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DEMAND ELASTICITIES IN ANTITRUST ANALYSIS

GREGORY J. WERDEN*

The concept of demand elasticity was introduced into antitrust jurisprudence more than four decades ago,¹ and the invocation of the concept has been routine for more than three decades.² Nevertheless, the use of demand elasticities in delineating markets, assessing market power, and analyzing competitive effects has increased dramatically over the last few years. Demand elasticity has become more than a mere concept in antitrust. Demand elasticities are actually being estimated, and the estimated demand elasticities are being used to delineate markets, to measure market power directly, and to predict the competitive effects of mergers.

This article offers a comprehensive recapitulation of the relevant economics and case law on demand elasticities and makes some efforts toward rapprochement. Its primary purpose is to make the relevant economic analysis readily available to non-economists concerned with antitrust law.³ The discussion is organized primarily by elasticity concept. Parts I and II consider uses of the own-price elasticity of demand. Part I relates to the identification and measurement of single-firm market power, while Part II relates to the delineation of markets. Part III considers the cross-price elasticity of demand and the diversion ratio, which involves both own- and cross-price elasticities. The topics discussed are the uses of these tools in delineating markets, ranking the closeness of substitutes, and assessing the competitive effects of mergers. Concluding remarks appear in Part IV.

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¹ That introduction occurred in a seemingly unimportant footnote in *Times-Picayune Publishing Co. v. United States*, 345 U.S. 594, 612 n.31 (1953).

² It has been routine at least since the market delineation rule of *Brown Shoe Co. v. United States*, 370 U.S. 294, 325 (1962).

³ Nevertheless, some of the legal and economic analysis is novel. For readers interested in a deeper understanding of the relevant economics, derivations of most important results are provided in footnotes and in an Appendix.

I. THE MARSHALLIAN OWN ELASTICITY OF DEMAND AND SINGLE-FIRM MARKET POWER

A. THE MARSHALLIAN DEMAND CURVE AND ITS OWN ELASTICITY OF DEMAND⁴

Demand is a tabular, graphical, or abstract mathematical representation of consumer preferences expressed in terms of quantities consumers will purchase at different prices. A *demand schedule* is a tabular representation—a list of quantities that will be purchased at various discrete prices.⁵ A *demand curve* is a graphical or abstract mathematical representation, indicating the quantity that will be purchased at each price in a specified range.⁶

The treatment of demand in modern economic theory owes much to Alfred Marshall and generally follows conventions he adopted in his 1890 *Principles of Economics*.⁷ Indeed, the demand curve used in nearly all microeconomic analysis is formally termed the *Marshallian demand curve*.⁸ The hallmark of the Marshallian demand curve is the *ceteris paribus* assumption—“other things being equal.” A Marshallian demand curve indicates, for a product or group of products, the quantity that will be purchased at each price, holding constant the prices of all other goods, nominal income, and consumer tastes.⁹

As the price of a product changes, there is said to be a “movement along its demand curve” or an “increase (or decrease) in its quantity

⁴ These topics are discussed in every introductory economics and intermediate microeconomics textbook. Especially useful presentations are MICHAEL L. KATZ & HARVEY S. ROSEN, MICROECONOMICS 82–91 (1991); GEORGE J. STIGLER, THE THEORY OF PRICE ch. 3, 326–36 (3d ed. 1966).

⁵ By most modern accounts, the demand schedule was introduced in 1699 by Charles Davenant in his *Essay upon the Probable Methods of Making People Gainers in the Balance of Trade*. See JOHN CREEDY, DEMAND AND EXCHANGE IN ECONOMIC ANALYSIS: A HISTORY FROM COURNOT TO MARSHALL 7–9 (1992); G. Herberton Evans, Jr., *The Law of Demand—The Roles of Gregory King and Charles Davenant*, 81 Q.J. ECON. 483 (1967).

⁶ The first expression of a demand curve as a mathematical equation is credited to Pietro Verri in his 1760 *Elementi del Commercio*. See DONALD W. KATZNER, STATIC DEMAND THEORY 7 (1970); JOSEPH A. SCHUMPETER, HISTORY OF ECONOMIC ANALYSIS 307 n.13 (1954). The first serious mathematical treatment of demand was by Antoine Augustin Cournot in his 1838 *Researches into the Mathematical Principles of the Theory of Wealth* 44–55 (Nathaniel T. Bacon trans., Augustus M. Kelley 1971), which also introduced oligopoly theory.

⁷ Marshall's analysis was largely contained in earlier works, but its most complete expression was in the *Principles*. ALFRED MARSHALL, PRINCIPLES OF ECONOMICS ch. 3–4 (8th ed. 1920, reset and reprinted 1949, Porcupine Press).

⁸ See, e.g., DAVID M. KREPS, A COURSE IN MICROECONOMIC THEORY 37–62 (1990).

⁹ For a detailed discussion of the assumption, see Milton Friedman, *The Marshallian Demand Curve*, 57 J. POL. ECON. 463 (1949), reprinted in MILTON FRIEDMAN, ESSAYS IN POSITIVE ECONOMICS 47 (1953).

demanded." The effect on demand of changes in prices of other goods, nominal income, or tastes is termed a "shift in the demand curve" or an "increase (or decrease) in demand." Marshall's *ceteris paribus* assumption helps to keep these phenomena separate.

Because a demand curve expresses quantity as a function of price, the normal practice of modern mathematics would be to graph demand with price on the horizontal axis (the "abscissa") and quantity on the vertical axis (the "ordinate"). Marshall, however, did the opposite, and economics has followed his lead ever since; quantity is plotted on the horizontal axis and price is plotted on the vertical axis. In mathematical terms, what is plotted is not the demand curve itself, but rather the *inverse demand curve*, which expresses price as a function of quantity. When inverse demand curves are used below, they are referred to as just "demand curves," as is common in economics. Marshall also introduced the *Law of Demand*, which states that consumers will purchase less of a product the higher its price.¹⁰ In graphical terms, this means both demand curves and inverse demand curves slope downward (as one moves from left to right). The economic theory of the consumer, however, allows for the possibility that small sections of demand curves slope upward.

Another of Marshall's important contributions to the theory of demand was the concept of elasticity of demand, or more precisely, *own-price elasticity of demand*.¹¹ The elasticity of demand for a product indicates the responsiveness of its quantity demanded to a change in its price. Specifically, the own-price elasticity of demand for a product is the proportionate change in its quantity demanded divided by the proportionate change in price that induced the quantity change. Using the symbol Δ (upper case delta) to denote "change in," the elasticity of demand is symbolically written as

$$-\frac{\Delta q}{q} \bigg/ \frac{\Delta p}{p} = -\frac{\Delta q}{\Delta p} \bigg/ \frac{q}{p}.$$

¹⁰ See MARSHALL, *supra* note 7, at 84. Though referred to sometimes by non-economists, there is no such thing as "the law of supply and demand."

¹¹ Most authorities unreservedly credit Marshall for elasticity of demand. See, e.g., SCHUMPETER, *supra* note 6, at 992–93; George J. Stigler, *The Nature and Role of Originality in Scientific Progress*, 22 *ECONOMICA* (n.s.) 293 (1955), reprinted in GEORGE J. STIGLER, *ESSAYS IN THE HISTORY OF ECONOMICS* 1, 2 (1965); JOHN M. KEYNES, *ESSAYS IN BIOGRAPHY* 187 (1951). Precursors are discussed by CREEDY, *supra* note 5, at 24–32, and Peter Newman, *Elasticity*, in 2 *THE NEW PALGRAVE: A DICTIONARY OF ECONOMICS* 125 (John Eatwell et al. eds., 1987). Marshall wrote the first drafts of the *Principles* chapters on demand and its elasticity while on leave in Italy for the academic year 1881–82. See 1 J.K. WHITAKER, *THE EARLY ECONOMIC WRITINGS OF ALFRED MARSHALL, 1867–1890*, at 85 (1975). He

Marshall's Law of Demand implies that a price change induces a quantity change that is opposite in sign; a price increase causes a quantity decrease, and a price decrease causes a quantity increase. He inserted the minus sign in the definition of demand elasticity to make demand elasticities positive. This convention is followed throughout this article and in most introductory texts; however, modern economic literature typically does not include the minus sign in the definition, so own-price elasticities of demand in this literature are negative.

It is often impossible to measure the quantity demanded for two different products in the same units, and this complicates inter-product demand comparisons. The elasticity of demand eliminates this problem. As is easily verified from the expression above, the elasticity of demand is a unitless or "pure" number. Whatever units quantity and price are measured in, those units cancel out in the elasticity calculation.¹² Thus, even without its many applied uses, elasticity of demand was considered a significant concept because it characterized a useful property of a particular demand curve in a single, pure number.¹³

Elasticity of demand can be measured either at a single point, yielding a *point elasticity*, or measured between two points, yielding an *arc elasticity*. The point elasticity is conventionally used in economic analysis.¹⁴

At a given point, demand is said to be *elastic* if its elasticity exceeds one; demand is said to be *inelastic* if its elasticity is less than one; and demand is said to be *unitary elastic* if its elasticity is one exactly. Since elasticity of demand indicates how quantity changes relative to price, it also indicates how total revenue—price times quantity sold—changes as price changes. If demand is elastic, a price increase decreases revenue;

first published on elasticity of demand five years prior to the publication of the *Principles*. See Alfred Marshall, *On the Graphic Method in Statistics*, J. [LONDON] STAT. SOC'Y (Supp. 1885), reprinted in MEMORIALS TO ALFRED MARSHALL 175, 187 (A.C. Pigou ed., 1956) (1925).

¹² When arithmetic is done on numbers with units, the arithmetic is also done on the units. For example, if 100 barrels of oil (measured in barrels) were sold for \$200 (measured in dollars), the average price would be \$20 per barrel (measured in dollars/barrel).

¹³ See Newman, *supra* note 11, at 126.

¹⁴ Elasticities of demand estimated using conventional econometric methods are point elasticities, as are all elasticities in the formulae below. Formally, the point elasticity of demand is defined as

$$-\frac{dq}{dp} \frac{p}{q}.$$

The first term in this expression differs from that above in that the symbol Δ has been replaced by "d." The expression dq/dp is the limit of $\Delta q/\Delta p$ as Δp becomes arbitrarily small; it is called the "derivative of quantity demanded with respect to price." The derivative of any curve at a given point is the slope of the line tangent to the curve at that point.

if demand is inelastic, a price increase increases revenue; and if demand is unitary elastic, revenue is unaffected by a change in price. A single demand curve normally contains regions in which it is elastic, unitary elastic, and inelastic.

For one special family of demand curves, the elasticity of demand does not change as one moves from one point on the demand curve to another. These constant elasticity or *isoelastic* demand curves are commonly used for illustrative purposes.¹⁵ An isoelastic demand curve with unitary elasticity of demand is pictured in Figure 1. *Linear* demand,¹⁶ shown in Figure 2, is another demand curve commonly used for illustrative purposes.

As Marshall first noted, the elasticity of demand for any point on a linear demand curve equals the length of the segment between the quantity axis intercept and that point, divided by the length of the segment from that point to the price intercept.¹⁷ Thus, demand is unitary elastic half way between the two intercepts, elastic above the half-way point, and inelastic below the half-way point. Even with nonlinear demand curves, the elasticity of demand normally increases as one moves up the demand curve.

B. MARKET POWER IN ECONOMICS

The model of monopoly is central to the notion of market power in economics. A monopolist is the supplier of a product with neither perfect nor even “close” substitutes. The absence of close substitutes may mean much less in economics than in law. In economics it means that substitutes are sufficiently distant that, as the monopolist changes price or quantity, it reasonably ignores any feedback effects, i.e., effects on its demand curve caused by changes in the prices of other products in response to changes in its own price.

¹⁵ Isoelastic demand curves have the mathematical form $p = aq^{-1/b}$, where a and b are positive constants, and b is the elasticity of demand. Demand is unitary elastic if $b = 1$, so that $pq = a$. This is the equation of a rectangular hyperbola (a hyperbola with the price and quantity axes as asymptotes). It is also the very first mathematical demand curve ever used. See KATZNER, *supra* note 6, at 7; SCHUMPETER, *supra* note 6, at 307 n.13. Since revenue is defined as pq and a is a constant, it is readily apparent that revenue is the same at all points on this demand curve. Isoelastic demand curves are also commonly written in logarithmic form: $\log(q) = \alpha - \beta \log(p)$.

¹⁶ A linear demand curve has the mathematical form $p = a - bq$, where a and b are positive constants. The price axis intercept is a , while the slope of the line is $-b$.

¹⁷ See Marshall, *supra* note 11, at 187. A simple geometric proof is provided in STIGLER, *supra* note 4, at 330–31. As Stigler explains, the elasticity of demand for any demand curve can be reckoned in this way, by drawing a tangent at the point of evaluation and applying the same rule to the tangent.



Figure 1. Isoelastic Demand

Economics posits that a monopolist adjusts price or quantity to achieve the maximum profit. It does not matter whether the monopolist sets price or quantity (since one determines the other through the demand curve), and quantity is used as the choice variable in the present discussion. A decrease in output cannot increase a monopolist's cost, but if demand is inelastic, it does increase a monopolist's revenue and, hence, increases its profit as well. It follows that a monopolist will always restrict output enough so that it operates in the elastic region of its demand curve. Quantity will be decreased to the point at which an incremental decrease in output decreases revenue by just as much as it decreases cost. In economic terminology, profit is maximized at the point at which *marginal revenue equals marginal cost*.

Denoting the elasticity of demand by ϵ and the price by p , marginal revenue can be expressed¹⁸ as $p(1 - 1/\epsilon)$. The condition for profit

¹⁸ One way to see this is to consider the effect on revenue of a small quantity increase. Increasing quantity by Δq would entail reducing price by the corresponding Δp . The effect on revenue of the quantity increase alone is $p\Delta q$, while the effect of the price change

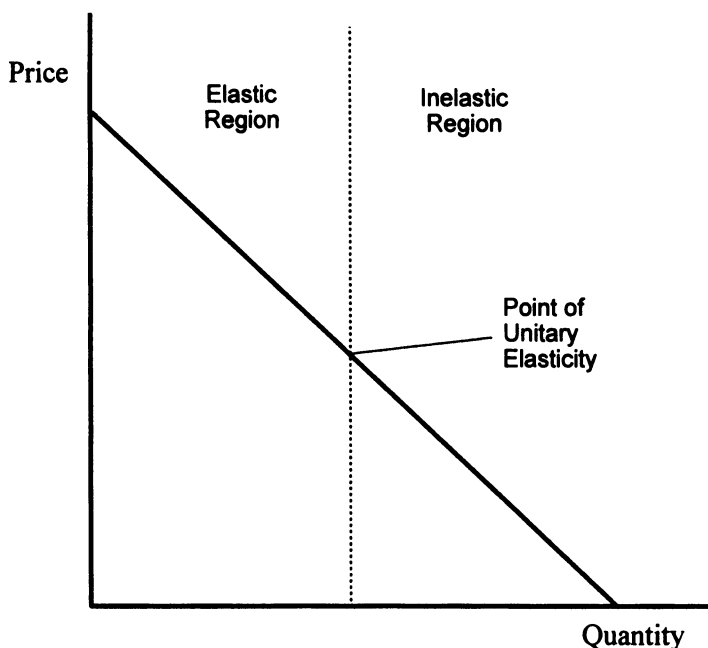


Figure 2. Linear Demand

maximization by a monopolist is that marginal revenue equals marginal cost. Denoting marginal cost by c , using $p(1 - 1/\epsilon)$ for marginal revenue, and rearranging terms, yields

$$\frac{p - c}{p} = \frac{1}{\epsilon}.$$

This is the form in which the condition for profit maximization by a monopolist is most commonly written in economics. It indicates that the proportionate amount by which the monopolist raises price above marginal cost—called its *price-cost margin*—is determined by the elasticity of the demand curve the monopolist faces. It is essential to understand that in this condition, the elasticity of demand is not independent of the price, and the relevant elasticity is that at the monopoly price.

The foregoing result for monopoly generalizes to the case of the *dominant firm*, which takes as given the competitive supply by smaller

alone is $q\Delta p$. Marginal revenue is the change in revenue divided by the change in quantity that brought it about. Adding the two components (if Δq is very small, $\Delta p\Delta q$ can be neglected as too small to matter) and dividing by Δq , yields $(p\Delta q + q\Delta p)/\Delta q$, which equals $p[1 + (\Delta p/\Delta q)(q/p)]$, which is $p(1 - 1/\epsilon)$.

rivals (termed the “competitive fringe”) that produce the same product. The dominant firm is a monopolist with respect to the portion of industry demand that remains when the supply of the competitive fringe at each price is subtracted. The demand curve faced by the dominant firm is termed a *residual demand curve* because it is the result of this subtraction. The profit-maximization condition for the dominant firm is precisely the same as that for a monopolist, provided that the elasticity of demand in the condition is understood to be that faced by the dominant firm.¹⁹

The competitive firm maximizes profit just as the monopolist, but it faces a different demand curve. The competitive firm is a price taker; it can sell at the market price all it can produce, but it cannot affect that price by changing its output. Thus, the competitive firm faces an infinitely elastic demand curve throughout the relevant range, i.e., a demand curve that is a horizontal line. Put another way, the marginal revenue for the competitive firm is just the market price. The condition for profit maximization is that marginal revenue—price—equals marginal cost. Consequently, the competitive price is marginal cost.

