Critical Loss: Let's Tell the Whole Story

BY MICHAEL L. KATZ AND CARL SHAPIRO

I N LITIGATION CHALLENGING A proposed or consummated horizontal merger, the government typically attempts to establish a presumption that the challenged merger would likely harm competition based on a showing that the merger would significantly increase concentration in one or more defined relevant antitrust markets. Because the delineation of the relevant market determines the market shares of the merging firms and the impact of the merger on concentration, market definition can be critically important in merger litigation.

Market definition also plays a role in governmental decisions whether to challenge mergers. Although many economists think that market definition and market shares tend to get too much attention in the analysis of horizontal mergers, in practice market definition is often a central topic in agency investigations of mergers. The Antitrust Division of the U.S. Department of Justice, the Federal Trade Commission, and at least one other federal agency that examines mergers, the Federal Communications Commission, all conduct market definition exercises.

The now-standard procedure for defining relevant product markets in horizontal merger cases asks whether a hypothetical monopolist controlling a group of products would find it profitable to raise the price of at least one product significantly above the prevailing level.[1] According to the DOJ and FTC Horizontal Merger Guidelines, a relevant product market is:

> a product or group of products such that a hypothetical profit-maximizing firm that was the only present and future seller of those products ("monopolist") likely would impose at least a "small but significant and nontransitory" increase in price. . . .

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Specifically, the Agency will begin with each product (narrowly defined) produced or sold by each merging firm and ask what would happen if a hypothetical monopolist of that product imposed at least a "small but significant and nontransitory" increase in price, but the terms of sale of all other products remained constant. If, in response to the price increase, the reduction in sales of the product would be large enough that a hypothetical monopolist would not find it profitable to impose such an increase in price, then the Agency will add to the product group the product that is the next-best substitute for the merging firm's product. [footnote omitted] . . .

The price increase question is then asked for a hypothetical monopolist controlling the expanded product group. 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. This process will continue until a group of products is identified such that a hypothetical monopolist over that group of products would profitably impose at least a "small but significant and nontransitory" increase, including the price of a product of one of the merging firms. The Agency generally will consider the relevant product market to be the smallest group of products that satisfies this test.[2]

To illustrate, consider a proposed merger between two companies manufacturing prescription sleeping pills. If a single firm controlling all brands of prescription sleeping pills would find it profitable to impose a small but significant and nontransitory increase in price (SSNIP) for at least one of the brands sold by the merging parties, then prescription sleeping pills constitute a relevant product market. If not, then the next-best substitute, e.g., non-prescription sleeping pills, is added to the candidate relevant market and the test is repeated.

As a matter of arithmetic, the effect of a SSNIP on the hypothetical monopolist's profits depends upon the prevailing profit margin earned on each unit sold and on the percentage of unit sales that would be lost as a result of the price increase. We call the latter the "actual loss." The maximal percentage of unit sales that can be lost for the price increase to be profitable is known as the "critical loss."[3] If the actual loss from a price increase would be greater than the critical loss, the price increase would be unprofitable.

A critical loss calculation can thus usefully frame the empirical estimation of demand responsiveness for the pur-

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pose of delineating relevant product markets. Critical loss analysis is commonly used, both by economists for private parties and by economists in the DOJ and the FTC.[4] However, critical loss analysis can also be misused. This article examines a common—but incomplete and potentially misleading—argument based on critical loss analysis. This argument has been used to justify broad relevant markets, and it runs as follows: "Because the suppliers' profit margins are high, any lost sales have a big adverse impact on profits, and so even a hypothetical monopolist controlling a group of products could not profitably raise price." This story is incomplete because high margins also tend to imply that the actual loss is small, and thus a price increase might be profitable even when the critical loss is small.[5]

We explain a simple approach that uses the "aggregate diversion ratio"—the percentage of the total sales lost by a product when its price rises that are captured by all of the other products in the candidate market—to make greater use of the available market evidence. Our central result is that an aggregate diversion ratio greater than the critical loss creates a presumption that the candidate product market is in fact a relevant antitrust market. This implies that, all other things being equal, higher pre-merger margins, which lead to a low critical loss, tend to support a finding of narrower markets.

