Unilateral Effects of Mergers: The Simulation Approach

by

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I.   Introduction

The Department of Justice and Federal Trade Commission's Horizontal Merger Guidelines (Guidelines) are intended to "reduce the uncertainty associated with enforcement of the antitrust laws."[2] In 1992, the Guidelines were revised to address the lessening of competition through *unilateral effects.* The Department of Justice and Federal Trade Commission (Agencies) are utilizing new methods of analysis in this area; however, their methodology is not explicitly set forth in the Guidelines.   Uncertainty among merging parties may persist without an understanding of the theory of unilateral effects and the methods employed to analyze them.

This paper provides an overview of a recent development in the analysis of unilateral effects.   Specifically, we explore simulation methods of merger analysis, providing insights to both economists and non-economists into the underlying theory and application of the approach.

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[1] Robert Mills and Roy Weinstein are Senior Consultant and Chairman of Micronomics, Inc., respectively.
[2] Department of Justice and Federal Trade Commission Horizontal Merger Guidelines, April 2, 1992, § 0.

II.   Unilateral Effects of Mergers

Theories of adverse unilateral effects address the potential for merging firms, acting alone, to profitably raise price above cost subsequent to the consummation of the merger. The capacity unilaterally to raise price above cost depends upon the extent to which consumers view products in the market as interchangeable. When products of the merging firms are close substitutes (highly interchangeable) and products of non-merging firms in the same industry are distant substitutes (interchangeable with the products of the merging firms to a lesser degree), merging firms may be motivated to raise price.[3]

Consider a differentiated product market characterized by two competing firms producing close substitutes and several other firms producing more distant substitutes. An increase in the price of one of the products with a close substitute may lead price sensitive consumers to purchase less of that product and more of its close substitute. Therefore, lost sales may render the price increase unprofitable despite the continued support of less price sensitive consumers.

A merger between the two firms producing close substitutes may render an increase in price profitable. Price sensitive consumers facing the price increase would continue to switch to alternative goods. However, lost revenues may be recouped through increased sales of the other product. Accordingly, consumer substitution does not provide the same constraint to the merged firm that it did prior to the merger.

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[3] Incentives to raise price unilaterally are typically greatest among firms producing differentiated products. Firms often attempt to differentiate their products from those of competitors, affording them some market power by reducing consumers' willingness to choose alternative products when faced with an increase in price. See

In 1995, a proposed merger between Interstate Bakeries Corporation and the Continental Baking Company was alleged to have posed such a competitive threat.[4] The Department of Justice contended:

> Following the acquisition, Interstate likely would unilaterally raise the price of its own brands, Continental's Wonder, or both. Because Interstate and Continental's brands are perceived by consumers as close substitutes, Interstate could pursue such a pricing strategy without losing so much in sales to competing white pan bread brands or to private labels that the price increase would be unprofitable. Interstate could, for instance, profitably impose a significant increase in the price of the Wonder white pan bread, since a substantial portion of any sales lost for that product would be recaptured by increased sales of Interstate's other brands… Since many consumers consider Interstate and Continental brands to be closer substitutes than most other branded or private label white breads, the competitive discipline provided by rivals after the acquisition would be insufficient to prevent Interstate from significantly increasing the prices now being charged for Interstate and Continental branded white pan bread.[5]

Similar unilateral effects concerns have appeared frequently in recent years.[6] Jonathan Baker, Director of the Bureau of Economics at the Federal Trade Commission, confirmed that "[u]nilateral theories are now by far the most common."[7] But prior to the 1992 revision, the Guidelines and Agencies focused almost exclusively on the anti-competitive effects of coordinated interaction in analyzing proposed mergers.

Baker (1997) for a discussion of differentiated products and associated antitrust policy issues.

[4] The merger was consummated upon approval of a consent decree requiring Interstate Bakeries Corp. to divest various brands in four territories.

[5] *United States v. Interstate Bakeries Corp.*, 1996-1 Trade Cases ¶71,271 (N.D. Ill.)

[6] See, e.g., *United States v. Kimberly-Clark Corp.*, 1996-1 Trade Cases ¶71,405 (N.D. Tex.), *New York v. Kraft General Foods, Inc.*, 1995-1 Trade Cases ¶70,911 (S.D.N.Y.), and *United States v. Gillette Co.*, 1993-1 Trade Cases ¶70,210 (D.D.C.).

