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Merger Simulation in an Administrative Context

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MERGER SIMULATION IN AN ADMINISTRATIVE CONTEXT

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This article addresses the application of the existing technical economic literature on merger simulation in the practical context of merger review and enforcement under the antitrust laws. It highlights the use of simple simulations as a basis for creating screens and presumptions to aid senior enforcement officials and judges, who may not have specialized in competition policy, and to provide guidance to merging firms.

Economists increasingly analyze proposed mergers through the lens of merger simulation. Comprehensive simulations attempt to incorporate a wide range of available information in a fully specified economic model, while simple simulations are based upon a limited number of parameters and variables. Simulation models have been relied upon by the antitrust agencies in multiple jurisdictions and by expert economists testifying in merger litigation.[1] They are also the subject of a growing academic literature.[2]

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[1] For a discussion of examples drawn from the United States and Europe, see Gregory J. Werden & Luke M. Froeb, *Unilateral Competitive Effects of Horizontal Mergers*, *in* HANDBOOK OF ANTITRUST ECONOMICS 43 (Paolo Buccirossi ed., 2008), and Oliver Budzinski & Isabel Ruhmer, *Merger Simulation in Competition Policy: A Survey*, 6 J. COMPETITION L. & ECON. 277 (2010).

[2] In addition to the articles cited in the previous note, see PETER DAVIS & ELIANA GARCÉS, QUANTITATIVE TECHNIQUES FOR COMPETITION AND ANTITRUST ANALYSIS 382–435 (2010); Jonathan B. Baker & David Reitman, *Research Topics in Unilateral Effects Analysis, in* RESEARCH HANDBOOK ON THE ECONOMICS OF ANTITRUST LAW (Einer Elhauge ed., forthcoming 2011) (working paper version available at http://ssrn.com/abstract=1504863).

The goal of merger simulation varies with the context. In an academic setting, the object is to obtain the best prediction possible. Although researchers do not ordinarily specify formally the criterion by which a prediction should be judged,[3] and do not routinely test predictions against outcomes,[4] the focus of simulation in an academic context is on improving its precision.

Additional considerations beyond precision come into play when proposed mergers are analyzed in a setting in which administrability and implementation are important, which, for purposes of this discussion, I call an administrative setting and include both antitrust enforcement agencies and the courts. In this context, merger analysts must explain their conclusions to senior agency officials and perhaps a district court judge, many of whom may not be specialists in competition law and economics. Moreover, in the administrative context, it is important to provide guidance to firms trying to understand the likely outcome of agency review so they can determine in advance the antitrust risks of the mergers and acquisitions they are considering.[5]

This article focuses on how merger simulation can and should be applied to address proposed mergers in the context of antitrust enforcement, not on providing a technical survey of the literature on merger simulation.[6] In particular, it argues that simple simulations of both unilateral and coordinated effects of horizontal mergers, incorporated as screens or to create presumptions, should be relied upon in the early stages of the administrative review process and in litigation to aid non-specialist decisionmakers in understanding the likely competitive effects of mergers and provide guidance to merging firms.[7] This role for simple simulations is consistent with the direction in which the U.S. horizontal merger guidelines are evolving.

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[3] One possibility is to minimize the mean absolute value or mean square of the forecast errors. If the costs of false positives and false negatives are thought to differ, the appropriate loss function would instead be asymmetric.

[4] Testing is only possible when the merger is allowed to proceed. *Cf.* Dennis W. Carlton, *Why We Need to Measure the Effect of Merger Policy and How to Do It* (Nat'l Bureau of Econ. Research, Working Paper No. w14719, Feb. 2009) (premerger and postmerger data are required to measure the effectiveness of merger policy, along with enforcement agency predictions about the postmerger market).

[5] Although this article focuses on the way these issues appear in the U.S. administrative context, in connection with both unilateral and coordinated effects, similar issues arise in other jurisdictions.

[6] In this respect, its ambition is similar to that of Derek Bok's influential 1960 article on merger policy. Derek C. Bok, *Section 7 of the Clayton Act and the Merging of Law and Economics*, 74 HARV. L. REV. 226 (1960). *See generally*, Herbert Hovenkamp, *Derek Bok and the Merger of Law and Economics*, 21 U. MICH. J.L. REFORM 515 (1988).

[7] A simple simulation can be thought of as an approximation to a comprehensive simulation.

I. ANTITRUST ENFORCEMENT CHALLENGES IN HORIZONTAL MERGER REVIEW

The merger review problems discussed here arise because it can be difficult to provide appropriate guidance to non-specialist decisionmakers in the enforcement agencies and at the merging firms. These difficulties appear in a litigation dilemma involving market definition that is characteristic of unilateral effects enforcement in the United States.[8] They also appear in a disjunction between the historical reliance on market concentration and market shares for merger decisionmaking in the United States and the limited economic relevance of these statistics for demonstrating both unilateral and coordinated effects.

A. THE LITIGATION DILEMMA IN UNILATERAL EFFECTS ENFORCEMENT

Unilateral effects have been treated more skeptically by the courts in the United States than by the antitrust enforcement agencies.[9] The Federal Trade Commission prevailed in its high-profile 1997 challenge to Staples's proposed acquisition of Office Depot, but the case was not framed by the court as a unilateral effects matter.[10] In 2004, a district court declined to enjoin Oracle's acquisition of PeopleSoft and, in doing so, set forth a legal standard which, if followed in the future, would make unilateral effects very difficult to prove.[11]

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[8] In practice, unilateral effects most commonly arise from mergers among firms that sell differentiated products without binding capacity constraints. This article follows both the legal literature and the economic literature by focusing on this setting. Unilateral effects also arise in other settings, including markets in which prices are set by bargaining or auctions and markets with relatively homogeneous goods in which firms compete by choosing production levels or capacities. *See* U.S. Dep't of Justice & Fed. Trade Comm'n, Horizontal Merger Guidelines §§ 6.2–6.3 (2010) [hereinafter Guidelines], *available at* http://ftc.gov/os/2010/08/100819hmg.pdf. Simulation methods appropriate for analyzing unilateral effects in various settings other than the differentiated products markets considered here are discussed in Werden & Froeb, *supra* note 1.

[9] For discussion of the enforcement agencies' treatment of unilateral effects, see Jonathan B. Baker, *Why Did the Antitrust Agencies Embrace Unilateral Effects?* 12 GEO. MASON L. REV. 31 (2003). The discussion of unilateral effects in this article emphasizes the most common setting, of mergers between sellers of differentiated products.

[10] FTC v. Staples, Inc., 970 F. Supp. 1066 (D.D.C. 1997). *Staples* is commonly and properly understood as a unilateral effects case, but it was described by the court as a merger to monopoly in a narrowly defined product market (or submarket) in a number of metropolitan areas. The court adopted the product market proposed by the government: consumable office supplies sold through office superstores. *See generally* Jonathan B. Baker & Robert Pitofsky, *A Turning Point in Merger Enforcement:* Federal Trade Commission v. Staples, *in* ANTITRUST STORIES 311 (Eleanor M. Fox & Daniel A. Crane eds., 2007) (legal discussion of the case). *Cf.* Jonathan B. Baker, *Stepping Out in an Old* Brown Shoe*: In Qualified Praise of Submarkets*, 68 ANTITRUST L.J. 203, 210 n.30 (2000) [hereinafter Baker, *Stepping Out*] (collecting examples of submarkets that may have been defined narrowly to capture localized competition, obviating the need for unilateral effects analysis).

