Unilateral Effects for Differentiated Products: Theory, Assumptions, and Research

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One focus of the potential revision of the Department of Justice and Federal Trade Commission Horizontal Merger Guidelines is unilateral effects analysis in markets with differentiated products.[1] Unilateral effects analysis was first introduced to the Guidelines in the 1992 revisions. The reliability of the predictions of post-merger prices arising from the economic models underlying that unilateral effects analysis, however, has been the subject of substantial controversy. Specifically, it has long been well known that these models[2] predict that *any* merger between sellers of competing differentiated products will lead to a price increase absent offsetting efficiencies.[3]

There has been considerable discussion, including recently, of what role these underlying economic models should have, including potentially superseding market definition and providing a presumption of anticompetitive effects.[4] In our view, reliance on these models for either purpose is not justified. We will explain in this article that the theoretical economic models underlying the Guidelines unilateral effects analysis for differentiated products make a subtle, but strong and critical mathematical assumption that is not likely to be satisfied in real world situations. Without this

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[1] U.S. Dep't of Justice & Fed. Trade Comm'n Horizontal Merger Guidelines § 2.211 (1992, rev. 1997), *available at* http://www.justice.gov/atr/public/guidelines/hmg.htm#22.

[2] One uncontroversial assumption in the models is that (incremental) price-cost margins are positive.

[3] In order to avoid this extreme outcome with respect to differentiated products, the 1992 Guidelines included language suggesting that either a substantial percentage of consumers view the merging parties as their first or second choices or that the two firms have at least a 35 percent share in a properly defined relevant market in order to establish the likelihood of a unilateral effects concern. *See* Guidelines, *supra* note 1, § 2.211. Nevertheless, the federal antitrust enforcement authorities still bore the burden of demonstrating that the merger eliminated sufficient constraints from the merging parties to allow them to profitably increase price.

[4] *See, e.g.*, Fed. Trade Comm'n & U.S. Dep't of Justice, Horizontal Merger Guidelines: Questions for Public Comment, Question 10 (Sept. 22, 2009), *available at* http://www.ftc.gov/bc/workshops/hmg/hmg-questions.pdf. Also, Assistant Attorney General Christine Varney stated in a recent speech:

> [T]he Agencies, courts, merging parties, and commentators have all struggled with assessing unilateral effects in markets with differentiated products. This important concept was first introduced into the Guidelines in 1992. Since then, the Agencies and private practitioners have gained extensive experience in analyzing unilateral effects, and a large body of academic and economic learning has grown around the treatment of unilateral effects. This appears to be an area where practice has evolved and where revisions to the Guidelines could be very helpful.

Christine Varney, Assistant Att'y Gen., Antitrust Div., U.S. Dep't of Justice, Speech at the Third Annual Georgetown Law Global Antitrust Enforcement Symposium (Sept. 22, 2009), *available at* http://www.justice.gov/atr/public/speeches/250238.htm. A relatively recent prominent and widely discussed paper by Joseph Farrell and Carl Shapiro advocates a modified version of the typical model. Joseph Farrell & Carl Shapiro, *Antitrust Evaluation of Horizontal Mergers: An Economic Alternative to Market Definition*, B.E. J. Theoretical Econ.: Policies and Perspectives, Vol. 10, Issue 1 (2010), http://www.bepress.com/bejte/vol10/iss1/art9. *See also* Serge Moresi, *The Use of Upward Price Pressure Indicies in Merger Analysis*, Antitrust Source, Feb. 2010, at 1–12, http://www.abanet.org/antitrust/at-source/10/02/Feb10-Moresi2-25f.pdf; Steven C. Salop & Serge Moresi, *Updating the Merger Guidelines: Comments* (2009), *available at* http://www.ftc.gov/os/comments/horizontalmergerguides/545095-00032.pdf. These models make the same mathematical assumption that we explain is not likely to be satisfied in real world situations.

assumption, the prediction of price increases based on margins and diversion ratios or simulations, as suggested by these models, is not justified.[5]

This critical mathematical assumption requires that the relevant demand, cost, and competitor response relationships be very "smooth," that is, they must be differentiable. This will be explained further below. The models make this assumption, not on a factual basis, but rather for technical convenience as it allows the mathematical modeling to be based on the use of calculus. In fact, as discussed below, there is considerable published research indicating that this mathematical assumption is not likely to be factually justified.

