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## HARVARD LAW REVIEW

## MARKET POWER IN ANTITRUST CASES

*William M. Landes and Richard A. Posner\**

*With many antitrust prohibitions, the existence of a violation depends upon whether the defendant possesses sufficient market power. In this Article, Professors Landes and Posner present an economic analysis of market power that provides the necessary foundation for application to particular cases and for formulation of antitrust policy. They use their approach to illuminate the perplexing issues of product and geographical market definition, the measurement of market power arising from mergers and within regulated industries, and the quantification of damages in monopolization and price-fixing cases. Finally, they argue that, despite the novelty of their formulation, it is compatible with the dominant judicial approach to these issues.*

THE term "market power" refers to the ability of a firm (or a 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above the competitive level without losing so many sales so rapidly that the price increase is unprofitable and must be rescinded. Market power is a key concept in antitrust law. A finding of monopolization in violation of section 2 of the Sherman Act<sup>1</sup> requires an initial determination that the defendant has monopoly power — a high degree of market power. A lesser but still significant market power requirement is imposed in attempted-monopolization cases under section 2. Section 7 of the Clayton Act<sup>2</sup> also requires proof of market power; in fact, the main purpose of section 7 is to limit mergers that increase market power. There is increasing authority that proof of market power is also required in Rule of Reason cases under section 1 of the Sherman Act.<sup>3</sup> Issues of market power arise even in cases involving per se rules of illegality. Proof of some market power (though perhaps little) is required in a tie-in

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<sup>1</sup> 15 U.S.C. § 2 (1976).

<sup>2</sup> *Id.* § 18.

<sup>3</sup> See note 35 *infra*.

case; and in a private price-fixing case, proof of effect on prices (*i.e.*, proof of the exercise of market power), while unnecessary to establish liability, is necessary to establish damages.

The standard method of proving market power in antitrust cases involves first defining a relevant market in which to compute the defendant's market share, next computing that share, and then deciding whether it is large enough to support an inference of the required degree of market power. Other evidence — for example, of the defendant's profits, or of the ability of new firms to enter the market, or of price discrimination — may be presented to reinforce or refute the inference from market shares. In this Article, we attempt to introduce greater rigor into the antitrust analysis of market power, and to demonstrate the contribution that economic analysis of market power can make to both conceptual clarification and practical measurement.

The foundation of our approach is developed in Part I, where we define market power in economic terms and show how it is related to market share and other characteristics of market structure. We point out that the Lerner index provides a precise economic definition of market power, and we demonstrate the functional relationship between market power on the one hand and market share, market elasticity of demand, and supply elasticity of fringe competitors on the other.

Part II shows how the theoretical analysis in Part I can be used to resolve concrete questions of market definition and market power in monopolization, merger, and other antitrust cases. Among other things, we show how the inference of market power can be adjusted so that defining a market broadly or narrowly will not affect the inference that is drawn, and how, in principle at least, market power standards could be quantified for the guidance of courts and enforcement agencies. Some of the specific implications of our analysis may strike lawyers as novel, such as the proposition that the total output of distant producers (including foreign producers) often should be included in figuring market shares in a local market even if there are transportation costs or tariffs. Part II also discusses briefly damages in monopolization and price-fixing cases and the measurement of monopoly power in cases arising in regulated industries.

Although the proposed analysis and its applications utilize a somewhat novel method of antitrust analysis,<sup>4</sup> they are not

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<sup>4</sup> We note, however, the use of a similar analytic apparatus in Schmalensee, *On the Use of Economic Models in Antitrust: The ReaLemon Case*, 127 U. PA. L. REV. 994, 1006, 1011 (1979), to analyze the market power issue in a recent FTC monopoly case.

incompatible with the dominant judicial approach to these questions. Not every antitrust decision can be explained by our analysis, but, as we show in Part III, the doctrines announced in the leading cases are consistent with our approach. Hence the tools we propose could assist the courts in deciding antitrust cases without doing violence to established antitrust principles.

## I. A FORMAL ANALYSIS OF MARKET POWER

### A. Market Power and the Firm's Elasticity of Demand

A simple economic meaning of the term "market power" is the ability to set price above marginal cost. Under perfect competition, price equals marginal cost, so if a firm's price is above its marginal cost, the implication is that the firm does not face perfect competition, *i.e.*, that it has at least some market power. But the fact of market power must be distinguished from the amount of market power. When the deviation of price from marginal cost is trivial, or simply reflects certain fixed costs,<sup>5</sup> there is no occasion for antitrust concern, even though the firm has market power in our sense of the term.

Our concept of market power is illustrated in Figure 1 on the next page, where a monopolist is shown setting price at the point on his demand curve where marginal cost equals marginal revenue rather than, as under competition, taking the market price as given. At the profit-maximizing monopoly price,  $P^m$ , price exceeds marginal cost,  $C'$ , by the vertical distance between the demand and marginal cost curves at the monopolist's output,  $Q^m$ ; that is, by  $P^m - C'$ .