[11] The court held that the Justice Department was required to show that the transaction would create a monopoly or near-monopoly but had failed to prove the narrowly defined product mar-

More recently, in *Whole Foods,* a district court denied the Federal Trade Commission's request that it enjoin preliminarily a proposed merger based upon a unilateral effects theory, although that decision was reversed and remanded on appeal.[12]

These enforcement difficulties arise in part because the government faces a litigation dilemma in unilateral effects cases. To illustrate the problem, suppose, counterfactually, that during the late 1970s, Anheuser-Busch (Bud), the brewing company that owned Budweiser, sought to acquire another national brewer, Pabst.[13] Bud was the market leader, accounting for about one-fourth of the beer sold in the United States, and the three leading firms—Bud, Miller, and Schiltz—together controlled about 55 percent of U.S. sales. Three other national firms—Pabst, Coors, and Stroh—each had national shares between 5 percent and 15 percent (though greater shares in certain regions of the country).[14]

Beer is a differentiated product,[15] and unilateral effects would have been a plausible competitive effects theory were it not anachronistic to suppose that a modern unilateral effects analysis would have been advanced in litigation at that time. An econometric study found that Pabst constrained Bud's pricing

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ket it alleged (high-function software used for financial management systems and human relations management). The decision also questioned whether narrow markets could ever be defined in a principled way. It emphasized the difficulty of identifying clear breaks in the chain of substitutes and the danger that submarket analysis would improperly identify narrow groupings as markets based on inappropriate non-economic criteria. United States v. Oracle Corp., 331 F. Supp. 2d 1098 (N.D. Cal. 2004). *See generally* Jonathan B. Baker & Carl Shapiro, *Reinvigorating Horizontal Merger Enforcement* 235, 241–44, *in* HOW THE CHICAGO SCHOOL OVERSHOT THE MARK: THE EFFECT OF CONSERVATIVE ECONOMIC ANALYSIS ON U.S. ANTITRUST (Robert Pitofsky ed., 2008) (highlighting ways in which the *Oracle* decision sought to limit the ability of courts to find adverse unilateral effects).

[12] FTC v. Whole Foods Mkt., Inc., 502 F. Supp. 2d 1 (D.D.C. 2007), *rev'd*, 533 F.3d 869 (D.C. Cir. 2008) *and* 548 F.3d 1028 (D.C. Cir. 2008). The appeals court concluded that the district court had improperly discounted some of the market definition evidence on the government's side of the argument. The FTC had alleged that premium natural and organic supermarkets constituted a relevant product market appropriate to analyzing the competitive effects of the transaction.

[13] Facts about the industry are set forth in Jonathan B. Baker & Timothy F. Bresnahan, *Estimating the Residual Demand Curve Facing a Single Firm* 6 INT'L J. INDUS. ORG. 283 (1988); Jonathan B. Baker & Timothy F. Bresnahan, *The Gains from Merger or Collusion in Product-Differentiated Industries*, 33 J. INDUS. ECON. 427 (1985) [hereinafter *Gains from Merger*]. *See also* Baker, *Stepping Out*, *supra* note 10, at 215 (discussing a similar counterfactual).

[14] The U.S. brewing industry has grown more concentrated since that time, perhaps reflecting the consequences for market structure of endogenous sunk expenditures on national advertising. *See generally* JOHN SUTTON, SUNK COSTS AND MARKET STRUCTURE (1991). Multistate regions were likely geographic markets for U.S. brewing during the late 1970s. *See* Christian Schmidt Brewing Co. v. G. Heileman Brewing Co., 753 F.2d 1354 (6th Cir. 1985) (upholding challenge to brewing industry merger within a twelve-state upper Midwest geographic market).

[15] Differentiation among the leading U.S. brands at the time was based on non-physical product attributes, not taste.

and a simple simulation analysis based upon that study predicted that the postmerger price of Bud would increase by at least 10 percent.[16] The litigation problem facing the government in challenging a merger based upon a unilateral effects theory can be illustrated by supposing that the government, convinced by this economic study, sought to challenge the transaction in court.

The government might have attempted to prove its case by showing that the merger would create a dominant firm within a narrowly defined product market: a market or submarket that included both Bud and Pabst. But it is hard to imagine a court defining a Bud/Pabst submarket while excluding from the market other large national firms, particularly Miller and Schlitz. Such a submarket would have looked like result-oriented gerrymandering that arbitrarily excluded some competing products to make the postmerger market share appear high.[17] Yet most litigators (today and undoubtedly also then) think it would be even more difficult for the government to prevail by showing harm to competition from unilateral effects within a broad product market—here, all beer—in which the merging firms have several rivals, even if the government could introduce a simulation study demonstrating the likelihood of a substantial price rise based upon econometric estimates of demand elasticities.[18] However difficult the task of proving unilateral effects of the hypothetical merger within a broad product market, moreover, it would become virtually impossible under the legal standard adopted by the district court in *Oracle*, which requires the government to show a merger to near-monopoly.[19]

The litigation dilemma may appear idiosyncratic to the U.S. antitrust enforcement system, but it makes a point of general applicability. Non-specialist decisionmakers do not automatically focus their attention on the key issue at stake in unilateral effects: whether, given the nature of buyer substitution patterns, either merging firm constrained its merger partner's ability to raise price prior to the transaction (notwithstanding the presence or absence of the additional constraints posed by the possibility of buyer substitution to other firms).

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[16] Baker & Bresnahan, *Gains from Merger, supra* note 13.

[17] In the hypothetical brewing industry example, this problem would have been especially acute if the government had also alleged that the merger would have generated adverse coordinated effects within an "all beer" product market. More generally, the government would be expected to have the greatest difficulty defending market boundaries when challenging mergers in industries where products differ on narrow characteristics (perhaps as with shampoo or soft drinks) or where firms sell their products at multiple locations near each other (perhaps as with convenience stores, coffee shops, or banks).

[18] *See, e.g.*, Daniel M. Wall, FTC Unilateral Effects Analysis and Litigation Workshop: Panel on the Role of Market Definition 97, 100–01 (Feb. 12, 2008) (transcript), *available at* http://www.ftc.gov/bc/unilateral/transcript.pdf.

[19] This legal standard makes no economic sense. A dominant position is not required for the exercise of market power in a differentiated product setting, and low market shares do not necessarily make unilateral effects unlikely (for example, because competition may be localized). *See generally* Baker & Shapiro, *supra* note 11, at 243.

In the context of litigation, defendants exploit the process of market definition—regardless of whether the government seeks to define a broad market or a narrow one—to emphasize rivalry from third firms and downplay the competitive constraint either merging firm poses for its partner.[20] If the government defines a broad market, defendants make that point by highlighting the possibility that buyers would substitute to market participants beyond the merging firms. If the government defines a narrow market, defendants question whether the market has been gerrymandered to downplay those substitution possibilities. But this defense effort can mislead a non-specialist decisionmaker because rivalry from third firms does not matter in unilateral effects analysis for its own sake; it is only relevant to the extent that buyer substitution to those firms provides a competitive constraint that duplicates the constraint that the merging firms provide for each other.