[T]he theoretical economic models underlying the Guidelines unilateral effects analysis for differentiated products make a subtle, but strong and critical mathematical assumption that is not likely to be satisfied in real world situations.

Intuition Underlying Unilateral Effects Analysis

In order to explain the critical role of the technical mathematical assumption of differentiability and its implications, it is first necessary to briefly discuss the basic intuition underlying the unilateral effects analysis.

Suppose that pre-merger, there are two products, X, which is produced by Firm X, and Y, which is produced by Firm Y. Suppose further that X and Y are differentiated.[6] In the differentiated products models at issue here, Y is a substitute for X in the sense that an increase in the price of X leads to an increase in the units sold of Y, holding all else equal. These assumptions, alone, do not *require* that the demands for X and Y have any specific additional mathematical properties. They require only that, for any price of X above the current price, other things held constant, the number of units sold of Y are higher. In the usual terminology, sales are *diverted* from X to Y when the price of X is increased from the current level.

Suppose now that the sellers of X and Y merge. An increase in the price of X for the merged company is more profitable than it is for the company that sold only X because the merged company obtains additional profits from the increased sales of Y that result when consumers switch from product X to product Y. This result does not depend on any specific economic modeling. It requires only the assumption that Y is a substitute for X.

The assumption that an increase in the price of X increases sales of Y implies that a merger of the sellers of X and Y *may* make it profitable for the merged firm to raise the price of X.[7] However, constraints on the price of X posed by substitutes other than Y may nonetheless make price increases of X, *on net*, unprofitable. The fact that Y is a substitute for X does not, without much more, tell us whether Y uniquely constrains the price of X.

Consider the following example: Some purchasers of product X consider product Y to be their only substitute for X. However, other purchasers of X consider products A, B, C, and D to be substitutes for X. Competition from A, B, C, and D could prevent a merger of the sellers of X and Y from increasing profitably the price of X post merger. Suppose that a significant number of very price sensitive consumers would shift to C if the price of X increased. If the sales that are diverted to C are large enough, it would not be profitable for the merged firm to increase the price of X,

[5] For a summary of the analyses based on diversion ratios, see, for example, Carl Shapiro, Dep. Assistant Att'y Gen., U.S. Dep't of Justice, Mergers with Differentiated Products, Speech Before the ABA and IBA (Nov. 9, 1995), *available at* http://www.justice.gov/atr/public/speeches/shapiro.spc.htm.

[6] Examples of differentiated products include breakfast cereals and beer.

[7] The merged firm may instead find it profitable to raise the price of Y (or raise the price of both products).

even with the increased profits derived from the diversion of sales from X to Y.[8] All of the basic economic models of unilateral effects for differentiated product mergers, including "differentiated Bertrand,"[9] various simulation models,[10] or the recent "Upward Pricing Pressure" (UPP) model of Farrell and Shapiro,[11] rule out the preceding example only because these models make the critical *mathematical* assumption of differentiability.

As discussed below, there is a substantial body of research that indicates that this technical mathematical assumption is likely to be inconsistent with real world markets. We stress here that it is not just that there can be situations in which the "standard" unilateral effects models may not be valid; rather it is the case generally that the "standard" unilateral effects models are not likely to be valid. This does not mean that a whole new analysis is required in order to consider the potential for unilateral effects arising from mergers of differentiated products. Rather, as with mergers involving products that are not assumed to fit into the differentiated products models, the analysis must focus on what constrains the prices of the parties to the proposed merger. Diversions and margins are only one part of the analysis, and thus, it is not appropriate that they provide a basis for a presumption of anticompetitive effects.[12]

The Lerner Equation and Its Implications

The mathematical assumption of differentiability leads to what is known as the "Lerner Equation," which, as will be explained below, underlies the prediction that any merger between two substitute products will lead to a price increase. For a single-product firm, the Lerner Equation says: A firm's profit-maximizing mark-up (price minus marginal cost divided by price) is equal to (minus) one divided by the price elasticity of demand for the firm's product.[13]

Thus, the Lerner Equation states an exact relationship between the profit-maximizing price-cost margin and the own-price elasticity of demand for a firm's product. If the Lerner Equation is satisfied, then the own-price elasticity of demand can be inferred from information on price and marginal cost. Specifically, you know, at least for small price increases, approximately how much unit sales of X will change after an increase in the profit-maximizing price of X.