The competitive firm is the benchmark used by economics to define market power. A firm lacks market power if it faces an infinitely elastic demand curve, and a firm possesses market power if it faces a downward sloping demand curve. An essentially equivalent definition is that a firm possesses market power if its profit-maximizing price is above the competitive level. Prominent statements in the antitrust context adopting the economic usage of the term “market power” are:

Market power is the ability to raise price by restricting output.²⁰

Market power to a seller is the ability profitably to maintain prices above competitive levels for a significant period of time.²¹

The term “market power” refers to the ability of a firm (or group of firms, acting jointly) to raise price above the competitive level without losing so many sales so rapidly that the price increase is unprofitable and must be rescinded.²²

These definitions, however, may fail to convey the central fact that market power in the economic sense is entirely a creature of demand.²³ Conse-

¹⁹ For a detailed discussion of the determinants of the elasticity of the dominant firm’s demand, see 2A PHILLIP E. AREEDA ET AL., *ANTITRUST LAW* 138–42 (1995); William Landes & Richard A. Posner, *Market Power in Antitrust Cases*, 94 HARV. L. REV. 937, 944–47, 985–86 (1981).

²⁰ AREEDA ET AL., *supra* note 19, at 86.

²¹ U.S. Department of Justice and Federal Trade Commission, *Horizontal Merger Guidelines* § 0.1 (1992), *reprinted in* 4 Trade Reg. Rep. (CCH) ¶ 13,104.

²² Landes & Posner, *supra* note 19, at 937.

²³ This is a slight overstatement in the case of the dominant firm, for which market power depends on the supply of the competitive fringe. Still, it is only the residual demand curve faced by the dominant firm that determines its market power.

quently, gauging the demand conditions faced by a firm is the only possible way of assessing its market power. Moreover, economists fully subscribe to the ancient proverb "*de gustibus non est disputandum*" (there is no accounting for tastes).²⁴ Market power exists at the whim of consumer preferences, so assessing a firm's market power requires either understanding consumer preferences, which often is quite difficult, or directly measuring demand.

The economic definition of market power means, of course, that the possession of market power is the rule rather than the exception; the vast majority of firms have at least a little market power. In particular, every seller of a product that is differentiated with respect to any relevant dimension almost certainly has some market power. This includes, for example, the corner convenience store, which is spatially differentiated from rivals. Even if rivals are only a few blocks away, a small increase in price above the competitive level would not be likely to induce all customers to go elsewhere.

Although the concept of market power applies to firms other than monopolists, Marshall's analysis of demand did not. Except for the case of monopoly, when the industry demand curve is the demand curve of the monopolist, Marshall did not consider the demand curve faced by an individual firm with market power. In the early 1930s, Edward Chamberlin and Joan Robinson independently published treatises concerning competition among sellers of differentiated products, and they introduced the notion of the demand curve faced by the firm.²⁵

Sellers of differentiated products are most commonly assumed by economists to engage in *Bertrand competition*.²⁶ Firms engaged in Bertrand competition choose prices non-cooperatively to maximize their profits. The equilibrium with Bertrand competition is a set of prices such that each firm cannot, by changing its price, increase its own profits, given its rivals' prices.²⁷ Because rivals' prices are, in effect, held constant in this equilibrium concept, the condition for profit maximization is again the same as that for a monopolist, again with the demand elasticity being that for the firm.

²⁴ JOHN SIMPSON, *THE CONCISE OXFORD DICTIONARY OF PROVERBS* 1 (2d ed. 1992).

²⁵ EDWARD H. CHAMBERLIN, *THE THEORY OF MONOPOLISTIC COMPETITION* 68–70 (7th ed. 1956) (1933); JOAN ROBINSON, *THE ECONOMICS OF IMPERFECT COMPETITION* 21 (2d ed. 1969) (1933).

²⁶ It is named after Joseph Louis François Bertrand, who postulated it in his 1883 review of Cournot's 1838 book (see *COURNOT*, *supra* note 6). A modern translation of that review by James W. Friedman appears in *COURNOT OLIGOPOLY* 73 (Andrew F. Daugherty ed., 1988).

²⁷ Formally, this is termed a Nash, non-cooperative equilibrium to the one-shot, price-setting game. This equilibrium concept was pioneered by mathematician John F. Nash,

Since market power is a matter of degree, the problem of measuring the degree of market power immediately presents itself. Building directly on the work of Chamberlin and Robinson, Abba Lerner²⁸ proposed to measure the “degree of monopoly power” by

$$\frac{p - c}{p}.$$

Above, this expression was termed the price-cost margin, but it has also come to be known as the Lerner Index. Since the Lerner Index is on the left-hand side of the profit-maximization condition for the monopolist, dominant firm, and differentiated Bertrand competitor, it follows that the degree of market power is closely related to the elasticity of demand faced by the firm.

The discussion thus far has neglected the time frame of the analysis. Conventional microeconomic models, such as the model of the competitive firm and the monopolist, are concerned with price determination in the short run. In the short run, a significant portion of total costs typically are *fixed*, in that they do not vary with output. Only *variable* costs, which vary with output, are part of marginal cost, so fixed costs do not affect the short-run profit-maximization condition. In all of the analysis above, the relevant marginal cost is that in the short run.

The long run is defined as a period sufficiently long that all costs are variable. The long run, therefore, is like *Annie's* “tomorrow,” except it is much more than just a day away. The short run is far more important in antitrust law than the long run, but there is a great gulf between the two that is also of concern in antitrust. In this “intermediate run,” some costs that are fixed in the short run are variable and affect prices.

Because short-run marginal cost is implicit in the definition of market power, the possession of market power is not sufficient to assure that a firm will recover its total costs (including a competitive return on investment), much less that it will reap excessive profits. Consequently, market power may not be of antitrust significance unless present in a degree sufficient to allow a firm to earn more than just a competitive return on investment, i.e., to earn monopoly profits.²⁹ This suggests a definition for “monopoly power,” a term not conventionally used or defined in economics. *Monopoly power* can be defined as a degree of

who shared the 1994 Nobel Memorial Prize in Economics for this and other work in game theory.

²⁸ Abba P. Lerner, *The Concept of Monopoly and the Measurement of Monopoly Power*, 1 REV. ECON. STUD. 157, 169 (1934).

²⁹ See AREEDA ET AL., *supra* note 19, at 122–27; George A. Hay, *Market Power in Antitrust*, 60 ANTITRUST L.J. 807, 814 (1992); Richard Schmalensee, *On the Use of Economic Models in Antitrust: The Realemon Case*, 127 U. PA. L. REV. 994, 1107–09 (1979).

market power sufficient to cause a profit-maximizing firm to price in excess of long-run marginal cost. The measure of monopoly power is also the Lerner Index, but with long-run marginal cost used in place of short-run marginal cost. While not conventional in antitrust law or economics, this treatment is consistent with the convention in antitrust law that monopoly power is "a high degree of market power."³⁰

C. MARKET POWER IN ANTITRUST LAW

Antitrust case law has used the term "market power" in its economic sense since Justice Black's opinion in *Fortner*: "Market power is usually stated to be the ability of a single seller to raise price and restrict output, for reduced output is the almost inevitable result of higher prices."³¹ The practice was continued in Justice Stevens's opinions in *Jefferson Parish*—"As an economic matter, market power exists whenever prices can be raised above levels that would be charged in a competitive market."³²—and *NCAA*—"Market power is the ability to raise prices above those that would be charged in a competitive market."³³ *NCAA* is especially significant because it was the first case not involving tying to use the economic definition of market power. In the recent *Kodak* case, the Court defined market power as "the ability of a single seller to raise price and restrict output,"³⁴ and in *Brooke Group* it applied, but did not specifically state, the economic definition of market power.³⁵ The courts of appeals have widely used the economic definition of market power.³⁶

³⁰ Landes & Posner, *supra* note 19, at 937.

³¹ *Fortner Enters. v. United States Steel Corp.*, 394 U.S. 495, 503 (1969).

³² *Jefferson Parish Hosp. Dist. No. 2 v. Hyde*, 466 U.S. 2, 27 n.46 (1984) (citing *United States Steel Corp. v. Fortner Enters.*, 429 U.S. 610, 620 (1977); *Fortner Enters. v. United States Steel Corp.*, 394 U.S. 495, 503–04 (1969)).

³³ *NCAA v. Board of Regents of the Univ. of Okla.*, 468 U.S. 85, 109 n.38 (1984). For this definition, Justice Stevens cited his opinion in *Hyde*, the second *Fortner* case (see *supra* note 32), and *Cellophane* (see *infra* text accompanying note 37).

³⁴ *Eastman Kodak Co. v. Image Technical Servs., Inc.*, 504 U.S. 451, 464 (1992).

³⁵ See *Brooke Group Ltd. v. Brown & Williamson Tobacco Corp.*, 509 U.S. 209, 235 (1993) (referring to the ability "to exert market power" by raising "prices above a competitive level").

³⁶ This is especially true of the Seventh Circuit. See, e.g., *United States v. Rockford Mem'l Hosp. Corp.*, 898 F.2d 1278, 1283 (7th Cir. 1990) (Posner, J.) (market power is the ability "to increase price above the competitive level without losing so much business to other suppliers as to make the price increase unprofitable"); *Wilk v. American Med. Ass'n*, 895 F.2d 352, 359 (7th Cir. 1990) ("Market power is the ability to raise prices above the competitive level by restricting output."); *Flip Side Prods. Inc. v. Jam Prods. Ltd.*, 843 F.2d 1024, 1032 (7th Cir. 1988) (market power is the "power to raise prices significantly above the competitive level without losing all of one's business"); *Ball Mem'l Hosp., Inc. v. Mutual Hosp. Ins., Inc.*, 784 F.2d 1325, 1335 (7th Cir. 1986) (Easterbrook, J.) (market power is "the ability to raise price significantly higher than the competitive level by restricting output").

It is also true of the First, Third, and Fourth Circuits. See *Coastal Fuels of P.R., Inc. v.*

Antitrust case law more commonly uses the term "monopoly power." The precise distinction between "market power" and "monopoly power" requires an extended discussion, but the one critical point is that the courts use the term "monopoly power" in a manner compatible with the economic concept of "market power."

"Monopoly power" was first used as a defined term by the Supreme Court in the *Cellophane* case. The Court defined it as "the power to control prices or exclude competition."³⁷ Although the "power to control prices" clearly invokes the economic concept of market power, the phrase "or exclude competition" has been something of a puzzle to economists

Caribbean Petroleum Corp., 79 F.3d 182, 196 (1st Cir.) (market power is the power "to raise price by restricting output"), *cert. denied*, 117 S. Ct. 294 (1996); Grappone, Inc. v. Subaru of New England, Inc., 858 F.2d 792, 794 (1st Cir. 1988) (Breyer, J.) (market power is the power to "raise [] [price] above the levels that would be charged in a competitive market"); Orson, Inc. v. Miramax Film Corp., 79 F.3d 1358, 1367 (3d Cir. 1996) (market power is "the ability to raise prices above those that would prevail in a competitive market"); United States v. Brown Univ., 5 F.3d 658, 668 (3d Cir. 1993) (market power is "the ability to raise prices above those that would prevail in a competitive market"); Murrow Furniture Galleries, Inc. v. Thomasville Furniture Indus., Inc., 889 F.2d 524, 528 n.8 (4th Cir. 1989) ("Market power is the ability to raise prices above the levels that would be charged in a competitive market."); Consul, Ltd. v. Transco Energy Co., 805 F.2d 490, 495 (4th Cir. 1986) (market power is "the ability to raise prices above levels that would exist in a perfectly competitive market").

The remaining regional courts of appeals have invoked the economic definition of market power at least once. See *K.M.B. Warehouse Distribs., Inc. v. Walker Mfg. Co.*, 61 F.3d 123, 129 (2d Cir. 1995) (market power is "the ability to raise price significantly above the competitive level without losing all of one's business"); *Muenster Butane, Inc. v. The Steward Co.*, 651 F.2d 292, 298 (5th Cir. 1981) ("[I]f a firm lacks market power, it cannot affect the price of its product"); *PSI Repair Servs., Inc. v. Honeywell, Inc.*, 104 F.3d 811, 817 (6th Cir.) (market power is "the ability of a single seller to raise price and restrict output"), *cert. denied*, 117 S. Ct. 2434 (1997); *Ryko Mfg. Co. v. Eden Servs.*, 823 F.2d 1215, 1232 (8th Cir. 1987) ("Market power generally is defined as the power of a firm to restrict output and thereby increase the selling price of its goods in the market."); *Rebel Oil Co. v. Atlantic Richfield Co.*, 51 F.3d 1421, 1441 (9th Cir. 1995) ("[t]he ability to control output and prices [is] the essence of market power"); *Drinkwine v. Federated Publications, Inc.*, 780 F.2d 735, 738 n.3 (9th Cir. 1986) ("Market power exists whenever prices can be raised above the competitive market levels."); *SCFC ILC, Inc. v. VISA USA, Inc.*, 36 F.3d 958, 965 (10th Cir. 1994) ("market power is the ability to raise price by restricting output"); *Westman Comm'n Co. v. Hobart Int'l, Inc.*, 796 F.2d 1216, 1225 (10th Cir. 1986) ("Market power is the ability to raise prices above those that would be charged in a competitive market."); *Graphic Prods. Distribs., Inc. v. Itek Corp.*, 717 F.2d 1560, 1570 (11th Cir. 1983) ("Market power is the ability to raise price significantly above the competitive level without losing all of one's business."); *Superior Ct. Trial Lawyers Ass'n v. FTC*, 856 F.2d 226, 249 (D.C. Cir. 1988) (market power is "the ability profitability to raise price"), *aff'd in part, rev'd in part and remanded*, 493 U.S. 411 (1990).

³⁷ *United States v. E.I. du Pont de Nemours & Co.*, 351 U.S. 377, 391 (1956). See also *id.* at 393 ("control of price or competition establishes the existence of monopoly power"). The Court reiterated this definition in *United States v. Grinnell Corp.*, 384 U.S. 563, 571 (1966), which is often cited in preference to *Cellophane*. Since *Grinnell*, the Court restated this definition in *Eastman Kodak Co. v. Image Technical Servs., Inc.*, 504 U.S. 451, 481 (1992); and in *Aspen Skiing Co. v. Aspen Highlands Skiing Corp.*, 472 U.S. 585, 596 n.20 (1985).

because it does not appear to define a kind of economic power.³⁸ The *Cellophane* Court most likely added the latter phrase in an awkward attempt to make the point that monopoly power is something that could be used either to control prices or to exclude competitors.³⁹ Thus, the definition should be read to state two alternative ways of exercising monopoly power, rather than two alternative sources of monopoly power.⁴⁰

Indications that the Court intended a single test for monopoly power are found in the balance of the paragraph containing the definition. In elaborating the definition in context, the Court explained: "Price and competition are so intertwined that a discussion of theory must treat them as one. It is inconceivable that price could be controlled without power over competition or vice versa."⁴¹ The Court also indicated that the only issue for the trial court was the effect of "competition from other wrappings."⁴² Moreover, later in the opinion the Court omitted "exclude competition" in explaining that "monopoly power over cellophane" is "power over its price in relation to or competition with other commodities."⁴³ The Court did make separate findings that du Pont neither had "monopoly power over prices"⁴⁴ nor "possess[ed] power to exclude" any of its flexible packaging competitors,⁴⁵ but that does not imply that two alternative tests were applied.

Forerunners of the *Cellophane* definition during the preceding decade or so provide further indications of the Court's intention.⁴⁶ A good place

³⁸ See, e.g., Hay, *supra* note 29, at 819–20 (1992); Landes & Posner, *supra* note 19, at 977.

³⁹ While many other commentators may share this view, it was most clearly expressed by Thomas G. Krattenmaker et al., *Monopoly Power and Market Power in Antitrust Law*, 76 GEO. L. REV. 241, 248 (1987).

⁴⁰ In his famous article written immediately after the case was decided, the late Donald F. Turner indicated that the Court did not intend two alternative definitions. *Antitrust Policy and the Cellophane Case*, 70 HARV. L. REV. 281, 288 (1956) ("[M]onopoly power is the power to vary one's price within a substantial margin—a choice of profitable alternatives—and, correspondingly, the power to exclude competition entirely or to a substantial extent when it is desired to do so."). A more recent and clearer statement of the point was made by Richard G. Price, Note, *Market Power and Monopoly Power in Antitrust Analysis*, 75 CORNELL L. REV. 190, 202–03 (1989).

⁴¹ *Cellophane*, 351 U.S. at 392.

⁴² *Id.*

⁴³ *Id.* at 393–94.

⁴⁴ *Id.* at 401.

⁴⁵ *Id.* at 403.

