CPI COMPETITION POLICY INTERNATIONAL

The CPI Antitrust Journal
February 2010

Upward Pricing Pressure and Critical Loss Analysis: Response

Joseph Farrell, Federal Trade Commission
&
Carl Shapiro, Antitrust Division, Department of Justice

Upward Pricing Pressure and Critical Loss Analysis: Response

Joseph Farrell & Carl Shapiro[1]

I. INTRODUCTION

As members of the Department of Justice ("DOJ")/Federal Trace Commission ("FTC") working group that is reviewing the Horizontal Merger Guidelines, we thank Competition Policy International for organizing the nine papers in their December 2009 Release 1, Revising the Merger Guidelines.[2] These papers helpfully supplement the information that the DOJ and FTC are receiving in the form of public comments and at the five scheduled public workshops. Public comments and information about the workshops are posted at the FTC web site for the Guidelines review project.[3]

Below, we respond to two of the papers in the release directed specifically at papers we wrote before taking our current positions at the FTC and DOJ. The positions taken here and in those papers are our own and do not necessarily reflect the positions taken by our respective Agencies.

II. UPWARD PRICING PRESSURE

In our paper *Antitrust Evaluation of Horizontal Mergers: An Economic Alternative to Market Definition*,[4] we develop a simple measure of the upward pricing pressure ("UPP") due to a merger between firms selling differentiated products. We propose that this measure be used as an indicator of the merger's likely unilateral effects.

Consider a merger between Products 1 and 2, with pre-merger prices P_1 and P_2, and corresponding marginal costs C_1 and C_2. The diversion ratio from Product 1 to Product 2, D_{12}, is the fraction of sales gained by Product 1 when P_1 falls, that come at the expense of sales of Product 2. For screening purposes, an efficiency credit of E_1 is applied to Product 1, meaning that the merger is assumed to reduce the marginal cost of Product 1 by E_1C_1. We measure the net upward pricing pressure on Product 1—the increase in its effective marginal cost at pre- merger prices and outputs—by

$$UPP_1 = D_{12}(P_2 - C_2) - E_1C_1$$

[1] Joseph Farrell is Director, Bureau of Economics, Federal Trade Commission, on leave from his position as Professor of Economics, University of California at Berkeley. Carl Shapiro is Deputy Assistant Attorney General for Economics in the Antitrust Division of the Department of Justice, on leave from his position as the Transamerica Professor Business Strategy at the Haas School of Business, University of California at Berkeley. We thank Serge Moresi, Steve Salop, and Glen Weyl for very helpful comments on earlier drafts.

[2] The CPI Antitrust Chronicle Symposium on rewriting the merger guidelines is *available at* https://www.competitionpolicyinternational.com/dec-091/.

[3] *Available at* http://www.ftc.gov/bc/workshops/hmg/index.shtml.

[4] We first posted a version of this paper in November 2008. We have since revised the paper for publication. The current version is *available at* http://faculty.haas.berkeley.edu/shapiro/alternative.pdf.

We proposed that mergers generating positive net upward pricing pressure warrant, at least, further scrutiny.

The thoughtful paper by Richard Schmalensee, *Should New Merger Guidelines Give UPP Market Definition?*[5] primarily discusses our UPP paper. We agree with much of what Schmalensee says, including his closing remark that our approach "should be used carefully and with due regard for other relevant evidence." We take Schmalensee's main points to be:

a) He suggests a measure of upward pricing pressure that we discussed but that differs somewhat from the one that we proposed.
b) He proposes the use of a simple merger simulation instead of upward pricing pressure.
c) He asks whether introducing UPP means dropping market definition; he urges clarification that available information on efficiencies will not be ignored; and he reminds the reader that no single quantitative measure is perfect.

We address these points in turn.

III. UPP*: A MORE ACCURATE—BUT LESS TRANSPARENT—MEASURE

Our measure of upward pricing pressure for Product 1 is $UPP_1=D_{12}(P_2-C_2)-E_1C_1$. Schmalensee prefers the measure $UPP_1^* = UPP_1 + E_2D_{12}C_2$, which unlike UPP, recognizes that efficiencies on Product 2 raise that product's margin and thus increase upward pricing pressure for Product 1.[6]

For given values of the efficiency allowances, a UPP* version of the test is more interventionist than our UPP version: $UPP_1^* - UPP_1 = E_2D_{12}C_2 \geq 0$. For example, in the symmetric case, as our paper showed, UPP > 0 if $D\frac{M}{1-M} > E$, whereas UPP* > 0 if $D\frac{M}{1-M} > E(1-D)$. Therefore, the UPP* test is equivalent to the UPP test with an efficiency credit reduced by the factor $1-D$. With a diversion ratio of 25 percent, the UPP* test is equivalent to our UPP test with a 25 percent smaller efficiency credit.

While UPP* is theoretically correct, we are leery of using it as a merger screen for two reasons. First, it has the flavor of the discredited "efficiency offense" that counted efficiencies as reasons to prohibit the merger.[7] Second, it is more complicated and less intuitive than UPP, and one of our chief goals is to offer a very simple, intuitive, robust, and informative measure.

IV. PRICING PRESSURE OR PRELIMINARY PRICE PREDICTION?

Schmalensee then argues for using simplified estimates of post-merger price increases as a screening tool, rather than measures of upward pricing pressure:

> ranking mergers by estimated post-merger price increase seems more likely to generate an appropriate enforcement agenda than ranking them by a better estimate of a less directly relevant quantity like upward pricing pressure. On the other hand, if formulaic simplicity is of paramount importance, one might choose to employ a measure like UPP or UPP* despite its indirect relation to consumer

[5] Richard Schmalensee, *Should New Merger Guidelines Give UPP Market Definition?*, 12(1)CPI ANTITRUST CHRON.(2009), *available at* https://www.competitionpolicyinternational.com/should-new-merger-guidelines-give-upp-market-definition/.

[6] As far as we know this was first noted in Gregory Werden, *A Robust Test for Consumer Welfare Enhancing Mergers Among Sellers of Differentiated Products*, J. INDUS. ECON., 44, 409-413 (1996).

[7] 3 Federal Trade Commission v. Procter & Gamble, Co. 286 U.S. 568 (1967) at 579.

welfare.