The U.S. litigation dilemma thus makes evident a difficulty with proving unilateral effects likely to arise in any enforcement system: the problem of ensuring that the system leads non-specialist decisionmakers to evaluate the competitive constraint the merging firms pose for each other prior to their merger, given the nature of buyer demand. The litigation dilemma can be understood as a problem of inadequate guidance. It arises to the extent that the decisionmaking rules for the U.S. courts do not lead judges to focus attention on key questions and do not induce litigants to bring forward the most probative evidence for answering them.

B. Legal Rules Based on Market Concentration

The guidance problem in the U.S. system goes beyond the unilateral effects litigation dilemma because legal rules that emphasize market concentration and market share also provide inadequate guidance to the courts and the merging firms.[21] Merger review in U.S. courts is based on the "structural presumption" of harm arising from high and increasing market concentration.[22] Yet rules based on market shares and market concentration provide poor guidance for analyzing mergers, whether the competitive effects theory involves unilateral or coordinated effects.

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[20] *See* Jonathan B. Baker, FTC Unilateral Effects Analysis and Litigation Workshop: Panel on the Role of Market Definition 97, 108–09 (Feb. 12, 2008) (transcript), *available at* http://www.ftc.gov/bc/unilateral/transcript.pdf.

[21] For a recent effort to describe the appropriate relevance of market concentration in merger analysis, highlighting factual settings in which market shares and market concentration have probative value, see Jonathan B. Baker, *Market Concentration in the Antitrust Analysis of Horizontal Mergers, in* ANTITRUST LAW AND ECONOMICS 234 (Keith N. Hylton ed., 2d ed. 2010) [*Market Concentration*] (corrected in a working paper available at http://ssrn.com/abstract=1092248).

[22] *See generally* Baker & Shapiro, *supra* note 11, at 236–38.

Market shares, from which concentration statistics like the Herfindahl-Hirschman Index (HHI) are derived, do not convey much information about buyer substitution, the key economic issue in unilateral effects cases. Shares do not measure the extent to which buyers view the products of the merging firms as close substitutes. More precisely, market shares measure buyers' first choices, while unilateral effects instead turn on buyers' second choices—on where customers would go if the price were to rise on the product they previously preferred.[23] Accordingly, an enforcement system that places heavy weight on market shares will likely perform poorly in evaluating unilateral effects.

The structural presumption is more important in the analysis of coordinated effects than for unilateral effects, but market concentration again provides only limited guidance as to the likely harm from a merger. The problem arises from the nature of the theory underlying the application of the structural presumption to coordinated effects. That theory can be described as a "dinner party story": If more people are invited to dinner, it becomes more difficult to coordinate calendars and less likely that others will notice if someone who accepted the invitation does not show (cheats). The dinner party story is essentially an empirical generalization that recognizes that the odds of coordination rise as market concentration increases.

Yet the underlying empirical support for a relationship between concentration and price, while present, is not strong.[24] Moreover, the dinner party story does not describe the mechanism at work. It does not explain why a particular increase in concentration through merger will help coordinating firms solve their "cartel problems" of reaching consensus on the terms of coordination or deterring cheating. Instead it is a probabilistic statement based on a rough empirical regularity that suggests that enforcers and courts should be concerned with every non-trivial merger in a concentrated market.[25]

The strength of the structural presumption applied by U.S. courts has eroded greatly since the presumption was established during the 1960s.[26] The

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[23] Although the process of market definition, from which market shares are generated, incorporates information about buyer second choices, and one theoretical model (logit demand) relates buyer first choices and second choices, there is little empirical basis in general for making such a connection.

[24] There is no well-established "critical" concentration level beyond which the risk of coordination rises markedly, and firm-specific and industry-specific factors beyond concentration are also important in determining prices. *See generally* ANDREW I. GAVIL, WILLIAM E. KOVACIC & JONATHAN B. BAKER, ANTITRUST LAW IN PERSPECTIVE: CASES, CONCEPTS AND PROBLEMS IN COMPETITION POLICY 505–06 (2d ed. 2008) (Sidebar 5–6).

[25] Jonathan B. Baker, *Mavericks, Mergers, and Exclusion: Proving Coordinated Competitive Effects Under the Antitrust Laws,* 77 N.Y.U. L. REV. 135, 139 (2002) [hereinafter *Mavericks*].

[26] Baker & Shapiro, *supra* note 11, at 236–38. In *United States v. Baker Hughes Inc.*, the D.C. Circuit described market concentration as simply "a convenient starting point" for a "totality-of-

erosion of the structural presumption has, on the whole, been beneficial, given the limited value of market concentration measures for evaluating both unilateral and coordinated competitive effects. But that benefit comes at the cost of making litigation less predictable, thereby reducing the guidance that legal rules provide to both non-specialist decisionmakers and merging firms.[27]

II. MERGER SIMULATION AS A SOLUTION

The remainder of this article considers how merger simulation can help solve these enforcement problems in evaluating unilateral and coordinated effects in assessing proposed mergers in an administrative setting. It shows how screens and presumptions based upon simple simulations can help the government win good unilateral effects cases in court, provide guidance to merging firms, and explain why (not just whether) particular mergers make harm to competition likely. Simple simulations would supplement comprehensive simulations, which would remain important in detailed agency review and in litigation.

A. UNILATERAL EFFECTS

Whether simulations are simple or comprehensive, they are based on the same underlying economic theory, which can quickly be sketched. Suppose that each firm in a differentiated consumer product industry sells a single product (ruling out multi-product producers). The firms have constant marginal costs that may differ. The premerger price for a particular firm, firm 1, is set at the level at which the firm is indifferent to a small change.

$$(1)\ \Delta P^1 Q^1 = (P^1 - C^1)\ \Delta Q^1$$

Equation (1) is the first order condition for profit maximization by firm 1 written in differential form. The left-hand expression is the benefit from a small increase in price (greater revenues ΔP^1 on each of the Q^1 units sold); the right-hand expression represents the cost (the forgone price-cost margin ($P^1 - C^1$) times the ΔQ^1 sales lost by raising price).

A merger of this firm with firm 2 provides the merged firm with an incentive to raise the price of the first product.

$$(2)\ \Delta P^1 Q^1 + (P^2 - C^2)\ \Delta Q^2 > (P^1 - C^1)\ \Delta Q^1$$

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the-circumstances" analysis. United States v. Baker Hughes Inc., 908 F.2d 981, 984 (D.C. Cir. 1990). *But cf.* FTC v. H.J. Heinz Co., 246 F.3d 708 (D.C. Cir. 2001) (merging firms did not successfully rebut the presumption of harm to competition in a merger to duopoly with evidence that the efficiencies from merger would allow the merged firm to compete more effectively against the dominant firm in the market).

[27] *Oracle* arguably would provide a great deal of guidance by circumscribing the government's ability to win in court, but this "solution" to the problem is obviously unsatisfactory.