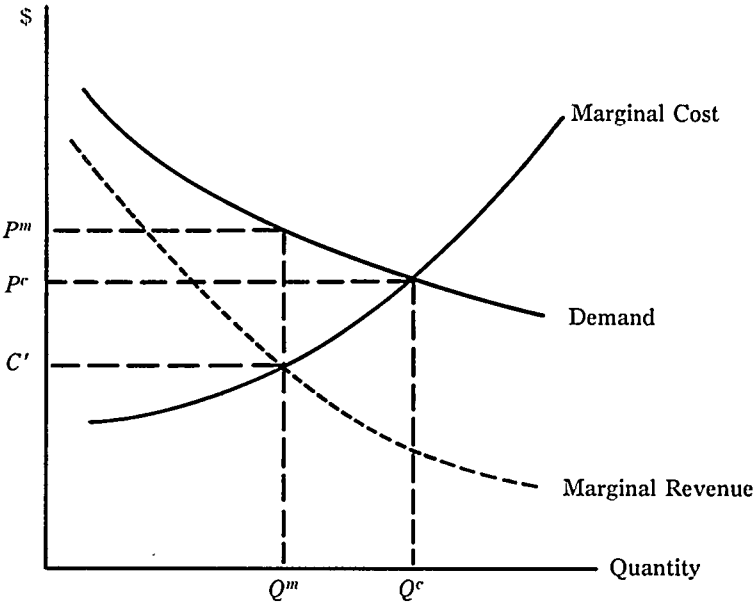
The concept of market power as the setting of price in excess of marginal cost is formalized in the "Lerner index," which measures the proportional deviation of price at the firm's profit-maximizing output from the firm's marginal cost at that output,<sup>6</sup> as in equation (1):

<sup>5</sup> See p. 957 *infra*.

<sup>6</sup> See, e.g., F. SCHERER, INDUSTRIAL MARKET STRUCTURE AND ECONOMIC PERFORMANCE 56 (2d ed. 1980). The Lerner index was first developed in Lerner, *The Concept of Monopoly and the Measurement of Monopoly Power*, 1 REV. ECON. STUD. 157 (1934). In Figure 1, the Lerner index would be  $(P^m - C')/P^m$ . The Appendix to this Article, p. 983 *infra*, derives the Lerner index mathematically from the assumption that firms are profit maximizers. The Appendix also analyzes another measure of market power, called the deadweight loss, and relates it to the Lerner index. Note that the "firm" in the Lerner index could be a group of firms acting like a single firm — a cartel or price-fixing conspiracy; whether it is realistic to use equation (1) to model cartel behavior is discussed at p. 951 *infra*.

$$L_i = (P_i - C'_i)/P_i = 1/\epsilon_i^d. \tag{1}$$

$L_i$  is the Lerner index for firm  $i$ ;  $P_i$  and  $C'_i$  are price and marginal cost, respectively, at the firm's profit-maximizing output; and  $\epsilon_i^d$  is the elasticity of demand facing the firm.<sup>8</sup> The Lerner index indicates the relative size of the monopoly overcharge. For example, if  $L_i = .5$ , the firm's price is double its marginal cost. Equation (1) not only defines market power



Monopoly vs. Competitive Pricing

FIGURE 1

To simplify our exposition, we ignore the case of natural monopoly, where marginal cost is below average cost at the intersection of the marginal cost and demand curves.

<sup>7</sup> Note that equation (1) can also be written as

$$P/C'_i = \epsilon_i^d / (\epsilon_i^d - 1), \tag{1a}$$

which is a more direct measure of the overcharge, but less convenient for use in our formal analysis.

<sup>8</sup> Elasticity of demand measures the responsiveness of quantity demanded to a change in price. Its technical meaning is explained in the Appendix. For present purposes, a sufficiently close approximation to that meaning is that it is the percentage change in quantity brought about by a one percent change in price. Thus, for example, an elasticity of demand of  $-2$  would mean that if price rose (or fell) by one percent, quantity demanded would fall (or rise) by two percent. The negative sign (often dropped for expositional simplicity) indicates that price and quantity demanded move in opposite directions — people demand less of a good when its price rises, and

but also asserts the dependence of the firm's market power on the elasticity of demand that faces it. If marginal cost were known, the Lerner index could be determined directly (assuming price is observable), without measuring the firm elasticity of demand. But because marginal cost is a hypothetical construct — the effect on total costs of a small change in output — it is very difficult to determine in practice, especially by the methods of litigation.

It should be noted that the Lerner index yields an upper estimate, rather than a precise estimate, of the proportional deviation of the monopoly from the competitive price. In a competitive market, price equals marginal cost. Thus, if the firm's marginal cost ( $C_i$ ) were constant in the relevant output range, an expansion of its output to the competitive level would make price ( $P^c$ ) equal  $C_i$  in equation (1). The Lerner index could then be written as  $L_i = (P_i - P^c)/P_i$ . However, because the output of a competitive industry is greater than that of a monopolist, and because in most markets marginal cost will increase as output increases, the competitive price will usually be greater than the marginal cost at the monopoly output. Hence the Lerner index will tend to overstate the proportional deviation of the monopoly from the competitive price.<sup>9</sup> Figure 1 shows this tendency graphically.

Equation (1) shows that the higher the elasticity of demand for the firm's product at the firm's profit-maximizing price, the closer that price will be to the competitive price, and the less, therefore, the monopoly overcharge will be. If the elasticity

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more of it when its price falls. An elasticity of 1 is said to be unitary; of below 1, inelastic; of above 1, elastic.

It is important to distinguish between *firm* elasticity of demand and *market* elasticity of demand. The first concept refers to the impact of change in price on the firm's demand, the second to the impact on the market's demand. Since the Lerner index is a measure of a firm's market power, the relevant elasticity is the firm elasticity of demand, for it is the response of the firm's output to a change in its price that determines the degree to which it has market power.