That demand elasticity facing a given company's product can be found simply from price-cost margins any time products are differentiated is, empirically, a "curious" result. Cost comes entirely from the producer side. Demand elasticity comes entirely from the consumer side.[14] But according to the Lerner Equation, you can determine demand elasticity from cost and price, i.e., without

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[8] A potentially important source of competition in consumer differentiated products is private label "versions" of the leading brands. There may be many consumers who consider a specific major brand and its private label "version" good substitutes for one another. For example, one significant constraint on Kelloggs' Corn Flakes may be private label corn flakes.

[9] *See, e.g.*, Robert L. Pindyck & Daniel S. Rubinfeld, Microeconomics 438–41 (2009); Jeffrey Perloff, Microeconomics 462–64 (2008); Gregory J. Werden, *Unilateral Competitive Effects of Horizontal Mergers I: Basic Concepts and Models*, *in* 2 ABA Section of Antitrust Law, Issues in Competition Law and Policy ch. 55, at 1319 (2008).

[10] *See, e.g.*, Gregory J. Werden, *Simulating the Effects of Differentiated Products Mergers: A Practical Alternative to Structural Merger Policy*, 5 Geo. Mason L. Rev. 363 (1997).

[11] *See, e.g.*, Farrell & Shapiro, *supra* note 4.

[12] The same is true of the "UPP" analysis discussed by Farrell & Shapiro, *id.*, which depends on the Lerner Equation for its results.

[13] Mathematically: $(p_X^* - c)/p_X^* = -1/\varepsilon^*$, where c is the marginal cost of X and ε^* is the own-price elasticity of demand for X at the profit-maximizing price (p_X^*) of X. This condition comes directly from profit maximization *assuming differentiability*, i.e., that the derivative of X's profits with respect to the price of X is zero at the profit-maximizing price.

[14] As will be discussed below, "residual" demand reflects the reaction functions for substitute products.

knowing anything about demand, characteristics of the product, etc. This curious relationship set forth by the Lerner Index was questioned by the judge in the FTC's preliminary injunction litigation of the *Swedish Match* matter:

> Moreover, Dr. Simpson's [one of the FTC's economic experts] use of the Lerner Index in this case is at least questionable. The FTC's own expert, Dr. Orley Ashenfelter, testified at the hearing that if price and quantity data are available, as they are here, he normally would use econometrics, not the Lerner Index, to estimate demand elasticity.[15]

In all the relevant economic models of unilateral effects, satisfying the Lerner Equation leads to the conclusion that a merger between two competing differentiated products, X and Y, always leads to a price increase absent offsetting efficiencies. The basic intuition is this: as discussed above, in order for a post-merger increase in the profit-maximizing price to be profitable, the increased profits on Y caused by diversion from X to Y must outweigh the reduced profits on X. If the Lerner condition is satisfied at the pre-acquisition profit-maximizing price, then, for a very small increase in the price of X, the change in profits on X is close to zero, but the change in profits on Y is positive, so, on net, the profits of X increase for at least small increases in the price of X. The proof of this requires the use of calculus, which requires the assumption of differentiability.

The Lerner Equation Requires Differentiability

Differentiability, as it relates to the Lerner Index, requires three components. First, the own-price elasticity of demand for X must exist (i.e., have a specific value). Second, the own-price elasticity of demand for X must be about the same for small price increases as for equally small price decreases. Third, the elasticity of the incremental cost curve must be about the same for small output increases as for equally small output decreases.[16]

The second condition is the basis of a common criticism of "Critical Loss Analysis," i.e., that estimates of demand elasticities that are larger than that required for a given price increase to be profitable cannot be correct. The basis of the argument is that the demand elasticity is about the same for price increases as for price decreases—i.e., the basis of the argument is an assumption that arises from the assumption of differentiability. Thus, this critique is only valid if the Lerner Equation holds, and specifically, the second condition, at current prices, and in the case of market definition, over the range of output reduction necessary to bring about the small but significant and transitory increase in price called for by the market definition algorithm of the Guidelines.

For a number of reasons, demand functions for differentiated products are not likely to be differentiable. One situation in which the Lerner Equation will not hold is if the relevant own-price elasticity of demand is significantly larger for price increases than for price decreases. Consider the following diagram of a hypothetical demand curve facing X before an acquisition of Y.