The new term in equation (2), $(P^2 - C^2)\,\Delta Q^2$, represents the gain to the merged firm from internalizing the benefit a higher price charged by the first firm confers on the profitability of the second firm, by virtue of the fact that some of the lost sales on firm 1's product shift to the product produced by firm 2.[28] For similar reasons, the transaction also provides the merged firm with an incentive to increase the price of the second product. The merged firm chooses the price of each product simultaneously to optimize total profits, taking into account the feedbacks that result from raising the price of each. It is likely that it will increase the price of both products.

There are several ways of understanding intuitively why the merger leads to an increase in the price for the first product.[29] One is the "profit recapture" idea emphasized above: The merger allows firm 1 to recapture some of the profit margin it previously lost to firm 2. Another, an "opportunity cost" intuition, is based on the idea that after the merger, the firm recognizes that expanding output of the first product would cannibalize sales from the second product, which it now owns. Accordingly, the merger raises the opportunity cost of selling the first product, leading it to reduce output of that product and raise price.[30] A third intuition emphasizes the way the merger "removes a competitive constraint." Prior to the merger, the products of multiple firms, firm 2 included, constrain firm 1 from raising price. The merger removes one of these constraints, thereby making the residual demand for the first product less elastic and providing the merged firm with an incentive to raise that product's price.[31]

These intuitions can be captured in both comprehensive and simple simulations. A comprehensive merger simulation works out the postmerger equilibrium prices and output for both products, accounting for a wide range of potentially relevant information. For example, in the setting above, if *n* firms selling the differentiated product can reasonably be assumed to interact in accordance with a Bertrand-Nash oligopoly solution concept, the premerger first-order condition for each firm *i* can be written as in equation (3), where $L^i = (P^i - C^i)/P^i$ is the Lerner Index for product i and ε^{ii} is own price elasticity of demand for that product.

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[28] The expression $\Delta Q^2/\Delta Q^1$ is termed a "diversion ratio."

[29] For a more extensive discussion, see Baker & Reitman, *supra* note 2. Unilateral effects could also arise if the merger allowed the new firm to increase the marginal costs of rivals through exclusionary conduct, but this possibility is ignored in the class of simulation models discussed here.

[30] This perspective is emphasized in Joseph Farrell & Carl Shapiro, *Recapture, Pass-Through, and Market Definition*, 76 ANTITRUST L.J. 585 (2010). *See also* E. Glen Weyl & Michal Fabinger, Pass-Through as an Economic Tool 30–34 (Oct. 29, 2009), *available at* http://ssrn.com/abstract=1324426.

[31] This perspective is emphasized in Baker & Bresnahan, *Gains from Merger*, *supra* note 13.

(3) $L^i = -1/\varepsilon^{ii}$, for i = 1. . . .n

The simultaneous solution of the *n* equation (3) determines the prices and output for all producers.

In this model, the merger alters two of the *n* first order conditions, those corresponding to firms 1 and 2 (the merger partners). The two modified post-merger first-order conditions can be specified analytically,[32] as indicated in equations (4) and (5), where the ε^{ij} terms are demand cross-elasticities.

(4) $L^1 = -1/\varepsilon^{11} - L^2(\varepsilon^{12}/\varepsilon^{11})(Q^2P^2)/(Q^1P^1)$

(5) $L^2 = -1/\varepsilon^{22} - L^1(\varepsilon^{21}/\varepsilon^{22})(Q^1P^1)/(Q^2P^2)$

The two new first-order conditions above, combined with the *n – 2* first-order conditions for the other products can then be solved simultaneously for the postmerger equilibrium prices and outputs.

This is not the only approach possible for comprehensive simulation. Alternative approaches in the economic literature can be understood as relaxing or modifying various assumptions in the above model,[33] thereby making a different tradeoff between tractability (which pushes toward reducing the number of parameters) and flexibility (which pushes toward increasing them).[34]

The advantages of comprehensive simulation are independent of how the key parameters are identified. In particular, econometrics is not required to perform a merger simulation, even a comprehensive one. The demand functions, oligopoly conduct, and marginal cost functions in the model could indeed be estimated econometrically. It is also possible to incorporate qualitative information about these inputs and non-econometric quantitative information, such as engineering studies of cost, and to combine such information with econometric estimates.

The potential advantages of comprehensive simulation instead largely relate to increased precision in evaluating unilateral effects given the best information available about the key model inputs. A comprehensive simulation synthesizes a great deal of information (in the example above, about demand elasticities and margins) in a logically consistent way. It may provide a metric for understanding what key parameters mean for the merged firm's incentive

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[32] In the simple model in the text, if marginal costs are constant and the oligopoly solution concept known, information on the premerger demand parameters (own and cross elasticities, or their diversion ratio analogues) can be used to infer marginal cost, which need not be estimated separately. The model can also incorporate information about marginal cost savings from merger.

[33] For surveys see Baker & Reitman, *supra* note 2; Werden & Froeb, *supra* note 1.

[34] This tradeoff is emphasized in Baker & Reitman, *supra* note 2.

to raise price and can be used to identify critical uncertainties in model specification and parameter estimates.

It may be possible, moreover, to use a comprehensive simulation to identify subtle unilateral effects in dense markets, for example when the products of the merging firms are substitutes, but not the closest substitutes, premerger. A comprehensive simulation can be used to improve predictions beyond what can be inferred from buyer substitution, the first-order issue in the analysis of unilateral effects among sellers of branded consumer products,[35] by accounting for issues, including rival reactions and repositioning.[36] Finally, it can be difficult to assess the net effect of a merger between rivals that also confers efficiencies without a model, which a comprehensive simulation may provide. For all these reasons, a comprehensive simulation can be valuable when undertaking a detailed assessment of an individual merger proposal, particularly when the transaction is subject to detailed agency review (e.g., following a second request) or litigation.

Yet comprehensive simulations also have features that are not well-matched to the administrative context. They can be difficult and time-consuming to develop. They are typically custom-designed for each merger to account for key features of the industry and the available information. They routinely incorporate judgment calls that structure the analysis, often made with an eye toward mathematical tractability.[37] And the information demands are high because the goal is to work out the implications of a discrete change in key variables on price and output arising from merger, not simply to iden-

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[35] Buyer substitution is the key issue in evaluating unilateral effects in many common merger settings, particularly mergers between sellers of branded consumer products, where the main difficulty firms face in expanding output is in obtaining buyer acceptance (rising marginal cost of marketing differentiated products) rather than in overcoming capacity constraints. Consistent with this view, simulation models of unilateral effects involving branded consumer products typically treat the marginal cost of production as constant.

[36] *See, e.g.*, Craig Peters, *Evaluating the Performance of Merger Simulation: Evidence from the U.S. Airline Industry*, 49 J.L. & ECON. 627 (2006) (simulation methods can improve predictions by incorporating information about rival reactions); *see generally* Michael Doane, Luke Froeb & Steven Tschantz, *WARNING*: Improper Use of the New Horizontal Merger Guidelines *Can Result in Overly Narrow Markets, Mistaken Inferences of Market Power, and Wrong-Headed Analyses*, CPI ANTITRUST CHRON., Autumn 2010, Vol. 10, No. 2, at 1, 4 (simple models can give misleading merger predictions if they do not account for repositioning, capacity constraints, vertical relationships, promotional competition, switching costs, and bargaining, bidding, or quantity competition).