The Defendants' Story

We begin by describing more fully the (potentially misleading) argument that high margins support a finding of a broad antitrust market. The "gross margin," (also known as the Lerner Index) is defined as the percentage difference between price and incremental cost.[6] If the price per unit is P and the incremental cost per unit is C, then the gross margin is

$$M = \frac{P - C}{P}.$$

For example, if price equals $100 and incremental cost is $40, then the gross margin is

$$\frac{100 - 40}{100},$$

or 60 percent. As a matter of arithmetic, the gross margin must fall between zero and 100 percent. A gross margin of zero means that price equals incremental cost, as under textbook perfect competition. If incremental cost is a very small fraction of price, then the gross margin is near 100 percent. In our experience, gross margins are often in the 50 percent range, or even larger, in industries (such as computer software or pharmaceuticals) with large fixed costs and/or highly differentiated products.[7]

Gross margins play a central role in critical loss analysis. The larger the gross margin, the smaller the critical loss. This result is quite intuitive: if a firm is making more money per unit sold, then it will take fewer lost sales to offset the profitability gains associated with any given price increase. A well-known formula can be used to calculate the critical loss associated with a particular price increase given the value of

the gross margin.[8] For an X percent price increase, the critical loss is

$$L = \frac{X}{X + M}.$$

Table 1 uses this formula to illustrate how the critical loss for a 5 percent price increase varies with the gross margin.[9]

Table 1: Critical Loss for a 5 Percent Price Increase

Gross Margin	40%	75%	90%
Critical Loss	11.1%	6.3%	5.3%

When pre-merger gross margins are large, merging parties frequently use this relationship to support their arguments for broad relevant markets by observing that the critical loss is small and asserting that a 5 percent price increase would be unprofitable. For example, when the Antitrust Division tried to enjoin SunGard Data Systems, Inc. from acquiring Comdisco, Inc.'s disaster recovery business, the defendants in *SunGard* asserted that the margin between price and marginal cost for an incremental customer was over 90 percent of the price.[10] As shown in Table 1, given an alleged margin of 90 percent, a 5 percent price increase would be unprofitable if unit sales fell by 5.3 percent or more. According to the district court,

> Defendants' economist hypothesized that SunGard could not profitably afford to lose more than 5 percent of its customers in response to a SSNIP because of the relatively high profit derived from each additional customer. Because SunGard has insufficient information as to whether its customers would switch in response to a SSNIP, Harris testified that the company could not take the risk of raising prices.[11]

Roughly put, the defendants asserted that, if they raised prices by 5 percent, the actual loss very likely would be larger than the critical loss, making the price increase unprofitable. Although it is not clear how strong a role this argument played, the district court ruled in favor of the merging parties on the grounds that the DOJ had not met its burden in establishing a relevant antitrust market.

High Gross Margins Indicate that Sales Volumes Are Not Price-Sensitive

A high gross margin implies a small critical loss. But a high gross margin also tends to indicate a small actual loss. For this fundamental reason, the defendants' critical loss story described above is seriously incomplete.

How does the gross margin provide information about the likely actual loss? As long as each firm sets price to maximize its profits—an assumption that underlies virtually all merger analysis—one can safely infer that a firm charges the price that it does, rather than a higher or lower one, because the firm believes other prices would be less profitable. Consider how a lower price would affect the firm's profits. If a lower price set by a single firm were to generate a great many more sales for that firm, the lower price would be more profitable

for the firm in question. For this reason, one can use the fact that lower prices are *not* more profitable to make inferences about the price sensitivity of sales and thus about the likely actual loss.

Our sleeping pill example illustrates the general point. Suppose that the prevailing price charged by a manufacturer is $1 per pill, the marginal cost is 25 cents, and 100 million pills are sold per year. The profit margin is 75 cents per pill, resulting in total profits of $75 million per year.[12] Compare this figure to the profits that the firm would earn

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at a price 5 percent lower—95 cents per pill. If the lower price were to cause unit sales to rise by 5 percent to 105 million pills per year, profits would fall to $73.5 million (105 million pills times the new margin of only 70 cents per pill). However, if the lower price were to cause unit sales to rise by 10 percent to 110 million pills per year, annual profits would *rise* to $77 million (110 million pills times the new margin of 70 cents per pill).

For the purpose of merger analysis, one assumes that the firm has selected its pre-merger price of $1 per pill to maximize its profits. Therefore, one can infer that a price of 95 cents per pill would generate no more than $75 million in annual profits. This implies that no more than 107.1 million pills would be sold if the price were 95 cents per pill.[13] In other words, one can put an upper limit on the extent to which the demand for this firm's prescription sleeping pills is responsive to price.

Furthermore, by this same logic, the higher the gross margin, the fewer the new sales that must be generated by the price reduction in order for the reduction to be profitable. To see this relationship, suppose that marginal costs were only 10 cents per pill, so that the initial gross margin were 90 percent, rather than the 75 percent used above. Then the initial profits per year would be $90 million. Now, if sales were to rise even 6 percent in response to a 5 percent price cut, profits would rise to $90.1 million (106 million pills times 85 cents margin per pill). Intuitively, if a firm makes more money per unit sold, then it will take fewer new sales to offset the profitability losses associated with a given price decrease. The bottom line is that high margins indicate the supplier perceives demand for its product to be relatively insensitive to its own price reductions.