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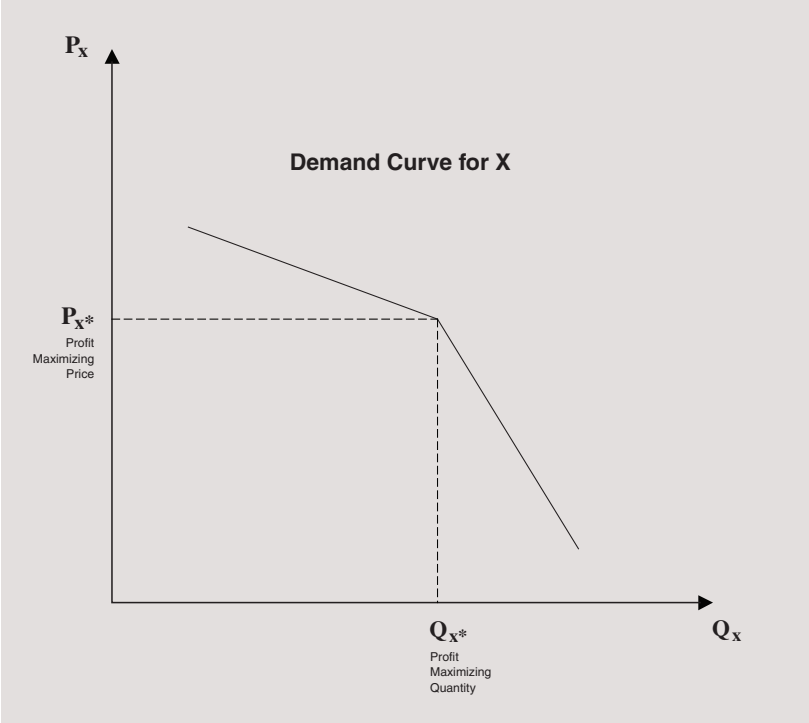
[15] FTC v. Swedish Match, 131 F. Supp. 2d 151, 161 (D.D.C. 2000).

[16] Technically, the second and third requirements are that the demand curve and the incremental cost curves are differentiable.



As shown in the figure, there is a kink in the demand curve at the profit-maximizing price P_X^*. Notice that the demand curve is significantly flatter (more elastic) for price increases away from the profit-maximizing price than for price decreases. That is, price increases result in a substantially larger decrease in unit sales compared to the increase in unit sales associated with price decreases. One reason for such a kink to exist is that purchasers, in aggregate, react more strongly to price increases than to price decreases from the existing price P_X^*.[17]

With such a demand curve, the Lerner Equation no longer holds at the profit-maximizing price. In this situation, Y may no longer be a unique constraint on the price of X and whether or not the merger of X and Y will lead to an increase in the price of X is fact specific. Specifically, the benefit from the diversion of sales from X to Y would still exist, but the loss in sales of X due to diversion to other products may be too large to make a post-merger price increase profitable.

Differentiability is a very strong assumption to impose on actual real world relationships and may not be satisfied for a number of reasons other than kinked consumer demand. For example, the demand curve facing firm X depends on the actions of X's competitors, who are likely to react to changes in X's prices. Thus, the relevant demand curve depends not only consumer reactions, but the reactions of competing producers as well. This is discussed further below. In addition, supply curves for competitors may have kinks or steps resulting from the need to overcome transportation costs to the geographic area in question. As the price of X rises over a range, it may be the case that transport costs from more and more distant locations are increasingly exceeded by the price increase on X, making additional amounts of capacity competitive where X is sold. There is no a priori reason to think that the relationship between increases in the price of X and supply from distant locations should be smooth. Finally, the marginal cost curve of the firm may not be differentiable.

[17] As explained below, another reason for a kink can be that substitute products respond differently to an increase in the price of X than to a decrease in the price of X.

Below we discuss a body of marketing and economics research, both theoretical and empirical, which indicates that there is likely to be a kink at the pre-merger profit-maximizing price because purchasers are likely to react differently to price increases compared to price decreases.

Marketing Research Indicates the Likelihood of Kinked Demand

Marketing research indicates that it is likely that purchasers respond differently to price increases than to price decreases. The intuition is straightforward: Purchasers view a price increase as a loss while viewing price decreases as a gain. There is substantial research indicating that purchasers respond asymmetrically to losses and gains.