Leaving aside Schmalensee's thought-provoking departure from the standard question "how should we evaluate whether this merger is likely to harm consumers?", and follow-on questions such as whether priority should also be based on market size, we of course agree that a merger's impact on consumers depends upon the magnitude of any price increases.[8] However, as the merger simulation literature shows, predicted price increases vary, sometimes dramatically, with the demand system assumed.[9] It was partly for that reason we sought a more robust measure; it was also (a closely related point) partly because merger simulation is not very transparent. We do see UPP as a simple and useful measure that is generally indicative of likely price effects. Schmalensee proposes a hill-climbing metaphor, arguing that a hill's height is unrelated to how steep the hill is at its base. We would argue that a football metaphor is at least as apt. A ball that is kicked harder might not travel further—it might get stuck in a tree, or might be kicked into a stiff wind—but as a general matter hard-kicked balls tend to go further. We thus respectfully disagree with Schmalensee when he writes that upward pricing pressure is "a quantity unrelated to any measure of consumer harm."

Our point about robustness to demand specification was stressed in our paper; here, we follow up a little on our concern that even Schmalensee's very simplified linear-demand merger simulation approach is more complex and less transparent than UPP, at least in the asymmetric case.

In the symmetric case, three variables are needed: the margin, the diversion ratio, and the efficiency credit. As Schmalensee reports, if one also assumes linear demand, we have:

$$\frac{\Delta P}{P} = \frac{DM - E(1-D)(1-M)}{2(1-D)} = \frac{UPP^*/P}{2(1-D)}$$

which he calls the Price Change Assuming Linearity ("PCAL").[10] This expression is not much more complex than the expressions for UPP or UPP* for the symmetric case, although we think it would be considerably harder to explain to someone not trained in mathematics or economics. However, outside the restrictive symmetric case, the three variables are needed for each product, for a total of six: M_1, M_2, D_{12}, D_{21}, E_1, and E_2. Shapiro has derived the asymmetric formula corresponding to Schmalensee's PCAL:[11]

$$\frac{\Delta P_1}{P_1} = \frac{[2D_{12}M_2 - E_2(1-M_2)(D_{21}-D_{12})]\frac{\overline{P}_2}{\overline{P}_1} + [D_{21}(D_{21}+D_{12})M_1 - E_1(1-M_1)(2-D_{21}(D_{12}+D_{21}))]}{4-(D_{21}+D_{12})^2}.$$

Following Schmalensee, we define this expression as $PCAL_1$; clearly it is quite a bit more complex than $UPP_1 = D_{12}(P_2 - C_2) - E_1C_1)$, in addition to relying on linear demand.[12] So, while

[8] This entire discussion takes as given the products offered by the firms and focuses on pricing competition. In practice, of course, mergers also affect non-price competition, and those effects can be more important than pricing effects. We briefly indicate in our paper how our ideas can be applied to non-price competition.

[9] *See*, for example, Luke Froeb, Steven Tschantz, & Gregory J. Werden, *Pass-Through Rates and the Price Effects of Mergers*, INT'L J. INDUS. ORG., 23, 703-15, (December 2005), which is cited by Schmalensee.

[10] The linear model can be solved explicitly. The symmetric formula without efficiencies is reported in Carl Shapiro, *Mergers with Differentiated Products*, ANTITRUST, 1996.

[11] *See* Carl Shapiro, *Unilateral Effects Calculations*, *at* http://faculty.haas.berkeley.edu/shapiro/unilateral.pdf.

[12] Different formulas for the predicted price increase apply with other shapes of the demand system, as

we are sympathetic to Schmalensee's argument, we still regard UPP_1 as more practical, more robust, and more transparent for initial screening purposes than $PCAL_1$. Perhaps merger simulation, such as $PCAL_1$, would be more suitable for estimating price effects, as part of the full inquiry, in cases that warrant further study.

V. THREE OTHER ISSUES

A. Market Definition

In the title of his paper, Schmalensee asks whether the Guidelines should drop market definition. Numerous economists have criticized the market definition exercise, and indeed our proposal was prompted in part by recognition that the market definition and concentration approach does not always work well, especially in cases involving differentiated products. But we are not suggesting that antitrust enforcement, or the Guidelines, should drop market definition. Rather, we think that market definition and concentration measures can be informative, but are not always, and that UPP can be informative, but is not always. Thus we view UPP as a competitively valuable entrant into the market for merger evaluation, but this does not mean we want to close down market definition, the incumbent in that market. Indeed, while sometimes the approaches will be alternatives (substitutes), they will sometimes be complements. Whether or not market definition is a legal requirement, as some argue, the market definition enquiry and concentration can certainly be, at a minimum, relevant evidence.

B. Marginal-Cost Efficiencies

In our paper we did not mean to focus very much on just how to quantify marginal-cost efficiencies; the important point is to introduce some credit for efficiencies from the beginning and to weigh it against the gross UPP or similar measure. We argued relatively briefly, and with a focus on keeping the screening enquiry transparent and manageable, that a natural way to do this is with a broad default efficiency allowance ("standard deduction"). Perhaps we made it sound too much as if that was a key part of our proposal. Responding perhaps to such a perception, Schmalensee states: "While I recognize that efficiencies are difficult to estimate in practice, it is hard to see the merit in deciding in advance to ignore any relevant case-specific information that might be present." He goes on to say: "It would seem to be preferable to begin with a default value for efficiencies but to depart from it if the merging parties can convincingly argue that they will do better or if they fail to make a credible showing that there will be any significant efficiencies at all."

We can only agree. But as a practical matter, an initial screening tool cannot be based on case-specific measures of efficiencies, whose accurate evaluation normally requires a relatively thorough review of the merger. Under the approach we proposed, as under the current Guidelines, cognizable, case-specific efficiencies will be explored later, if and when a full analysis is performed. In that respect, the magnitude of gross upward pricing pressure necessary to cause net upward pricing pressure serves much like the HHI thresholds in the current Guidelines.

One could take a broader view of what is to be set against gross upward pricing pressure $D_{12}(P_2 - C_2)$. In such a broader view, the default efficiency credit might not necessarily correspond to marginal cost savings commonly achieved in horizontal mergers, but might more generally establish a threshold on the level of gross upward pricing pressure, prompting further scrutiny of the merger or raising serious concerns. This threshold could reflect a variety of

explored in the literature on merger simulation and stressed in our paper. *See especially* Froeb *et al.*, *supra* note 9 at 4.

considerations related to the cost of false positive and false negative signals at the screening stage, such as the costs and delays associated with additional review, the magnitude of harm caused by mergers that harm competition, and the likelihood that additional factors such as product repositioning or entry will negate any initial concerns.