[37] Relatedly, simulation models must be structured to ensure consistency among the assumptions made concerning marginal cost, oligopoly conduct, and demand. In the simple Bertrand model set forth above, for example, the first-order conditions take the form $L = 1/\varepsilon$. If the demand elasticity and marginal cost are not consistent, and the underlying data (e.g., the measure of price) are reliable, then an assumption as to at least one key factor (demand function, marginal cost function, or Bertrand conduct) cannot be maintained.

tify the direction of the change in price and output resulting from a small shift in market structure.[38]

These features may be a poor fit for the administrative context, which often demands rapid decisionmaking. For example, the enforcement agencies must decide quickly whether they should request additional information to conduct an in-depth analysis. The administrative context also places a premium on guidance and accessibility. Put differently, in an administrative context, increased precision is not the only goal.

By contrast, simple simulations to create screens or presumptions may be particularly useful in the administrative context. One example of a simple simulation, set forth in equation (6), is a formula derived by Carl Shapiro that computes the percentage price increase for one product (product 1) after a merger between two single product sellers.[39] The formula assumes linear demand, constant marginal cost, and Bertrand conduct.[40]

$$(6)\ \Delta P^1/P^1 \geq (1/2)d^{12}[(P^2 - C^2)/P^1]$$

An analogous formula would apply to predict the percentage price increase for the second product.[41]

Equation (6) employs simple algebra and only four variables or parameters: one diversion ratio (d^{12}), from the first product to the second;[42] two premerger prices; and one marginal cost, for the second product. Through the diversion ratio, it accounts for buyer substitution, the key economic force at issue in

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[38] For example, the postmerger outcome could require out-of-sample predictions about demand.

[39] Carl Shapiro, Unilateral Effects Calculations 8 (Oct. 2010), *available at* http://faculty.haas.berkeley.edu/shapiro/unilateral.pdf; *see also* Carl Shapiro, *Mergers with Differentiated Products*, ANTITRUST, Spring 1996, at 23.

[40] Shapiro writes the formula as $\Delta P^1/P^1 \geq (1/2)d^{12}[(P^2 - C^2)/P^2](P^2/P^1)$ to define $[(P^2 - C^2)/P^2]$ as a price-cost margin. Cancellation of the P^2 terms in the right-hand expression gives the expression (6).

[41] Joseph Farrell and Carl Shapiro propose an upward pricing pressure (UPP) index that is a variant of this formula: $d^{12}(P^2–C^2) \geq EC^1$. Joseph Farrell & Carl Shapiro *Antitrust Evaluation of Horizontal Mergers: An Economic Alternative to Market Definition,* B.E. J. THEORETICAL ECON.: POLICIES & PERSPECTIVES, vol. 10, issue 1, art. 9 (2010), http://www.bepress.com/bejte/vol10/iss1/art9. The left-hand side of this inequality represents the expected recaptured profit per switching customer if the merged firm increases the price of the first product a small amount. This profit increase is calibrated by requiring that it equal or exceed an arbitrary percentage E of the first product's premerger marginal cost. A related price pressure index was previously proposed in Daniel P. O'Brien & Steven C. Salop, *Competitive Effects of Partial Ownership: Financial Interest and Corporate Control*, 67 ANTITRUST L.J. 559 (2000).

[42] The diversion ratio d^{12} is defined as the percentage of unit sales lost by the first product resulting from a price increase that is captured by the second product. Diversion ratios are related to demand elasticities. For example, $d^{12} = [\varepsilon^{12}/–\varepsilon^{22})][Q^1/Q^2]$, where ε^{12} is the cross elasticity of demand from product 1 to product 2, ε^{22} is the own elasticity of demand for product 2, and the Qs are quantities for the two products.

unilateral effects in branded consumer product settings. It is not too simplistic: it does not assume symmetry in prices, marginal costs, or diversion ratios. But it makes assumptions about what are usually less fundamental features of the analysis in such settings: how marginal cost varies with output, third-firm responses, and efficiencies from merger. Because equation (6) incorporates the most important information relevant to assessing unilateral effects, and integrates that information in a manner consistent with the underlying economic theory, it provides a plausible basis for developing a screen or presumption about the unilateral competitive effects of merger.

One way to understand the formula (6) is to recognize that the expression $[d^{12}(P^2 - C^2)]$ represents the expected recaptured profit per switching customer if the merged firm increases the price of the first product by a small amount.[43] The greater that recaptured profit, the greater the incentive of the merged firm to raise the price of the first product.

Another interpretation arises from recognizing the close relationship between the right-hand expression in equation (6) and the gross upward pricing pressure index (GUPPI) adopted in the 2010 Horizontal Merger Guidelines.[44] The GUPPI for product 1 (denoted $GUPPI^1$) is defined as $GUPPI^1 = d^{12}[(P^2 - C^2)/P^1]$. The GUPPI is interpreted in the Guidelines as the value of sales of the first product diverted to the second by virtue of a small price increase in the first, divided by the total revenues lost by the first product as a result of the price increase.[45] It is in effect a diversion ratio expressed in revenue terms and would fall in a range between 0 and 100 percent. Substitution of the definition of the GUPPI for firm 1 into equation (6) yields equation (7).

(7) $\Delta P^1/P^1 = (1/2)GUPPI^1$

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[43] Here the diversion ratio is interpreted as the probability that a customer of firm 1's product would switch to the second firm's product in response to a price increase for the first product.

[44] *See* Guidelines, *supra* note 8, § 6.1 & n.11. The Guidelines do not use the specific term GUPPI, however.

[45] If ΔQ^1 is the unit quantity lost by firm 1 in response to a small price increase, then $\Delta Q^1 d^{12}(P^2 - C^2)$ represents the value of lost sales of the first product that were diverted, while $\Delta Q^1 P^1$ represents the total lost revenues on the first product. Their ratio is the GUPPI. For derivations and more detailed discussion, see Carl Shapiro, *The 2010 Horizontal Merger Guidelines: From Hedgehog to Fox in Forty Years*, 77 ANTITRUST L.J. 701 (2010); Steven C. Salop, Serge X. Moresi & John R. Woodbury, *Scoring Unilateral Effects with the GUPPI: The Approach of the New Horizontal Merger Guidelines*, CRA COMPETITION MEMO (Aug. 31, 2010) , *available at* http://www.crai.com/uploadedFiles/Publications/Commentary-on-the-GUPPI.pdf. *See also* Serge Moresi, *The Use of Upward Price Pressure Indices in Merger Analysis*, ANTITRUST SOURCE, Feb. 2010, http://www.americanbar.org/content/dam/aba/publishing/antitrust_source/Feb10_Moresi2_25f.authcheckdam.pdf. The information used to derive the GUPPI (prices, costs, and diversion ratios) could also be combined to simulate price increases in other ways, but at the loss of the accessibility advantages that make the GUPPI approach an appealing basis for guidance in an administrative context. *See* Jerry Hausman, Serge Moresi & Mark Rainey, *Unilateral Effects of Mergers with General Linear Demand,* 111 ECON. LETTERS 119 (2011).