<sup>9</sup> To illustrate, suppose that under perfect competition firm  $i$  would produce 1,000 widgets and the marginal cost of the last widget would be \$10, but if only 950 are produced the marginal cost of the last widget will be \$6. Then if firm  $i$  were selling 950 widgets at \$12 each, the Lerner index would equal one-half, and if we used it to calculate the maximum overcharge resulting from  $i$ 's restriction on output we would estimate the monopoly overcharge at 50%, or \$6 per widget. Under perfect competition, however, 1,000 widgets would be sold at a price of \$10 each (equal to the marginal cost of the last widget at that level of output). Hence the net monopoly overcharge would be only \$2 per widget (the price charged, \$12, less the competitive price of \$10) rather than \$6. An implicit simplifying assumption in this example and our analysis in general is that the marginal cost curve does not depend on industry structure. Thus, the monopolist's marginal cost curve is assumed to be identical to what the industry supply or marginal cost curve would be if the industry were competitive.

of demand is infinite at the firm's profit-maximizing price, the Lerner index will equal zero and the "monopoly" and competitive price will be the same. This makes sense, for an infinite elasticity of demand means that the slightest increase in price will cause quantity demanded to fall to zero. In the opposite direction, the formula "comes apart" when the elasticity of demand is 1 or less.<sup>10</sup> The intuitive reason is that a profit-maximizing firm would not sell in the inelastic region of its demand curve, because it could increase its revenues by raising price and reducing quantity. Suppose, for example, that the elasticity of demand were .5. This would mean that if the firm raised its price by one percent, the quantity demanded of its product would fall by only one-half of one percent. Thus its total revenues would be higher, but its total costs would be lower because it would be making fewer units of its product. Raising price in these circumstances necessarily increases the firm's profits, and this is true as long as the firm is in the inelastic region of its demand curve, where the elasticity of demand is less than 1.<sup>11</sup>

If the formula comes apart when the elasticity of demand facing the firm is 1 or less, it yields surprising results when the elasticity of demand is just a little greater than 1. For example, if the elasticity of demand is 1.01, equation (1a) implies that the firm's price will be 101 times its marginal cost. There is a simple explanation: a firm will produce where its demand elasticity is close to one only if its marginal cost is close to zero, and hence a relatively low price will generate a large proportional deviation of price from marginal cost.<sup>12</sup>

<sup>10</sup> An intermediate step in the derivation of the Lerner index (*see* Appendix) is that  $P(1 - 1/\epsilon^d) - C' = 0$ . If  $\epsilon^d < 1$ , this would mean that  $P(1 - 1/\epsilon^d)$  was negative.  $P(1 - 1/\epsilon^d)$  is marginal revenue, and if negative could not equal marginal cost, which is positive. Thus, the firm would not be maximizing profits if it were operating where its demand was inelastic. To maximize profits, the firm would reduce its output (and thus raise its price) until it was operating in the region where  $\epsilon^d > 1$ . Hence the maximum value of the Lerner index is just below one.

<sup>11</sup> It may seem paradoxical that the profit-maximizing monopolist, no matter how great his monopoly, always faces an elastic demand. After all, the more elastic the demand, the less the firm's market power — why then is that power not maximized when demand is inelastic? It is true that if a firm faces an inelastic demand, it will raise its price; and the more inelastic the demand facing it, the higher it will raise its price. It will continue raising its price until it reaches a region of the demand curve where demand is elastic, and sooner or later any real-world demand curve must have an elastic region — otherwise the profit-maximizing price would be infinite.

<sup>12</sup> We are indebted to Robert Stillman for pointing this out to us. Since marginal revenue can be written as  $P(1 - 1/\epsilon^d)$ , marginal revenue will be near zero if  $\epsilon^d$  is close to one. And since the firm equates marginal revenue to marginal cost, the latter will also be near zero at the profit-maximizing output.

Such cases, although rare, are possible. For example, the marginal cost of using a patent might be close to zero, but the patent might confer substantial market power, in which event the ratio of price to marginal cost would be very high. In general, however, the very high multiples generated by firm elasticities of demand as they approach 1 from above are of theoretical rather than practical interest.

Finally, it should be noted that equation (1) assumes that the monopolist charges a single price. If he is able to price discriminate, he will group customers by their elasticities of demand for his product and charge a different price to each group based on each group's elasticity. The Lerner index for the price-discriminating firm will be a range of numbers rather than a single number.

Quite apart from these qualifications, the utility of the Lerner index as a measure of monopoly power may be questioned on the ground that for a firm to "use" the index, and hence for the index to predict correctly the price that the firm will charge relative to its marginal cost, the firm would have to know the elasticity of demand facing it at its profit-maximizing output. That output may be different from its current output; hence knowledge of the relevant elasticity may be hard to come by. Although most firms probably do not know the price elasticity of demand for their product at different outputs, they have a strong incentive at least to approximate, if only by a process of trial and error, the optimal output. Mistakes do happen, but the assumption that firms are generally both rational and well informed about the market conditions facing them seems more sensible than the contrary assumption.

More important is the difficulty that would face a court or an enforcement agency in estimating elasticities of demand for purposes of using our approach in antitrust enforcement and adjudication. We have written elsewhere of the practical difficulty of administering antitrust rules that require an explicit measurement of the elasticity of demand or supply.<sup>13</sup> While at first glance equation (1) appears to offer a shortcut to the determination of market power in an antitrust case, its crucial dependence on the firm's elasticity of demand makes its utility, as we shall see, primarily conceptual.

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<sup>13</sup> See Landes & Posner, *Should Indirect Purchasers Have Standing to Sue Under the Antitrust Laws? An Economic Analysis of the Rule of Illinois Brick*, 46 U. CHI. L. REV. 602, 619-20 (1979). We noted that the difficulties of estimation are particularly acute when the elasticity of demand and the elasticity of supply are being estimated for the same market.