[7] Baker, Jonathan B., "Unilateral Competitive Effects Theories in Merger Analysis." Speech before Antitrust Developments Program, American Bar Association Section of Antitrust Law, Annual Meeting, Grand Floridian Hotel, Orlando, Florida, August 6, 1996.

A.   Guidelines Approach to Analyzing Unilateral Effects

Under the Guidelines, the enforcement Agencies' approach to merger analysis involves the familiar delineation of product and geographic markets, followed by a measure of concentration such as the Herfindahl-Hirschman Index (HHI)[8]. The concentration measure is calculated and then compared to an arbitrary threshold to determine whether the likelihood of an anti-competitive outcome warrants further analysis. An economic rationale for using this approach is the notion that concentration facilitates coordination. In other words, the ability of parties to coordinate price behavior is greater in a market consisting of fewer, larger parties.

However, the approach has been criticized on the grounds that an analysis based solely on concentration may fail to account for anti-competitive unilateral effects.[9] Traditionally, once the product and geographic markets were delineated, the extent to which products included in the relevant market were interchangeable was essentially ignored. Yet, it is the substitutability between these goods that may enable firms to unilaterally raise price upon consummation of a merger.

Further, the delineation of relevant markets is often difficult when analyzing mergers among firms producing differentiated products. Under the Guidelines approach, products that are close substitutes for the merging goods are included, while distant substitutes are excluded. However, differentiated product markets are typically

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[8] The HHI is given by the sum of the squared market shares for each firm in the market.

[9] See Hausman, Leonard and Zona (1992) for a discussion of the shortcomings of conventional measures of market concentration in markets characterized by differentiated products.

characterized by a large variety of goods with varying degrees of distinction. Thus, the line scribed through the continuum of substitutes is often arbitrary and contentious.

The 1992 revision of the Guidelines partially addressed the concerns by setting forth, in a unilateral effects context, circumstances under which market share data may be reliable:

> Where market concentration data fall outside the safeharbor regions…, the merging firms have a combined market share of at least thirty-five percent, and where data on product attributes and relative product appeal show that a significant share of purchasers of one merging firm's product regard the other as their second choice, then market share data may be relied upon…[10]

However, the revision has failed to appease the critics, many of whom are employed by the Agencies. Jonathan Baker argues, "[w]hen it comes to identifying market power in differentiated product industries … it may not be helpful to commence the antitrust analysis by asking, What is the relevant market?"[11] Carl Shapiro, then Deputy Assistant Attorney General in charge of economics at the U.S. Department of Justice, suggested, "to assess unilateral effects most accurately, it is highly desirable to go beyond industry concentration measures to look directly at the extent of competition between the merging brands."[12] Meanwhile, Gregory Werden, Director of Research with the Economic Analysis Group of the Department of Justice and Professor Luke Froeb, of Vanderbilt University maintain, "a standard based on the combined market share is

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[10] 1992 Horizontal Merger Guidelines §2.211

[11] Baker, Jonathan B., "Product Differentiation through Space and Time: Some Antitrust Policy Issues." *The Antitrust Bulletin* (Spring 1997), 183.

[12] Shapiro, Carl, "Mergers with Differentiated Products." *Antitrust* 10 (Spring 1996): 23.

problematic because the price and welfare effects of mergers vary greatly for a given combined market share."[13]

These criticisms were largely motivated by, and have further motivated a body of research focusing on the quantitative analysis of unilateral effects. At the forefront, economists have united elements from price theory and econometrics into quantitative approaches termed *merger simulations*.

B. Simulation Approach to Analyzing Unilateral Effects

Simulation approaches to merger analysis provide a means of quantifying anticipated unilateral effects, offering insight into changes in price, output and consumer welfare. The results are often more definitive than those obtained from the conventional Guidelines approach. Specifically, estimated changes in price and output are tangible, allowing a more straightforward interpretation with less reliance on arbitrary thresholds.

Merger simulation does not rely on formal market definition nor does it require measures of concentration.[14] Rather, the analysis is based on the closeness of the merging parties' products and the extent to which the availability of substitutes may constrain the parties' ability unilaterally to raise price.