Equation (7) indicates that under the assumptions implicit in equation (6), a merger between the firms would increase the price of the first firm's product by half the first firm's GUPPI.[46]

If equation (7) were viewed as a comprehensive simulation, it would be woefully inadequate. It presumes single product firms, linear demand, constant marginal cost, Bertrand conduct, no efficiencies from merger, and no rival responses including price changes, entry, or repositioning. It also assumes that the merged firm raises only the price of one merger partner's product, not both.[47] In practice, evidence can generally be brought to bear to test or modify many of these assumptions, and that information would be incorporated into a comprehensive simulation, yet equation (7) ignores such evidence. For this reason, commentary on the use of the GUPPI in the Guidelines describes it as a "diagnostic measure" or "scoring" rather than as a tool for generating a "prediction" of the postmerger price,[48] and the Guidelines stop short of computing the implied percentage price increase.

Equation (7) is better understood as a simple simulation. It has several virtues that make it particularly useful in an administrative context: it can likely be applied more rapidly, would be better anticipated by merging firms, and would be more accessible to decisionmakers than any comprehensive simulation. In consequence, a price increase implied by equation (7) could be used by enforcers as a screen to identify mergers creating the potential for unilateral effects and by courts as a basis for a presumption that a merger among sellers of differentiated products would harm competition.[49] Because a simple

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[46] Under the "opportunity cost" intuition, the merger raises the opportunity cost of selling the first product. The division by two reflects the fact that a monopolist with a linear demand function and constant marginal cost passes through 50 percent of a cost change to its buyers. Differently shaped demand functions would generate different passthrough rates.

[47] The comprehensive simulation model set forth in equations (1) through (5) differs most importantly from the simple simulation specified by equation (7) because it accounts for feedback effects between the price change for the first product and other prices, including both the price the merged firm charges for its other product and the prices that its non-merging rivals charge.

[48] Shapiro, *supra* note 45, at 97; Salop, Moresi & Woodbury, *supra* note 45; *see* Dennis W. Carlton, *Use and Misuse of Empirical Methods in the Economics of Antitrust,* CPI ANTITRUST CHRON., Spring 2011, Vol. 3, No. 1, at 1, 10 (describing UPP as "being suggested as a screen to use in merger cases that is a short-cut to a full merger simulation").

[49] An alternative simple approach to merger simulation, relying on estimating partial residual demand elasticities, is described in Baker & Bresnahan, *Gains from Merger*, *supra* note 13. Michael Whinston provides a recent discussion of its limitations as a comprehensive simulation approach, but does not address its value for creating a screen or presumption. MICHAEL D. WHINSTON, LECTURES ON ANTITRUST ECONOMICS 105–10 (2006). Another alternative approach, computing compensating marginal cost reductions (cost reductions that would be necessary to offset the incentive of the merged firm to raise price), is closely related to the GUPPI (and was developed first). *See generally* Doane, Froeb & Tschantz, *supra* note 36, at 5–6; Gregory J. Werden, *A Robust Test for Consumer Welfare Enhancing Mergers Among Sellers of Differentiated Products*, 44 J. INDUS. ECON. 409 (1996); Gregory J. Werden & Luke Froeb, Choosing Among Tools

simulation like equation (7) limits the information that is employed in predicting the postmerger price, price forecasts based upon it would likely lead to greater error than those that would result from the use of a comprehensive simulation.[50] Some error can be tolerated in a simulation employed as a screen or presumption, but it would be useful for researchers to examine case studies exploring the direction and size of such errors before adopting any particular simulation approach as a screen.[51] Such information would also be useful in setting a critical value for the GUPPI, above which the merger would be presumed to harm competition.[52]

If equation (7) is used as the basis for creating a presumption or screen,[53] it would give guidance to firms considering mergers as to whether their transaction would draw scrutiny from enforcers or courts.[54] Government reliance on equation (7) would also help make clear the logic by which unilateral effects harm competition, and encourage the courts to adopt a presumption based on it, thereby addressing the litigation dilemma by helping the government win good unilateral effects cases in court.

B. COORDINATED EFFECTS

Simulation methods for coordinated effects are less developed than those used for unilateral effects. One possible comprehensive simulation approach, roughly at the state of the art in the academic literature, would begin by speci-

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for Assessing Unilateral Merger Effects (Mar. 1, 2011), *available at* http://ssrn.com/abstract=180424.

[50] A comprehensive simulation could perform less well than the corresponding simple simulation in an individual case—for example, if the additional information it incorporates is noisy and is particularly misleading—but comprehensive simulations are likely to perform better than simple simulations on average.

[51] Simulation modeling might also provide insight as to the circumstances (functional form of demand, extent of asymmetry between the merging firms, degree of substitution to non-merging firms, etc.) under which the predictions from simple simulations are most similar to the predictions from comprehensive simulations.

[52] As an illustrative example, the threshold GUPPI might be set at 10 percent, consistent with an implied price increase of 5 percent. This figure might tend to overestimate the actual magnitude of the price rise from a merger, given that it does not account for repositioning, entry, or efficiencies. Or it might tend to underestimate the price rise, given that it does not account for feedback effects. Studies evaluating the errors from using simple simulations rather than comprehensive ones could provide information about the distribution of these possible biases. Moreover, the choice of threshold may also depend on administrative considerations (a higher threshold reduces the number of investigations, lessening administrative costs) and policy considerations (the social costs of failing to investigate harmful mergers that fall under the threshold compared with the social costs of investigating mergers unlikely to harm competition that would not be screened out).

[53] The 2010 Horizontal Merger Guidelines do not incorporate equation (7) expressly, but they represent an evolution in that direction.

[54] If equation (7) is used for this purpose, it may be appropriate to set a benchmark or threshold for concern for the percentage price increase.

fying how the firms were interacting before the merger, perhaps as a non-cooperative game or an imperfect coordinated interaction. Then the post-merger cooperative equilibrium would be computed by making an (arbitrary) assumption about how cooperation works—perhaps Nash bargaining to split the surplus,[55] a balanced temptation equilibrium,[56] or the application of some focal rule[57]—subject to the incentive constraint that no firm prefers cheating to cooperation.

Other quantitative approaches for understanding coordinated effects in the academic literature ask a related question: whether the merger relaxes a constraint limiting coordination. One such method looks at how the merger changes the profitability of collusive agreements among all subsets of the market participants.[58] Another evaluates how the merger alters the incentive constraint for each firm under the assumption that any deviation leads to a permanent return to the non-cooperative outcome, to identify how the transaction alters the minimum discount factor at which coordination is profitable.[59] In theory, these methods could form the basis for creating a presumption or screen to be applied in the administrative context, but that use is impractical in practice as their computational demands are similar to those required for comprehensive simulation.

By contrast, a presumption that relies on the idea that a maverick constrains more effective coordination may be simpler to employ and, thus, may be particularly useful in the administrative context.[60] Mavericks arise because coordination is typically imperfect and incomplete, falling short of obtaining the

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[55] Kai-Uwe Kühn, *The Coordinated Effects of Mergers*, *in* HANDBOOK OF ANTITRUST ECONOMICS, *supra* note 1, at 105, 140.