One body of marketing research is devoted to the hypothesis that purchasers use "reference prices," typically incorporating information about past prices into current purchase decisions. As explained in a survey article:

> The concept of a reference price is that it is an internal standard against which observed prices are compared . . . . The purpose of this paper is to argue that there is now sufficient empirical evidence from the marketing literature to strongly support the reference price concept . . . .
>
> Reference price is also a uniquely marketing "spin" on the traditional economics view of price. The classical microeconomic agent makes purchase decisions based on actual prices and income. The concept of a reference price asserts that consumers make decisions based on both actual and perceived prices. Incorporating both concepts into the classical microeconomic model changes the results in some interesting ways, such as producing kinked demand curves . . . .[18]

This paper concludes that "*[c]onsumers react differently to price increases and price decreases relative to the reference price. Consumers react more strongly to price increases than to price decreases.*"[19]

In the context of merger analysis, pre-merger prices (and historical relationships of prices) for the products involved in the merger and for substitute products may be reference prices for consumers. Specifically, a merger that leads to, say, an increase in the price of X (relative to historic levels) and that increases the historic differentials with prices of substitute products will be a deviation from the references that purchasers are likely to rely upon. In that case marketing research tells us that a post-merger price increase is likely to lead to a much larger response by purchasers than would a price reduction of the same amount, and hence the relevant demand curves may be kinked.

Economics Research Indicates the Likelihood of Kinked Demand

Economics research also provides support for asymmetric responses by purchasers. For example, a paper by two leading economists in the area of behavioral economics finds that

> asymmetric evaluations of gains and losses will affect the responses of both buyers and sellers to changes of price or profit, relative to the reference levels established in prior transactions . . . . The

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[18] Gurumurthy Kalyanaram & Russell S. Winer, *Empirical Generalizations from Reference Price and Asymmetric Price Response Research*, 14 MKTG. SCI. No. 3 (Part 2 of 2), 161–62 (1995) (emphasis added). This article cites and discusses a number of papers with similar conclusions. *See also* Daniel S. Putler, *Incorporating Reference Price Effects into a Theory of Consumer Choice*, 11 MKTG. SCI. No. 3, 287 (1992).

[19] *Id.* at 165 (emphasis added).

> response to changes is expected to be more intense when the changes are unfavorable (losses) than when they are for the better.[20]

As explained in an empirical econometrics paper:

> Asymmetric demand responses to price changes are not one of the observable implications of classical demand theory; however, they are not precluded by one notable alternative to classic demand theory, namely prospect theory. The basic premise of prospect theory is that a consumer's utility from a particular commodity bundle depends on a reference bundle. When consumers evaluate commodity bundles below the reference bundle, they suffer a loss. On the other hand, when they evaluate commodity bundles above the reference bundle, they enjoy a gain. The key insight for our purposes is that differences in the absolute value of the assessed gains and losses can cause asymmetric demand responses.[21]

The paper estimates demand elasticities with data for local telephone calls and finds that customers react more quickly and strongly when prices go up than they do when prices go down.

Another body of work in economics focuses on the reactions of firms to changes in their competitors' prices. When the federal antitrust agencies are investigating a merger between differentiated products X and Y that appear to be close substitutes, one can infer that they suspect that the number of other close substitutes for X and/or Y is small. When the number of substitutes is small, competitors are likely to react to changes in the prices of X and Y, and the sellers of X and Y are likely to anticipate this. The demand curve for X will have a kink at the pre-merger equilibrium price of X if competitors' responses to changes in the price of X—and therefore the effects of these responses on the demand curve for X—are asymmetric.

To understand the role of competitor responses, we need to understand that the demand for differentiated product X is quite complex. As pointed out by Katz and Shapiro:

> [T]he demand curve facing a single firm acting unilaterally accounts for the responses that firm anticipates its rivals will make if it changes its price. The rivals' responses can come in the form of price changes, quantity changes, product quality changes, or some other competitive variable. Moreover, rivals' anticipated reactions can be the results of highly complex competitive interactions that take place over time. In other words, the firm-specific demand curve can be viewed as a summary of how an individual supplier perceives its competitive environment.[22]

It has long been postulated by economists that there are reasons why competitors' responses to changes in the price of X, or what are known as "reaction functions," may be asymmetric.[23] A reduction in the price of X diverts sales from competitors to X, and this likely leads the competitors to reduce their prices to mitigate the loss in sales to X and to each other. On the other hand,

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[20] Amos Tversky & Daniel Kahneman, *Loss Aversion in Riskless Choice: A Reference-Dependent Model*, 106 Q.J. Econ. 1055 (1991). The coauthor, Daniel Kahneman, was a 2002 recipient of the Nobel Prize in Economics for his work in behavioral economics. *See also* Russell S. Winer, *A Reference Price Model of Brand Choice for Frequently Purchased Products*, 13 J. Consumer Res. 250–56 (1986).