The simulation approach has gained popularity among the enforcement Agencies of late. Unfortunately, the Agencies have been reluctant to share specific methodological details and analytical results, fueling confusion and frustration among merging parties. Parties must attempt to demonstrate the merits of their merger with tools

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[13] Werden, Gregory J. and Luke M. Froeb, "The Effects of Mergers in Differentiated Products Industries: Logit Demand and Merger Policy." *Journal of Law, Economics and Organization* 10 (October 1994): 423.

of analysis that are highly technical, requiring a background in economic theory and econometrics. Our experience with the enforcement Agencies, however, has provided insight into the type of analysis commonly undertaken. In the following section, we describe the application of merger simulation approaches in an effort to reach non-economists working with the Agencies.

III. Application of the Simulation Approach

The quantification of unilateral effects is a relatively new undertaking. A variety of methods have surfaced, but the approaches are similar in that they focus on the nature of competition rather than emphasizing the number of competitors. We introduce a general merger simulation approach, often employed by the Agencies when analyzing mergers among firms producing differentiated retail products.

The applicability of the outlined generally requires detailed historical price and sales data at the firm or product level. The advent of the retail point-of-sale scanner has contributed greatly to the collection of such data, permitting merger simulation in a wide variety of retail product markets. Alternative assumptions may facilitate merger simulations in circumstances where comprehensive data are unavailable.[15]

A. Scope of Simulation Analysis

The capacity unilaterally to raise price subsequent to the consummation of a merger depends on consumers and the firms involved. Consumers' sensitivity to changes in price as well as firms' costs of production weigh into pricing decisions.

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[14] Recent experience indicates the Agencies may forego altogether product and geographic market delineation in their preliminary analysis. But, whether or not they are inclined to file preliminary injunctions without definitions in place remains to be seen.

Consequently, a comprehensive analytical approach must unite elements of consumer demand and the profit-maximizing behavior of firms.

The approach outlined here begins with an analysis of consumer demand, followed by the estimation of price and sales volume but for the merger. Together, these elements are used to estimate the marginal cost of production for products considered in the analysis. The marginal cost estimates and results of the demand analysis permit the simulation of post-merger prices. Finally, the simulated prices are compared to the prices but for the merger to determine the extent of the impact.

B.   Consumer Demand

Demand refers to the quantity of a good or service consumers purchase at prevailing prices. Increases in the prevailing price of a good tend to result in reduced sales volume because some consumers choose alternative products or refrain altogether from making a purchase. Conversely, decreases in the prevailing price tend to result in sales volume increases. The term *price elasticity* refers to the extent to which sales volume is affected by price changes.

Own-price elasticity of demand reflects the responsiveness of the quantity of a good demanded to changes in its price. Meanwhile, *cross-price* elasticity between two products reflects the responsiveness of the quantity of one good demanded to changes in the other good's price. For example, in instances where the price of a product is increased, the own-price elasticity describes the extent to which the sales volume of that product falls, while cross-price elasticities describe the extent to which the sales

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[15] See Werden and Froeb (1994) for an overview of the Antitrust Logit Model, a model that is useful in situations where comprehensive data are unavailable or too costly to obtain.

volumes of substitute goods increase. Together, own-price and cross-price elasticities of demand summarize anticipated substitution patterns among consumers faced with changes in price.

Elasticities of demand generally vary with price and quantity. Thus, estimates of elasticity of demand depend on the price and quantity at which they are estimated. For example, when a demand curve is linear, as depicted in Figure One, own-price elasticity is given by the inverse of the slope of the demand curve times price divided by quantity. The slope of the line is constant; hence, own-price elasticity must vary with the price level and volume of sales.

Figure One:
Own-Price Elasticity of Demand

$$\text{Own-Price Elasticity} = \frac{1}{slope} \bullet \frac{price}{quantity}$$

Price

Slope

Demand

0

Quantity

The objective of the demand analysis is to obtain a means of estimating the elasticities for any given price and quantity. Merger simulations commence with the estimation of consumer demand for each of the products produced by the merging firms

and their rivals.[16]   Estimation involves quantifying the relationship between sales

volumes and the variables that influence sales such as the price of the goods, the price of

substitutes and consumer income. [17] For example, in the simple case illustrated in Figure

One, the estimation process would involve finding a formula for the linear demand curve.

The formula for the demand curve provides the slope of the line, allowing an estimation

of the elasticity of demand for any given price and quantity.[18] In practice, the solutions

are more complex; however, the approach remains the same.