C. Estimate of Marginal Cost

Schmalensee reminds us that UPP requires an estimate of marginal cost. He states: "It is not uncommon in practice to use average variable cost as an estimate of marginal cost, but that estimate is typically biased downward, particularly under competitive conditions." He adds: "While it is possible in principle for firms facing relatively inelastic demand curves to be in equilibrium with marginal cost below average variable cost, this seems unlikely to be the typical case." We have three responses here. First, in the concentration screen (the incumbent method against which UPP competes), market definition using the hypothetical monopolist test and critical loss requires an estimate of marginal cost. Second, we agree that average variable cost, as defined in the textbooks, is not in general the right measure; the right concept is indeed marginal cost—more precisely average incremental cost ("AIC") measured over a relevant discrete change in output. Third, in our experience, the Agencies are relatively well prepared to measure AIC, using the discovery tools available to them under the Hart-Scott-Rodino Act.

VI. USE OF AVAILABLE EVIDENCE

Whatever measure is used for screening purposes, it is important that the full analysis give proper weight to all the available evidence. We thus agree with Schmalensee when he writes: "In the presence of differentiation, it is important to avoid rigid, formulaic use of any quantitative screening device."[13] Indeed, we would make that statement with or without product differentiation and apply this same principle to the use of HHIs in markets for relatively homogeneous goods.

Schmalensee's example of the merger between two neighboring gasoline stations, with many others nearby, nicely illustrates the dangers from "formulaic use of any quantitative screening device." Evidence that non-merging parties offer very close substitutes for the products offered by the merging firms, as judged by the vast majority of customers, would be highly relevant for assessing unilateral effects. And in some cases such evidence might be so clear and convincing as to justify ending the inquiry. But such evidence must be reconciled with evidence from observed pre-merger conduct, including pre-merger margins and diversion ratios.

How might this consistency check operate in Schmalensee's gasoline station example? The margins might be low, as indeed we would expect if there is as much overall competition as his example suggests. And with "stations fairly densely situated along both intersecting roads," the diversion ratios could also be low.[14] A merger between the two stations thus might not cause upward pricing pressure, so the fear of a false positive test result may be misplaced.[15] For the

[13] *See* Schmalensee, *supra* note 5 at 6; there, the word "not" was mistakenly inserted into this sentence. (Email communication with Schmalensee, December 29, 2009.)

[14] In practice, the diversion ratio is often measured based on a small but significant price increase on Product 1, not based on an infinitesimal price increase.

[15] Indeed, as we point out in our paper, the UPP test could generate a false negative result in this type of situation. Suppose that pricing competition between the two stations is intense, leading to very low margins, say 10 percent. Even with a diversion ratio of 80 percent, UPP would be negative using a 10 percent default efficiency credit. However, departing from Schmalensee's example, if rival stations were far away, the merger could lead to a significant price increase.

merger to cause upward pricing pressure in the symmetric case requires $D\frac{M}{1-M} > E$. Using a 10 percent efficiency credit purely for illustrative purposes, this requires at least moderately high margins. For example, even if the diversion ratio is quite large, say 40 percent, the margins would have to be at least 20 percent. If the margins are at least this large, and the firms are setting their prices independently, this should alert us not to accept too readily claims that neighboring gasoline stations are viewed by consumers as very close substitutes for the merging stations.

Another possibility is that the merging stations and their neighbors are not pricing independently. Perhaps each station anticipates a rapid response from the others if it changes its price, especially if it lowers its price. This mode of oligopoly behavior may allow the various stations to maintain prices sufficient to cover their fixed costs. In this case, any adverse unilateral effects of the merger may indeed be small. But theories of coordinated effects could well come into play. Whether the merger will increase the risk of future pricing coordination could be central. UPP is not designed to address theories of coordinated effects, and UPP may well not be the best tool in this situation going forward. However, if the UPP test flags such a merger for further scrutiny, we would call it a serendipitous feature rather than a bug. And, of course, no simple diagnostic can perform perfectly for screening purposes. In any event, if $UPP > 0$ but a quick look reveals that the merger will not lead to any meaningful price increase because of the competition from other nearby gas stations, using UPP "with due regard for other relevant evidence" will quickly allow the merger to be cleared. Even in this case, measuring UPP and then looking for nearby substitutes might well be easier and quicker than trying to define the geographic market using the hypothetical monopolist test and measuring HHIs in that market.

Overall, Schmalensee's proposal and ours are fairly closely related ways of screening certain mergers for further scrutiny. Both methods seek to flag substantial risks of harm to competition from unilateral effects by quantifying how the merger will change the merging firms' pricing incentives. To do so, both methods focus on margins and diversion ratios, at least in part by multiplying those two variables together. Both methods compare these measures of the loss of direct competition between the merging firms against some level of merger-specific marginal cost efficiencies, either assumed or demonstrated. These differences may be meaningful in specific cases, but they are minor compared to their shared differentiation from evaluations based on concentration in a collection of products deemed to be a relevant market.

VII. CRITICAL LOSS ANALYSIS AND MARKET DEFINITION

We now turn to critical loss and market definition, the topics of a large literature including our paper *Improving Critical Loss Analysis*.[16] In markets with differentiated products, the economics underlying critical loss analysis can instructively be illustrated by asking whether just two products form a relevant market under the Guidelines' hypothetical monopolist test.

In the symmetric case with linear demand, Bertrand competition pre-merger, and ignoring efficiencies, Schmalensee's PCAL approach predicts the profit-maximizing price

[16] Joseph Farrell & Carl Shapiro, *Improving Critical Loss Analysis*, ANTITRUST SOURCE, 7, (February 2008) *available at* http://www.abanet.org/antitrust/at-source/08/02/Feb08-Farrell-Shapiro.pdf.

increase for the hypothetical monopolist controlling Products 1 and 2, as $\frac{\Delta P}{P} = \frac{DM}{2(1-D)}$.[17] The two products form a market if this exceeds *S*, the size of the SSNIP. Simplifying, this condition can be written as $D > \frac{2S}{M+2S}$, the formula presented as Proposition 1A in our paper.[18]

This reminds us that the same underlying economics applies to market definition and to unilateral pricing effects. Both of those enquiries ask the analyst to predict a profit-maximizing response to a loss of rivalry—in the case of competitive effects, the loss of rivalry between the merging firms; in the case of market definition, the loss of rivalry among firms that control products in a candidate market.[19] As we stressed in our UPP paper, such predictions can be viewed as requiring a quantitative estimate of oligopoly pass-through of idiosyncratic or asymmetric marginal-cost shocks, and a fully rigorous version of that is rarely if ever possible given the available information, especially at a screening stage. As a practical matter, effective merger enforcement requires a tractable way to proceed when those oligopoly pass-through rates are not observed with any great accuracy.