⁴⁶ Authorities cited by the Court (*see id.* at 391 n.18), listed in the order cited and noting the most likely relevance, are: *Apex Hosiery Co. v. Leader*, 310 U.S. 469, 510 (1940) (indicating that "effect on price" is the hallmark of a restraint of trade); *Standard Oil Co. v. United States*, 221 U.S. 1, 58 (1911) (indicating that "the dread of enhancement of prices and of other wrongs" motivated the Sherman Act); Arthur H. Cole, *Twentieth-*

to start is Learned Hand's 1945 *Alcoa* opinion, in which he referred to both the "power to monopolize" and the "power to fix prices."⁴⁷ In its 1946 *American Tobacco* opinion, the Supreme Court held that "the material consideration in determining whether a monopoly exists is . . . that power exists to raise prices or to exclude competition when it is desired to do so."⁴⁸ This formulation is very close to that of *Cellophane*, except for the use of the word "raise" and the fact that this phrasing does not explicitly use and define the term "monopoly power."

Coming very close to explicitly defining the term "monopoly power" was the 1950 district court opinion on remand in *Alcoa*: "In considering the matter of monopoly power, two ingredients are of outstanding significance; viz, the power to fix prices and the power to exclude competitors."⁴⁹ By using the word "power" twice, this formulation seems to refer to two different types of power, rather than one type of power capable of exercise in two ways. A 1953 article by law professor Phil Neal, however, seems to have intended the latter. Relying on Judge Hand's opinion in *Alcoa* and on *American Tobacco*, he argued that "[u]nder the Sherman Act, the meaning of the term 'monopoly' has come to approximate the concept in economics. In this sense monopoly means an excessive degree of market control, whether viewed in terms of power to fix prices or power to exclude rivals from the market or both."⁵⁰

The district court opinion in *Cellophane* was issued later in 1953. It began with a discussion of the relevant economic thinking, and there can be little doubt that the court intended to be guided by economics.⁵¹ When it came time to define "monopoly power," the court explicitly relied only on *American Tobacco*, and that term was defined as the power

Century Entrepreneurship in the United States and Economic Growth, 44 AM. ECON. REV. (PAPERS & PROC.) 35, 61 (1954) (using the term "market power"); CLAIR WILCOX, COMPETITION AND MONOPOLY IN AMERICAN INDUSTRY 9 (TNEC Monograph No. 21, 1940) ("Monopoly power is the monopolist's ability to augment his profit either by fixing the price at which he will sell and thus, indirectly, the quantity that will be sold, or by fixing the quantity that he will sell and thus, indirectly, the price at which it will be sold."); Louis B. Schwartz, *The Schwartz Dissent*, 1 ANTITRUST BULL. 37, 39 (1955) (referring to a "monopoly" "extracting from the public more than a competitive price"); REPORT OF THE ATTORNEY GENERAL'S NATIONAL COMMITTEE TO STUDY THE ANTITRUST LAWS 43 (1955) (Stanley N. Barnes & S. Chesterfield Oppenheim, co-chairs) (indicating that "monopoly power" exists when there is "control over the market price").

⁴⁷ *United States v. Aluminum Co. of Am.*, 148 F.2d 416, 428, 432 (2d Cir. 1945).

⁴⁸ *American Tobacco Co. v. United States*, 328 U.S. 781, 811 (1946).

⁴⁹ *United States v. Aluminum Co. of Am.*, 91 F. Supp. 333, 342 (S.D.N.Y. 1950).

⁵⁰ Phil C. Neal, *The Clayton Act and the Transamerica Case*, 5 STAN. L. REV. 179, 213-14 (1953) (footnotes omitted).

⁵¹ See *United States v. E.I. du Pont de Nemours & Co.*, 118 F. Supp. 41, 48-53 (D. Del. 1953).

to “arbitrarily raise prices and to exclude competition.”⁵² The court correctly recognized that power over price was a matter of degree and held that the “[p]rohibited degree of control is that which permits disregard for competitive factors.”⁵³

In 1955 economists George Stocking and Willard Mueller severely criticized the district court for failing to recognize the fact of, and significance of, du Pont’s supracompetitive pricing.⁵⁴ The court, they argued, stumbled badly in formulating “the test of monopoly” as the power to “arbitrarily raise price.” Their preferred phrasing was “the power to exclude competition and the power to *control* prices.”⁵⁵ Although the *Cellophane* Court clearly borrowed the phrase “control price” from Stocking and Mueller, it did not adopt their reasoning associated with the phrase.

There is now a consensus that the Court erred in that regard.⁵⁶ The Court’s error, commonly termed the “*Cellophane* fallacy,”⁵⁷ was mistaking competition created by the exercise of market power for competition that can prevent the exercise of market power. As a firm with market power raises price above competitive levels, there is a strong tendency for demand to become more elastic as other products become better substitutes at the margin. A firm fully exercising its substantial market power is necessarily constrained by competition from further raising price. As Learned Hand explained in *Alcoa*, “substitutes are available for almost all commodities, and to raise price is enough to evoke them.”⁵⁸

A modern interpretation of *Cellophane*’s definition of “monopoly power” holds that it has two *conjunctive* conditions: The “power to control prices” defines “market power” in the economic sense, and the “power to exclude competitors” is an added condition distinguishing “monopoly power.” This most plausibly was the intent behind the conjunctive formulation of the definition by the district court in *Cellophane* and by Stocking

⁵² *Id.* at 195. The court discussed at length du Pont’s inability to exclude competitors. *See, e.g., id.* at 126, 181, 209–13.

⁵³ *Id.* at 196.

⁵⁴ George W. Stocking & Willard F. Mueller, *The Cellophane Case and the New Competition*, 45 AM. ECON. REV. 29 (1955).

⁵⁵ *Id.* at 54.

⁵⁶ This is evident from leading treatises: AREEDA ET AL., *supra* note 19, at 208–09 & n.6; HERBERT HOVENKAMP, *FEDERAL ANTITRUST POLICY* 99–101 (1994); RICHARD A. POSNER & FRANK H. EASTERBROOK, *ANTITRUST* 360–62 (2d ed. 1981); LAWRENCE A. SULLIVAN, *HANDBOOK OF THE LAW OF ANTITRUST* 53–58 (1977).

⁵⁷ *See, e.g.,* Gene C. Schaerr, Note, *The Cellophane Fallacy and the Justice Department’s Guidelines for Horizontal Mergers*, 94 YALE L.J. 670 (1985).

⁵⁸ 148 F.2d at 426.

and Mueller. Reasoning that monopoly power requires both elements, the Tenth Circuit has actually reformulated the *Cellophane* definition by replacing the Court's "or" with "and."⁵⁹ Professor Areeda has argued that market power becomes an antitrust concern only when it is "both substantial in magnitude and durable"⁶⁰ and that the two parts of the *Cellophane* test should be interpreted as relating to magnitude and durability.⁶¹ Professor Areeda, therefore, also reads the word "and" into the *Cellophane* definition.

Circuit courts have commonly distinguished "market power" from "monopoly power" as a matter of degree,⁶² and the Supreme Court has used the two terms in essentially this manner.⁶³ Commentators have argued that durability is an important sense in which monopoly power is a high degree of market power.⁶⁴ This, of course, is consistent with

⁵⁹ See *Shoppin' Bag of Pueblo, Inc. v. Dillon Cos.*, 783 F.2d 159, 164 (10th Cir. 1986) ("While the concepts of price and competition are closely connected, it is conceivable that if a company has obtained control over prices that it still may not have the power to exclude other competitors from the market. . . . It seems that in most instances a true evaluation of market power will not ultimately be possible without substantial data presented on both elements. We hold, therefore, that monopoly power is correctly defined in this circuit as the ability to control prices and exclude competition."). The Tenth Circuit most recently reiterated its stance in *Biswell Stores Inc. v. Indian Nations Communications of Cushing Inc.*, 1996-2 Trade Cas. ¶ 71,578, at 78,103 (10th Cir. Oct. 3, 1996).

The Tenth Circuit also held: "The *Cellophane* opinion holds that du Pont had power to control prices in cellophane but that the company lacked the power to exclude competition from the relevant market. Therefore, du Pont was not found to possess the requisite market power even though it possessed one of the elements." *Shoppin' Bag*, 783 F.2d at 163. This reading of *Cellophane*, however, conflicts with important language in the opinion (see *supra* text accompanying notes 41-43).

⁶⁰ See AREEDA ET AL., *supra* note 19, at 86. They use only the term "market power" in this discussion, but a sound basis for distinguishing monopoly power from market power is with respect to both its magnitude and durability.

⁶¹ *Id.* at 87.

⁶² See, e.g., *Reazin v. Blue Cross and Blue Shield of Kan., Inc.*, 899 F.2d 951, 966 (10th Cir. 1990) ("Market and monopoly power only differ in degree—monopoly power is commonly thought of as 'substantial' market power."); *Bacchus Indus., Inc. v. Arvin Indus., Inc.*, 939 F.2d 887, 894 (10th Cir. 1991) ("Monopoly power is also commonly thought of as substantial market power."); *Deauville Corp. v. Federated Dep't Stores Inc.*, 756 F.2d 1183, 1192 n.6 (5th Cir. 1985) (monopoly power is an "extreme degree of market power"); see also *Levine v. Central Fla. Med. Assocs.*, 72 F.3d 1538, 1555 (11th Cir. 1995) ("Monopoly power under § 2 requires, of course, something greater than market power under § 1."), *cert. denied*, 117 S. Ct. 75 (1996). On the other hand, a few cases explicitly state that the terms have the same meaning. See, e.g., *U.S. Anchor Mfg., Inc. v. Rule Indus., Inc.*, 7 F.3d 986, 994 n.12 (11th Cir. 1993); *International Dist. Centers, Inc. v. Walsh Trucking Co., Inc.*, 812 F.2d 786, 791 n.3 (2d Cir. 1987).

⁶³ "Monopoly power under § 2 requires, of course, something greater than market power under § 1." *Eastman Kodak Co. v. Image Technical Servs., Inc.*, 504 U.S. 451, 481 (1992).

⁶⁴ See George A. Hay, *Market Power in Antitrust*, 60 ANTITRUST L.J. 807, 819 (1992); Richard Schmalensee, *Another Look at Market Power*, 95 HARV. L. REV. 1789, 1795 (1982); Schmalensee, *supra* note 29, at 1107-09.

Professor Areeda's analysis, which does not draw a distinction between market power and monopoly power. The case law does not explicitly distinguish market and monopoly power on the basis of durability, but it does stress the importance of the durability of market power under the rubric of entry conditions or "barriers to entry."⁶⁵

The Supreme Court twice remarked: "[W]ithout barriers to entry into the market it would presumably be impossible to maintain supracompetitive prices for an extended time."⁶⁶ The Court recently indicated that summary judgment may be appropriate when "new entry is easy."⁶⁷ Lower courts now commonly invoke easy entry to dispose of cases involving allegations of monopoly power.⁶⁸ The rationale was explained by the Ninth Circuit: "If there are no significant barriers to entry . . . eliminating

⁶⁵ In the classic work on entry, Joe Bain approached the issue from a long-run perspective, arguing that the "conditions of entry" should be "evaluated roughly by the advantages of established sellers in an industry over potential entrants, these advantages being reflected in the extent to which established sellers can persistently raise their prices above a competitive level without attracting new firms to enter the industry." JOE S. BAIN, *BARRIERS TO NEW COMPETITION* 3, 6–7, 10–11, 17 (1956). George Stigler also approached entry from a long-run perspective, defining: "A barrier to entry . . . as a cost of producing . . . which must be borne by a firm which seeks to enter an industry but is not borne by firms already in the industry." GEORGE J. STIGLER, *THE ORGANIZATION OF INDUSTRY* 67 (1968). Many economists have followed Stigler, defining a "barrier to entry" in terms of differential costs for potential entrants and incumbents.

⁶⁶ *Cargill, Inc. v. Monfort of Colo., Inc.*, 479 U.S. 104, 119–20 n.15 (1986); *Matsushita Elec. Indus. Co. v. Zenith Radio Corp.*, 475 U.S. 574, 591 n.15 (1986). This statement is not correct if the Stiglerian definition of "barriers to entry" (see *supra* note 65) is used. See AREEDA ET AL., *supra* note 19, at 61; see also Gregory J. Werden & Luke M. Froeb, *The Entry Inducing Effects of Horizontal Mergers*, J. INDUS. ECON. (forthcoming) (showing that anticompetitive mergers plausibly would not induce entry when entry is free in the Stiglerian sense). Yet the Ninth Circuit has held: "The disadvantage of new entrants as compared to incumbents is the hallmark of an entry barrier." *Los Angeles Land Co. v. Brunswick Corp.*, 6 F.3d 1422, 1428 (9th Cir. 1993). (The court may have backed away from its Stiglerian position when it later held that entry barriers include any "factors in the market that deter entry while permitting incumbent firms to earn monopoly returns." *American Prof'l Testing Serv., Inc. v. Harcourt Brace Jovanovich Legal and Prof'l Publications, Inc.*, 108 F.3d 1147, 1154 (9th Cir. 1997).) The court in *Los Angeles Land Co.* added that the "main sources of entry barriers are: (1) legal license; (2) control over an essential or superior resource; (3) entrenched buyer preferences for established brands or company reputations; and (4) capital market evaluations imposing higher capital costs on new entrants." 6 F.3d at 1427 n.4; see also *Rebel Oil Co., v. Atlantic Richfield Co.*, 51 F.3d 1421, 1439 (9th Cir. 1995); *American Prof'l Testing Serv.*, 108 F.3d at 1154.

⁶⁷ *Brooke Group Ltd. v. Brown & William Tobacco Corp.*, 509 U.S. 209, 226 (1993).

⁶⁸ See, e.g., *American Prof'l Testing Servs., Inc. v. Harcourt Brace Jovanovich Legal and Prof'l Publications, Inc.*, 108 F.3d 1147, 1154 (9th Cir. 1997) (affirming judgment as a matter of law); *Dial A Car, Inc. v. Transportation, Inc.*, 82 F.3d 484, 487–88 (D.C. Cir. 1996) (affirming dismissal); *Advo, Inc. v. Philadelphia Newspapers, Inc.*, 51 F.3d 1191, 1200 (3d Cir. 1995) (affirming summary judgment); *Los Angeles Land Co. v. Brunswick Corp.*, 6 F.3d 1422, 1425–29 (9th Cir. 1993) (reversing denial of motion for judgment notwithstanding verdict); *American Academy Suppliers, Inc. v. Beckley-Cardy Inc.*, 922 F.2d 1317, 1319 (7th Cir. 1991) (affirming summary judgment).

competitors will not enable the survivors to reap a monopoly profit: any attempt to raise prices above the competitive level will lure into the market new competitors able and willing to offer their commercial goods or personal services for less."⁶⁹ Lower courts also have explicitly related entry conditions to the durability of market power⁷⁰ and held that a high market share is not evidence of monopoly power when entry is easy.⁷¹ In merger litigation, the degree of market power created by a merger is the central issue, and entry has been an important aspect of this issue.⁷²

D. ASSESSING MARKET POWER BY ESTIMATING A FIRM'S OWN ELASTICITY OF DEMAND

To prove or disprove market power, economists now commonly estimate demand elasticities, and recent cases suggest that courts will rely on such evidence. The Supreme Court recently noted that "[w]hat constrains [a] defendant's ability to raise prices . . . is 'the elasticity of demand faced by the defendant—the degree to which its sales fall . . . as its price rises.'"⁷³ While market share has long been the staple of market power analysis, three courts of appeals have held: "Market share is just a way of estimating market power, which is the ultimate consideration. When there are better ways to estimate market power, the court

⁶⁹ *United States v. Syufy Enters.*, 903 F.2d 659, 664 (9th Cir. 1990).

⁷⁰ *Rebel Oil Co. v. Atlantic Richfield Co.*, 51 F.3d 1421, 1439 (9th Cir. 1995) ("To justify a finding that a defendant has the power to control prices, entry barriers must be significant—they must be capable of constraining the normal operation of the market to the extent that the problem is unlikely to be self-correcting."); *Reazin v. Blue Cross & Blue Shield of Kan.*, 899 F.2d 951, 968 (10th Cir. 1990) ("market power, to be meaningful for antitrust purposes, must be durable") (dictum); *Colorado Interstate Gas Co. v. Natural Gas Pipeline Co.*, 885 F.2d 683, 695–96 (10th Cir. 1989) ("If the evidence demonstrates that a firm's ability to charge monopoly prices will necessarily be temporary, the firm will not possess the degree of market power required for the monopolization offense.").

⁷¹ See, e.g., *Oahu Gas Serv., Inc. v. Pacific Resources Inc.*, 838 F.2d 360, 366 (9th Cir. 1988); *Ryko Mfg. Co. v. Eden Servs.*, 823 F.2d 1215, 1232 (8th Cir. 1987); *Ball Mem'l Hosp., Inc. v. Mutual Hosp. Ins.*, 784 F.2d 1325, 1336 (7th Cir. 1986).