C.   Prices and Sales But For the Merger

Merger simulations require estimates of the own- and cross-price

elasticities of demand but for the merger. Consequently, estimates of price and sales

volume but for the merger are necessary. Prevailing pre-merger prices and sales figures

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[16] Determining which products to include in the analysis is similar to market delineation under the Guidelines albeit the results of the merger simulations are not nearly as sensitive to the product set as those of the conventional concentration approach. Erroneously omitting a borderline product from the conventional relevant product market negates its price constraining effect, biasing the HHI upward. Conversely, the omission of a product from the simulations only nullifies the price response of the product, a response that is often negligible for products on the fringe.

[17] Economic theory suggests the quantity of a good demanded depends on its price, the price of substitutes and complements, total expenditures, and consumer tastes. However, theory does not dictate an exact functional relationship (roughly, the shape of the demand curve) between quantity demanded and these variables. The properties of a specific functional form may lead the researcher to believe it superior, but the choice is often somewhat arbitrary. If sufficient data are available, a variety of functional forms are commonly estimated during the course of a merger investigation to assess the sensitivity of the results to the choice of functional form. The practice may lend credibility to the results if they are shown to be insensitive to the choice of functional form. Conversely, simulation results that are extremely sensitive to functional form may prove difficult to defend. See Werden (1997), for a general overview of several functional forms commonly used in the simulation of mergers.

[18] Graphical representations of demand curves are based on the assumption that *other things* are held equal. The *other things* include the price of substitutes, the price of compliments, income, and consumer preferences. In practice, demand estimation would, at a minimum, include the price of substitutes.

often provide a reasonable estimate. However, historical data may suggest the use of an average over some recent period if prices are found to fluctuate over time. Historical trends also may be incorporated if they are pronounced.

D.   Marginal Costs

The profit-maximizing price for a given good depends on the marginal cost of producing the good and the extent to which consumers tend to alter their purchases when faced with a change in price.[19] Under assumptions commonly invoked in merger simulation analysis, firms set product price prior to the merger such that the price-cost margin is equal to the inverse of the own-price elasticity of demand for the product.[20]

$$(1) \qquad \frac{price - marginal\ cost}{price} = \frac{1}{own\text{-}price\ elasticity}.$$

The equality suggests that a firm's profit margins are higher when the own-price elasticity for its product is lower; that is, when consumers are less inclined to choose alternative products in response to price increases. Intuitively, this is exactly what we should expect; profit margins are higher when consumers are less willing to choose alternative products.

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[19] Marginal cost is the extra cost of producing one additional unit. Marginal costs differ from accounting costs but can be roughly approximated by variable cost.

[20] This result depends primarily on three assumptions. First, each firm produces only one product prior to the merger. This assumption simplifies the algebra for our purposes but may be relaxed. Second, marginal costs are assumed constant (i.e. x dollars per unit regardless of the number of units). Lastly, firms are assumed to maximize profits under the assumption that rival firms hold their prices constant, ruling out collusive behavior.

Note that cross-price elasticities of demand are not considered in the equality. Intuitively, this suggests that firms set profit-maximizing prices based on costs and the extent to which sales volume is impacted by price. However, firms are not concerned with the extent to which rivals' sales volumes are impacted by the change in price.

Once the elasticities of demand and prices but for the merger have been estimated, the equality may be directly solved to estimate marginal cost but for the merger:

$$(2) \qquad marginal\ cost = price \left(1 + \frac{1}{own \text{ - } price\ elasticity} \right)$$

The ensuing marginal cost inferences, however, are based on pre-merger market conditions and are subject to change when a merger generates cost-reducing efficiencies. Cognizable efficiencies result in lower marginal costs by way of per-unit cost savings in production, distribution, etc. Accordingly, inferred post-merger marginal costs should be adjusted to reflect these savings.

E.   Post-Merger Price and Sales

The final step in the analysis is the simulation of post-merger price and sales. Non-merging firms producing in the market are assumed to act independently to maximize profits, just as they did prior to the merger. The profit-maximizing price is a function of the marginal cost of production and the extent to which consumers alter their purchasing behavior when faced with changes in price. However, the structure of the market changes subsequent to the merger. Specifically, the merged firm produces both of

the products previously produced by autonomous firms. Hence, the merged firm must in setting profit-maximizing prices for its products, consider the extent to which decreased sales of one product (as a result of a price increase) result in increased sales of the other. That is, cross-price elasticities are now relevant.

Under assumptions commonly invoked in merger simulations, non-merging firms set prices in the same manner they did prior to the merger. Specifically, they set price such that the price-cost margin is equal to the inverse of the own-price elasticity of demand. However, the conditions under which the merged firm sets price become more complex due to the added cross-price elasticity components.