[56] Pierluigi Sabbatini, *How to Simulate the Coordinated Effects of a Merger*, 12 Autorità Garante della Concorrenza e del Mercato, Temi e Problemi (June 2006), *available at* www.agcm.it/trasp-statistiche/doc_download/2659-tp012.html.

[57] For example, coordinating firms may reach a simple understanding by which they raise all prices by the same percentage, grandfathering in prior differentials. Or they may pick a price with the understanding that all firms would achieve it by reducing output by the same percentage (and so preserve prior market shares). Focal rules are discussed in Jonathan B. Baker, *Two Sherman Act Section 1 Dilemmas: Parallel Pricing, the Oligopoly Problem, and Contemporary Economic Theory*, 38 ANTITRUST BULL. 143, 162–69 (1993).

[58] William E. Kovacic, Robert C. Marshall, Leslie M. Marx & Steven P. Schulenberg, *Coordinated Effects in Merger Review: Quantifying the Payoffs from Collusion*, *in* 2006 FORDHAM COMPETITION L. INST. 271 (Barry E. Hawk ed., 2007), *available at* http://faculty.fuqua.duke.edu/~marx/bio/papers/FordhamChapter%2013.pdf. This methodology could form a basis for creating a presumption or screen if the likelihood of coordination is thought to be an increasing function of those payoffs.

[59] Peter Davis & Cristian Huse, *Estimating the "Coordinated Effect" of Mergers* (Jan. 2010), *available at* http://www.competition-commission.org.uk/our_role/analysis/Peter%20Davis_Cristian%20Huse_2010.pdf; Davis & Garcés, *supra* note 2, at 426–34. Mergers that lower the critical discount factor are thought to make coordination more likely.

[60] *See* Baker, *Market Concentration*, *supra* note 21 (corrected working paper); Baker, *Mavericks*, *supra* note 25.

fully collusive price. Coordination is generally limited for many reasons, including these four: First, coordinating firms may be unable to commit to responding to cheating with steep punishments. For example, they may be able to commit to return to a repeated non-cooperative stage game only. Second, coordinating firms may be unable to make side payments to recalcitrant firms. Third, the firms may find it necessary to rely on expensive strategies to deter cheating when a noisy environment makes cheating difficult to detect, for example, when firms engage in price wars in response to unexpected demand shocks.[61] Finally, the firms may find it difficult to identify the joint profit-maximizing outcome without communicating, especially as the number of products and markets involved increases. So instead of communicating, they may find themselves relying on focal rules to determine the terms of coordination. When coordination is incomplete, as in general would be expected, it would not be surprising to find that most firms are not indifferent between coordination and cheating—preferring more effective coordination—while some firms, the mavericks, are close to the line and thus constrain coordination from becoming more complete. When coordination takes place in oligopoly markets with differentiated firms, the firms are likely to differ in attributes affecting costs and demand, so there is most likely only one maverick.

The role of a maverick in constraining coordination can be illustrated through a simple model.[62] The model assumes that sellers of homogeneous products interact premerger in an infinitely repeated oligopoly supergame. Industry demand can be written $Q(P)$, for market price P. Marginal cost (C^i) and capacity (k^i) may differ across firms *i*. Under the terms of coordination, firms reach consensus on price and firm shares (s^i). The discount rate, common to all firms, is denoted δ, with $0 < \delta < 1$.

If cheating were to occur, the cheater would undercut the market price by a tiny amount (epsilon), allowing it to sell its entire production capacity. Because the market price would not fall more than trivially with cheating, industry output would remain unchanged. This state of affairs would continue for *T* periods, after which the cartel would break down permanently and the firms would earn zero profits.[63]

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[61] Edward J. Green & Robert H. Porter, *Noncooperative Collusion Under Imperfect Price Information*, 52 ECONOMETRICA 87 (1984).

[62] The model is described in more detail in Baker, *Market Concentration*, *supra* note 21 (corrected working paper).

[63] This simplification does not account for differences in marginal costs and capacities across firms. (If breakdown of coordination leads to a repeated one-shot Cournot equilibrium, some firms—namely those with low costs and high capacities—may earn profits, contrary to the assumption made here, and they may, in consequence, find it profitable to deviate from the coordinated outcome for some rates of capacity utilization that would satisfy equation (9).) The model abstracts from these and other complications to highlight two broad intuitions likely to hold in general: a merger involving a maverick is likely to raise price, and a maverick may have struc-

With these assumptions, each firm's incentive constraint can be specified.

(8) $(P–C^i)s^iQ(P)/(1 - \delta) \geq (P - C^i)k^i(1 - \delta^T)/(1 - \delta)$, for i = 1. . . .n

As equation (8) indicates, firm *i* prefers coordination to cheating if and only if the present value of the profit stream from continued cooperation equals or exceeds the present value of the profit stream from cheating. The incentive constraint is simplified algebraically in equation (9).

(9) $s^i\ Q(P)/k^i \geq (1 - \delta^T)$, for i = 1. . . .n

The left-hand expression in equation (9) is the firm's rate of capacity utilization (quantity sold as a fraction of capacity).

Equation (9) illustrates the role of a maverick firm in constraining coordination. Picture arraying the *n* firms in terms of their capacity utilization rate, from highest to lowest. The firm with the lowest rate is the maverick. At a low enough price, all firms will operate at high enough capacity to satisfy the inequality. The coordinated price can rise, making coordination more effective, until one firm, the maverick, becomes indifferent between cooperation and cheating. The other firms would prefer a higher price, but coordination is imperfect. The industry price stays below the fully collusive price, constrained by the maverick.

A merger involving the maverick (firm 1) and a rival (firm 2) relaxes the constraint that the maverick imposes, as indicated in equation (10).

(10) $(s^1 + s^2)Q(P)/(k^1 + k^2) \geq (1 - \delta^T)$

Relaxing the constraint will likely lead to a higher price. That price increase might be small, however, if the firm that steps in as the constraint has a capacity utilization rate close to that of the premerger maverick and thus prefers a price only slightly higher than the premerger maverick desired.

As the model indicates, a merger involving a maverick is likely to raise price.[64] This intuition provides a plausible basis for a presumption, appropriate for application to merger review in administrative setttings, that a merger involving a maverick will harm competition.[65]

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tural characteristics suggesting limited benefits to continued cooperation or substantial benefits from cheating.

[64] If one were willing to assume no third firm is waiting in the wings, and the other assumptions in the model plausibly applied to an industry setting, the equality in equation (10) could in principle be employed to simulate the postmerger price. Given the strong assumptions underlying that equation, however, the formula is better thought of as supporting a more general intuition.

[65] The implications of mergers not involving a maverick for the coordinated price are discussed in Baker, *Mavericks*, *supra* note 25, at 182–88. For example, the merger of firms that are not mavericks can alter the maverick's incentives or create a new maverick.