This relationship has been expressed formally. As any microeconomics textbook demonstrates, an economically rational firm acting unilaterally sets its price so that its gross margin is inversely related to its elasticity of demand: $M = 1/E$, where E is the elasticity of demand facing the firm in question. Using this fundamental economic principle, there is a strong economic presumption that a high gross margin indicates that the product faces inelastic demand, i.e., there is a lack of price sensitivity by the customers purchasing that product. A typical reason why customers purchasing a single product are insensitive to price is that the product is differentiated from other products. When products are differentiated, those customers who like a particular brand's attributes will continue to purchase that brand even after its price increases somewhat.

This standard economic relationship between gross margin and demand elasticity has not gone unnoticed in merger analysis.[14] It was used, for example, by one of the FTC's economic experts in *FTC v. Swedish Match*:

> With fifty-five to sixty-five percent margins, which both sides agree exist here, Dr. Simpson calculated the critical loss—the largest amount of sales that a monopolist can lose before a price increase becomes unprofitable—of a five-percent price increase of loose leaf at approximately seven to eight percent. Using the Lerner Index, which relates margins to elasticity, Dr. Simpson then estimated the demand elasticity for Swedish Match with a price-cost margin of approximately sixty-five percent at an absolute value of approximately 1.67. At this level, a five-percent price increase by Swedish Match on its loose leaf brands would lead to approximately an eight percent decrease in its sales. [Internal footnote omitted.][15]

We still do not have the whole story relating gross margins to actual loss, however. A central question for market definition is how price-induced changes in the quantity demanded would affect the profits of the *hypothetical monopolist*. This is different from asking how a price increase would affect the profits earned by one of multiple competitors. One must go from evidence about the demand elasticity faced by a single competitor for one of its products to drawing inferences about the elasticity faced by a hypothetical monopolist controlling all of the products in the candidate market.

In general, the elasticity of demand facing the hypothetical monopolist is less than that facing a single firm because the monopolist does not lose sales competing with itself. This point was observed by the *Swedish Match* court:

> If *all* loose leaf producers increase their price by five percent, however, the industry-wide loss of sales will be less than eight percent. This is because it is easier for consumers to switch from one loose leaf brand to another than it is to switch to moist snuff. In other words, the elasticity of demand facing an individual firm in an industry will be greater that the elasticity of demand facing an industry.[16]

Although the overall logic of the court's opinion is sound, several issues need to be addressed before using this chain of reasoning to draw conclusions in a specific merger analysis. We turn next to those issues.

Are Defendants Telling a Coherent Story?

The "defendants' story" involves a situation in which gross margins are high and the merging parties claim that unit sales levels are sufficiently price sensitive that the actual loss exceeds the critical loss. What are the Agencies and the courts to make of such claims in the light of the relationship between gross margins and the sensitivity of demand to price just discussed?

When gross margins are large, defense claims that the elasticity of demand is high should be treated with a healthy dose of skepticism. More specifically, we advocate an approach under which there is a *presumption* that high gross margins go along with a low elasticity of demand faced by the hypothetical monopolist. However, this presumption could be rebutted in any given case by the showing of evidence that included an alternative, coherent explanation for the observed gross margins.

Econometric studies of consumer demand could be one means of rebuttal. The *Swedish Match* court explicitly addressed the possibility of using econometric analysis to estimate directly the elasticity of demand rather than inferring it from the observed gross margins:

> Moreover, Dr. Simpson's 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. [Footnote omitted.] [17]

When price, cost, and sales data, as well as other more qualitative evidence, are available, we favor using that information to estimate the elasticity of demand and/or the actual loss. And, we fully expect that courts will do so. However, the approach described here can supplement other types of empirical analysis or even substitute for them when other data are lacking. Moreover, it can provide an important reality check. As part of any empirical analysis, courts should ask defendants to explain how a large alleged actual loss (e.g., one based on econometric estimates showing demand is relatively elastic) is consistent with pre-merger pricing behavior, especially the presence of high gross margins.[18] If defendants cannot tell a coherent story that is consistent with profit-maximizing pre-merger behavior and the observed gross margins, their economic claims should be given far less weight.

There are three coherent stories regarding consumer demand and the nature of competition that defendants might use to reconcile large observed gross margins with claims that unit sales would be sensitive to a price increase imposed by the hypothetical monopolist.