To determine post-merger prices, the profit maximization equations for all firms are simultaneously solved for price, holding cost constant. However, a solution is not straightforward since the elasticities of demand vary with price.

F.   Interpreting the Results

The simulated price changes are compared to the prices but for the merger to determine the extent of the impact. Typically, the prices of the merging products and all substitutes increase as a result of the merger. In this sense, the term unilateral effect may seem a misnomer. However, price increases are indeed a result of a unilateral action on the part of the merged firm. The other firms merely raise price in response to the increase in demand for their goods (Figure Two).

Figure Two
Post-Merger Equilibrium
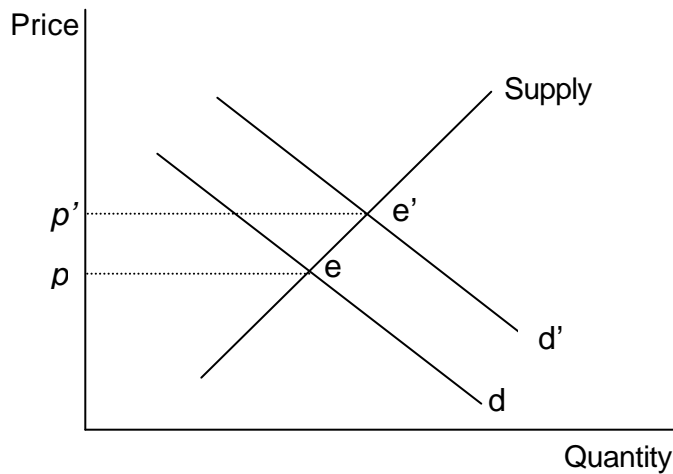
The market for goods produced by non-merging firms is in equilibrium at price **p** prior to the merger. The merger results in a shift in demand from **d** to **d'** as consumers substitute towards the rival goods in response to the unilateral price increase. The post-merger equilibrium price for the non-merging firms' goods increases to **p'**.

IV.   Assumptions and Concomitant Points of Contention

Disagreement between merging parties and the enforcement Agencies in conventional merger analysis often centers on product and geographic market definitions. Because the results from the simulation approach are less sensitive to market definition, the importance of these arguments is diminished. Instead, the debate shifts to the merits of economic models, assumptions and estimation techniques. The following is a synopsis of several assumptions employed in simulation approaches that may be points of contention between merging parties and the Agencies.

A.   Marginal Costs

The plausibility of marginal costs inferred from the simulation analysis is indicative of the model's ability to explain the given market or industry. Negative or otherwise implausible marginal costs are likely indications of poor data or inaccurate assumptions, rendering simulation results unreliable. Unfortunately, marginal costs are

difficult to estimate from accounting data; thus, a direct comparison between inferred costs and actual costs might not be possible.[21]

B.   Entry

The ability of merging parties to increase price unilaterally may be significantly constrained by entry or the threat of entry.[22] The Guidelines make specific allowances for entry. Specifically, "a firm is viewed as a participant if, in response to a … price increase, it likely would enter rapidly into production or sale of a market product in the market's area…"[23] Conversely, the simulation approach is implemented under the assumption that entry or threat of entry has no bearing on the competitive outcome. The simulation approach cannot embody entry since information on price and output are unavailable for potential competitors. Thus, any evidence of entry must be evaluated separate from the simulations.

C.   Product Repositioning

Repositioning is a marketing strategy employed to change consumers' perceptions about a product. A merger that changes the competitive structure of the market may induce product repositioning among rival firms. Specifically, products viewed as distant substitutes may be repositioned to compete more closely with products of the merged firm, thereby diminishing the merged firm's ability to raise price. Merger simulations are based on the assumption that the pre-merger positions of products prevail in the post-merger market, discounting altogether any potential product repositioning.

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[21] A comparison of the inferred marginal costs to variable costs derived from accounting data may prove insightful, depending on the nature of the industry.

[22] Products produced by entering firms must be viewed as close substitutes for the merging products; else, entering firms provide little constraint to the merged firm's ability to unilaterally raise price.

D.   Efficiencies

Mergers are often motivated by anticipated efficiency gains in production, distribution, research, and administration. The agencies have acknowledged the potential benefit to consumers of efficiency gains in a unilateral effects context. Under the Guidelines, "[t]he greater the potential adverse competitive effect of a merger … the greater must be cognizable efficiencies in order for the Agency to conclude that the merger will not have an anticompetitive effect in the relevant market."[24] However, the method set forth for analyzing the benefit of such gains is arbitrary since there are no means, other than instinct, of comparing efficiencies, as measured in dollars, to increases in concentration.

