addressed the question of how big a shift in policy is suggested by the data. A simple split of the sample showed an enforcement probability of 59.3 percent prior to June 2001 and 76.2 percent after. Without statistical decomposition, it is impossible to tell how much difference is due to the change in understanding and how much is related to the specific sample.⁶⁵ Data limitations (there are only 21 Bush administration cases) preclude this analysis. However, it is possible to simulate the pre-Bush situation that would have occurred had the Bush administration merger been filed prior to June 2001. Focusing on the 16 collusion findings, the data suggest that the Bush effect is responsible for 3 of the conclusions. Of course, it is impossible to draw any overall conclusions without an analysis of entry barriers. If the Bush administration also made it easier to reach an ease of entry finding, the two effects could cancel out.

VI. CONCLUSIONS

FTC enforcement policy allows the analyst to draw insights into the agency's best understanding of coordinated interaction in oligopolistic industries. By focusing on the sub-sample of collusion cases and excluding the matters in which entry is easy, the enforcement decision effectively proxies a finding on ease of collusion. Statistical results are broadly consistent with economic theory. Concentration-related variables like the Herfindahl, a count of the number of competitors, the homogeneity of the market, and the sophistication of the customer base for homogeneous goods all have strong and expected effects on the outcome. Proxies for inelasticity, vertical relationships, and changes in cost caused by efficiencies also have expected effects in some specifications. A leadership variable appears to contribute to the analysis, while no consistent effect for the size of the fringe can be found.

This structural model retains some explanatory power when a variable associated with exogenous evidence (natural experiments, validated customer concerns, and hot documents) is added to the model. This test of the Folk Theorem of Merger Enforcement (if evidence supports a structural problem, then it is reasonable to infer a competitive concern from a relevant change in structure) confirms the importance of the natural experiment evidence. Other results note a maverick theory of violation does not add to the concern associated with the structure and the

⁶⁵ For an example of decomposition, see Bergman et al. (2007), *supra* note 39.

Finally, well-done coordinated interaction analyses are simply more likely to prevail in court, because these studies will provide a link to real-world evidence

Bush administration was more aggressive in its analysis of coordinated interaction.

A number of practical implications are obvious. First, market definition must remain the first step in merger analysis. Coordinated interaction only makes sense if the rivals that the merged firm is expected to coordinate with can be identified. Second, market shares can be integrated into the

analysis in a sophisticated manner when the detailed data is available. Third, natural experiment evidence can be very useful in confirming the implications of a structural model. Thus, the *Guidelines*' focus on market institutions remains highly relevant, because understanding the competitive dynamics of the market is likely to aid the search for natural experiments. Fourth, customer concerns and hot documents should be analyzed in great detail in an attempt to isolate the natural experiments that underpin these concerns. While some facts may be lost to history, the reconstruction of even a qualitative natural experiment could serve to confirm a coordinated effects theory. Fifth, it appears customer sophistication serves to reduce the likelihood of collusion. This observation also implies a need to understand how the market of interest actually performs. Finally, well-done coordinated interaction analyses are simply more likely to prevail in court, because these studies will provide a link to real-world evidence. While it is possible to ground unilateral effects analyses in fact, it is also possible to become captured by the deductive logic that builds from the profit-maximization assumption to the theoretical conclusion on a price increase. In court, assumptions are not proof.