First, defendants could argue that the *M = 1/E* relationship fails to provide information about the demand faced by the hypothetical monopolist because the firms in the candidate market are coordinating their prices rather than setting their prices independently.[19] Coordination breaks the tight link between the elasticity faced by one of several competitors and the elasticity faced by the hypothetical monopolist because

the former depends on the nature of competitor interaction. Nevertheless, if the scope of coordination is roughly the same as the scope of the candidate market, then there are good reasons to suspect that these products indeed form a relevant product market.[20] After all, there is little or nothing to gain from coordinating prices among a group of products that collectively have no market power. Therefore, defendants are unlikely to be able to argue coherently for a broader relevant market based on pre-merger coordination of prices by the suppliers in the (narrow) candidate market. However, evidence of coordination among a larger group of suppliers might provide a coherent argument for a broader relevant market.

Second, defendants might argue that there is a "kink" in the underlying demand curve, so that consumers would be very sensitive to price *increases* even though they are not sensitive to price *decreases*.[21] For example, the elasticity of demand facing the hypothetical monopolist at a price just above the prevailing level could be very high if an alternative technology or product (supplied elastically) would become an attractive substitute for many customers in the event of a SSNIP. While kinks in demand are logically possible, the following is a reasonable starting presumption: If demand is inelastic for prices slightly below prevailing levels, then demand is also inelastic for prices slightly above current levels. Any party—plaintiff or defendant—arguing for a kink in the underlying demand curve should be required to present factual evidence that the kink exists.

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Third, defendants might claim that there is a "kink" in the underlying cost curve, so that the marginal cost associated with additional output is much higher than the marginal cost associated with the last units actually produced (which is presumably used to measure the gross margin). This could occur, for example, if the firms are all producing at or near capacity. In this case, demand could be sensitive to price yet no firm would find it profitable to lower price because each firm would find it very costly to serve additional consumers. While it is logically possible for marginal cost to increase sharply with output around the pre-merger level of output, here too any party—plaintiff or defendant—arguing for a kink in the underlying cost curve should be required to present factual evidence that the kink exists. Presumably, this would involve showing that all firms in the candidate mar-

ket are operating at or very near full capacity and that capacity would be costly to expand even given a "nontransitory" period of time.

In order to focus on our core critique of critical loss analysis as it is often practiced, for the remainder of this article we assume that: (1) the merging firms are not engaging in coordinated conduct prior to the proposed merger; (2) there is no kink in the underlying demand curve at the pre-merger price; and (3) there is no kink in the underlying cost curve at the pre-merger level of output. We show that in this context—with independent pricing, smooth demand conditions, and smooth cost conditions—high gross margins tend to imply relatively narrow markets. We also provide a simple and superior means to project the relationship between the actual loss and the critical loss.

Using the Aggregate Diversion Ratio to Tell the Rest of the Story

The hypothetical monopolist test in the Merger Guidelines examines the profitability of a SSNIP for at least one product, including at least one product of one of the merging firms. We begin by asking the traditional question posed by critical loss analysis: Would a given SSNIP yield higher profits for the hypothetical monopolist than do the pre-merger prices?[22]

Consider the effects of raising the price of just one product, Product Z, which is produced by one of the merging parties. A hypothetical monopolist would consider the effect of that price increase on the profits earned on all of the products in the candidate market, not just Product Z. When the price of Product Z rises, some of the sales lost by Product Z will shift to other products in the candidate relevant market. These sales are not lost to the hypothetical monopolist. Indeed, if the difference between price and incremental cost is larger for these products than for Product Z, such diversion of sales actually boosts the monopolist's profits (thus making the price increase relatively more attractive). To keep the analysis as simple as possible, we focus on the case in which all of the products in the candidate market have the same difference between price and incremental cost, $P - C$. (The more general case is sketched in footnotes below.)

With this simplification, we can focus attention on the sales actually lost by the hypothetical monopolist when raising the price of Product Z, namely the sales that are lost by Product Z and not gained by any of the other products in the candidate relevant market. For this purpose, it is useful to define the "aggregate diversion ratio" for a given Product Z. For a given price increase for Product Z, the aggregate diversion ratio is the fraction of overall sales lost by Product Z that are captured by—or diverted to—any of the other products in the candidate relevant market. Suppose, for example, that a five-percent increase in the price of Product Z causes the sales of Product Z to fall by 200 units, but the sales of other products in the candidate market to rise by 90 units. Then the aggregate diversion ratio is

$$D = \frac{90}{200} = 45 \text{ percent.}$$

The aggregate diversion ratio must lie between zero and 100 percent.[23]