### B. Relating Market Power to Market Share and Other Factors

Equation (1) shows that if the firm elasticity of demand is known, the firm's power to raise price above marginal cost can be computed without measuring its market share. However, market share enters into the computation of market power when, as is often the case, the firm elasticity of demand is unknown. The reason is that the firm elasticity of demand, and hence the firm's market power, can be derived by combining the firm's market share with other factors such as the market elasticity of demand.<sup>14</sup>

To show this concretely, we shall use the example of a single large or dominant firm (firm *i*) that faces competition in its sales from a fringe of domestic firms (called *j*), each with a trivial share of the market.<sup>15</sup> As we show later,<sup>16</sup> the analysis can be extended to other industry settings, such as where a cartel controls part of the market, or where the market is oligopolistic (in the sense of being dominated by a few large sellers rather than by just one). We assume initially that all the firms in the market produce the same product — *i.e.*, that there is no dispute over the definition of the relevant product market — and that transportation or other distance-related costs for the product are zero or negligible relative to its market price so that there is no dispute over the geographical market either.

The linkage between firm *i*'s market power and its market share can be derived from equation (2), which expresses the demand elasticity faced by firm *i* as a function of its market share ( $S_i$ ), the market elasticity of demand ( $\epsilon_m^d$ ), and the elasticity of supply of competing or fringe firms ( $\epsilon_j^s$ ):<sup>17</sup>

<sup>14</sup> For the distinction between firm and market elasticity of demand, see note 8 *supra*.

<sup>15</sup> It is impossible to be precise regarding the minimum share that is necessary to term firm *i* a "large" or "dominant" one. Although we use a figure of 80% in some of the later numerical calculations, a lower figure would be defensible; for example, Scherer uses a minimum share of 40%. F. SCHERER, *supra* note 6, at 232. What is critical is not that the dominant firm have a particular share but that each member of the fringe have a small share, implying that the fringe firms have little incentive to engage in strategic behavior and thus that each is a price taker. If the other firms are not price takers, our analysis is not directly applicable. The analysis can, however, be applied to a group of firms that do not compete with each other; this application is discussed later.

<sup>16</sup> See p. 951 *infra*.

<sup>17</sup> Elasticity of supply can be defined as the percentage increase in quantity supplied in response to a one percent change in price. It is positive (rather than negative, as is the elasticity of demand) because firms produce more when the market price is high.

$$\epsilon_i^d = \epsilon_m^d/S_i + \epsilon_j^s(1 - S_i)/S_i. \quad (2)$$

Since the Lerner index is simply  $1/\epsilon_i^d$ , we can substitute the right-hand side of equation (2) for  $\epsilon_i^d$  and express firm  $i$ 's market power as a function of its market share and the relevant demand and supply elasticities:

$$L_i = (P_i - C_i)/P_i = S_i/(\epsilon_m^d + \epsilon_j^s(1 - S_i)). \quad (3)$$

Several interesting implications follow from equations (2) and (3) (more transparently, perhaps, from the former):

1. *Market Demand Elasticity.* — The higher the market elasticity of demand ( $\epsilon_m^d$ ), other things constant, the higher will be firm  $i$ 's elasticity of demand (from equation (2)) and hence the closer will its price approach marginal cost at the profit-maximizing output. A high market elasticity of demand implies that there are good substitutes for the product the industry sells, and the existence of such substitutes limits the firm's market power.

2. *Fringe Supply Elasticity.* — The higher the elasticity of supply of the competitive fringe, other things constant, the higher the elasticity of demand facing firm  $i$  will be and hence the smaller its market power. A high supply elasticity means that a small price increase will lead to a large increase in the output of the competitive fringe.<sup>19</sup> Therefore, to maintain a given price increase, firm  $i$  must reduce its output by a greater amount the greater the supply elasticity of the fringe. At an extreme, if that elasticity were infinite in the relevant range, the elasticity of demand facing firm  $i$  would also be infinite and  $i$  would have no market power.<sup>20</sup>

<sup>18</sup> This formula, like the Lerner index, has long been a part of the industrial organization literature. See F. SCHERER, *supra* note 6, at 232-36; Stigler, *Notes on the Theory of Duopoly*, 48 J. POL. ECON. 521 (1940). For its derivation, see the Appendix.

Consistently with our earlier assumption that there are no exclusionary practices in this market, firm  $i$  is "passive": it does not attempt to drive the fringe out of business but instead sets its profit-maximizing output on the assumption that the fringe firms will produce where their marginal cost equals price. As we show later, however, exclusionary practices can be analyzed using the above formula since their effects will often show up in changes in market shares or supply elasticities. A second and related limitation of our analysis is that it is not dynamic: we ignore the possibility that the dominant firm will set a lower price today than given by the above formula, a price that by discouraging entry may allow it to sell at a higher price than otherwise in the future. See Gaskins, *Dynamic Limit Pricing: Optimal Pricing under Threat of Entry*, 3 J. ECON. THEORY 306 (1971).

<sup>19</sup> The supply elasticity of the competitive fringe is determined by both the ability of existing firms to expand output and the ability of new firms to enter the market.