[21] Miles O. Bidwell, Jr., Bruce X. Wang & J. Douglas Zona, *An Analysis of Asymmetric Demand Response to Price Changes: The Case of Local Telephone Calls*, 8 J. Reg. Econ. 285, 285–95 (1995) (footnotes omitted). This article also refers to other studies with similar results ("Specifically, a number of marketing studies . . . have attempted to measure the extent of asymmetry in terms of elasticity differences. These studies suggest that consumers react, in the short run, more strongly to price increases than they do to price decreases."). *Id.* at 286.

[22] Michael L. Katz & Carl Shapiro, *Further Thoughts on Critical Loss*, Antitrust Source, Mar. 2004, at 4, http://www.abanet.org/antitrust/at-source/04/03/katzshapiro.pdf.

[23] *See, e.g.*, Pindyck & Rubinfeld, *supra* note 9, at 457–48 (discussing a kinked demand model where the kink is due to competitors responding differently to price increases than to price decreases).

an increase in the price of X diverts sales to competitors, who may not respond by raising their prices because they view an increase in their market shares as valuable in the long run. There does not have to be much asymmetry to lead to a kink in the demand curve. If significant competitors much more closely match price decreases than price increases, the relevant demand curve is likely to have a kink. Suppose, for example, significant competitors match a price decrease one-for-one, but increase prices relatively only 50 percent.

The way in which parties to a merger perceive how significant competitors are likely to respond to price changes is an empirical issue. Specifically, the parties' perceptions of their competitors' likely reactions to changes in the firm's prices can be investigated in a merger investigation. Evidence on past price changes are relevant. However, analyses of past price changes will generally have to be supplemented by evidence bearing on how competitors may react to an anticompetitive price increase arising from a merger. This is because past price changes may arise primarily or entirely from competition. Competitors might react to an anticompetitive price increase arising from a merger as an opportunity from which they can gain market share. Alternatively, competitors may react as an opportunity to increase short run profits. In our experience with many mergers involving differentiated products, firms typically expect competitors to react to a firm's "unusual" unilateral price decrease by lowering their prices, but do not necessarily expect their competitors to match an "unusual" price increase.[24]

There is economic literature pointing out that asymmetric competitor responses might facilitate tacit collusion.[25] However, asymmetric competitor responses are plausible *competitive* competitor responses, particularly when competitors view their market shares as important, and such responses do not necessarily facilitate tacit collusion, i.e., they might and probably do exist in quite competitive situations. If competitor responses are asymmetric, then further fact-based analysis is required to determine their implications. For example, a situation in which there are asymmetric responses but vigorous competition for market share is most likely a situation of strong competition, rather than tacit collusion, since inconsistent market share objectives are not conducive to tacit collusion.

Conclusion

The economic models underlying the Guidelines' analysis of unilateral effects of mergers between differentiated substitutes make a critical and unwarranted mathematical assumption that leads to the conclusion that such mergers always lead to higher prices, absent sufficient efficiencies. Specifically, the Lerner Equation, which underlies all the models of differentiated products, requires a mathematical assumption of differentiability.

A significant body of scholarly research establishes that differentiability is not likely to fit real world facts. For example, purchasers are likely to respond differently to price increases and price decreases, with the result that demand curves are likely to have kinks at pre-merger prices. Also, it may be that competitors respond differently to price increases and price decreases, which is another reason to expect that demand curves will be kinked at pre-merger price levels. Finally, there is no reason, a priori, why real world demand curves have the strong smoothness properties required for the Lerner Equation.

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[24] By "unusual" we mean a price increase brought about by an anticompetitive merger, not price increases brought about by demand and/or cost changes.

[25] *See, e.g.*, Katz & Shapiro, *supra* note 22, at 6–7.

[T]he economic models of differentiated products underlying analyses of potential unilateral effects cannot, in themselves, provide a basis for a presumption of anti-competitive effects.

For this reason, the economic models of differentiated products underlying analyses of potential unilateral effects cannot, in themselves, provide a basis for a presumption of anticompetitive effects. Rather, the conditions required for the Lerner Equation need to be verified in each specific setting. More importantly, more attention needs to be paid in the typical differentiated products merger to what constrains the prices of the parties to the merger. The fundamental issue in the analysis of potential unilateral effects arising from a merger of differentiated products is what constrains the prices of the relevant products. ●