⁷² The 1992 Horizontal Merger Guidelines issued by the U.S. Department of Justice and the Federal Trade Commission state that a "merger is not likely to create or enhance market power . . . if entry into the market is so easy that market participants, after the merger, either collectively or unilaterally could not profitably maintain a price increase above premerger levels." Horizontal Merger Guidelines, *supra* note 21, § 3.0. Similar language is found in the 1982 and 1984 Merger Guidelines promulgated by the U.S. Department of Justice. See 1982 Merger Guidelines, § II.B., *reprinted in* 4 Trade Reg. Rep. (CCH) ¶ 13,102; 1984 Merger Guidelines, § 3.3, *reprinted in* 4 Trade Reg. Rep. (CCH) ¶ 13,103. Several courts of appeals have permitted mergers on the grounds of easy entry. See *United States v. Baker Hughes Inc.*, 908 F.2d 981, 985–89 (D.C. Cir. 1990); *United States v. Syufy Enters.*, 903 F.2d 659, 664–69 (9th Cir. 1990); *United States v. Waste Mgmt., Inc.*, 743 F.2d 976, 981–84 (2d Cir. 1984).

⁷³ *Eastman Kodak Co. v. Image Technical Servs., Inc.*, 540 U.S. 451, 469 n.15 (1992) (quoting PHILLIP AREEDA & LOUIS KAPLOW, *ANTITRUST ANALYSIS* 576 (4th ed. 1988)).

should use them.”⁷⁴ The basic economic analysis above fully supports the use of estimated firm demand elasticities⁷⁵ to gauge market power,⁷⁶ but there are subtleties in the application of the theory that merit further discussion.

The economic tool for inferring the degree of a firm’s market power is a condition for short-run profit maximization that applies only to a monopolist, dominant firm, or Bertrand competitor selling a differentiated product. What all three situations have in common is that the firm does not coordinate its price or output decisions with rivals. Short-run profit maximization is a reasonable assumption in most cases, but the pursuit of longer run objectives may take precedence over short-run profit maximization. For example, prices are sometimes set below the short-run profit maximizing level to build market share, and such possibilities must be considered. The profit-maximization condition presented above also applies only for the single-product firm. This typically is not a significant limitation, and there is a more general condition that can be used instead. A common situation in which the sale of other products presents a significant issue arises when strong complements are involved, as when a firm both sells a durable good and makes aftermarket sales of parts and service. The ability to profit from aftermarket sales may lead to pricing the durable below the stand-alone, short-run profit-maximizing level.

Several things must be kept in mind when drawing inferences from estimated elasticities. First, market power is proportional to the reciprocal of the elasticity of demand, so in market power terms, the difference between demand elasticities of 4 and 3 is roughly the same as the difference between demand elasticities of 1.3 and 1.2. Second, the theoretical analysis above demonstrated that the elasticity cannot be less than 1, so an estimated elasticity of less than 2 must be considered rather low. Third, estimation cannot prove the total absence of market power, since a firm still has some market power unless its demand elasticity is infinite, and econometric methods can yield large, but not infinite, estimates. Finally, there is no direct way to gauge the degree of monopoly power;

⁷⁴ *Allen-Myland, Inc. v. IBM Corp.*, 33 F.3d 194, 209 (3d Cir. 1994); *United States v. Baker Hughes, Inc.*, 908 F.2d 981, 992 (D.C. Cir. 1990) (Thomas, J., joined by Ruth Bader Ginsburg, J.); *Ball Mem’l Hosp., Inc. v. Mutual Hosp. Ins.*, 784 F.2d 1325, 1336 (7th Cir. 1986) (Easterbrook, J.).

⁷⁵ Other methods for identifying market power using economic data are discussed by Jonathan B. Baker & Timothy F. Bresnahan, *Empirical Methods of Identifying and Measuring Market Power*, 61 ANTITRUST L.J. 3 (1992).

⁷⁶ A common practice is to infer firm elasticities of demand from accounting price-cost margins; however, difficulties in measuring price-cost margins make this problematic. See *infra* notes 109–10 and accompanying text.

a firm's measured elasticity of demand permits a reasonable inference of the extent to which it is pricing in excess of short-run marginal cost, but says nothing about pricing in relation to long-run marginal cost or about the durability of market power.

As was stressed above, the elasticity of demand normally varies as price is changed. To gauge a firm's market power, the elasticity of its demand should be measured at the price and quantity at which its market power is fully exercised. Although exercising market power normally causes a firm's elasticity of demand to be higher than it otherwise would be, that is a blessing rather than a curse. There is no *Cellophane* fallacy in using the value of the Lerner Index inferred from estimated firm elasticities of demand to measure the degree of market power. Although the *Cellophane* fallacy is real, its mythic qualities may obscure the reality. Contrary to what the *Cellophane* myth may suggest, when gauging a firm's market power by measuring its demand elasticity, it is essential—rather than problematic—that it has exercised its market power by raising price.

Further insights can be gleaned from consideration of *United States v. Eastman Kodak Co.*,⁷⁷ in which Kodak sought termination of consent decrees entered in 1921 and 1954 that continued to restrict its freedom to engage in various competitive practices. The central issue before the courts was whether Kodak continued to possess market power in color print film. “[T]here were no significant quality differences between Kodak’s film and any of its top three competitors,” but there was a strong “consumer preference” for Kodak’s film in the United States because it was “perceived to be superior to other films in the market.”⁷⁸ Kodak accounted for two-thirds to three-quarters of color print film sales in the U.S.⁷⁹

In the unusual posture of a decree termination proceeding, Kodak had the burden of proof on market power. It argued that the geographic scope of the relevant market was the entire world, and that its worldwide share was too low to support an inference of market power.⁸⁰ It also argued that direct evidence, in the form of estimated demand elasticities, proved that it did not possess market power. The court embraced this evidence, holding: “Price elasticities are better measures of market power

⁷⁷ 853 F. Supp. 1454, 1472 (W.D.N.Y. 1994), *aff’d*, 63 F.3d 95 (2d Cir. 1995). *See also* *New York v. Anheuser-Busch, Inc.*, 811 F. Supp. 848, 873 (S.D.N.Y. 1993) (citing Anheuser Busch’s high estimated elasticity of demand as proof that it did not possess significant market power).

⁷⁸ 853 F. Supp. at 1462, 1475.

⁷⁹ *Id.* at 1472. The former figure is for unit sales, while the latter is for dollar sales.

⁸⁰ The court agreed, but did not rest on this finding. *See id.* at 1467–72.

[than market shares].”⁸¹ Kodak’s evidence, introduced through expert economist Jerry Hausman, was that the “cross-elasticities between Kodak and Fuji film are high” and “if Kodak were to raise price by five percent, it would lose ten percent of sales.”⁸² The latter evidence means that Kodak’s estimated own elasticity of demand was about 2. Based on this and other evidence, Hausman testified that “Kodak does not have market power,” and the court agreed.⁸³

The court’s conclusion is curious, because the inference from an own demand elasticity of 2 is that Kodak was charging a price twice its marginal cost. By the definition of market power in both economics and law, the own elasticity evidence indicates that Kodak was exercising significant market power. Thus, on appeal the government argued that an own elasticity of demand of 2 was “strong evidence that Kodak exercise[d] market power in the United States.”⁸⁴

The court of appeals rejected the government’s argument for two reasons. The government had argued that the profit-maximization condition presented above applied because Kodak was non-cooperatively pricing a differentiated product. That the product was highly differentiated would appear to be both self-evident and strongly supported by the district court’s finding that U.S. consumers have a strong preference for Kodak film. The court of appeals, however, held that the government’s argument “rest[ed] on unwarranted factual assumptions”: “[T]he contention that Kodak film is differentiated from the film sold by its rivals is directly contradicted by the district court’s findings with respect to the elasticities of supply and demand for film.”⁸⁵ Upon reflection, the court’s analysis is wholly unpersuasive. Supply substitutability has no relation to the degree of product differentiation, and the elasticity of demand evidence at most could show that Kodak’s film is only moderately differentiated.

The court’s second and more important rationale was that “even if we were to accept the government’s contention that Kodak’s short-run marginal costs equal one-half of the product’s sales price, we do not

⁸¹ *Id.* at 1472.

⁸² *Id.* at 1473.

⁸³ *Id.*

⁸⁴ 63 F.3d 95, 108 (2d Cir. 1995).

⁸⁵ *Id.* at 109. The court specifically rejected the contention that “the strong preferences of United States customers for Kodak film demonstrates Kodak’s market power in the United States.” *Id.* at 108. The only evidence cited by the court was the own elasticity of demand for Kodak’s film. *Id.* The court’s logic is elusive, but it arguably held that there was not, in fact, a strong consumer preference for Kodak film. If so, it badly misconstrued the import of the elasticity evidence.

think that it necessarily follows that Kodak is earning monopolistic profits.”⁸⁶ This was certainly correct, and there was evidence that Kodak had substantial fixed costs, but in making this point, the court ceased asking whether Kodak possessed market power and began asking whether it possessed a great deal of market power, in particular, so much as to constitute monopoly power. Moreover, the record evidence did not reveal whether Kodak’s fixed costs accounted for all or even the lion’s share of the margin of price over cost, so the court was also improperly shifting Kodak’s burden to the government.

There are two important lessons from this case. One is that estimated firm own demand elasticities can be the most important source of evidence on market power. While this surely will not be true in every case, it can be expected to be a common occurrence. The other lesson is that courts can be expected to require far more than just a little market power, at least in monopolization cases. On the whole, the courts did not handle the elasticity of demand evidence especially well in the *Kodak* case, but that must be expected, given the novelty of the evidence to the court and the litigants, and it should not discourage future use of such evidence.

II. THE OWN ELASTICITY OF DEMAND AND MARKET DELINEATION

A. MARKET DELINEATION AND MARKET POWER

In the *Cellophane* case, the Supreme Court acknowledged the essential relationship between market delineation and market power. Immediately preceding its definition of monopoly power, the Court explained: “If cellophane is the ‘market’ that du Pont is found to dominate, it may be assumed that it does have monopoly power over that ‘market.’”⁸⁷ This remark indicates that the Court believed that the relevant market was limited to Cellophane only if significant market power could be exercised over Cellophane alone. A few sentences after defining monopoly power, the Court stated that the lower court “had to determine whether competition from the other wrappings prevented du Pont from possessing monopoly power.”⁸⁸ This statement, contained in the Court’s discussion of monopoly power, clearly alludes to the market delineation process. Finally, in its discussion of market delineation, the Court concluded an account of the relative costs of various wrappings by stating: “We cannot say that these differences in cost gave du Pont monopoly power over

⁸⁶ *Id.* at 109.

⁸⁷ 351 U.S. at 391.

⁸⁸ *Id.* at 392.

prices”⁸⁹ This statement clearly links market delineation back to the underlying market power inquiry.

The significance of this linkage for market delineation was little noted over the next two decades,⁹⁰ but by the late 1970s, it was emphasized by leading antitrust treatises. Sullivan explained:

Market definition is not a jurisdictional prerequisite, or an issue having its own significance under the statute; it is merely an aid for determining whether power exists. To define a market in product and geographic terms is to say that if prices were appreciably raised or volume appreciably curtailed for the product within a given area, while demand held constant, supply from other sources could not be expected to enter promptly enough and in large enough amounts to restore the old price or volume.⁹¹

Areeda and Turner began the market delineation section of their highly influential treatise by stating: “In economic terms a ‘market’ embraces one firm or any group of firms which, if unified by agreement or merger, would have market power in dealing with any group of buyers.”⁹²

The linkage between market delineation and market power has been explicitly stated in many modern court of appeals decisions. For example, the Eleventh Circuit held: “[T]he very purpose of defining the relevant market . . . is to determine whether a monopolist, cartel or oligopoly in that market would be able to reduce marketwide output simply by cutting its own output, and thereby raise marketwide prices above competitive levels.”⁹³ Most other circuits have made similar pronouncements.⁹⁴

⁸⁹ *Id.* at 401.

⁹⁰ This linkage was noted by economist Morris A. Adelman, Comment, *Economic Aspects of the Bethlehem Opinion*, 45 VA. L. REV. 684, 688 (1959) (“No matter how the boundaries may be drawn in terms of products or areas, there is a single test: If, within the purported market, prices were appreciably raised or volume curtailed, would supply enter in such amounts as to restore approximately the old price and output? If the answer is ‘yes,’ then there is no market, and the definition must be expanded. If the answer is ‘no,’ the market is at least not wider.”).

⁹¹ SULLIVAN, *supra* note 56, at 41.

⁹² 2 PHILLIP AREEDA & DONALD F. TURNER, ANTITRUST LAW 347 (1978).

⁹³ U.S. Anchor Mfg., Inc. v. Rule Indus., Inc., 7 F.3d 986, 995–96 (11th Cir. 1993).

⁹⁴ See *Israel Travel Advisory Serv. v. Israel Identity Tours, Inc.*, 61 F.3d 1250, 1252 (7th Cir. 1995) (“[A] market is defined to aid in identifying any ability to raise price by curtailing output.”); *Consul, Ltd. v. Transco Energy Co.*, 805 F.2d 490, 495 (4th Cir. 1986) (“The penultimate question, towards which this preliminary inquiry into market definition is directed, is whether the defendant has market power: the ability to raise prices above levels that would exist in a perfectly competitive market.”); *Weiss v. York Hosp.*, 745 F.2d 786, 826 (3d Cir. 1984) (“the purpose of market definition is to determine whether market power exists”). In addition, many courts have quoted the first sentence (or more) from the Sullivan passage quoted in the text accompanying note 91 *supra*. See, e.g., *SCFC ILC, Inc. v. VISA USA, Inc.*, 36 F.3d 958, 966 (10th Cir. 1994); *Rothery Storage & Van Co. v. Atlas Van Lines, Inc.*, 792 F.2d 210, 218 (D.C. Cir. 1986); *Satellite Television & Associated*

As indicated by the passage from Areeda and Turner, the linkage between market delineation and market power implies that, for purposes of antitrust analysis, a market is a group of products and area over which significant market power could be exercised. As stated by Areeda and Hovenkamp: "A market is any grouping of sales whose sellers, if unified by a hypothetical cartel or merger, could raise prices significantly above the competitive level."⁹⁵ As stated by the 1992 Horizontal Merger Guidelines issued by the U.S. Department of Justice and Federal Trade Commission:

A market is defined as a product or group of products and a geographic area in which a hypothetical profit-maximizing firm, not subject to price regulation, that was the only present and future producer or seller of those products in that area likely would impose at least a "small but significant and nontransitory" increase in price, assuming the terms of sale of all other products are held constant.⁹⁶

Resources, Inc. v. Continental Cablevision of Va., Inc., 714 F.2d 351, 356 (4th Cir. 1983); Home Placement Serv., Inc. v. Providence Journal Co., 682 F.2d 274, 280 (1st Cir. 1982); Dimmitt Agri Indus., Inc. v. CDC Int'l Inc., 679 F.2d 516, 526 n.7 (5th Cir. 1982).

⁹⁵ PHILLIP E. AREEDA & HERBERT HOVENKAMP, ANTITRUST LAW ¶518.1 (Supp. 1993). Courts have cited the same language from the 1987 edition of the annual supplement. See *infra* note 97 and accompanying text. After the 1993 annual supplement, the relevant material was deleted from the supplement and incorporated in the replacement volume AREEDA ET AL., *supra* note 19, at 151 ("a market can be seen as the array of producers that could control price if united in a hypothetical cartel or as a hypothetical monopoly").

⁹⁶ Horizontal Merger Guidelines, *supra* note 21, § 1.0. The Guidelines' approach to market delineation is discussed in great detail by Gregory J. Werden, *Market Delineation Under the Merger Guidelines: A Tenth Anniversary Retrospective*, 38 ANTITRUST BULL. 517 (1993) [hereinafter Werden, *Tenth Anniversary Retrospective*]; Gregory J. Werden, *Market Delineation and the Justice Department's Merger Guidelines*, 1983 DUKE L.J. 514 [hereinafter Werden, *Market Delineation*].

Perhaps the only important difference between the Areeda-Hovenkamp definition and that of the Guidelines is the benchmark price. While the Guidelines use the prevailing price, Areeda and Hovenkamp use the competitive price. Areeda and Hovenkamp use the competitive price to avoid the *Cellophane* fallacy, and the Guidelines have been criticized for making the same error as the Supreme Court. The Guidelines' use of the prevailing price, however, generally is appropriate for merger analysis, while the competitive price generally is the proper benchmark for other purposes. See Werden *Tenth Anniversary Retrospective*, *supra*, at 552-54; Gregory J. Werden, *The History of Antitrust Market Delineation*, 76 MARQ. L. REV. 123, 202-04 (1992) [hereinafter Werden, *History*].

The discussion in this section presumes that market delineation is for the purpose of merger analysis or for some other purpose such that the issue is whether proposed conduct would create market power. As a purely theoretical matter, the discussion also applies when the purpose of market delineation is to determine whether a firm already possesses significant market power, provided that the competitive price is used in place of the prevailing price as the benchmark; however, it may be impractical to follow that approach because the competitive price is not easy to determine. In any event, the analysis described in the text accompanying notes 73-77 *supra* can be used to address the market power issue directly.