<sup>20</sup> Theoretically, it is possible for firm  $i$  to have no market power even with a 100% market share, because the supply elasticity of potential competitors might be

3. *Market Share*. — Equations (2) and (3) show that the greater  $i$ 's market share at its profit-maximizing output, the smaller the demand elasticity facing it will be and the greater, therefore, its market power will be. This result comes about in two ways:

(a) *Effect in Relation to Market Demand Elasticity*. — If the firm's market share is large, the market price will rise proportionally more for a given reduction in its output. This makes it less costly for the firm to bring about a significant rise in price than if its market share were small. For example, in the simple case where the supply elasticity of competing sellers is zero, the firm elasticity of demand is simply the market elasticity of demand divided by the firm's market share.<sup>21</sup> Thus, if firm  $i$ 's market share is 50% and the market elasticity of demand is 1, firm  $i$  must reduce its output by 2% to raise price by 1%; but if firm  $i$ 's share is 90%, a reduction in its output of only a little more than 1% will raise price by 1%. The firm's demand elasticity is 2 in the former case and slightly more than 1 in the latter case, implying, plausibly, that more market power is conferred by a 90% market share than by a 50% market share.<sup>22</sup>

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infinite at a price slightly above that charged by firm  $i$ . As pointed out in P. SAMUELSON, *FOUNDATIONS OF ECONOMIC ANALYSIS* 79 (1947):

[T]he demand curve of any firm is equal to the demand curve of the industry minus the supply curve of the remaining firms, already in the industry or potentially therein. This being the case, it is easy to show that under uniform constant costs the demand curve for a firm is horizontal even though it produces 99.9 per cent of all that is sold[.] Geometrically, the long-run supply curve of potential rivals is horizontal, and a horizontal curve subtracted laterally from any curve must always yield a horizontal curve. Economically if the firm were to begin to restrict output so as to gain monopoly profit, it would cease to sell 99.9 per cent of the output or even anything at all. Consequently, it would not attempt to do so, but would find its maximum advantage in behaving like a pure competitor.

<sup>21</sup> See equation (2). The intuition behind this result is easily explained with an example. Imagine that the market elasticity of demand is 1 and that the firm has a market share of .5. The market elasticity figure means that if the quantity sold in the market fell from 100 to 99 units, the market price would rise by one percent. Therefore, the firm can cause a one percent increase in the market price by curtailing its output by one unit. But this is a two percent reduction in its output, since it produces 50 units. Hence the elasticity of demand facing the firm is 2, because it must reduce its output by two percent in order to raise the market price (and so its own price) by one percent. This elasticity, 2, is simply the market elasticity of demand, 1, divided by the firm's market share, .5.

<sup>22</sup> Assuming  $\epsilon_f^s = 0$ , then from equation (2) we have  $\epsilon_i^d = \epsilon_m^d/S_i$ . Hence, if  $\epsilon_m^d = 1$ , we have  $\epsilon_i^d = 2$  when  $S_i = .5$ , and 1.1 when  $S_i = .9$ . The assumption that  $\epsilon_f^s = 0$  is often useful in placing an upper bound on the monopoly overcharge. For example, if a firm controlling 50% of the market were alleged to be charging a price 100% greater than the competitive price, and the market demand elasticity were estimated to be 2, we would know the allegation was incorrect. The Lerner index in this case is only .25. This converts to a monopoly price 33.3% higher than marginal cost, and

(b) *Effect in Relation to Fringe Supply Elasticity.* — If competing sellers can expand their output in response to higher price — *i.e.*, if the elasticity of supply of the fringe is positive rather than zero — market share has additional significance in measuring market power. The smaller the market share of the competitive fringe, the smaller the increase in output of the fringe will be for any price increase (holding constant the fringe supply elasticity). Likewise, the smaller the increase in fringe output for a given price increase, the smaller will be the reduction in firm *i*'s output necessary to bring about that increase. Hence the demand elasticity for firm *i* will be lower the smaller the market share of the competitive fringe is. Intuitively, it is cheaper to raise price by curtailing output if fringe sellers have a lower market share since the same percentage increase by the fringe will yield a smaller absolute increase in their output.

4. *Market Share Alone Is Misleading.* — Although the formulation of the Lerner index in equation (3) provides an economic rationale for inferring market power from market share, it also suggests pitfalls in mechanically using market share data to measure market power. Since market share is only one of three factors in equation (2) that determine market power, inferences of power from share alone can be misleading. In fact, if market share alone is used to infer power, the market share measure in equation (2), which is determined without regard to market demand or supply elasticity (separate factors in the equation), will be the wrong measure. The proper measure will attempt to capture the influence of market demand and supply elasticity on market power.

Consider the following hypothetical examples:<sup>23</sup>

(a) *Substitutes in Consumption.* — Firm *i* produces widgets; gadgets are an excellent substitute for widgets, so that  $\epsilon_m^d$  in equation (3) is relatively high; and sales of widgets and gadgets are equal. Then even if firm *i*'s market share is large and competing sellers of widgets are unable to expand output ( $\epsilon_j^s = 0$ ), *i*'s market power may be slight. For example, if  $\epsilon_m^d = 10$  and  $S_i = .8$ , price would exceed marginal cost in equilibrium by 8%. The excess of price over marginal cost is identical when  $\epsilon_m^d = 1$  and  $S_i = .08$  (assuming firm *i* behaves like a dominant firm). Thus the degree of market power in this example for a firm with an 8% market share is identical to

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therefore at most 33.3% higher than the competitive price — even if the elasticity of supply of the competitive fringe is zero. With a positive supply elasticity the index would of course be even lower.