We see two basic strategies. One strategy, pursued in our UPP paper, is to look for measures of risk to competition that *do not* depend on oligopoly pass-through rates. Our paper described some substantial benefits of that approach. The downside, as Schmalensee stresses, is that one may gain little sense of the magnitude of likely price effects, only (if the method works well) a reliable sense of whether prices are likely to rise or fall. The second strategy, which Schmalensee favors and which underlies most merger simulation, explicitly or implicitly makes simplifying assumptions about oligopoly pass-through rates. In particular, assuming profit maximization along with a given mode of competition (such as differentiated-product Bertrand) and a given demand structure (such as linear, logit, or constant-elasticity) can imply such simplifying assumptions about oligopoly pass-through rates. As discussed above, Schmalensee puts forward the linear-demand Bertrand model (generating PCAL), although he indicates (see his footnote 12) openness to alternative implementations of this basic strategy.[20]

Professor Schmalensee, meet Malcolm Coate and Joseph Simons. In their paper, *Critical Loss vs. Diversion Analysis: Clearing up the Confusion*,[21] Coate and Simons (henceforth, "CS") criticize

---

[17] This is Schmalensee's formula for the predicted price increase without any efficiencies; it was also presented in Carl Shapiro, *Mergers with Differentiated Products*, ANTITRUST (1996), *available at* http://faculty.haas.berkeley.edu/shapiro/diversion.pdf.

[18] This same formula can be found earlier in Michael Katz & Carl Shapiro (2003), *Critical Loss: Let's Tell the Whole Story*, ANTITRUST, 49-56, (Spring, 2003) *available at* http://faculty.haas.berkeley.edu/shapiro/critical.pdf, and Daniel O'Brien & Abraham Wickelgren, *A Critical Analysis of Critical Loss Analysis*, 71 ANTITRUST L.J. 161. The diversion ratio here corresponds to the aggregate diversion ratio as defined in Katz & Shapiro, which is the fraction of lost sales from a price increase of one product in the candidate market that are captured by all the other products inside the candidate market. For a candidate market consisting of just two products, the aggregate diversion ratio is simply the diversion ratio to the other product in the candidate market.

[19] If some firms that control such products also control related products outside the candidate market, the hypothetical monopolist test often runs into problems and paradox. We briefly discussed this in our 2008 critical loss paper and do not pursue it here.

[20] UK competition authorities have in some cases used this strategy; the predicted price change is known as the "illustrative price rise."

[21] Malcolm Coate & Joseph Simons, *Critical Loss vs. Diversion Analysis?,* 12(1)CPI ANTITRUST CHRON.(2009), available at https://www.competitionpolicyinternational.com/critical-loss-vs-diversion-analysis-clearing-up-the-confusion/.

our paper, *Improving Critical Loss Analysis*, on various grounds, but largely for taking as a starting point the linear-demand Bertrand model favored by Schmalensee. Despite its title, the paper by CS is confusing. Here, we unpack and respond to what we believe are its main points.

VIII. CORRECTING THE RECORD

We must first respond to two suggestions by CS that inaccurately impugn our impartiality and our respect for evidence.

First, CS repeatedly indicate that we try to substitute economic theory for an examination of relevant evidence. Referring to our approach they state: "this type of analysis substitutes deductive logic for empirical evidence." They "conclude that any form of Critical Loss Analysis requires factual evidence," as if our approach did not. In rejecting our approach they state that "Theory cannot trump fact."

In fact, as we explicitly laid out, our paper is precisely about how to weigh and interpret a piece of evidence about demand responsiveness to price: the pricing decisions made by the firms prior to the merger. One would expect that the merging firms themselves know a great deal about the demand for the products they are selling. The inference from high margins that demand is relatively inelastic follows from the standard "price theory" taught in any undergraduate microeconomics class. In fact, the hypothetical monopolist test itself is premised on the idea that the hypothetical monopolist would raise prices to the profit-maximizing level. Antitrust analysis of mergers is replete with other instances where inferences are made from the behavior of market participants. Indeed, these may well be the strongest inferences available, and modern antitrust analysis would be impoverished and impossible without drawing such inferences.

At the same time, our paper explicitly recognized that other types of evidence may be relevant in estimating the loss of sales that a hypothetical monopolist (or the merging firms) would experience in response to a price increase. That is why much of our paper is devoted to explaining how to use different types of evidence, in conjunction with evidence of pre-merger margins. Indeed, the primary contribution of our paper was to show how such evidence can be used, building on Katz & Shapiro[22] and O'Brien & Wickelgren.[23]

Thus our approach is empirically grounded. In particular, we explain how, by focusing more on the change in incentives, our methods can better attempt to take into account a variety of important real-world factors such as coordinated interaction, sales of complementary products, and "dynamic and intangible considerations, such as customer loyalty, reputation, network effects, and learning curves." In contrast, the methods advocated by CS, which assume these factors are all absent, are the ones lacking empirical basis. We also explicitly discuss the treatment of conflicting evidence. Our paper provides no basis for any assertion that we favor dismissing or ignoring reliable evidence of any type.

The second point where we must correct the record is where CS state that our methodology is "designed to almost guarantee narrow markets, even in low-to-moderate margin industries." (emphasis added). On the contrary, our methodology follows clear economic principles and is not "designed to" achieve any particular market delineation. Our methodology explores how to implement the hypothetical monopolist test in a way that follows the Guidelines,

[22] Katz & Shapiro *supra* note 18.
[23] O'Brien & Wicklegren, *supra* note 18.

that uses sound economic logic, and that is focused on the goal of the market definition exercise: to identify possible markets in which a merger may lead to competitive harm.

CS also criticize us for using marginal cost to measure margins. They say (p. 12): "their entire methodology collapses if the analyst is unable to estimate the theoretical marginal cost." Any critical loss analysis requires an estimate of average incremental cost, i.e. marginal cost averaged over a perhaps substantial range of output. It is not clear why CS believe that this is easier than estimating marginal cost near the actually observed output (we are not sure why they call this "theoretical"). If the analyst can estimate incremental costs over ranges of output, she can use the same revealed-preference logic that leads to the Lerner equation, and derive a mild generalization of our approach, not a collapse. If incremental costs cannot even be approximated with any confidence, critical loss analysis as a whole does collapse.