Several courts of appeals have quoted or paraphrased the Areeda-Hovenkamp definition,⁹⁷ quoted from the Guidelines on market delineation, or explicitly followed the Guidelines' approach.⁹⁸

B. THE CRITICAL ELASTICITY OF DEMAND AND CRITICAL SALES LOSS⁹⁹

The Horizontal Merger Guidelines' definition of a market makes the Marshallian own elasticity of demand for a product group and area the basic determinant of whether they constitute a market.¹⁰⁰ Economic theory teaches that the profit-maximizing price for a hypothetical monopolist is determined by the elasticity of demand it faces. The Marshallian elasticity is unequivocally the relevant one as a consequence of the Guidelines' *ceteris paribus* assumption—that "the terms of sale of all other

⁹⁷ *Coastal Fuels of P.R., Inc. v. Caribbean Petroleum Corp.*, 79 F.3d 182, 197 (1st Cir.), *cert. denied*, 117 S. Ct. 294 (1996); *Rebel Oil Co. v. Atlantic Richfield Co.*, 51 F.3d 1421, 1434 (9th Cir. 1995); *Virtual Maintenance, Inc. v. Prime Computer, Inc.*, 957 F.2d 1318, 1325 (6th Cir. 1992); *H.J., Inc. v. International Tel. & Tel. Corp.*, 867 F.2d 1531, 1540 (8th Cir. 1989).

⁹⁸ The Guidelines' approach was applied in *United States v. Archer-Daniels-Midland Co.*, 866 F.2d 242 (8th Cir. 1988). Quoting the Guidelines on market delineation are *United States v. Eastman Kodak Co.*, 63 F.3d 95, 106 (2d Cir. 1995); *Olin Corp. v. FTC*, 986 F.2d 1295, 1299–300 (9th Cir. 1993). *See also* *Coastal Fuels of P.R., Inc. v. Caribbean Petroleum Corp.*, 79 F.3d 182, 198 (1st Cir.), *cert. denied*, 117 S. Ct. 294 (1996) ("The touchstone of market definition is whether a hypothetical monopolist could raise prices."). Other circuits have approvingly cited the Guidelines' approach. *See* *Superior Ct. Trial Lawyers Ass'n v. FTC*, 856 F.2d 226, 250 nn.33–34 (D.C. Cir. 1988), *aff'd in part, rev'd in part and remanded*, 493 U.S. 411 (1990); *Ball Mem'l Hosp., Inc. v. Mutual Hosp. Ins.*, 784 F.2d 1325, 1336 (7th Cir. 1986). Numerous district courts have quoted or followed the Guidelines on market delineation.

⁹⁹ The use of estimated demand elasticities in market delineation substantially predates the analysis of critical elasticities of demand. The first case of which I am aware in which a litigant explicitly relied on an estimated demand elasticity to delineate a relevant market was *United States v. Mrs. Smith's Pie Co.*, 440 F. Supp. 220 (E.D. Pa. 1976). "[T]he principal issue in this case [was] whether frozen dessert pies constitute[d] a relevant product market." *Id.* at 226. In support of this alleged relevant market, the government's expert economist introduced an estimate of the own elasticity of demand for frozen dessert pies (.44). *Id.* at 228. Although highly relevant to the principal issue in the case, the court found this "testimony completely useless, primarily because we have no basis for evaluating what a particular elasticity coefficient means." *Id.* at 227–28.

¹⁰⁰ Under the Guidelines' approach, market delineation begins with a narrowly defined product and area, to which the next-best substitute is repeatedly added until a hypothetical profit-maximizing monopolist would impose a significant price increase. *See* Horizontal Merger Guidelines, *supra* note 21, §§ 1.11, 1.21. Thus, only certain groups of products and areas are candidates for markets. For further discussion on this point, see Werden, *Tenth Anniversary Retrospective*, *supra* note 96, at 530–31. On the definition of the next-best substitute, see *infra* notes 154–60 and accompanying text.

products are held constant.”¹⁰¹ Thus, the Guidelines’ definition of a market can be implemented by identifying the *critical elasticity of demand*.¹⁰² If the premerger elasticity of demand is less than the critical value, demand is not so elastic that a hypothetical monopolist would refrain from increasing price by at least the given, significant amount on which the critical elasticity is based.

The Guidelines’ hypothetical monopolist paradigm is implemented by applying the monopoly profit-maximization condition, which involves the elasticity of demand at the monopoly price. But this monopolist is only hypothetical, so it is not possible to measure directly the elasticity of demand at the monopoly price. Thus, the critical elasticity of demand is defined at premerger prices, and account must be made of the fact that the elasticity of demand at the monopoly price normally exceeds (possibly by a great deal) that at premerger prices. Ignoring this fact would cause an over-estimation of the degree of market power and the delineation of overly narrow markets. The delineation of markets with estimated demand elasticities, thus, can give rise to a “reverse *Cellophane* fallacy,”¹⁰³ a phenomenon important for its irony value, if for no other reason. The common critique of the Supreme Court’s analysis in *Cellophane* is that the Court delineated an overly broad market because it measured the elasticity of demand when market power was already being exercised. While there is merit to this critique, the delineation of overly narrow markets also can result from measuring the elasticity of demand when market power is not already fully exercised.

For any given demand elasticity and prevailing price, the higher the rate at which the elasticity of demand increases as price is increased, the smaller the price increase that would be imposed by a hypothetical

¹⁰¹ The 1982/84 Merger Guidelines’ definition did not make this assumption. See 1984 Merger Guidelines, *supra* note 72, § 1.0; 1982 Merger Guidelines, *supra* note 72, § I. The implications of the prior assumption are discussed *infra* at notes 124–32 and accompanying text.

¹⁰² This term was introduced by Frederick I. Johnson, *Market Definition Under the Merger Guidelines: Critical Demand Elasticities*, in 12 RESEARCH IN LAW AND ECONOMICS 235 (Richard O. Zerbe, Jr. ed., 1989). The related term “critical sales loss” and its break-even calculation were introduced by Barry C. Harris & Joseph J. Simons, *Focusing Market Definition: How Much Substitution Is Enough*, in 12 RESEARCH IN LAW AND ECONOMICS 207 (Richard O. Zerbe, Jr. ed., 1989). Profit-maximization calculations for critical demand elasticities and critical sales losses were introduced by Gregory J. Werden, *Four Suggestions on Market Delineation*, 37 ANTITRUST BULL. 107, 119–20 (1992). Further results relating to critical sales loss were contributed by Michael G. Baumann & Paul E. Godek, *Could and Would Understood: Critical Elasticities and the Merger Guidelines*, 40 ANTITRUST BULL. 885 (1995). The derivations in the Appendix, *infra*, are more complete yet simpler than those in the published literature.

¹⁰³ See Luke M. Froeb & Gregory J. Werden, *The Reverse Cellophane Fallacy in Market Delineation*, 7 REV. INDUS. ORG. 241 (1992).

profit-maximizing monopolist. Using estimated demand elasticities to delineate markets in merger cases, therefore, requires an assumption about the shape of the demand curve between the monopoly and pre-merger prices. Table 1 below provides formulae for calculating critical elasticities of demand for the two simple demand curves commonly used for illustrative purposes—linear and isoelastic demand curves. In these formulae, m is the premerger price-cost margin, expressed as a proportion, and t is the specified price increase threshold, also expressed as a proportion. If the difference between price and marginal cost is half of price, m is .5, and if the threshold for a significant price increase is 5 percent, then t is .05.

A similar, but distinctly different, calculation avoids having to make an assumption about the shape of the demand curve. Rather than calculate the profit-maximizing price increase central to the concept of market power, we can calculate the price increase above the premerger level that causes the hypothetical monopolist exactly to break even as compared with its premerger profit level. This may not be a relevant calculation because the profit-maximizing price increase can be far lower than the break-even price increase,¹⁰⁴ but reasons for doing this calculation are discussed below, and the formulae for this calculation are also presented in Table 1.

While decidedly not equal, the four critical elasticity formulas in Table 1 may be approximately so under relevant conditions. Each expression in Table 1 converges to the same limit, $1/m$, as t approaches zero.¹⁰⁵ So

Table 1
Critical Elasticities of Demand for Market Delineation

<i>Demand Curve</i>	<i>Profit Maximization</i>	<i>Break-Even</i>
Linear	$\frac{1}{m + 2t}$	$\frac{1}{m + t}$
Isoelastic	$\frac{1 + t}{m + t}$	$\frac{\log(m + t) - \log(m)}{\log(1 + t)}$

¹⁰⁴ See Werden, *Tenth Anniversary Retrospective*, *supra* note 96, at 537–39.

¹⁰⁵ This is easy to see, except for the break-even critical elasticity with isoelastic demand. For the others, it suffices to set $t = 0$. For the remaining formula, the key insight is that limit of the formula as t approaches zero is actually the formal definition of the derivative of $\log(x)$ with respect to x evaluated at $x = m$, divided by the derivative of $\log(x)$ with

if the market delineation experiment involves a “small” price increase, i.e., a small value of t , all four formulae yield roughly the same result. In addition, price-cost margins tend to be rather high, and the larger m is, the closer the four critical elasticities are to each other.

Table 2 presents numerical values for critical elasticities of demand for various premerger price-cost margins, expressed in percentages, assuming that 5 percent is the threshold for a significant price increase ($t = .05$). Price-cost margins in real-world antitrust matters commonly are in the 40–70 percent range. The two extreme price-cost margins used in the tables (0 and 100 percent) are included primarily to show that the critical elasticity and critical sales loss values produced by the different formulas diverge substantially when margins are unusually low and differ little when margins are unusually high. For a 5 percent price increase, the tables also indicate that the four formulas produce approximately the same values for plausible price-cost margins. Finally, Table 2 indicates that critical elasticities of demand for a 5 percent price increase most commonly are in the 1–2 range.¹⁰⁶

We can also calculate a *critical sales loss* for a given price increase. It indicates the proportionate decrease in quantity sold, resulting from the price increase, that is just large enough so that a hypothetical profit-maximizing monopolist would not impose a price increase of at least

Table 2
Critical Elasticities of Demand for a 5% Price Increase

		<i>Demand Curve</i> <i>Premember Percentage Price-Cost Margin</i>					
		0	40	50	60	70	100
Profit-Maximization	Linear	10	2.00	1.67	1.43	1.25	0.91
	Isoelastic	21	2.33	1.91	1.62	1.40	1
Break-Even	Linear	20	2.22	1.82	1.54	1.33	0.95
	Isoelastic	∞	2.41	1.95	1.64	1.41	1

respect to x evaluated at $x = 1$. Since the derivative of $\log(x)$ with respect to x is $1/x$, it follows that relevant limit is $1/m$.

¹⁰⁶ An early attempt to implement the Guidelines’ approach to market delineation using estimated demand elasticities suggested critical demand elasticities as high as 20. See David T. Scheffman & Pablo T. Spiller, *Geographic Market Definition Under the U.S. Department of Justice Merger Guidelines*, 30 J.L. & ECON. 123, 143 n.79 (1987). The reason is that the premerger price-cost margin was assumed to be zero.

Table 3
Critical Percentage Sales Losses for a 5% Price Increase

	<i>Demand Curve</i>	<i>Premerger Percentage Price-Cost Margin</i>					
		0	40	50	60	70	100
Profit-Maximization	Linear	50	10.0	8.3	7.1	6.3	4.5
	Isoelastic	64.1	10.8	8.9	7.6	6.6	4.8
Break-Even	Any	100	11.1	9.1	7.7	6.7	4.8

the given amount. The relevant formulas for calculating critical sales loss are derived in the Appendix. Based on those formulas, Table 3 presents values of critical sales loss (expressed as a percentage) for various premerger price-cost margins, assuming that 5 percent is the threshold for a significant price increase. Table 3 also provides a rationale for using the break-even calculation for critical sales loss. The break-even calculation is valid for any demand curve, and for small price increases and typical margins, it yields only slightly higher critical sales loss values than profit-maximization calculations. While theoretically inappropriate, the break-even calculation avoids an assumption required for the theoretically appropriate calculation, yet it yields approximately the same result in some relevant circumstances.

C. THE USE OF THE CRITICAL DEMAND ELASTICITY AND CRITICAL SALES LOSS

Using critical sales loss calculations, one can easily lose track of the price increase associated with a critical sales loss number. To illustrate, assume demand is linear and the premerger price-cost margin is 50 percent. From Table 3, the critical sales loss is 8.3 percent. Suppose that in the candidate market proposed by a plaintiff, a hypothetical monopolist would maximize its profits by imposing a 25 percent price increase. Using a formula derived in the Appendix, the associated critical sales loss is 25 percent [$t/(m + 2t) = .25/(.5 + .5) = .25$]. It is quite possible that a 5 percent price increase would yield a sales loss of more than 8.3 percent, yet a price increase of 25 percent would yield a sales loss of less than 25 percent. In this case, the proposed market qualifies under the Guidelines, but defendants could be expected to argue otherwise. One argument would be that a 5 percent price increase is the relevant

one.¹⁰⁷ A subtler argument is more problematic. Defendants may identify the customers most likely to switch in the event of a price increase and just assume that a 5 percent price increase would induce them to switch. Defendants could argue against the proposed market on the grounds that the customers most likely to switch account for more than 8.3 percent of sales. It would be easy for a court to overlook the fact that a price increase much greater than 5 percent might be necessary to induce them to switch.

For the foregoing reasons, the use of critical demand elasticities may be preferable to the use of critical sales losses. Although the two contain the same information, the critical sales loss is more easily divorced from the price increase on which it is based. To get a quantity effect from a demand elasticity, it is necessary to multiply by a particular price change, so the price increase amount does not get lost in the shuffle. When the demand assumption matters, the linear assumption probably is preferable to the isoelastic assumption. With price increases large enough so that the shape of the demand curve makes a significant difference, the elasticity of demand most likely increases, and assuming the contrary can be problematic.

In using critical elasticities of demand to delineate markets, little things unfortunately mean a lot. Because the degree of market power is related to the reciprocal of the demand elasticity, small changes in demand elasticities are significant when they are reasonably close to one, and that is the range of primary interest. Moreover, a hypothetical monopolist normally would increase price significantly more than 5 percent when the premerger demand elasticity is a little smaller than the critical value. This is illustrated in Table 4, which presents the profit-maximizing price increase percentages for elasticities 20 percent less than, and .2 less than, the critical value. The difference between a demand elasticity of 1.2 and a demand elasticity of 1.4 may not seem important, but it often is.

Critical elasticity calculations are not always useful. One plausible scenario in which they are not comes from *United States v. Archer-Daniels-Midland Co.*¹⁰⁸ The case concerned the merger of two producers of high fructose corn syrup (HFCS), a sweetener made from corn. The main substitute for HFCS was sugar, and due to its lower price, HFCS had replaced sugar in all uses for which price on a sweetness-equivalency

¹⁰⁷ The Horizontal Merger Guidelines, *supra* note 21, § 1.0, corrected a small problem with previous versions by asking whether the hypothetical monopolist would impose a price increase "at least" as great as the significance threshold. On the problem with the prior version, see Werden, *Market Delineation*, *supra* note 96, at 543–44 & n.94.

¹⁰⁸ 695 F. Supp. 1000 (S.D. Iowa 1987), *rev'd*, 866 F.2d 242 (8th Cir. 1988), *on remand*, 781 F. Supp. 1400 (S.D. Iowa 1991). The discussion here is based on Froeb & Werden, *supra* note 103.

Table 4
Monopoly Price Increases When Actual Elasticities Are
“A Little” Less Than the Critical Value for a 5% Price Increase

	<i>Demand Curve</i>	<i>Premerger Percentage Margin</i>			
		40	50	60	70
Actual Elasticity 20% Below Critical Value	Linear	11.3	12.5	13.8	15.0
	Isoelastic	29.2	44.8	76.8	180
Actual Elasticity .2 Less Than Critical Value	Linear	7.8	9.1	10.7	12.6
	Isoelastic	12.9	20.5	36.3	80.0

basis was the criterion for selection. Depending on the time period, an increase in the price of HFCS of as little as 10 percent would have made it more expensive than sugar, and users of HFCS would have switched back. At a price increase of as little as 10 percent, the demand for HFCS would have become highly elastic. In other situations, demand can become much *less* elastic after a modest price increase, because a large number of customers are at the margin and the remaining customers have very inelastic demands. Neither a linear nor an isoelastic demand curve is appropriate in either of these situations. When the demand curve is kinked in either way, the key issue is how much price must be increased before the kink is reached, and critical elasticity calculations are to no avail.

In some other situations, critical elasticity calculations may be useful, but the formulas presented here may not apply because the strategic decision by the firm is not so much how much to sell, but rather to whom to sell it. When firms price discriminate among types of consumers, selling less to one group may not mean producing less, but rather selling more to another group. Airlines, for example, charge several prices for seats on a single flight. If fewer seats are sold to customers booking at least a certain number of days in advance, more will be sold to customers booking fewer days in advance. In situations such as these, alternative critical elasticity and critical loss formulae must be derived based on the particulars of the industry in question, and using these alternative formulae may make a huge difference.

The fundamental importance of price-cost margins in determining the critical elasticity of demand and critical sales loss should not be surprising. Premerger price-cost margins determine how costly it is to restrict output. If premerger margins are very low, then the lost margin

on units no longer sold is easily outweighed by the gain from selling the remaining units at a higher price. However, when premerger price-cost margins are high, restricting output has a substantial cost from the very first unit.