With this definition, the hypothetical monopolist considering whether to raise the price of Product Z will capture a fraction D of any lost sales through increased demand for its other products. Therefore, the hypothetical monopolist effectively loses only a fraction $(1 - D)$ of the sales that are lost by Product Z.[24] The greater the aggregate diversion ratio, the fewer the sales lost by the monopolist, and the more profitable is a price increase. Making use of some algebra, this fact leads to a powerful and surprisingly simple finding when gross margins are large: *If and only if the aggregate diversion ratio is larger than the critical loss, then the actual loss is less than the critical loss and thus a hypothetical monopolist would find a SSNIP profitable.*[25]

Although the comparison of the actual loss with the critical loss tells one whether a given price increase would be profitable, the hypothetical monopolist test of the Merger Guidelines asks whether the hypothetical monopolist's *profit-maximizing* SSNIP would be at least as large as the chosen threshold, say 5 percent.[26] As a rule, increasing the price of Product Z above its pre-merger level will cause the profits of the hypothetical monopolist to rise, reach a maximal level, and then decline. The price that *maximizes* profits is not as large as the price at which profits fall all the way back down to their pre-merger level. As a good working approximation, the profit-maximizing price increase is half as large as the maximal price increase that yields profits above their pre-merger level.[27] Therefore, if a 10 percent price increase would cause the hypothetical monopolist's profits to be higher than their pre-merger level, then the profit maximizing price increase is at least 5 percent.

Together, our earlier analysis and this approximation support the following presumption when gross margins are large:

> Given the pre-merger gross margin M, calculate the critical loss associated with a 10 percent price increase.[28] If and only if the aggregate diversion ratio associated with a group of products is at least as large as the critical loss, then this group of products forms a relevant market using a 5 percent price-increase threshold.[29]

This is a powerful and cautionary result. For example, with the 90 percent gross margin used in that *SunGard* case, the critical loss associated with a 10 percent price increase would be 10 percent. Based on our analysis, and assuming the firms were not engaged in coordinated pricing prior to the merger, there would have been a presumption that a hypothetical monopolist controlling all products in the relevant market alleged by the government would find it profitable to impose a 5 percent price increase for at least one product if and only if the aggregate diversion ratio were at least 10 percent. In other words, there would have been a presumption that the candidate market was in fact a relevant market if a total of at least 10 percent of any sales lost by one product

whose price was increased would have been captured collectively by the other products in the candidate market.

Of course, a more complete analysis is needed before reaching conclusions in any specific case; the presumption we advocate can be rebutted. For instance, the sample calculations are only an approximation based on the firm's perceived elasticity of demand at the pre-merger price, in conjunction with our standing assumption that the firms are pricing independently. But there should be little doubt that the "defendants' story" is seriously incomplete.

Up to this point, we have followed the letter of the Merger Guidelines in asking whether the hypothetical monopolist would find it most profitable to raise the price of at least one product of the merging parties by some threshold amount above prevailing levels. However, we are aware that the market definition test often employed in practice is slightly different. Specifically, the test often takes the form of asking whether the hypothetical monopolist would find it most profitable to raise the prices of *all* of the products in the candidate market at least 5 percent above prevailing levels. We now turn to an analysis of this slightly different question.

We are not arguing for "narrow" markets. Rather, we are arguing for consistency and economic coherence in the application of the Merger Guidelines.

To begin this modified inquiry, one first needs to decide what pre-merger gross margin to apply to products controlled by the hypothetical monopolist. In practice, the gross margins of the merging suppliers are typically taken as representative of the industry because the most reliable data on price and cost readily available usually come from the merging parties. In practice, then, the prices and costs of the merging parties serve as the basis for the hypothetical-monopolist calculations.[30]

With these standard working assumptions, one can easily extend our previous analysis to ask about the profitability of imposing a SSNIP uniformly on all of the products in the candidate relevant market. The trick is to perform this exercise by raising the price of one product after another *in sequence* until the prices of all products in the candidate market have been raised. We have already shown that raising the price of one product, Product #1, is profitable for the hypothetical monopolist if the aggregate diversion ratio for that product exceeds the critical loss. After the price of Product #1 has been raised, the same logic applies to Product #2, then Product #3, and so on until the prices of all products in the candidate market have been raised. So long as the aggregate diversion ratio for each product in the sequence does not go down sharply when the price of another product is raised by a small amount, the test we described above will apply to every product in the candidate relevant market.[31] Therefore, even under this version of the SSNIP test, there is a presumption that a set of products forms a relevant market if the aggregate diversion ratio for each product, as estimated at prevailing prices, exceeds the critical loss.

Are Markets "Too Narrow" Under the Merger Guidelines?