Lastly, we would like to correct the record regarding the predictions of unilateral effects models. CS state: "It is well known in economics, however, that virtually all unilateral effects models utilizing the Lerner Condition produce price increases for any horizontal merger. That is, every horizontal merger is predicted to raise price, which of course has no empirical support and would face serious Daubert issues if used in court." [footnote omitted]. In fact, even before accounting for non-price supply side responses such as repositioning and entry, models of unilateral effects are perfectly capable of including marginal-cost efficiencies, which can easily lead to price reductions from horizontal mergers. For instance, both our 2008 UPP paper and our 1990 paper on what would now be called unilateral effects did so.[24] The Daubert assertion by CS is a red herring—indeed, as we note in footnote 19 below, some who oppose the approach seemingly favored by CS also try to bring Daubert to their aid.

IX. CS DO NOT FOLLOW THE HORIZONTAL MERGER GUIDELINES

CS advocate two aspects of methodology for market definition and critical loss analysis. As they note in part, both aspects depart from the Guidelines. Especially since the Guidelines are under review, there is nothing wrong with that (and we have proposed non-Guidelines approaches ourselves), but it is worth being clear. The Guidelines state (§1.11):

> In performing successive iterations of the price increase test, the hypothetical monopolist will be assumed to pursue maximum profits in deciding whether to raise the prices of any or all of the additional products under its control.

CS suggest that this language is unclear concerning whether one should test whether a SSNIP would raise a hypothetical monopolist's profits in comparison with prevailing prices (a "break- even analysis"), or whether the hypothetical monopolist's profit-maximizing price change is at least equal to a SSNIP (a "profit-maximizing analysis"). CS state (footnote 9):

> We will leave it to others to discuss what the Guidelines meant by the term "likely would impose" in relationship to a SSNIP. Our position is clear: For roughly 20 years, merger analysts have applied the standard CLA to define markets with a break-even analysis.

We find it hard to see very much ambiguity in "what the Guidelines meant" here: they clearly call for a profit-maximizing analysis.[25] CS may believe that a break-even analysis is a

[24] Joseph Farrell & Carl Shapiro, *Horizontal Mergers: An Equilibrium Analysis*, AMER. ECON. REV., 80(1), 107-126, (1990).

[25] The 1982 Guidelines can fairly be read as ambiguous on this point. But for 25 years, going back to 1984, the Guidelines have expressly called for a profit-maximizing analysis of the pricing by the hypothetical monopolist.

better approach, and we could imagine arguments to that effect, but CS give none. Others have explicitly argued for the Guidelines approach on the merits. For instance, Werden explains that the break-even approach will err when the profit-maximizing price is much larger than 5 percent, but a 5 percent price increase would lead to lower profits than the prevailing price.[26]

Second, as the same passage from the Guidelines states, the Guidelines approach asks whether the hypothetical monopolist would raise "the prices of any or all" products. In contrast, CS propose a non-Guidelines methodology that asks only whether the hypothetical monopolist would profitably raise all of the prices under its control uniformly.

As CS stress, the uniform SSNIP approach and the variable SSNIP approach can differ substantially in markets with differentiated products. CS even explain, quoting Ordover & Willig, how the variable SSNIP approach in the Guidelines is necessary to identify valid competitive concerns involving price increases for some but not all of the products in the relevant market.[27] Despite this, CS reject the variable SSNIP approach in the Guidelines (describing it as "artificially" excluding products from the market) on the grounds that it "generally biases the analysis in favor of finding a competitive concern." But while they illustrate how the variable SSNIP approach can lead to narrower markets than the uniform SSNIP approach, that point is already in Ordover & Willig. CS do not show how the variable SSNIP approach leads to false positives in market definition, let alone show or even argue that such a possibility would outweigh the false negatives. Rather, their argument against the variable SSNIP approach (in the unilateral effects context) seems to be that repositioning and entry may later be given too little weight if the Guidelines variable SSNIP approach is used to define markets, so they seemingly prefer to broaden the market beyond Guidelines boundaries so that obstacles to such supply side substitution need never be considered. CS assert that considering these types of supply side substitution as part of the calculation of market shares and the analysis of competitive effects and entry, as the Guidelines do, "amounts to burden shifting."

X. DIVERSION RATIOS AND CRITICAL LOSS

While CS argue that our methodology almost always leads to narrow markets when applied as we describe it, they also discuss a modified form of the methodology that focuses only on uniform SSNIPs. Unfortunately, in doing so, they misappropriate our definition of the aggregate diversion ratio and mangle our Proposition 1, stating:

> This proposition, however, only results in narrow markets if there will be sufficient diversion in the face of an across-the-board price increase *by all of the firms in the market*. But why would customers divert volume among firms that are raising prices jointly, as opposed to diverting volume to firms that are not raising price? For example, if Mercedes, BMW, and Audi all raise prices simultaneously by the same amount, why would we expect any Mercedes customers to switch to BMW or Audi? We think that generally the Mercedes customers would not but, at a minimum, it is an empirical issue. If the answer is that we do not expect such

[26] He concludes that what he dubs "Critical Loss Analysis by Defendants (CLAD)" alone "does not supply the requisite analysis and therefore is unreliable. Consequently, expert economic testimony based on CLAD should be ruled inadmissible in U.S. courts under Rule 702 of the Federal Rules of Evidence." *See* Gregory J. Werden, *Beyond Critical Loss: Tailored Application of the Hypothetical Monopolist Test*, 4 COMPETITION L.J. 69 (2005), and Gregory Werden, *Beyond Critical Loss: Properly Applying the Hypothetical Monopolist Test*, 2(2) CPI ANTITRUST CHRONICLE, (2008) available at https://www.competitionpolicyinternational.com/beyond-critical-loss-properly-applying-the-hypothetical-monopolist-test/.

[27] Janusz Ordover & Robert Willig, *Economics and the 1992 Merger Guidelines: A Brief Survey*, 8 REV. INDUS. ORG. 139 (1993).

> switching, then the Farrell & Shapiro approach (with a linear demand curve) would result in expanding the candidate market for across the board SSNIPs because A would be very close to zero and thus, will be less than S/(M+S) in their Proposition 1. This result is the opposite of the one they seek to draw.

But as CS explicitly note elsewhere, *that was not our definition of A*. It is not legitimate to take our Proposition 1, redefine one of the quantities to be something dramatically different from what we defined it to be, and then mis-apply the formula given in our Proposition as if the Proposition applied—or as if we had claimed that it applied—with that unauthorized substitution. Yes, the measure that CS here call *A* very likely would be close to zero, but we certainly never claimed that market definition turns on comparing *that* measure to $S/(M+S)$, nor does it.

The analysis by CS in that paragraph, therefore, is mistaken and improper. In fact, a uniform SSNIP can readily be more profitable for a hypothetical monopolist than a single-product SSNIP, whose profitability our formula diagnoses, even though a uniform SSNIP may induce no switching among products in the candidate market. This fact is easily seen in a simple numerical example involving linear demand and a candidate market consisting of Mercedes and BMW.