The key to applying such a presumption is to identify the most likely maverick. Equation (9) should not be interpreted as suggesting that capacity utilization is the key to doing so. Rather, the equation depicts each firm as balancing the benefit from continued cooperation (the numerator) against the benefits of cheating (the denominator).[66] A maverick may thus have structural characteristics suggesting limited benefits to continued cooperation, such as a low market share. Or it may have characteristics suggesting substantial benefits from cheating, such as high excess capacity or an unusual ability to expand output without detection some other way (perhaps by exploiting vertical integration). A maverick might also be identified through a natural experiment—changes in a maverick's costs should affect the coordinated price but changes in a non-maverick's firm-specific costs should not—or through observing that price increases proposed by firms do not stick unless the maverick goes along.[67]

It is not always possible to identify the maverick firm that constrains more effective coordination, however, even if industry coordination appears likely. Under such circumstances, maverick thinking may suggest applying instead a presumption based on concentration. In particular, if there is one maverick in an industry with *n* firms, a random merger has a probability 2/n of involving the maverick. Mergers are not, of course, random events, but given the market power motive for a merger involving a maverick, it is plausible that the probability that a proposed merger does so exceeds 2/n, suggesting that in the absence of other information, a merger from four significant firms[68] to three in a market conducive to coordination is more likely than not to harm competition by changing the maverick's incentives. Moreover, if a merger reduces asymmetry among the firms, the probability that it involves a maverick is likely higher.[69]

Here the simple simulation model (10) is not used to generate a prediction about the postmerger price. Instead, an intuition based on the model justifies a presumption about adverse coordinated effects when one of the merging firms is a maverick (or, if the presumption is based upon concentration, when one of the merging firms is likely a maverick[70]). The benefits of relying on such a

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[66] The model and the intuition here assume that cheating firms would deviate from the coordinated outcome by cutting the coordinated price (cheating on the "reward state"), not by declining to punish cheating rivals (cheating on the "punishment state").

[67] These methods are discussed in Baker, *Mavericks*, *supra* note 25, at 173–77.

[68] A firm is significant for this purpose if it is large enough to defeat coordination by cheating.

[69] *Cf.* Andrew R. Dick, *Coordinated Interaction: Pre-Merger Constraints and Post-Merger Effects*, 12 GEO. MASON. L. REV. 65, 72–80 (2003) (narrowing firm asymmetries facilitates coordination); Olivier Compte, Frédéric Jenny & Patrick Rey, *Capacity Constraints, Mergers and Collusion,* 46 EUR. ECON. REV. 1 (2002) (same).

[70] As the text suggests, in the absence of evidence as to which firm is a maverick, one possibility would be to presume that the merger involves a maverick and thus raises a coordinated

presumption are similar to those arising from the direct use of a simple simulation: it can be applied rapidly, makes transparent the simple economic logic on which coordinated effects rests, is readily accessible to decisionmakers, and provides guidance to them and the merging firms. These are benefits in the administrative context and do not detract from the value of the ongoing research effort among academics to develop comprehensive simulation methods for coordinated effects.

III. SIMULATION IN AN ADMINISTRATIVE PROCESS

Simulation models can be comprehensive or simple. Comprehensive simulations aim at increased precision, limited only by the available information and considerations of mathematical tractability. Such approaches are appropriate in an academic context. They can also be useful in an administrative context, particularly in settings where precision is a very important consideration: when mergers have been targeted by enforcers for an extensive review (after a "second request" in the U.S. system) and as a basis for expert testimony in merger litigation.

As a decisionmaking tool for an antitrust enforcement system, comprehensive simulations resemble an unstructured standard for formulating legal rules, like a comprehensive reasonableness test.[71] As with unstructured standards generally, a comprehensive simulation uses all available information to minimize the likelihood of errors, but in doing so it can raise administrative costs and limit guidance to firms seeking to comply with the law and judges seeking to understand and enforce it.[72]

The additional demands of the administrative context for accessibility and guidance, however, call for greater use of simple simulations. Like bright-line legal rules, simple simulations use less than all available information, accepting less precision to reduce administrative costs and improve guidance.[73]

The previous discussion highlights two possibilities for the use of simple simulations in merger review: a simple simulation screen for the preliminary

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effects concern, if the merger reduces the number of significant firms to three or fewer in a market conducive to coordination, or reduces the number of significant firms to four or five or fewer if the merger reduces asymmetry among the rivals.

[71] The opposite pole consists of bright-line rules, though many legal rules are hybrids, located between the poles.

[72] *Cf.* GAVIL ET AL., *supra* note 24, at 103–06 (Sidebar 2-1) (describing policy considerations at stake in specifying the per se rule under Section 1 of the Sherman Act).

[73] Bright-line rules operate by limiting the information that will be considered. They condition decisions on observable information that is thought to be correlated with what would be learned were full information available and that is hard to manipulate by parties seeking to appear benign when they are not. Their benefit comes in reducing administrative costs and providing greater guidance to firms and judges. Their cost is in increased likelihood of error relative to a decision based on all information.

review of unilateral effects, and a presumption based on identifying mavericks for the analysis of coordinated effects. Screens and presumptions like these—and potentially these very ones—should be used by enforcement agencies to identify mergers for in-depth review and to explain the competitive problem to generalist decisionmakers.[74] Moreover, courts should be encouraged to accept them as the basis for a presumption of anticompetitive effect. Under this scheme, screens and presumptions would supplement the use of comprehensive simulations. The simple approaches would be used to decide whether extensive review is appropriate and to explain the competitive issues to generalist decisionmakers, but their implications could be questioned or qualified in an extensive review through the use of comprehensive simulations. Employing simple simulation approaches in this way would be analogous to using a bright-line rule for decisionmaking.

The main disadvantage in employing these approaches is the potential loss of precision resulting from the adoption of any particular screen or presumption, including the choice of a specific threshold of concern.[75] The errors could go either way, permitting anticompetitive mergers to proceed without challenge or deterring procompetitive transactions that might be caught by the screens. But these problems can be limited by relying upon the antitrust agencies to select appropriate simple simulation models and thresholds based on their experience.

The U.S. Horizontal Merger Guidelines are a natural place for establishing the use of presumptions and screens because they describe how the enforcement agencies go about their work and they are relied upon by courts as persuasive authority in merger review. Not surprisingly, therefore, the current Guidelines apply screens and presumptions similar to those advocated here. In analyzing unilateral effects, the 2010 Guidelines use the GUPPI measure of diverted sales as an indicator that the merger will create upward pricing pressure.[76] The 2010 Guidelines also follow previous guidelines by recognizing the role of mavericks in constraining coordinated effects and expressing concern about a merger involving a maverick.[77]

But the U.S. antitrust agencies could do more, in the Guidelines as well as in speeches, closing statements, and complaints, to make explicit their reli-

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[74] *Cf.* Oliver Budzinski, An Institutional Analysis of the Enforcement Problems in Merger Control 19–22 (May 2010) (recommending the use of economically based rebuttable presumptions), *available at* http://ssrn.com/abstract=1615486.

[75] Relatedly, it may be difficult to vary the screen over time if experience or economic studies show that the thresholds could be set at better levels without appearing to make political choices, though recent changes in the concentration thresholds in the Horizontal Merger Guidelines do not appear to have drawn such criticism.

[76] Guidelines, *supra* note 8, § 6.1 & n.11.

[77] *Id.* §§ 2.1.5, 5.3, 7.1.

ance on these screens and presumptions. Doing so will shape how merging parties evaluate and present their proposed transactions and ultimately how non-specialist judges evaluate them in litigation. Improved guidance will benefit the merging parties as well as the courts, agencies, and public.