<sup>23</sup> The approach in these examples is similar to that in Fisher, *Diagnosing Monopoly*, Q. REV. ECON. & BUS., Summer 1979, at 7.

that of a firm with an 80% share in a different market, because of offsetting differences in demand elasticities. To avoid the absurd conclusion that the firm with the 80% share therefore has tremendous market power, one could redefine the product market to include both widgets and gidgets, on the theory that the high substitutability of gidgets for widgets limits *i*'s market power. With this modification, *i*'s share would fall from 80% to 40%, making market share a more accurate index of market power. This is in fact the usual approach in antitrust cases: before market shares are computed, commodities that are very good substitutes for each other are aggregated into a single product.<sup>24</sup>

(b) *Substitutes in Production.* — Suppose *i*'s market share of product *x* is 80%, and *x* and *y* are poor substitutes in consumption, but producers of *y* can, at low cost, switch production to *x*. For example, *x* might be residential buildings and *y* commercial buildings. Consumers cannot substitute between the two, but firms putting up commercial buildings have the equipment and skills necessary to construct residential buildings. Therefore, if firm *i* tried to raise the price of residential buildings above the competitive level, commercial builders would substitute toward residential construction. This would make *i*'s price increase less profitable. In terms of equation (3), *i*'s market power might be far less than its 80% share otherwise appeared to indicate, because the ability of producers of commercial buildings to switch easily to residential construction implies a high supply elasticity of fringe firms (*i.e.*, a high value of  $\epsilon_j^s$ ) in the latter market. In the absence of explicit elasticity estimates, the appropriate procedure in this case is to redefine the product market to include both residential and commercial construction. This will yield a market share below 80%, which will be a better (though not necessarily highly accurate) indicator of *i*'s market power.

(c) *Output of Fringe Firms.* — If *i*'s market share is 80%, consumers cannot easily substitute other goods, and producers of other goods cannot easily switch to the production of this good, *i* may still lack substantial market power. Suppose the output of competing producers of the good is highly responsive to changes in its price. If their marginal costs were constant,  $\epsilon_j^s$  would be infinite and *i*'s market power would be zero notwithstanding its 80% share. Without an explicit estimate of  $\epsilon_j^s$ , there may be no obvious adjustment in market share to take account of differences in supply elasticity. Market share

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<sup>24</sup> See, e.g., *United States v. E.I. du Pont de Nemours & Co.*, 351 U.S. 377 (1956), discussed at pp. 960-61 *infra*.

alone would be a poor measure of market power in such a case, at least in the long run.<sup>25</sup>

Some adjustments in market share may be possible even in this case. Suppose  $\epsilon_i^s$  is very high because competitors of  $i$  have substantial excess capacity. Perhaps an unanticipated technological change has left firms with considerable excess capacity even though demand has not expanded. Alternatively, a decline in demand may have left firms with excess capacity. Whatever the reason, suppose  $i$ 's production of some good is 80 and fringe firm production is 20, but fringe firms have the capacity to produce another 60 units without a significant increase in marginal cost. The excess capacity of the fringe firms would limit  $i$ 's efforts to raise price above marginal cost. To reflect this factor, one could redefine  $i$ 's market share as its current output divided by the sum of  $i$ 's output and the fringe firms' capacity (*i.e.*, by their potential, rather than current, output). This adjustment would reduce  $i$ 's market share from 80% to 50% and thereby provide a better measure of  $i$ 's market power.<sup>26</sup>

The above example suggests a general rule for computing market share: the sum of the capacity, or potential output, of competitors and the current output of the firm in question should be the denominator in computing the firm's market share. The greater the difference between capacity and current output, the greater is the supply elasticity of competing firms, and therefore the greater is the constraint that these firms place on a firm that tries to raise price above marginal cost. A qualification should be noted, however. When the incremental cost of converting excess capacity to output is greater than the

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<sup>25</sup> Since supply elasticities tend to be higher in the long than in the short run, market share is a better estimate of market power the shorter the run. We return to this distinction at p. 959 *infra*.

<sup>26</sup> Firm  $i$  may also have substantial excess capacity. This is not relevant to determining its market power but may have a bearing on  $i$ 's ability to engage in predatory tactics. For example,  $i$ 's excess capacity may make a threat to engage in predatory pricing to keep out new entrants more credible. On the other hand, new entrants probably would not find an industry operating at excess capacity an attractive one to enter even in the absence of predatory threats.

A further point should be noted. In the long run, the excess capacity of both  $i$  and the fringe firms will be retired, assuming no further technological changes or growth in demand, so that in the long run  $i$ 's market share may actually approach 80%. The fringe firms' temporary excess capacity serves nevertheless to constrain  $i$  in the short run; and in the long run, the elasticity of supply is apt to be high even if there is no excess capacity, simply because in the long run there is considerable production flexibility. We conclude, therefore, that capacity (potential output) should be included — when it is feasible to do so — in calculating market share. The qualification is important, since it may be difficult to determine how much if any capacity is really excess.

marginal cost of the last units actually produced, only so much of the excess capacity as can be converted to output without increasing marginal cost should be included in computing market share.<sup>27</sup>

(d) *Entry of New Competitors.* — Suppose firm *i* has 80% of the market, there are no good substitutes, and existing firms are currently operating at full capacity, but entry is relatively easy. It might be a mistake to conclude that firm *i* had market power. Suppose that in the previous decade there had been both a rapid expansion in demand and a lot of entry into the industry. Assume further that this entry was responsible for a fall in firm *i*'s market share from an original level of nearly 100% to its present 80% level. This suggests a high supply elasticity of the competitive fringe ( $\epsilon_f^s$ ) and therefore a high  $\epsilon_f^d$  in equation (3). Yet there is no ready adjustment to the market share measure of 80% that would show that firm *i* lacked market power.<sup>28</sup> Since in these circumstances market share is not a good measure of market power, we might want a rule that a finding of significant recent entry and output expansion negates an inference of market power based on market share alone. We could of course have used this approach in all the examples examined above. That is, the 80% market share of firm *i* could have been disregarded or downgraded, rather than recomputed, because of the existence of good substitutes in consumption or production, or excess capacity in the competitive fringe. But in the previous examples it was possible to do more than disparage the significance of market share; it was possible to make a more accurate computation. This will usually be infeasible in the last example.