Suppose that Mercedes and BMW each sells 1000 units at pre-merger prices of $40,000, and that the diversion ratio from Mercedes to BMW, and from BMW to Mercedes, is 20 percent. Now consider a $2000 (i.e., 5 percent) price increase on Mercedes alone. Suppose that this $2000 price increase would cause Mercedes to sell 100 fewer units, with sales falling to 900 units. Since 20 percent of these lost sales go to BMW, BMW's sales would go up from 1000 units to 1020 units. Now suppose that BMW follows Mercedes with its own $2000 price increase. With symmetric linear demand, this also causes BMW to lose 100 units. BMW sales would fall from 1020 to 920. But 20 percent of the 100 lost sales go to Mercedes (linear demand implies constant diversion ratios), lifting its sales from 900 to 920. The net result is that both Mercedes and BMW are setting prices of $42,000 and selling 920 units.

In this thought experiment, we raised the prices sequentially, so we saw 20 customers switching from Mercedes to BMW, and then 20 customers switching back. But one can get to the same result by thinking about both brands simultaneously raising their prices from $40,000 to $42,000. We have already established that if Mercedes and BMW each charge $42,000, each sells 920 units. In comparison with the pre-merger prices of $40,000, each lost 80 units. (These sales were lost either to other auto brands or to the option of not purchasing an auto.) CS are quite right that when both prices are raised in unison, there is no "switching" between Mercedes and BMW. They are mistaken in their belief that our methods assume otherwise, mistaken that the diversion ratio (as we use the term) is zero because there is no such switching when both prices are raised, and mistaken if they believe that a uniform SSNIP is therefore unprofitable.[28]

This numerical example illustrates the logic behind the aggregate diversion ratio. One firm that raises its price alone loses 100 units. The hypothetical monopolist, by raising the price of all products in unison, only loses 80 units per brand. The aggregate diversion ratio tells us the fraction of the units that would be lost by an individual firm which are retained by the hypothetical monopolist. Standard antitrust analysis assumes that each price is set prior to the

[28] In fact, with symmetry in these models, the profit-maximizing uniform price increase is larger than the profit-maximizing price increase for a single firm that takes as given the pre-merger prices of the other firms.

merger to maximize the profits of the pre-merger firm controlling that price, and in particular that the $2000 price increase is not profitable for either Mercedes or BMW to undertake alone. However, that price increase might be profitable for the hypothetical monopolist, precisely because it only loses 80 units on each brand, not 100. The economic logic is the same as that of collusion: normally, it is more tempting to raise prices in unison than to do so alone.

In this illustration, and in general with linear demand, the hypothetical monopolist only loses a fraction $(1 - A)$ of the sales on a given brand that a single firm would lose if it raised its price alone, where A is the aggregate diversion ratio. In our example, the aggregate diversion ratio A is 20%, so $(1 - A)$ is 80 percent, and the hypothetical monopolist loses only 80 percent of the 100 sales that a single firm would have lost. This is why the aggregate diversion ratio is a key piece of evidence for performing the hypothetical monopolist test.[29]

If the quantities demanded are linear, or roughly linear, for prices close to pre-merger levels, then, there is no merit to the objections raised by CS. However, for sufficiently "curved" demand systems, the concerns expressed by CS could be logically valid.[30] Whether these concerns are significant in a given case is an empirical issue. We argued in our paper that evidence ought to be required to show in a given case that the necessary "kink" in demand is actually present at or slightly above pre-merger prices.[31] The Appendix to this note explores the type of demand structure necessary for this to occur in the luxury car example.

XI. APPENDIX

The verbal discussion given by CS suggests the following possibility in their luxury car example. Many Mercedes buyers would turn to BMW if the price of Mercedes alone were to rise, but many of these buyers would turn to Lexus if the prices of both Mercedes and BMW were to rise. Therefore, a SSNIP on Mercedes alone would be profitable for a Mercedes-BMW hypothetical monopolist, but a SSNIP on both Mercedes and BMW would not be profitable for this hypothetical monopolist because it would cause too much switching to Lexus.

Verbally, this sounds plausible enough. However, we and others have proved that it cannot happen with a symmetric linear demand system, as our numerical example above illustrates.[32] With such demand, and assuming two products for simplicity, the catch-up second single-product SSNIP that turns a unilateral SSNIP into a uniform SSNIP is always *more* profitable for the hypothetical monopolist than was the first unilateral SSNIP. The absolute loss of sales of the product whose price is rising is the same in each, but in the catch-up SSNIP (a) sales recaptured within the market generate a higher margin, and (b) the price increase applies on a larger starting base of unit sales. Thus with symmetric linear demand the profitability of a single-product SSNIP is a sufficient, but not necessary, condition for the profitability of a uniform

[29] In forthcoming work, we use the term "market recapture ratio" for this key piece of evidence. *See* Joseph Farrell & Carl Shapiro, *Recapture, Pass-Through, and Market Definition*, available at http://faculty.haas.berkeley.edu/shapiro/recapture.pdf.

[30] Our paper computes the minimum necessary curvature and relates it to the margins and the aggregate diversion ratio. *See* our Proposition 3. Equivalently, the pass-through rate must be sufficiently low.

[31] As explained by Katz & Shapiro, supra note 18,, the necessary kink must apply to the demand facing the hypothetical monopolist. The classic "kinked demand curve" in oligopoly theory, which applies to the demand facing individual firms, does not suffice.

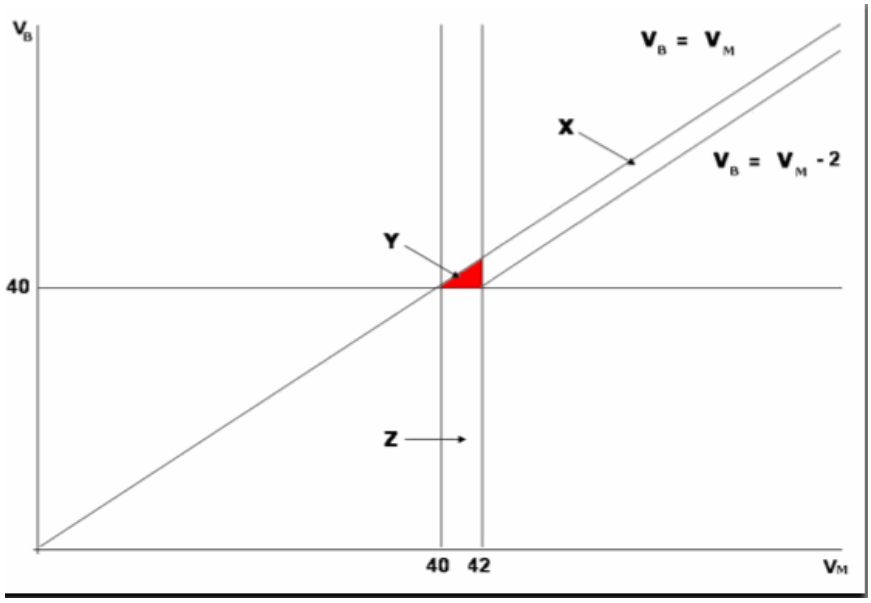
[32] In their footnote 26, CS observe that the same holds true more generally if higher-order derivatives are small; they need not be zero. They do not explore—as our paper did—just how curved demand would have to be to reverse our results.