We recognize that the relevant markets defined using the procedures described here, while faithful to the Merger Guidelines, may appear to be "too narrow" to some observers. In particular, these methods may lead to markets that are narrower than would be implied using the less formal "reasonable substitutes" standard that courts sometimes employ.

We are not arguing for "narrow" markets. Rather, we are arguing for consistency and economic coherence in the application of the Merger Guidelines. Our approach is to follow the logical conclusions of basic economic theory. If one does not like the answer, do not blame the logic. Instead, consider using a higher threshold for market definition. For example, using a 10 percent price-increase threshold tends to yield broader markets. With gross margins of 60 percent, using a 10 percent price increase to test for relevant markets would lead to an aggregate diversion ratio threshold of 25 percent (versus only 14 percent for a 5 percent price-increase test).

It is also worth noting that the narrow markets that can result from the Merger Guidelines' approach are not necessarily "pro-agency." Indeed, we are concerned that defining markets overly narrowly using the Merger Guidelines can lead to an incorrect finding that the merging parties do not compete with each other because each party's products are in narrow and distinct relevant markets.

Finally, practitioners and policy makers should remember that the role of market definition is to provide a basis on which the Government calculates market shares in making its prima facie case. One should be careful not to make too much of market delineation. It is not a substitute for a full analysis of likely competitive effects.

Conclusion: Telling the Whole Story

We and other authors have explained why it can be misleading simply to make the observation that high margins indicate a small critical loss and then conclude that high margins tend to support finding a broad relevant market. Nevertheless, some might argue that the calculation of critical loss is a matter of arithmetic, while going on to tell the full story requires making inferences about market behavior. We agree that the critical loss is the result of an arithmetic identity. But to stop there is to ignore important market facts, and the result can be to draw incorrect inferences. While high gross margins indicate that the critical loss will be small, they also indicate that the actual loss will very likely be small as well.[32]

Moreover, we have developed here a simple rule that provides an important benchmark in the determination of relevant markets: An aggregate diversion ratio greater than the critical loss creates an economic presumption that the products under consideration constitute a relevant market.[33]

The methodology advocated here has several virtues. It makes more complete use of pre-merger market facts. It requires consistency between the pre-merger behavior of the merging firms and the predictions for the behavior of the hypothetical monopolist. And our approach focuses attention on the key demand-side issue in projecting competitive effects: the extent to which the products in the candidate relevant market compete directly with each other rather than with products outside the candidate market, as captured by the aggregate diversion ratio. It is time to tell the whole story and stop telling an incomplete one that risks delineating overly broad markets and under-estimating the likely competitive effects of mergers. ■

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[1] Our discussion below is restricted to product market definition. However, similar considerations apply to delineating the geographic scopes of relevant markets as well. We also restrict our attention to markets or groups of consumers within which the suppliers do not practice significant price discrimination.

[2] U.S. Department of Justice and Federal Trade Commission, Horizontal Merger Guidelines § 1.11 (revised 1997) [Merger Guidelines].

[3] See Barry Harris & Joseph Simons, *Focusing Market Definition: How Much Substitution is Necessary*, 207 RES. IN L. & ECON. (Richard O. Zerbe, Jr., ed., 1989).

[4] Most recently, the FTC referred to critical loss analysis in its October 2002 statement in the cruise industry case, FTC File No. 021-0041; see http://www.ftc.gov/os/caselist/0210041.htm. In addition to the cases discussed below, critical loss analysis played an important role in several litigated hospital mergers, including *FTC v. Tenet Health Care Corp.*, 186 F. 3d 1045. 1053 (8th Cir. 1999), and *United States v. Mercy Health Services*, 902 F. Supp. 928 (N.D. Iowa 1995).

[5] Danger and Frech and Langenfeld and Li have also made this point. Kenneth L. Danger & H.E. Frech III, *Critical Thinking about "Critical Loss" in Antitrust*, 46 ANTITRUST BULL. 339. James Langenfeld & Wenqing Li, *Critical Loss Analysis in Evaluating Mergers*, 46 ANTITRUST BULL. 299. These authors also identify other pitfalls that can arise in applying critical loss analysis. After completing this article we became aware of O'Brien and Wickelgren, which offers a very similar critique of "standard critical loss analysis" to the one provided here. *See* Daniel P. O'Brien & Abraham L. Wickelgren, A Critical Analysis of Critical Loss Analysis (Working Paper No. 254, Bureau of Economics, Federal Trade Commission 2003), *available at* http://www.ftc.gov/be/workpapers/wp254.pdf. O'Brien and Wickelgren also provide more detail on how critical loss analysis was misused in the *FTC v. Tenet Healthcare* and in *FTC v. Swedish Match* cited below.