The fundamental importance of price-cost margins is unfortunate, however, because of difficulties in the measurement of marginal cost. Marginal cost normally cannot be measured at all, but rather only proxied for by average variable cost. This typically is a legitimate practice if marginal cost is roughly constant, which commonly is the case. Nevertheless, a measure of actual production costs, even the incremental cost of producing the last unit, may not be a valid indication of economic marginal cost. The relevant cost concept is opportunity cost. The opportunity cost of a variable input may exceed its accounting cost if, due to scarcity, it is valued in alternative uses at more than its accounting cost. A capacity constraint creates the same phenomenon for fixed inputs, unless the constraint ceases to bind when output is restricted through the exercise of market power.

When average variable cost is a valid proxy for marginal cost, there can be significant difficulties in determining average variable cost, stemming from ambiguities about which costs should be treated as fixed and which should be treated as variable.¹⁰⁹ The determination of price-cost margins is also sensitive to the choice of the incremental unit of output. For example, airline margins are very high indeed if the incremental unit of output is an additional passenger on a plane that is not full. They are drastically lower if the incremental unit of output is an additional flight per day.¹¹⁰ It may be difficult to determine which of these margins is the relevant one for various purposes of antitrust analysis.

D. AN ILLUSTRATION FROM A LITIGATED CASE

Critical elasticity and critical sales loss calculations are routinely used by economists in merger investigations. Critical loss calculations played

¹⁰⁹ Predatory pricing litigation often focuses on the determination of average variable cost, and litigated cases demonstrate that plausible alternative interpretations can yield substantially different estimates of average variable costs. *See, e.g.,* *Morgan v. Ponder*, 892 F.2d 1355, 1360–61 & n.12 (8th Cir. 1989); *U.S. Philips Corp. v. Windmere Corp.*, 861 F.2d 695, 700 (Fed. Cir. 1988); *Kelco Disposal, Inc. v. Browning-Ferris Indus. of Vt., Inc.*, 845 F.2d 404, 407–08 (2d Cir. 1988), *aff'd*, 492 U.S. 257 (1989); *Sunshine Books, Ltd. v. Temple Univ.*, 697 F.2d 90, 95–96 (3d Cir. 1982); *William Inglis & Sons Baking Co. v. ITT Continental Baking Co.*, 668 F.2d 1014, 1036–38 & n.37 (9th Cir. 1981); *AREEDA ET AL.*, *supra* note 19, at 96–100.

¹¹⁰ *See also AREEDA ET AL.*, *supra* note 19, at 96–100; Jonathan B. Baker, *Contemporary Empirical Merger Analysis*, 5 GEO. MASON L. REV. 347, 358 (1997).

a very prominent role in *United States v. Mercy Health Services*.¹¹¹ The case involved the merger of the only acute care hospitals in Dubuque, Iowa. While neither was especially large or sophisticated, the Dubuque hospitals were substantially larger and more sophisticated than the rural hospitals within a seventy-mile radius of Dubuque, and the district court found that these rural hospitals did not pose a significant competitive threat to the Dubuque hospitals.¹¹² Within a hundred miles of Dubuque, there were also many “regional” hospitals at least as large and sophisticated as the Dubuque hospitals.¹¹³ The central issue in the case was whether these regional hospitals were in the relevant market.¹¹⁴ The court addressed this issue with several alternative analyses focusing on managed care customers receiving significant discounts from the Dubuque hospitals. One analysis asked whether a hypothetical hospital monopolist in Dubuque¹¹⁵ would find it profitable to impose a 5 percent price increase on managed care customers. Another asked whether a hypothetical hospital monopolist in Dubuque would find it profitable to eliminate managed care discounts entirely.¹¹⁶

Defendants sought to demonstrate that the price increases would induce so much substitution to other regional hospitals that it would not be imposed. In making this argument, defendants’ economic expert, Barry Harris, determined the margin of the larger Dubuque hospital to be 57 percent,¹¹⁷ and calculated the break-even critical sales loss figure for a 5 percent price increase to be 8 percent.¹¹⁸ The district court used the 8 percent figure to evaluate the government’s arguments, and found that “the total of those likely to switch in the event of a 5% price rise [is] higher than the 8% necessary to make the price rise unprofitable.”

The government argued that the merger would cause far more than a 5 percent price increase for managed care customers. As the court put it:

The government contends that the more likely scenario is that the [merged firm] would reduce or eliminate all current discounts to managed care entities resulting in a 15–30% increase in prices. The evidence

¹¹¹ 902 F. Supp. 968 (N.D. Iowa 1995), *vacated*, 107 F.3d 632 (8th Cir. 1997).

¹¹² *Id.* at 980.

¹¹³ *See id.* at 971–72.

¹¹⁴ *See id.* at 976.

¹¹⁵ The court did not use the word “hypothetical” because the merger would create a literal monopolist in Dubuque.

¹¹⁶ *See* 902 F. Supp. at 976–77.

¹¹⁷ *See* Defendants’ Exhibit 447.

¹¹⁸ The profit-maximization critical sales loss would be 7.5% with linear demand and 7.9% with isoelastic demand.

was that such a price increase would have to be countered by a 20–35% loss of patients to make such a price increase unprofitable.¹¹⁹

For reasons not relevant here, the court found that the patient loss would exceed the critical value.¹²⁰ What is important is that the critical sales loss calculations played a central role in the court's analysis and did so even though demand was not estimated.

The court made several significant errors in its critical sales loss analysis for the elimination of the managed care discounts.¹²¹ The percentage price increase associated with the elimination of the discounts was not the same as the amount of the discounts in percentage terms. The discount from the larger Dubuque hospital to the largest managed care customer was roughly one-third. The customer, therefore, paid two-thirds of the full price, and increasing its price up to the full price level would add back the third represented by the discount. One-third is half of two-thirds, so the elimination of a 33 percent discount represents a 50 percent price increase. The court also understated somewhat the actual discounts; for Dubuque's two largest managed care firms, the average discounts were 30.9 percent and 20 percent. Their elimination would produce price increases of 44.6 percent and 25 percent. Using the break-even critical loss calculation preferred by defendants, and factoring these discounts into the estimated margin calculation,¹²² the overall critical patient loss for both managed care firms works out to 46.3 percent.¹²³ This is substantially greater than the 20–35 percent critical sales loss used by the court, and using the correct figure might have made a difference to the court when it parsed the switching evidence.

E. RESIDUAL DEMAND ELASTICITIES AND MARKET DELINEATION

Thus far, only the Marshallian demand curve has been considered. It holds constant the prices of all other products and has been criticized for this *ceteris paribus* assumption.¹²⁴ It is possible to define a demand

¹¹⁹ 902 F. Supp. at 981.

¹²⁰ *Id.* at 981–83.

¹²¹ The critical loss analysis in the litigants' briefs contains much the same errors.

¹²² The margin calculation was predicated on a discount of 15%. *See* Defendants' Exhibit 447. A larger discount implies a lower price and lower margin.

¹²³ The profit-maximization critical sales loss is 31.5% with linear demand and 42.1% with isoelastic demand. The former probably is the more reasonable estimate, and it is substantially less than the 46.3% produced by the break-even calculation. This highlights the fact that the break-even and profit-maximization calculations are not so close when large price increases are involved.

¹²⁴ *See, e.g.,* Robinson, *supra* note 25, at 20; Sidney Weintraub, *The Foundations of the Demand Curve*, 32 AM. ECON. REV. 538, 543–45 (1942).

curve that does not make this assumption. Instead, it incorporates the effects on a product's quantity demanded of changes in the prices of other products in response to changes in the first product's price. This alternative demand curve is most often referred to as a "residual demand curve."¹²⁵ This residual demand curve is the demand curve for a firm acting as a "Stackelberg leader," i.e., a firm that takes its rivals' reactions into account in determining its own optimal action.¹²⁶ If the Guidelines' hypothetical monopolist maximizes profit by setting price, as a Stackelberg leader, its demand curve would take into account the price reactions for other products.¹²⁷

The own-price elasticity of a residual demand curve is typically termed a "residual demand elasticity," but has also been termed the "total demand elasticity" for reasons having to do with the mathematics that define the elasticity.¹²⁸ The total, or residual own-price elasticity of demand for a hypothetical monopolist is the relevant demand elasticity for market delineation if the hypothetical monopolist acts as a Stackelberg leader.¹²⁹ Under the 1982 and 1984 editions of the Department of Justice's Merger Guidelines, it was generally assumed that this was the proper market delineation experiment.¹³⁰ As explained above, the 1992 Horizontal Merger Guidelines explicitly stated that it was not the relevant experiment.¹³¹ The change in approach can make a significant difference when substitutes are inelastically supplied.¹³² With inelastic supply, an increase

¹²⁵ This terminology was used in the works that first estimated such demand curves. Jonathan B. Baker & Timothy F. Bresnahan, *Estimating the Demand Curve Facing a Single Firm*, 6 INT'L J. INDUS. ECON. 282 (1988); Jonathan B. Baker & Timothy F. Bresnahan, *The Gains from Merger or Collusion in Product-Differentiated Industries*, 33 J. INDUS. ECON. 427 (1985).

¹²⁶ This sort of behavior was proposed by HEINRICH VON STACKELBERG, *MARKTFORM UND GLEICHGEWICHT* (1934). For a discussion of Stackelberg's analysis, see WILLIAM J. FELLNER, *COMPETITION AMONG THE FEW* ch.3 (Augustus M. Kelley 1965).

¹²⁷ The residual demand curve considered in the dominant firm context (*see supra* note 19 and accompanying text) is very similar, except that quantities were the choice variables.

¹²⁸ See Gregory J. Werden & Luke M. Froeb, *Correlation, Causality, and All that Jazz: The Inherent Shortcomings of Price Tests for Antitrust Market Delineation*, 8 REV. INDUS. ORG. 329, 331 (1993). The relevant mathematics is sketched in the Appendix below.

¹²⁹ The Appendix contains a formal analysis of the relationship between the Marshallian own elasticity of demand and the residual demand elasticity.

¹³⁰ On market delineation under the Merger Guidelines using total, or residual, demand elasticities, see Luke M. Froeb & Gregory J. Werden, *Residual Demand Estimation for Market Delineation: Complications and Limitations*, 6 REV. INDUS. ORG. 33 (1991); Scheffman & Spiller, *supra* note 106; Werden & Froeb, *supra* note 128.

¹³¹ The change in policy may have practical advantages. Reliable estimation of residual demand elasticities depends on data for firm-specific costs important to price determination. See Froeb & Werden, *supra* note 130, at 44–46. The requisite data typically is difficult to obtain, and will not even exist if competing brands have essentially the same input costs.

¹³² For elaboration on the point and an example, see Werden & Froeb, *supra* note 128, at 334–38.

in demand leads to a significant price increase. Therefore, inelastic supply of substitutes reduces the amount of substitution away from a product as its price is increased, and can significantly enhance the ability to exercise market power over that product. Thus, the change from total to partial elasticities of demand in the 1992 Guidelines broadened the scope of markets. While the magnitude of this broadening normally is trivial, it can be substantial.

III. APPLICATIONS OF CROSS ELASTICITIES OF DEMAND

A. CROSS ELASTICITIES OF DEMAND AND MARKET DELINEATION

To this point, only the own-price elasticity of demand has been considered. Since the quantity demanded for one product may be affected by the prices of all other products, it is possible to compute elasticities with respect to the prices of each other product. The *cross-price elasticity of demand* for product i with respect to the price of j is defined as

$$\frac{\Delta q_i / q_i}{\Delta p_j / p_j}.$$

For any pair of products, either can be i , so there are two cross elasticities of demand. They can be vastly different. If products are substitutes, an increase in the price of one increases the demand for the other, so they have positive cross elasticities of demand. If products are complements, an increase in the price of one decreases the demand for the other, so they have a negative cross elasticities of demand.¹³³ As demonstrated in the Appendix, the own elasticity of demand for a product is, roughly speaking, a weighted sum of the cross elasticities of demand for other products with respect to the first product's price.

Since cross elasticities of demand relate to the closeness of substitutes, it is only natural to think that cross elasticities of demand can play a useful role in market delineation. The first substantial efforts to base market delineation on cross elasticities of demand appear to have been in economics texts published in 1952.¹³⁴ By the next year, the concept had crept into the case law through footnote 31 of *Times-Picayune Publishing Co. v. United States*:

¹³³ Economics generally uses more complicated formal definitions of substitutes and complements. The reason is that a price increase can reduce the consumer's purchasing power and thereby cause what are termed "income effects." The effects of a price increase on consumption of other goods involve both substitution effects and income effects.

¹³⁴ JOE S. BAIN, PRICE THEORY 25–26, 50–53 (1952); FRITZ MACHLUP, THE ECONOMICS OF SELLERS COMPETITION 213–14 (1952).

For every product substitutes exist. But a relevant market cannot meaningfully encompass that infinite range. The circle must be drawn narrowly to exclude any other product to which, within reasonable variations in price, only a limited number of buyers will turn; in technical terms, products whose “cross-elasticities of demand” are small.¹³⁵

The first law review articles on market delineation and the report of the Attorney General’s National Committee to Study the Antitrust Laws appeared over the next two years, and all invoked the concept of cross elasticity of demand in explaining proper market delineation.¹³⁶

The *Cellophane* case followed in 1956. The government argued that the relevant market was limited to cellophane because other products were not “substantially fungible.”¹³⁷ The Court rejected this contention, holding that “monopoly does not exist merely because the product said to be monopolized differs from others.”¹³⁸ The Court proceeded to offer two formulations of the proper test. The first involved cross elasticity of demand¹³⁹: “What is called for is an appraisal of the ‘cross-elasticity’ of demand in the trade.”¹⁴⁰ In elaborating, the Court explained:

An element for consideration as to the cross-elasticity of demand between products is the responsiveness of the sales of one product to price changes of the other. If a slight decrease in the price of cellophane causes a considerable number of customers of other flexible packaging materials to switch to cellophane, it would be an indication that a high cross-elasticity of demand exists between them; that the products compete in the same market.¹⁴¹

In its 1957 *du Pont–General Motors* decision, the Court considered market delineation in the merger context, and held “that automotive finishes

¹³⁵ 345 U.S. 594, 612 n.31 (1953). The phrase “to which . . . only a limited number of buyers will turn” seems to relate more to diversion than cross elasticity. See text accompanying note 155–57 *infra*.

¹³⁶ ATTORNEY GENERAL’S COMMITTEE REPORT, *supra* note 46, at 322 (invoking the concept but not using the term); Note, *The Market: A Concept in Anti-Trust*, 54 COLUM. L. REV. 580, 585–86 (1954); David Macdonald, *Product Competition in the Relevant Market Under the Sherman Act*, 53 MICH. L. REV. 69, 82–84 & nn.61, 63–67 (1954).

¹³⁷ 351 U.S. at 394.

¹³⁸ *Id.*

¹³⁹ The second formulation was “reasonable interchangeability”: “In considering what is the relevant market . . . no more definite rule can be declared than that commodities reasonably interchangeable by consumers for the same purpose make up” the relevant market. *Id.* at 395. In the conclusion of the opinion, the Court restated this formulation to hold that the relevant market “is composed of products that have reasonable interchangeability for the purposes for which they are produced—price, use and qualities considered.” *Id.* at 404.

¹⁴⁰ *Id.* at 394.

¹⁴¹ *Id.* at 400 (footnote omitted). Interestingly, the Court focused on the *aggregate* substitution to other flexible packaging materials, which is directly related to the own elasticity of demand, and not to the cross elasticity of demand.

and fabrics have sufficient peculiar characteristics . . . to make them a 'line of commerce' within the meaning of the Clayton Act."¹⁴² There was no mention of cross elasticity of demand, nor any attempt to rationalize the *Cellophane* opinion a year earlier. In its 1962 *Brown Shoe* opinion, the Court held that *du Pont-General Motors, Cellophane*, and a host of lower court precedents on market delineation were all right:

The outer boundaries of a product market are determined by the reasonable interchangeability of use or the cross-elasticity of demand between the product itself and substitutes for it. However, within this broad market, well-defined submarkets may exist which, in themselves, constitute product markets for antitrust purposes. The boundaries of such a submarket may be determined by examining such practical indicia as industry or public recognition of the submarket as a separate economic entity, the product's peculiar characteristics and uses, unique production facilities, distinct customers, distinct prices, sensitivity to price changes, and specialized vendors.¹⁴³

This dictum originated the submarket concept and resolved the seeming inconsistency between *du Pont-General Motors* and *Cellophane* by holding that the former involved a "submarket" while the latter involved "outer boundaries" of the market. This resolution suggested that market delineation in merger cases was different than in monopolization cases. A few years later, however, the Court held that the same analysis of market delineation should be applied in both types of cases.¹⁴⁴ Over the last decade, most courts of appeals have indicated that market delineation should focus on cross elasticity of demand, generally citing *Brown Shoe*.¹⁴⁵

In delineating markets, courts have invoked the concept of cross elasticity of demand countless times, but they have rarely employed the

¹⁴² *United States v. E.I. du Pont de Nemours & Co.*, 353 U.S. 586, 593-94 (1957).