SSNIP. As a result, the possibility stressed by CS (and by Ordover & Willig) that restricting attention to uniform SSNIPs leads to broader hypothetical-monopolist markets does not arise in that case.

But could it instead work out as CS suggest with some other demand system? Yes, it could. We explore here the features of the demand system necessary for this to be possible. To illustrate, assume here that each buyer has some value for each brand and chooses the brand that maximizes buyer surplus, defined as the value of that brand less its price. This view, which is consistent with CS' discussion, is known as the "discrete choice" demand framework.

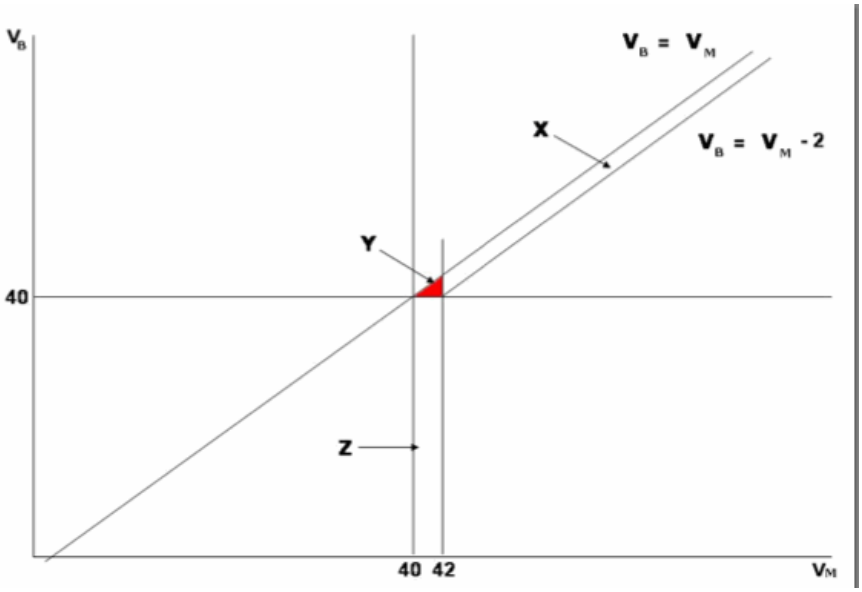
In the example, prior to the merger, Mercedes and BMW both charge a price of $40,000. Mercedes buyers are those who value Mercedes (a) more than they value BMW, and (b) at least at $40,000. Figure 1 shows a buyer's value for Mercedes, v_M, on the horizontal axis and his value for BMW, v_B, on the vertical axis. Values are measured in thousands of dollars and incorporate the fact that if a buyer chooses neither of these products, he can spend the money however he chooses, including possibly buying a Lexus, or buying a Hyundai and the vacation of a lifetime. In Figure 1, the Mercedes buyers at pre-merger prices are those represented by points that lie in area M, i.e., points that are both to the right of the vertical line $v_M = 40$ and also southeast of the 45 degree line $v_B = v_M$.

Figure 1



Now consider buyers' responses if the price of Mercedes alone rises to $42,000. The vertical line that bounds area M on the west shifts rightward by 2, because one necessary condition for choosing to buy a Mercedes at the new price is that it is worth that much to the buyer. And the diagonal 45 degree line that bounds area M on the northwest shifts downward by 2, because now the second necessary condition for buying a Mercedes is that the buyer values a Mercedes at least 2 thousand dollars more than he values a BMW. Figure 2 shows both sets of lines, labels the area corresponding to these loyal Mercedes buyers as M', and labels as X, Y, and Z three areas corresponding to buyers who will substitute away from Mercedes in response to this single- product SSNIP.

Figure 2



Of these, buyers represented by points in areas X and Y substitute to BMW, because they value a BMW at $v_B > 40$. Buyers in area Z substitute to other uses of their money, whether buying a Lexus or something else. The statement that the diversion ratio D between Mercedes and BMW is 20 percent means that the number of buyers located in areas X and Y together are 20 percent of the number of buyers in areas X, Y, and Z together. As shorthand, we will use the labels X, Y, and Z also to refer to the numbers of buyers located in the respective areas, so $D = (X+Y)/(X+Y+Z) = 0.2$. A hypothetical monopolist of BMW and Mercedes continues to make the same $40,000 in revenue, and the same amount in profit, on buyers in areas X and Y as it would have made absent the SSNIP, whereas of course Mercedes loses those buyers. In other words, in response to a SSNIP on Mercedes alone, Mercedes loses buyers in X, Y, and Z, while the hypothetical monopolist loses only buyers in Z. The diversion ratio precisely quantifies the ratio of these demand losses: since $D = (X+Y)/(X+Y+Z)$, we have that $Z/(X+Y+Z) = 1-D$.

As our paper stressed, since a hypothetical monopolist of BMW and Mercedes effectively loses only a fraction 1-D of the sales lost by pre-merger Mercedes in response to a price increase on Mercedes, when D is substantial, demand-side substitution alone might cease to deter such price increases. Our paper, following others, calculated just how big D must be for such a single-product SSNIP to become profitable for the hypothetical monopolist.

Following the Guidelines and the paper by Ordover & Willig, we see no reason not to infer that, in this example, a BMW-Mercedes merger would raise real concerns if D is so substantial. Absent sufficient marginal-cost efficiencies, repositioning, or entry, the merged entity would find it profitable to raise the price for Mercedes, and we see no reason to ignore this consumer harm, as defining the market more broadly might do. Nevertheless, to help clear up confusion, we also explore here, as CS recommend, the hypothetical monopolist's incentive to impose a uniform SSNIP on both Mercedes and BMW.