[6] Incremental cost is the cost of producing one more unit of output. As used here, "incremental cost" and "marginal cost" are synonymous. Measuring incremental cost can often be a tricky matter, with the results depending upon the magnitude of the incremental amount of output and the time frame over which costs are measured, i.e., the classification of different categories of cost as fixed or variable. The time frame over which costs are measured for our analysis should correspond to the time frame over which the "nontransitory" price increase (SSNIP) applies.

[7] High gross margins do *not* imply that firms are earning monopoly profits. In the long run, gross margins must be large enough to cover (what in the short run are) fixed costs, or suppliers will lose money and exit the business.

[8] For a derivation, see Harris & Simons, *supra* note 3. For a more recent and more complete treatment of demand elasticities in merger analysis, see Gregory J. Werden, *Demand Elasticities in Antitrust Analysis*, 66 ANTITRUST L.J. 363.

[9] Confusion sometimes arises regarding the 5% test. The Merger Guidelines indicate that a 5% price increase often is a useful threshold for market delineation and not the unique *threshold* at that. As the Merger Guidelines explain, the question asked in determining whether a set of products constitutes a relevant market is whether

> a hypothetical monopolist over that group of products would profitably impose *at least* a "small but significant and non-transitory" increase, including the price of a product of one of the merging firms [emphasis added] . . .

> what constitutes a "small but significant and nontransitory" increase in price will depend on the nature of the industry, and the Agency at times may use a price increase that is larger or smaller than 5 percent.

Merger Guidelines, *supra* note 2, § 1.11.

[10] For purposes of discussion, we take this to be a correct measure of the relevant margin. In fact, there were subtle issues about the proper treatment of capital costs for purposes of the market delineation hypothetical.

[11] United States v. SunGard Data Sys., Inc., 172 F. Supp. 2d 172 n.21 (D.D.C. 2001).

[12] For simplicity, we are treating fixed costs as zero. The presence of fixed costs such as R&D costs would have no effect on the comparison of profits at different price levels because, by definition, fixed costs would not vary with price.

[13] The sale of 107.1 million pills at 95 cents per pill would generate the same $75 million profit as the manufacturer currently earns on the sale of 100 million pills at $1.00 per pill. More generally, the largest percentage increase in unit sales that could occur for an *X*-percent price decrease *not* to be profitable is the "critical gain,"

$$G = \frac{X}{M - X}.$$

With $X = 5\%$ and $M = 75\%$, G equals 5/70 or 7.1%.

[14] Both Danger and Frech, *supra* note 5, and Langenfeld and Li, *supra* note 5, make the point that critical loss analysis is sometimes practiced in ways that fail to take account of the link between pre-merger margins and the elasticity of demand facing the pre-merger firms, and that this omission is most glaring when gross margins and high and the critical loss is small.

[15] FTC v. Swedish Match, 131 F. Supp. 2d 151, 160 (D.D.C. 2000).

[16] *Id.* at 161 (emphasis added).

[17] *Id.* However, the judge went on to say that "[t]he defendant's economics evidence is even less persuasive," and then ruled in the plaintiff's favor based on his reading of other evidence. *Id.*

[18] We would also urge courts to ask the Agencies to explain how a small alleged actual loss is consistent with low gross margins when that situation arises.

[19] As we use the term here, *independent* pricing means that each firm maximizes its profits given the current actions of the other firms. In game-theoretic terms, independent pricing means that a Nash Equilibrium in prices (also known as a Bertrand Equilibrium) or a Nash Equilibrium in quantities (also known as a Cournot Equilibrium) prevails prior to the proposed merger. If prices are not set independently, we say that they are *coordinated*, which may or may not involve an "agreement" in the sense this term is used in antitrust law.

[20] As recognized by the Merger Guidelines, taking prevailing prices as the starting point for considering post-merger price increases may be inappropriate if the pre-merger prices are the result of coordination:

> In the above analysis, the Agency will use prevailing prices of the products of the merging firms and possible substitutes for such products, unless premerger circumstances are strongly suggestive of coordinated interaction, in which case the Agency will use a price more reflective of the competitive price.

Merger Guidelines, *supra* note 2, § 1.11. This point is closely related to the *Cellophane* Fallacy that arises in monopolization cases.

[21] Here, we are referring solely to kinks that arise as the result of consumer behavior. In theory, a kink in an individual supplier's demand curve could result from a form of coordinated interaction. The standard story is that rival suppliers will match price decreases but not price increases. Such a kink is irrelevant for a hypothetical monopolist because that firm maximizes profits looking at the underlying demand curve for the various products in the candidate market.