In all of the examples, the effect of adopting the approach advocated in this paper was to reduce or eliminate the inference of market power drawn from market share data. This will probably be the result in most cases of using our approach, simply because exclusive and uncritical focus on market share data tends to produce an exaggerated impression of market power.<sup>29</sup> In some cases, however, our approach will result in

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<sup>27</sup> We emphasize again the information problem, *see* note 26 *supra*, that may make it infeasible in many cases to use capacity in calculating market shares.

<sup>28</sup> One possibility is to include the productive capacity, or part of it, of firms that could enter — if these firms could be identified. This is the procedure used in the commercial-residential building example discussed above, but it will often be infeasible because of — once again — lack of information.

<sup>29</sup> To be sure, this assumes that antitrust enforcers and factfinders would not want to intervene if a defendant did not have substantial market power. We think the assumption is correct, but recognize that those who want to intervene to correct trivial departures from perfect competition could derive support from the implication of the

correcting an underestimation of market power based on market share. Some illustrations are found in Table I in the next Part of this Article; we give one example here. Suppose firm  $i$  has only 40% of the widget market, but the demand for widgets is highly inelastic (suppose it is .5), the other firms in the market are price takers, and the elasticity of supply of the competitive fringe is very low (say .5) because of, say, government regulations requiring the licensing of new additions to capacity. In these circumstances, although firm  $i$ 's market share is well below the 60-70% range conventionally used in antitrust cases as the threshold for inferring monopoly power from market share evidence, firm  $i$  has in fact great market power as measured by the Lerner index. The firm elasticity of demand is 2, implying that the firm will set a price twice as high as the competitive price (see equation (1a)). An inference of monopoly power is warranted notwithstanding the firm's relatively modest market share.

5. *Application to Cartels and Oligopoly.* — Although we have explained the Lerner index and its relationship to market share in the setting of a large firm constrained by a competitive fringe, the analysis can be extended to other types of market structure. Consider a cartel or price-fixing conspiracy that has in the aggregate a large market share. If the cartel is able to enforce its cartel price and output allocation scheme among its members, it will behave as if it were a single large firm and the Lerner index will measure its market power. If, as is more likely, the cartel agreement is imperfectly enforced, output will tend to be greater and price lower, and the Lerner index will overstate the cartel's market power. Even here, our approach would be useful because it would place an upper bound on the cartel's market power.

Suppose there is no specific cartel agreement, but a small group of leading firms have a large market share in the aggregate. Although the formula for the firm elasticity of demand technically is inapplicable when there is interdependent behavior among the leading firms, one could use the formula to make a rough estimate of either the market power of the leading firms as a group or a change in their power brought about by a merger between a leading and a fringe firm. The tacit collusion, or oligopolistic interdependence, that many economists believe characterizes the relationship among leading firms in highly concentrated markets is analogous to express collusion and so to pricing by a dominant firm. There-

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Lerner index that even firms with small market shares in narrowly defined markets may have *some* market power.



fore, one can interpret the concentration ratio as a market share and compute the relevant Lerner index, which would again provide an upper estimate of the market power of the group of leading firms.<sup>30</sup>

## II. APPLICATIONS

This Part discusses some concrete uses to which the formal analysis developed in Part I can be put in antitrust litigation. Our discussion will incidentally help to elucidate further the limitations of the analysis.

### A. Market Power

We begin with two questions: (1) What level of market power (*i.e.*, what ratio of the firm's price to its marginal cost) must be attained for antitrust consequences to attach? (2) What weight should be ascribed to market share evidence when the elasticities in equation (2) cannot be quantified?

1. *Requisite Market Power.* — Lawyers often identify monopoly or market power with specific market shares. A monopoly "means" having 100% of a market or something reasonably close to it. But equation (2) makes clear that a given

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<sup>30</sup> A variant of this example deals with an industry consisting of  $n$  firms of equal size, *e.g.*, four firms each with a 25% market share, that are assumed not to collude even tacitly. The well-known Cournot model of the equilibrium in such a market yields a demand elasticity faced by each firm of  $n\epsilon_m^d$  or, equivalently,  $\epsilon_m^d/S_1$  since  $n = 1/S_1$ . Obviously, the fewer the firms, the greater the market share of each firm, and the smaller the demand elasticity. The Cournot solution is a special case of our analysis of a firm's demand elasticity since it assumes that each firm maximizes profits assuming that the output of all other firms is fixed (*i.e.*,  $\epsilon_j^s = 0$ ). Since, in general, firms will have upward-sloping supply curves, the Cournot solution would tend to understate a firm's demand elasticity and overstate its market power. The Cournot solution ( $\epsilon_j^d = n\epsilon_m^d$ ) implies that even if the market elasticity of demand is relatively high, and the number of firms is large, each firm will be able to charge a price above the competitive level. For example, if the market elasticity of demand is 2 and each firm has 10% of the market, price will be more than five percent higher than the competitive price. Yet most economists would expect a market having 10 firms of equal size to behave competitively. Even more dramatic results are derived if we assume a much lower market elasticity of demand — say 1/2 (there is nothing to constrain the market elasticity of demand to be above 1, as there is to constrain the firm elasticity of demand to be above 1). Then our 10% firm will be able to charge a price 25% above the competitive price.

But all that these examples really demonstrate is the importance of elasticity of supply as a check on market price. Where there is zero elasticity of supply — where competing firms cannot expand output at all — then a firm with a very small share of the market *can* raise the market price above the competitive level by curtailing its own output. (The only limitation on this policy is that the smaller the firm's market share, the less any proportional reduction in its output will raise the market price.) But once we admit the possibility that other firms can expand output as price rises, the market power of a small firm falls dramatically.

market share is neither necessary nor sufficient for a firm to be able to raise prices above the competitive level. The lower the market elasticity of demand and the lower the elasticity of supply of the competitive fringe, the smaller is the market share that will enable a firm to raise price substantially above the competitive level. In those cases (perhaps very few) where the market elasticity of demand and the elasticity of supply of the competitive fringe are known, equation (2) can be used to measure the firm's market power directly, and no market share criterion of market power is either necessary or appropriate. In such cases the question arises: What degree of market power should be deemed actionable?