¹⁴³ *Brown Shoe Co. v. United States*, 370 U.S. 294, 325 (1962) (citations and footnotes omitted). While once the primary basis for decision in most market delineation cases, the "practical indicia" are rarely actually applied these days. Notable anachronisms are *FTC v. Warner Communications Inc.*, 742 F.2d 1156, 1163 (9th Cir. 1984); *Moore Corp. Ltd. v. Wallace Computer Servs., Inc.*, 907 F. Supp. 1545, 1575-79 (D. Del. 1995), *vacated in relevant part as moot* (3d Cir. Aug. 20, 1996); *Ansell, Inc. v. Schmid Lab., Inc.* 757 F. Supp. 467, 472-74 (D.N.J.), *aff'd without opinion*, 941 F.2d 1200 (3d Cir. 1991). For a discussion of the origin, application, and utility of the "practical indicia," see Werden, *History, supra* note 96, at 146-51, 154-55, 172-79; Lawrence C. Maisel, *Submarkets in Merger and Monopolization Cases*, 72 GEO. L.J. 39, 59-69 (1983).

¹⁴⁴ *United States v. Grinnell Corp.*, 384 U.S. 563, 573 (1966).

¹⁴⁵ See, e.g., *United Farmers Agents Ass'n v. Farmers Ins. Exch.*, 89 F.3d 233, 236 n.3 (5th Cir. 1996); *Allen-Myland, Inc. v. IBM Corp.*, 33 F.3d 194, 201 n.8 (3d Cir. 1994); *U.S. Anchor Mfg., Inc. v. Rule Indus., Inc.*, 7 F.3d 986, 995 (11th Cir. 1993); *Olin Corp. v. FTC*, 986 F.2d 1295, 1298 (9th Cir. 1992); *Murrow Furniture Galleries, Inc. v. Thomasville Furniture Indus., Inc.*, 889 F.2d 524, 528 (4th Cir. 1989); *H.J., Inc. v. International Tel. & Tel. Corp.*, 867 F.2d 1531, 1537 (8th Cir. 1989); *Rothery Storage & Van Co. v. Atlas Van Lines, Inc.*, 792 F.2d 210, 218 (D.C. Cir. 1986).

concept using estimated cross elasticities. Perhaps the only example is the recent *Kraft* case, in which the State of New York challenged the acquisition of Nabisco by Kraft, which already owned Post.¹⁴⁶ Both sides presented the court with estimates of own and cross elasticities of demand.¹⁴⁷ Judge Kimba Wood held:

Cross-price elasticity is a more useful tool than own-price elasticity in defining a relevant antitrust market. Cross-price elasticity estimates tell one where the lost sales will go when the price is raised, while own-price elasticity estimates simply tell one that a price increase would cause a decline in volume.¹⁴⁸

Consequently, Judge Wood placed great weight on evidence of “statistically significant positive cross-price elasticities among cereals in each of the five Post marketing segments.”¹⁴⁹ None of the cross elasticities is reported by the court, and it seems likely that their statistical significance was all that mattered to the court in delineating the relevant market. Nothing in Judge Wood’s opinion suggests any way in which the magnitudes of cross elasticities could be translated into market power conclusions upon which market delineation should be based.

It is most unfortunate that the case law has focused on cross elasticities of demand in the delineation of markets.¹⁵⁰ This focus obscures the essential link between market delineation and the underlying market power inquiry. Although there is a direct relationship between the own elasticity of demand for a product and the potential to exercise market power over that product, the same cannot be said for the cross elasticities of demand between that product and any other product. Except through their effect on the own elasticity, cross elasticities have nothing to do with market power.¹⁵¹

Market delineation based on cross elasticities of demand also asks a different question—and one inherently less interesting—than market delineation based on own elasticities of demand. Using own elasticities of demand to delineate markets, the question is whether a given group

¹⁴⁶ *New York v. Kraft Gen. Foods, Inc.*, 926 F. Supp. 321 (S.D.N.Y. 1995). Preliminary relief was denied twice. *New York v. Kraft Gen. Foods, Inc.*, 862 F. Supp. 1030 (S.D.N.Y.), *aff’d without opinion*, 14 F.3d 590 (2d Cir. 1993); 862 F. Supp. 1035 (S.D.N.Y. 1994).

¹⁴⁷ 926 F. Supp. at 333–35, 356–57.

¹⁴⁸ *Id.* at 333.

¹⁴⁹ *Id.* Each pair of products has two different cross elasticities of demand, and there is no indication as to which she relied on.

¹⁵⁰ For comparable views, see AREEDA & KAPLOW, *supra* note 73, at 576; Louis Kaplow, *The Accuracy of Traditional Market Power Analysis and a Direct Adjustment Alternative*, 95 HARV. L. REV. 1817, 1829 n.52 (1982); Werden, *Market Delineation*, *supra* note 96, at 572–75.

¹⁵¹ Furthermore, only one of the two cross elasticities for a product pair is directly relevant.

of products and area constitute a market. That question must ultimately be addressed when market delineation is used for antitrust analysis. Using cross elasticities to delineate markets, the question posed is whether one given product is in the same market with another, and this question not only tends to obscure the ultimate issue, but also necessarily evokes a fundamentally flawed analysis.¹⁵²

Asking whether one product is in the same market with another imposes a symmetry condition—if *A* is in the market for *B*, *B* must be in the market for *A*, and imposing this condition may greatly frustrate a market power analysis. Suppose that a small increase in the price of *A* induces some substitution to *B*, but so little total substitution to *B* and other products, that a hypothetical monopolist over *A* would raise price significantly. Suppose also that a small increase in the price of *B* would induce so much substitution to *A* and to other products that a hypothetical monopolist over *B* would not raise price significantly. Under these circumstances, *A* is a market by itself, but *B* is not. If the question posed is whether *A* and *B* are in the same market, there is no rational way of answering it, particularly on the basis of the relevant market power considerations.

Asking whether one product is in the same market with another also focuses on the competitive significance of individual substitutes rather than on the collective competitive significance of all substitutes. The folly of this practice is illustrated by a common scenario with branded products. If there are many brands, as with breakfast cereals, the cross elasticities of demand between any pair of products may be quite small. Yet, it may also be the case that no brand has any significant market power because a small increase in its price would induce substitution to many other brands, each of which gains only a small fraction of the customers. If cross elasticities were the basis for market delineation, each brand probably would have to be considered a market unto itself.¹⁵³

B. CROSS ELASTICITIES OF DEMAND AND THE RANKING OF SUBSTITUTES

The Horizontal Merger Guidelines specify a process for market delineation that proceeds in discrete steps, beginning with a very narrow product group and area, and adding next-best substitutes, one at a

¹⁵² The own elasticity of demand for a product normally also can be estimated with greater precision than can cross elasticities.

¹⁵³ This is not the normal outcome when courts invoke cross elasticities to delineate markets for branded products only because courts use cross elasticities as a mantra rather than a systematic mode of analysis.

time, until a hypothetical profit-maximizing monopolist would impose a significant price increase. To implement this approach, it is essential to rank substitutes in order of closeness, and doing so may be useful for other purposes as well. Cross elasticities of demand play a central role in this ranking.

One way to rank substitutes is according to the magnitude of “raw” cross elasticities of demand,¹⁵⁴ i.e., for some base product the cross elasticities of demand for substitutes with respect to the price of the base product could be used to rank their closeness to the base product. It is doubtful, however, that proportionate increases in quantities of substitutes demanded, as indicated by cross elasticities of demand, are an appropriate measure of relative closeness. A substitute consumed in small quantity could experience a huge proportionate increase in its quantity demanded, even though that increase accounts for only a tiny portion of the total switching away from the base product. The least important substitute could have the highest cross elasticity of demand.

The amount of switching to any particular substitute can be measured in terms of the increase in the substitute’s unit sales or in terms of the increase in the substitute’s dollar sales. It also can be measured either in absolute terms or relative to the total amount of switching away from the base product. Absolute substitution measures result from multiplying the cross elasticities of demand for the substitutes by their premerger quantities, or their premerger quantities and prices. Doing so yields an estimate of the increase in unit or dollar sales of the substitutes induced by a given increase in the price of the base product.¹⁵⁵ Both the “unit diversion” and the “sales diversion” are sensitive to the magnitude of the price increase for the base product. This defect is remedied by dividing unit or sales diversion by the corresponding decrease in unit or dollar sales of the base product, to yield *diversion ratios*.¹⁵⁶ Diversion ratios indicate the proportion (in units or dollars) of the substitution

¹⁵⁴ Perhaps the first both to recognize and to reject this approach was GEORGE J. STIGLER, *THE THEORY OF PRICE* 281 (2d ed. 1946). The case law generally has not undertaken the ranking of substitutes, but one court that did so used cross elasticities of demand for the purpose. See *New York v. Kraft Gen. Foods, Inc.*, 926 F. Supp. 321, 356 (S.D.N.Y. 1993).

¹⁵⁵ The latter is favored by the Horizontal Merger Guidelines, which state that “the term ‘next-best substitute’ refers to the alternative which, if available in unlimited quantities at constant prices, would account for the greatest value of diversion of demand in response to a ‘small but significant and nontransitory’ price increase.” Horizontal Merger Guidelines, *supra* note 21, § 1.11 n.9. The phrase “if available in unlimited quantities at constant prices” serves to eliminate any effect of supply conditions for the substitutes and assure that only demand substitution is considered.

¹⁵⁶ This term appears to have been introduced by Carl Shapiro, *Mergers with Differentiated Products*, ANTITRUST, Spring 1996, at 23.

away from the base product, as its price is increased, that goes to each of its substitutes.¹⁵⁷

Whether any of these four measures yields an appropriate ranking depends on exactly what we are trying to measure, and perhaps the best way to approach the issue is to define circumstances in which substitutes are “equally close.” One possible definition holds that two substitutes are equally close substitutes to a base product when they experience the same increase in unit or dollar sales in response to a small increase in the price of the base product. The four diversion measures make sense using this benchmark. Two substitutes also could be considered equally close to a base product if, when the price of the base product is increased, the increase in unit or dollar sales of both substitutes is in proportion to their relative shares of unit or dollar sales. This alternative definition relates to a property of consumer preferences termed by economists Independence of Irrelevant Alternatives (IIA),¹⁵⁸ which implies that when the price of one product is increased, substitution to other products is in proportion to their relative shares.¹⁵⁹ While the IIA property may not accurately describe consumer preferences in any particular case, it has appeal as a benchmark for defining equally close substitutes.

This benchmark immediately suggests another measure for ranking the closeness of substitutes. It is dubbed the *relative diversion ratio* (which could be in units or dollars) because it is the diversion ratio relative to what it would be under the IIA property. Rankings of substitutes based on relative diversion ratios are likely to be substantially different than ranking based on diversion ratios, as can be seen in a simple example. Suppose that a price increase for some base product leads to increases in the unit sales of substitutes *A*, *B*, and *C* in the proportions 3:2:1. Using diversion ratios to rank the substitutes, *A* is closest to the base product and *C* is most distant. Suppose also that, prior to the price increase, the relative shares of substitutes *A*, *B*, and *C* are in the proportions 9:3:1.

¹⁵⁷ The diversion ratios for a product need not sum to one. One reason is that the units in which the products are measured are not necessarily compatible. Another is that the price increase tends to make consumers poorer in real terms, in that less can be consumed.

¹⁵⁸ The IIA property states that the relative odds of any two choices is independent of the presence or absence of other possible choices. See Gregory J. Werden, Luke M. Froeb & Timothy J. Tardiff, *The Use of the Logit Model in Applied Industrial Organization*, 3 INT'L J. ECON. BUS. 83, 86–87 (1996). The IIA property was termed the “choice axiom” by psychologist R. Duncan Luce, who found it consistent with behavior in some choice experiments and constructed a choice theory using it. R. DUNCAN LUCE, *INDIVIDUAL CHOICE BEHAVIOR* 9, 12–15 (1959).

¹⁵⁹ The IIA property implies that all of the cross elasticities of the quantity demanded with respect to the price of a given product are the same.

Using relative diversion ratios, *C* is closest to the base product and *A* is most distant.

The relative diversion ratio is the preferred measure if the closeness of substitutes is an inherent property of the products themselves. What that means is clearest when the delineation of geographic market boundaries is the issue. Closeness of geographically differentiated substitutes could be measured in terms of physical distance, travel time, or travel cost, all of which are based on physical location.¹⁶⁰ All three measures are unrelated both to the number of consumers currently purchasing the products and to other factors that may affect the ability to exercise market power. Physical location is an inherent property of the substitutes, while the other factors affecting market power are not. If closeness of substitutes in geographic space should be measured in terms of distance, travel time, or travel cost, the comparable thing should be done in product space, and relative diversion ratios are most consistent with that notion.

All of the measures discussed in this section are summarized in Table 5. Employing conventions used above, ϵ_{ii} is the own elasticity of demand for the base product; ϵ_{ji} is the cross elasticity of demand for substitute *j*

Table 5
Alternative Measures for Ranking Substitutes, *j*, of Base Product *i*

Cross Elasticity of Demand	ϵ_{ji}	Percentage increase in quantity of substitute <i>j</i> , relative to percentage change in price of product <i>i</i>
Unit Diversion	$\epsilon_{ji}q_j$	Absolute increase in unit sales of substitute <i>j</i>
Sales Diversion	$\epsilon_{ji}p_jq_j$	Absolute increase in dollar sales of substitute <i>j</i>
Unit Diversion Ratio	$\frac{\epsilon_{ji}q_j}{\epsilon_{ii}q_i}$	Increase in unit sales of substitute <i>j</i> , relative to decrease in unit sales of product <i>i</i>
Dollar Diversion Ratio	$\frac{\epsilon_{ji}p_jq_j}{\epsilon_{ii}p_iq_i}$	Increase in dollar sales of substitute <i>j</i> , relative to decrease in dollar sales of product <i>i</i>
Relative Unit Diversion Ratio	$\frac{\epsilon_{ji}q_js_i}{\epsilon_{ii}q_is_j}$	Increase in unit sales of substitute <i>j</i> , relative to decrease in unit sales of product <i>i</i> ; relative to that if substitution proportionate to share

¹⁶⁰ Indeed, one can imagine a map in which distance separating points is travel time or travel cost.

with respect to the price of the base product i ; and $p_i, p_j, q_i, q_j, s_i, s_j$ are the prices, unit sales, and shares of the base product and substitutes.

C. CROSS ELASTICITIES OF DEMAND AND THE COMPETITIVE EFFECTS OF MERGERS

At the urging of the federal enforcement agencies, courts have held that the legality of a merger under the Clayton Act turns on its net effect on consumer welfare.¹⁶¹ When a single product of constant quality is involved, the test is whether its price rises or falls. Price can fall if the price-reducing effect of a marginal cost reduction generated by the merger outweighs the price-increasing effect of the reduction in rivalry caused by the merger. In conventional one-period oligopoly models, it is not difficult to calculate the marginal cost reductions necessary to prevent an increase in price. To simplify matters, only the results with identical, single-product merging firms are presented here.¹⁶²

If sellers of a homogeneous product compete by setting quantities and two of them merge, the proportionate reduction in the merged firm's marginal cost necessary to restore premerger prices is

$$\frac{s}{\varepsilon - s},$$

where s is the premerger quantity share of both merging firms and ε is the premerger elasticity of demand for the market. If sellers of differentiated products engage in Bertrand competition and two of them merge, the proportionate reduction in each firm's marginal cost necessary to restore premerger prices is

$$\frac{m}{1 - m} \quad \frac{d}{1 - d},$$

where m is the premerger price-cost margin for both products and d is common, premerger diversion ratio. The relevant demand elasticities and diversion ratios for these calculations are those at premerger prices, yet these calculations require no assumption about the shape of the demand curve. The fact that elasticities of demand change as price

¹⁶¹ See *FTC v. University Health, Inc.*, 938 F.2d 1206, 1222–23 (11th Cir. 1991); *United States v. United Tote, Inc.*, 768 F. Supp. 1064, 1084–85 (D. Del. 1991). The new guidelines on merger efficiencies issued by the federal enforcement agencies (*reprinted in* 4 Trade Reg. Rep. (CCH) ¶ 13,104, at 20,573–11–13) lean in the direction of consumer welfare but do not exclude alternatives. See Gregory J. Werden, *An Economic Perspective on the Analysis of Merger Efficiencies*, ANTITRUST, Summer 1997, at 12, 13–14.

¹⁶² For the general results, see Gregory J. Werden, *A Robust Test for Consumer Welfare Enhancing Mergers Among Sellers of Differentiated Products*, 44 J. INDUS. ECON. 409 (1996); Gregory J. Werden & Luke M. Froeb, *A Robust Test for Consumer Welfare Enhancing Mergers Among Sellers of a Homogeneous Product*, 58 ECON. LETTERS 367 (1998).

change is not a problem because the formulas state a condition under which prices do not change. Table 6 presents the necessary percentage cost reductions computed from the latter formula for plausible values of m and d . If both m and d are large, the necessary marginal cost reductions are implausibly large.