In response to a uniform SSNIP, buyers in area X do not change their choice: they value a Mercedes at more than its new price of $42,000, and at more than they value a BMW, which continues to be priced at parity with a Mercedes, so Mercedes remains their best choice. Mercedes buyers in areas Y and Z, however, now substitute to uses of their money other than BMWs and Mercedes.[33] As CS stress, in this demand system (as with linear demand) no buyers substitute between Mercedes and BMW in response to this uniform price increase.

Comparing the hypothetical monopolist's incentive for a SSNIP with a pre-merger firm's, then, we have the following. For a single-product SSNIP, the hypothetical monopolist loses only a fraction $1-D=Z/(X+Y+Z)$ of the sales that would be lost by that pre-merger firm if it unilaterally imposed a SSNIP. For a uniform SSNIP, the hypothetical monopolist loses a fraction $(Y+Z)/(X+Y+Z)$ of the sales lost by each pre-merger firm in response to a unilateral SSNIP (not in response to a uniform SSNIP). The substantive question raised by CS is in effect: How different are these two fractions?

CS (p.8) propose to frame this by defining a Retention Rate as "the percentage of the sales 'initially' diverted from each firm to its rivals within the market in response to a single-firm SSNIP that is retained by firms within the market when all the rivals raise price by the SSNIP." In our notation, we believe that this amounts to setting the Retention Rate R to equal X (those lost by the single firm but retained by the hypothetical monopolist in response to a uniform SSNIP) divided by $X+Y$ (those lost by the single firm but "diverted ... to its rivals within the market in response to a single-firm SSNIP"): $R \equiv X/(X+Y)$. CS are correct that linear demand implies $R=1$, and within the discrete-choice framework $R \leq 1$ generally. Thus by that particular measure, linear demand is analogous to an extreme case in the discrete-choice framework.[34]

However, it does not, of course, follow that it would be just as legitimate to assume that R is small or equal to zero. On the contrary, within the discrete choice framework, in those cases where a "narrow" market might even be mooted, we think that R is likely to be reasonably near 1: that is, area Y is likely to represent many fewer buyers than areas X and Y together.

To illustrate this, we drew Figure 3, which is just Figure 2 redrawn to scale: The illustrated price increases are depicted at 5 percent. As Figure 3 then illustrates, area Y is very much smaller than area X. Of course, there is no reason to expect buyers to be uniformly distributed by area, such that physical areas of these zones accurately reflect number of buyers. However, given the respective areas, to have R much less than 1 would require that buyers are very much more densely packed in area Y than in area X.[35] While logically possible, it requires

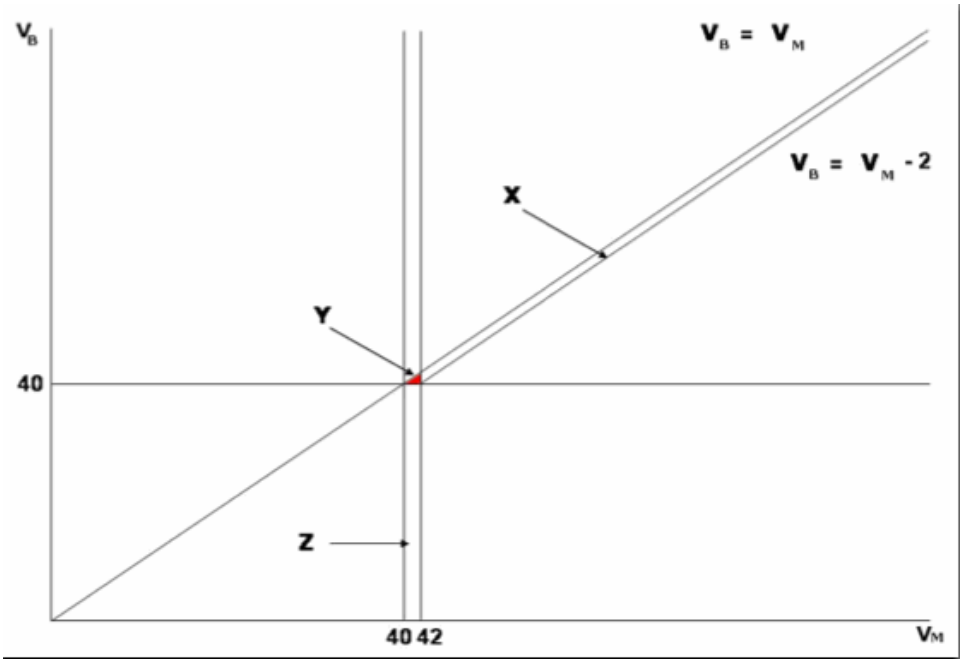
[33] Of course, an analogous set of those who before the SSNIPs were BMW buyers—specifically, those buyers in the mirror-images of areas Y and Z via reflection in the 45 degree line—will also substitute to other goods.

[34] We say "analogous to" because with more than two options linear demand is not reducible to a special case of the discrete choice framework. *See* Sonia Jaffe & Glen Weyl, *Linear Demand Systems are Inconsistent with Discrete Choice*, Harvard University, (2010).

[35] This pattern is akin to the highly curved demand that we showed in our paper was necessary for markets to be significantly broader than indicated by our formulas based on linear demand. In the discrete choice framework used here, to have R near zero would require that almost all customers diverted from Mercedes to BMW in response to a Mercedes SSNIP would be almost indifferent between BMW and a third option, such as Lexus. If there is almost no product differentiation, this would be the case, but then high pre-merger margins would be indicative of pre-merger coordinated effects. Otherwise the implied pattern is that many buyers have a preferred brand but if they don't buy that brand then they don't care what they buy. This is possible—for instance, it could arise if differentiation comes from switching costs—but when it arises there should be supporting evidence.

that, of buyers who view Mercedes and BMW as close substitutes (but prefer Mercedes), many value each of those brands just above $40,000, perhaps because they view Lexus also as a close substitute. Yet, if many buyers overall view all three brands (or both brands and the outside good) as close substitutes, then pre-merger competition would keep gross margins low and ensure that our diagnostic does not after all identify Mercedes and BMW as a relevant market.

Figure 3



Thus CS correctly observe that symmetric linear demand implies a particular relationship ($R = 1$) between the hypothetical monopolist's loss of sales in response to a unilateral SSNIP and its loss of sales in response to a uniform SSNIP. There are at least intuitive reasons to expect that the departure from the implications of that framework, even as measured by R, will not be very great, however, at least in cases with substantial gross margins; nor is it clear which is more characteristic of reasonable demand systems in general. More importantly, perhaps, R is not directly relevant to evaluation of the prospect that a merger may harm customers through a loss of competition, nor even to the Guidelines' approach to market definition.