Conversely, merger simulations provide a method of directly incorporating anticipated efficiency gains. Efficiencies are analyzed as reductions in post-merger marginal cost or directly compared to the estimated welfare effect of the merger. However, our experience indicates that unless the parties convincingly demonstrate their ability to actually achieve proposed efficiencies, the agencies will assume, for the purposes of the simulations, that no cognizable efficiencies exist. [25]

E.   Thresholds

There are no standard guidelines for interpreting the results of simulation analysis. When the analysis suggests price will increase significantly as a result of the merger, it is reasonable to assume a regulatory challenge is imminent, but it is unclear how to interpret slight increases in post-merger price. In practice, the Agencies may rely

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[23] 1992 Horizontal Merger Guidelines § 1.0

[24] 1992 Horizontal Merger Guidelines § 4, revised April 8, 1997.

on additional information (possibly from a second request) for their evaluation. Unfortunately, the Agencies have not shared the results of their work when mergers go unchallenged. Consequently, gaining insight into tolerable thresholds is difficult.[26]

V.   Conclusion

The analysis of unilateral effects associated with mergers has become increasingly popular at the Department of Justice and Federal Trade Commission in recent years. While the Guidelines focus on market concentration, the Agencies have begun quantifying unilateral effects with simulation approaches that address the nature of competition more than the number of competitors.

Merger simulations produce results that often are more definitive than those obtained from conventional analysis of market concentration. Further, simulations provide a means of incorporating efficiencies directly into the analysis, diminishing the importance of arbitrary comparisons of efficiencies and concentration. Of course, the benefits do not come without cost; merger simulation is complex and difficult to implement. We have attempted to provide some insight into the general methodology and application of the approach. Nevertheless, merger simulation remains a complicated undertaking, requiring a thorough understanding of the economic theory, assumptions and econometrics involved.

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[25] In practice, this typically requires a detailed efficiency study that demonstrates the scale, scope and ability to actually achieve the projected efficiencies.

[26] In *United States v. Staples,* 1997-2 Trade Cases ¶71,867 (D.D.C. 1997), merger simulations were introduced, offering some insight into anticipated price increases considered intolerable by the Federal Trade Commission. The price for of a group of selected products was simulated to increase between five and ten percent, depending on the assumptions used in the analysis. See Baker (1998) for further detail. Shapiro (1996) provides insight into simulated price increases in the merger between Interstate and

References

Baker, Jonathan B., "Unilateral Competitive Effects Theories in Merger Analysis." Speech before Antitrust Developments Program, American Bar Association Section of Antitrust Law, Annual Meeting, Grand Floridian Hotel, Orlando, Florida, August 6, 1996.

Baker, Jonathan B., "Product Differentiation through Space and Time: Some Antitrust Policy Issues." *The Antitrust Bulletin* (Spring 1997): 177-196.

Baker, Jonathan B., "Econometrics Analysis in FTC v. Staples." Prepared remarks presented before the American Bar Association's Antitrust Section, Economics Committee, Willard Hotel, Revised: March 31, 1998.

Hausman, Jerry A., Gregory Leonard and J. Douglas Zona, "A Proposed Method for Analyzing Competition among Differentiated Products." *Antitrust Law Journal* 60 (1992): 889-900.

Shapiro, Carl, "Mergers with Differentiated Products." *Antitrust* 10 (Spring 1996): 23-30.

United States Department of Justice, "U.S. Department of Justice Merger Guidelines," June 14, 1984.

United States Department of Justice and Federal Trade Commission, "1992 Horizontal Merger Guidelines," April 2, 1992.

Werden, Gregory J., "Simulating the Effects of Differentiated Products Mergers: A Practitioners Guide," in "Strategy and Policy in the Food System: Emerging Issues." *Proceedings of NE-165 Conference* (1997): 95-110.

Werden, Gregory J. and Luke M. Froeb, "The Effects of Mergers in Differentiated Products Industries: Logit Demand and Merger Policy." *Journal of Law, Economics and Organization* 10 (October 1994): 407-426.

Continental. He suggests the Department of Justice expected prices of the merging products to increase between five and fifteen percent in some territories.