It is also possible to predict the price effects of differentiated products mergers using a procedure termed *merger simulation*, through which prices, shares, and demand elasticities are systematically processed through a conventional economic model to predict the price effects of mergers.¹⁶³ Estimated, or possibly intuited, demand elasticities play a central role in merger simulations.¹⁶⁴ The multiproduct version of the

Table 6
Minimum Percentage Marginal Cost Reductions
Necessary to Prevent Price Increases

<i>Diversion Ratio</i>	<i>Premerger Percentage Price-Cost Margin</i>			
	40	50	60	70
.05	3.5	5.3	7.9	12.3
.10	7.4	11.1	16.7	25.9
.15	11.7	17.7	26.5	41.2
.20	16.7	25.0	37.5	58.3
.25	22.2	33.3	50.0	77.8

¹⁶³ For a concise statement of the analysis, see Gregory J. Werden, *Simulating Unilateral Competitive Effects from Differentiated Products Mergers*, ANTITRUST, Spring 1997, at 27. More complete statements of the analysis are found in Jerry A. Hausman & Gregory K. Leonard, *Economic Analysis of Differentiated Products Mergers Using Real World Data*, 5 GEO. MASON. L. REV. 321 (1997); Jerry Hausman, Gregory Leonard & J. Douglas Zona, *Competitive Analysis with Differentiated Products*, 34 ANNALES D'ECONOMIE ET DE STATISTIQUE 159 (1994); Gregory J. Werden, *Simulating the Effects of Differentiated Products Mergers: A Practical Alternative to Structural Merger Policy*, 5 GEO. MASON. L. REV. 363 (1997); Gregory J. Werden, *Simulating the Effects of Differentiated Products Mergers: A Practitioners' Guide*, in STRATEGY AND POLICY IN THE FOOD SYSTEM: EMERGING ISSUES (Julie A. Caswell & Ronald W. Cotterill eds., 1997) [hereinafter, Werden, *Practitioners' Guide*]; Gregory J. Werden & Luke M. Froeb, *Simulation as an Alternative to Structural Merger Policy in Differentiated Products Industries*, in THE ECONOMICS OF THE ANTITRUST PROCESS 65 (Malcolm B. Coate & Andrew N. Kleit eds., 1996). The prediction accuracy of merger simulation is not known, but that is also true of every other methodology. Merger simulation has two major virtues: It yields quantitative predictions, which are essential in making welfare trade-offs, and it clearly focuses the debate on the assumptions or estimates that matter.

¹⁶⁴ The central role of demand elasticities in merger simulation may be demonstrated most powerfully by the observation that the use of merger simulation eliminates the need for market delineation because the predictions of merger simulations are not sensitive to the make-up of the product group used in the simulations. The prices of products included

profit-maximization condition presented above, which contains both own and cross elasticities of demand, is employed twice in a merger simulation. It is first used to infer premerger marginal costs from premerger prices and shares. It is then used to predict postmerger prices and outputs from the elasticities and the inferred marginal costs. Because prices change, it is necessary in both steps to make an assumption concerning the demand system that characterizes all of the competing products of interest.¹⁶⁵

Although demand elasticities play a central role in merger simulations, knowledge of the relevant demand elasticities certainly does not obviate the need to perform the simulations. Only under highly unrealistic assumptions do simple formulas determine the price and welfare effects of differentiated products merger. Moreover, merger simulations demonstrate the falsity of two seemingly intuitive propositions about the effects of cross elasticities of demand on the price effects of differentiated products mergers.

It is not true that differentiated products mergers necessarily have insignificant effects on price unless the merging products are next-best substitutes. Consider a differentiated product industry consisting of four single-product firms. Assume that the four products (*A*, *B*, *C*, and *D*) have the same premerger prices (\$1) and shares (25 percent), and the same own elasticities of demand (1.5). Now assume that all of the cross elasticities of demand among the four products are the same (.5) except for those between products *A* and *B*, which are only half as large (.25). By every one of the measures presented in Table 5 for ranking closeness of substitutes, *A* and *B* are much less close to each other than they are to *C* and *D*. For example, the diversion ratios between all pairs of products other than *A* and *B*, are $1/3$, while those for *A* and *B* are $1/6$. The assumptions of this example were chosen so that all of the remaining measures in Table 5 have the same two-to-one relationship. But if the

in merger simulations are allowed to respond to those of the merging firms, while prices of the excluded products are held constant. The prices of all included substitutes increase in response to price increases by the merged firm, and that stimulates further price increases by the merged firm. Thus, the exclusion of substitutes from a simulation biases downward the price increases from a merger. The bias is very slight, however, unless excluded products are *individually* very important substitutes for a product of the merged firm.

¹⁶⁵ I do not currently advocate any one demand system. For a general discussion of alternatives, see Werden, *Practitioners' Guide*, *supra* note 163, which also presents details on simulation with linear demand. For details on simulation with logit demand, see Werden & Froeb, *supra* note 163. For details on simulation with AIDS demand, see Hausman & Leonard, *supra* note 163. The implications of alternative demand assumptions are explored by Philip Crooke, Luke M. Froeb, Steven Tschantz & Gregory J. Werden, Effects of the Assumed Demand System on Simulated Postmerger Equilibria (August 14, 1997) (Economic Analysis Group Discussion Paper 97-3).

demand system for these products is linear¹⁶⁶ and *A* merges with *B*, they will raise their prices by a significant 7.9 percent. Mergers of products that are not next-best substitutes clearly can cause significant price effects.

It is also not true that differentiated products mergers necessarily have insignificant effects on price unless the cross elasticities of demand between the merging product are quite large. Consider a differentiated product industry having a premerger own elasticity of demand of one. Assume there are four single-product competitors, each with same premerger price (\$1) and share (25 percent), the same premerger own elasticity of demand, and the same premerger cross elasticities of demand with respect to the prices of each of the other three products. If the IIA property holds, so that when the price of one product is increased, substitution to others is proportionate to their relative market shares, then the demand system must be "logit."¹⁶⁷

The parameter in a logit demand system controlling substitutabilities among products can be varied to achieve a wide range of cross elasticities of demand among the four products. Over most of this range, increasing the parameter, and hence the cross elasticities of demand, has the effect of decreasing the price effects of the merger of any two of the four firms. The reason for this possibly counter-intuitive result is that increasing all the cross elasticities not only makes the merging firms' products better substitutes for each other but also makes the non-merging firms' products better substitutes for those of the merging firms. If, for example, all of the cross elasticities are one-half, then the merging firms increase price 7 percent. But if all of the cross elasticities are 5, the merging firms increase price only 1.7 percent. Low cross elasticities clearly need not imply small price effects from mergers, and large cross elasticities need not imply large price effects.

IV. CONCLUSION

Demand elasticity concepts have been used in antitrust law for nearly a half century, but until recently the concepts were invoked in abstract ways that required only the most basic comprehension of those concepts. Today, however, a variety of very specific calculations of, and with, demand elasticities are commonly employed in antitrust analysis. A careful study of demand elasticity concepts and their many applied uses has become essential to the antitrust practitioner. This article can serve as a text for that study and as a guide to the economic and legal literature.

¹⁶⁶ The assumption of linear demand yields a smaller price increase than any of the alternative assumptions that have been used in merger simulation. See Crooke, Froeb, Tschantz & Werden, *supra* note 165.

¹⁶⁷ See Werden, Froeb & Tardiff, *supra* note 158, at 86–87, and sources cited therein.

APPENDIX

A. DERIVATION OF CRITICAL ELASTICITY OF DEMAND AND CRITICAL SALES LOSS FORMULAS

All of the formulas in Table 1 are easily derived using simple algebra. Define

- p^0 = the premerger price
- p^1 = the premerger price plus some specified price increase
- p^m = the profit-maximizing price for a hypothetical monopolist
- c = (short-run) marginal cost, assumed to be constant
- m = the premerger price-cost margin = $(p^0 - c)/p^0 = 1 - c/p^0$
- t = the minimum price increase deemed significant = $(p^1 - p^0)/p^0 = p^1/p^0 - 1$.

Both m and t are expressed as proportions; thus, if the threshold for a significant price increase is 5%, then $t = .05$.

Profit-maximization by the hypothetical monopolist requires $(p^m - c)/p^m = 1/\varepsilon(p^m)$. Solving for the elasticity of demand yields $\varepsilon(p^m) = p^m/(p^m - c)$. The elasticity of demand is written as a function of price to make its dependence explicit; $\varepsilon(p^m)$ denotes the elasticity at the monopoly price. The premerger price-cost margin is m , and the price-cost margin after increasing price by t is $m + t = (p^1 - c)/p^0$. By definition, $1 + t = p^1/p^0$. The critical demand elasticity is defined as the premerger demand elasticity at which the profit-maximizing price increase is the minimum increase deemed significant. Setting $p^m = p^1$, $\varepsilon(p^m) = p^m/(p^m - c) = p^1/(p^1 - c) = [p^1/p^0]/[(p^1 - c)/p^0] = (1 + t)/(m + t)$. This result holds for all demand curves. With isoelastic demand, the premerger elasticity of demand equals the elasticity of demand at the monopoly price, so the critical elasticity of demand is

$$\frac{1 + t}{m + t}.$$

Linear demand has the form $p = a - bq$, or $q = (a - p)/b$. The elasticity of demand is -1 , times the slope of the demand curve $(-b)$, times p/q , i.e., $bp/(a - p)$, $\varepsilon(p) = p/(a - p)$. Substituting this into the monopoly profit-maximization condition and rearranging yields $p^m = (a + c)/2$. For

reasons that will become apparent, it is useful to note that $1/(m+2t) = p^0/(2p^1 - c - p^0)$. To find the critical elasticity of demand, we again set $p^m = p^1$, and substituting $p^m = (a+c)/2$ for p^1 yields $1/(m+2t) = p^0/(a-p^0) = \varepsilon(p^0)$. Thus, the critical elasticity of demand is

$$\frac{1}{m+2t}.$$

A critical sales loss is defined for a given price increase as the proportionate decrease in quantity sold resulting from that price increase just large enough so that a hypothetical profit-maximizing monopolist would not impose a price increase of at least the given amount. The sales loss resulting from a price increase of p^0 to p^1 is $1 - q(p^1)/q(p^0)$. With isoelastic demand, $q = ap^{-\varepsilon}$, so $1 - q(p^1)/q(p^0) = 1 - (p^1/p^0)^{-\varepsilon} = 1 - (1+t)^{-\varepsilon}$. This becomes the critical sales loss if ε is the critical demand elasticity. For isoelastic demand, the critical demand elasticity is $(1+t)/(m+t)$, so the critical sales loss is

$$1 - (1+t)^{-\frac{1+t}{m+t}}.$$

With linear demand, $q = (a-p)/b$, so $1 - q(p^1)/q(p^0) = 1 - (a-p^1)/(a-p^0) = (p^1-p^0)/(a-p^0) = [(p^1-p^0)/p^0][p^0/(a-p^0)] = t\varepsilon(p^0)$. This is the critical sales loss if $\varepsilon(p^0)$ is the critical demand elasticity, which is $1/(m+2t)$. So the critical sales loss is

$$\frac{t}{m+2t}.$$

The break-even price, p^b , is defined by equating premerger profit with the post-price-increase profit. Assuming that marginal cost is constant, profit is quantity times the difference between price and marginal cost, so the break-even condition can be written: $q(p^0)(p^0 - c) = q(p^b)(p^b - c)$, which can be rearranged to yield

$$\frac{q(p^b)}{q(p^0)} = \frac{p^0 - c}{p^b - c}.$$

Setting $p^1 = p^b$, $(p^0 - c)/(p^b - c) = [(p^0 - c)/p^0]/[(p^1 - c)/p^0] = m/(m+t)$. The break-even critical sales loss is $1 - q(p^b)/q(p^0) = 1 - m/(m+t) = t/(m+t)$. For any demand curve, the break-even critical sales loss is

$$\frac{t}{m+t}.$$

Unlike the break-even critical sales loss, the break-even critical demand elasticity does depend on the shape of the demand curve. With isoelastic

demand, $q(p^1)/q(p^0) = (p^1/p^0)^{-\epsilon} = (1+t)^{-\epsilon}$. Setting $p^1 = p^b$, recalling that break-even requires that $q(p^m)/q(p^0) = m/(m+t)$, taking logarithms, and rearranging, yields a break-even critical demand elasticity of

$$\frac{\log(m+t) - \log(m)}{\log(1+t)}.$$

With linear demand, $q(p^1)/q(p^0) = (a - p^1)/(a - p^0) = 1 - [(p^1 - p^0)/p^0][p^0/(a - p^0)] = 1 - t\epsilon(p^0)$. If we set $p^1 = p^b$ and recall that break-even requires that $q(p^b)/q(p^0) = m/(m+t)$, we have $t\epsilon(p^0) = 1 - m/(m+t) = t/(m+t)$. So the break-even critical elasticity of demand is

$$\frac{1}{m+t}.$$

B. THE RELATIONSHIP BETWEEN MARSHALLIAN AND RESIDUAL DEMAND ELASTICITIES

In precise mathematical terms, the Marshallian own elasticity of demand for product i should be written as

$$-\frac{\partial q_i}{\partial p_i} \frac{q_i}{p_i},$$

where the use of the symbol ∂ (a "round d") denotes a "partial" derivative. Using the partial derivative notation indicates that, although quantity of product i demanded is a function of the price of i and other prices, the prices of the other products are held constant in taking the derivative. Formally, the elasticity of residual demand is written as

$$-\frac{dq_i}{dp_i} \frac{q_i}{p_i},$$

where the letter "d" denotes a "total" derivative. Using the total derivative notation indicates that the prices of other products are not held constant as the price of i changes, but rather vary in response to the changes in the price of i .

The relationship between the total and Marshallian, or "partial," elasticity of demand for product i is given by

$$\epsilon_{ii}^{total} = \epsilon_{ii}^{partial} - \sum \epsilon_{ij} \omega_{ji},$$

where ϵ_{ii} is the own elasticity of demand, the ϵ_{ij} are Marshallian cross-price elasticities of demand for product i with respect to the prices of products j , and the ω_{ji} are the price response elasticities for products j

with respect to product i .¹⁶⁸ The cross elasticities of demand indicate the proportionate change in the quantity of i demanded from a change in the prices of other products,¹⁶⁹ while the price response elasticities indicate the proportionate change in the prices of other products in response to changes in the price of product i .

C. THE RELATIONSHIP BETWEEN OWN AND CROSS ELASTICITIES OF DEMAND

With income, y , the consumer's problem is to maximize utility subject to the "budget constraint" that total expenditure is limited to income¹⁷⁰:

$$p_1 q_1 + p_2 q_2 + \dots + p_n q_n = y.$$

A change in p_1 , Δp_1 , affects all of the quantities, but the total expenditures still must add up to income, so we have

$$(p_1 + \Delta p_1)(q_1 + \Delta q_1) + p_2(q_2 + \Delta q_2) + \dots + p_n(q_n + \Delta q_n) = y.$$

Subtracting the budget constraint before the price increase from this equation, multiplying both sides by $p_1/y\Delta p_1$, and rearranging,¹⁷¹ yields

$$\frac{p_1 q_1}{y} \frac{\Delta q_1}{\Delta p_1} \frac{p_1}{q_1} + \frac{p_2 q_2}{y} \frac{\Delta q_2}{\Delta p_1} \frac{p_1}{q_2} + \dots + \frac{p_n q_n}{y} \frac{\Delta q_n}{\Delta p_1} \frac{p_1}{q_n} = -\frac{p_1 q_1}{y}.$$

The share of total expenditure on product j is given by $p_j q_j/y$, so each of the terms on the left-hand side is an elasticity multiplied by the corresponding expenditure share. The first term includes an own elasticity, while the others include cross elasticities. Denote the own elasticity of product 1 as ϵ_{11} , the cross elasticity of demand for product j with respect to the price of product 1 as ϵ_{j1} , and the expenditure shares of products 1 and j as s_1 and s_j . Divide through by $-s_1$ and move the cross elasticity terms over to the right-hand side to yield¹⁷²

$$\epsilon_{11} = 1 + \sum \epsilon_{j1} s_j / s_1.$$

¹⁶⁸ See Werden & Froeb, *supra* note 128, at 331.

¹⁶⁹ Cross elasticities of demand are formally defined and explained in the text accompanying note 133 and in the balance of this Appendix.

¹⁷⁰ This analysis concerns the allocation of income among commodities at a given point in time. Adding allocation over time, through saving or borrowing, does not materially alter the result.

¹⁷¹ It is also necessary to drop out a term containing a Δq_1 that is not divided by a Δp_1 . This is justified if a very small price increase is considered. Using calculus, this term would not have existed in the first place.

¹⁷² Other works present this formula without the 1 on the right-hand side of the equation. See AREEDA ET AL., *supra* note 19, at 105 n.4; Landes & Posner, *supra* note 19, at 961 n.43. Landes and Posner assume that "real income [is] constant." *Id.* This assumption means that the elasticities are not Marshallian demand elasticities, since the Marshallian assumption is that nominal income is held constant. AREEDA ET AL. do not explain the result.

It must be emphasized that the cross elasticities of demand in this equation are not cross elasticities of demand for product 1 with respect to the prices of the other products. Although the own elasticity on the left-hand side of the equation is that for product 1, the cross elasticities of demand on the right-hand side are cross elasticities of demand for the other products with respect to the price of product 1. This equation is not a condition relating all of the demand elasticities characterizing a single demand curve, but rather a condition relating all of the demand elasticities with respect to a single price. It is a relationship among all demand curves.