[22] The Merger Guidelines pose a different question: whether a price increase at least as large as the SSNIP would *maximize* the profits of the hypothetical monopolist. Merger Guidelines, *supra* note 2, § 1.0. This difference is discussed below.

[23] The aggregate diversion ratio is a cousin to the widely used "diversion ratio." The difference is that the aggregate diversion ratio includes sales lost to all other products in the candidate market, whereas the traditional diversion ratio includes only sales lost to a single product, usually one produced by the other merging party. The aggregate diversion ratio is obtained by adding up the diversion ratios between Product Z and each of the other products in the candidate market.

[24] If $P - C$ differs across products, define

$$\lambda = \frac{P_L - C_L}{P_Z - C_Z},$$

where Z and L denote the values for product Z and the product with the smallest value of $P - C$, respectively. In terms of their effects on profits, it is as if the monopolist lost no more than $1 - \lambda D$ of its sales. This relationship holds because D sales are captured by other products, but the profit impact of these diverted sales may be as low as λD. If the data are available, one can calculate the precise profit effects by looking at the diversion to each product separately and weighting it by the value of λ calculated specifically for that product.

[25] The result is derived as follows. The product-specific elasticity for Product Z is

$$E = \frac{1}{M},$$

where M is the pre-merger gross margin for Product Z. Therefore, the decline in unit sales of Product Z associated with an X-percent price increase is approximately XE, which equals $\frac{X}{M}$.

(This formula overstates the actual loss when the demand exhibits constant elasticity, because arc elasticity and point elasticity are not identical. Thus, the presumption in the test below favors finding broader markets. However, the approximation is very good for small price changes and high margins.) Because a fraction D of these sales are captured by other products owned by the hypothetical monopolist, the actual loss for the monopolist associated with an X-percent price increase is (no more than)

$$A = \frac{X(1 - D)}{M}.$$

Recall that the critical loss is

$$L = \frac{X}{X + M}.$$

With a few steps of algebra, it can be shown that $A < L$ if and only if $D > L$. For the case of unequal price-cost differences, the corresponding result is that $A < L$ if $\lambda D > L$.

[26] Merger Guidelines, *supra* note 2, § 1.0. Baumann and Godek discuss this distinction. Michael Baumann & Paul Godek, *Could and Would Understood: Critical Elasticities and the Merger Guidelines*, 40 ANTITRUST BULL. 885.

[27] This approximation is precise for quadratic profit functions (which arise with linear demand and constant marginal cost), and more generally is based on the second-order (quadratic) approximation to the profit function in the region of the pre-merger prices.

[28] This is done using the standard formula $L = \frac{10}{10 + M}$.

[29] If $P - C$ varies across products, compare the calculated value of L with λD.

[30] If realized prices or marginal costs are different for the two merging parties, both sets of numbers could be used to see if they give different results in the market-definition exercise.

[31] In principle, the aggregate diversion ratio facing one product can fall sharply as the prices of the other products in the candidate market rise. Intuitively, as the prices of the other products in the candidate market rise, consumers look to products outside of the candidate market as substitutes when the price of the next product in the sequence is increased. We would begin, however, with a presumption that aggregate diversion ratios change smoothly as prices vary, while permitting either side to rebut this presumption.

[32] We offer Werden's analysis as further support of the proposition that high gross margins tend to support a relatively narrow relevant market. Gregory J. Werden, *A Robust Test for Consumer Welfare Enhancing Mergers Among Sellers of Differentiated Products*, 44 J. INDUS. ECON. 409. Werden presents a rather general approach that identifies how big merger-specific cost savings must be to offset the tendency of a merged firm to set higher prices once the merging brands are no longer independent competitors. For our purposes, the main lesson from Werden's work is that higher gross margins are associated with larger necessary cost reductions. For the same reason that high gross margins require greater synergies in order for consumers to benefit from the merger, high gross margins make it profitable for a hypothetical monopolist to impose a larger price increase.

[33] Our analysis focused on market definition, but a similar approach can be used to study competitive effects. For the same underlying economic reasons discussed here, high gross margins tend to make it more likely that the merged entity will find it profitable to impose a significant price increase. A useful starting point projection of the post-merger percentage price increase is $\frac{d}{1 - d} \frac{M}{1 - M},$

where d is the traditional diversion ratio between the products of the two merging firms. Note that a larger gross margin (as well as a larger diversion ratio) tends to imply a larger post-merger price increase. Of course, a far more complete analysis, including rivals' supply responses and merger synergies, is required to project the magnitude of any competitive effects with confidence.