The answer in any particular case depends on the interaction of two factors: the size of the market (total volume of sales) and the antitrust violation alleged. The first factor, which is usually neglected, is relevant because the actual economic injury caused to society is a function of not only the deviation between price and marginal cost but also the amount of economic activity over which the deviation occurs. If the amount of activity is small, the total social loss is small, and an antitrust proceeding is unlikely to be socially cost justified; this is especially true when the remedy sought (such as divestiture) involves heavy administrative and disincentive costs even in cases where the stakes to the parties are relatively modest. Incidentally, the relevant sales volume is not the defendant's, but the market's. To make a monopoly profit, the firm must raise the *market* price, because the same product will sell for the same price regardless of who produces it.

In giving weight to the size of the market, we may seem to be neglecting the deterrent effect of antitrust proceedings. The benefits of antitrust enforcement are not limited to the restoration of competitive conditions in the particular market in which the case is brought, but include deterrent effects in other markets. The existence of such deterrent benefits is an argument for occasionally bringing a suit against a small monopolist, so that other small monopolists will be deterred, even if most cases are brought against large monopolists. This point argues against announcing a threshold market size below which the exercise of monopoly power will be deemed lawful. But the size of the market is relevant to the benefits of enforcement action, so we think it useful, at least for purposes of designing internal enforcement agency guidelines, to suggest how it might be combined with other factors to yield such guidelines.

To do this, we must first pick some threshold below which the social costs of a firm's market power will be deemed insufficient to warrant legal proceedings (except perhaps in the

occasional case designed to deter the small monopolist). The determinants of these social costs are complex, and a number of simplifying assumptions must be made to derive a particular threshold. Our assumptions are the following:

1. The only social costs considered are the "deadweight loss" brought about by monopoly pricing. Deadweight loss is the loss of consumer and producer surplus when output declines from the competitive to the monopoly level; it is the most common measure of the social costs of monopoly.<sup>31</sup> We ignore possible distributional objections to monopoly, as both controversial and difficult to quantify.

2. The industry demand curve is linear.

3. The firm whose market power we seek to evaluate, firm *i*, has constant marginal costs.

4. The output of the competitive fringe is fixed (*i.e.*,  $\epsilon_j^s = 0$ ).

5. If a firm has a 70% market share in an industry that has \$100 million in annual sales, and the market elasticity of demand is 1, the resulting annual deadweight loss (\$24.5 million)<sup>32</sup> is sufficiently great to warrant legal proceedings.

These assumptions allow us, in Table I, to show how the market share threshold of 70% changes with changes in the size of the industry and in the market elasticity of demand. As the size of the industry increases, the market share that keeps the deadweight loss constant drops substantially. This relationship continues to hold, although at a higher level, when higher market elasticities of demand are assumed. Notice that

<sup>31</sup> Deadweight loss is explained more fully in the Appendix.

<sup>32</sup> We ignore the complications introduced by allowing the deadweight loss to vary over time, reflecting the fact that the elasticities of demand and supply are likely to be higher in the long than in the short run, *see* p. 959 *infra*, implying that the deadweight loss will fall over time.

The formula for the deadweight loss is

$$D = S_i^2 P \times Q / 2 \epsilon^d,$$

which is derived as follows. Since the Lerner index for firm *i* is  $(P - C')/P = S_i/\epsilon^d$ , we can write

$$D = 1/2(Q^c - Q)(P - C') = 1/2(S_i P/\epsilon^d)(Q^c - Q),$$

where  $Q^c$  is the competitive output. Observe that  $Q = Q_i + \bar{Q}_j$  where  $Q_i$  is *i*'s output,  $\bar{Q}_j$  is the fringe's output and  $Q < Q^c$ . With a linear demand curve, one can show that  $2Q_i + \bar{Q}_j = Q^c$ , and hence  $Q + Q_i = Q^c$ . Therefore  $(Q^c - Q) = Q(Q^c/Q - 1) = Q(S_i)$ . Substituting into *D* yields the formula above.

The Appendix explains the relationship between the Lerner index and the deadweight loss. Some scholars believe that the deadweight loss underestimates the social costs of monopoly, and that the sum of the monopoly overcharge and the deadweight loss would be a better measure. *See* Posner, *The Social Costs of Monopoly and Regulation*, 83 J. POL. ECON. 807 (1975). Table I could be modified to reflect this alternative measure, but its qualitative results would not be affected. As throughout this Article, we ignore any possible noneconomic objections to monopoly.

TABLE I  
MARKET SHARE VARIATIONS

$\epsilon^d$	$P \times Q$ (millions of dollars)			
	\$100	\$200	\$500	\$1000
1	.70	.49	.31	.22
1.5	.86	.61	.38	.27
2	.99	.70	.44	.31

Note: Deadweight loss is constant at \$24.5 million.

even if the leading firm had as little as 22% of sales, if the remainder of the industry were fragmented (so that each of the other firms acted as a price taker) the firm would have substantial market power, as in Table I, if our assumptions about the relevant elasticities (particularly that  $\epsilon_j^s = 0$ ) and the shape of the demand curve are correct.

The main point of Table I is the arbitrariness of basing judgments of legality on market share figures evaluated independently of the size of the market. If very high market shares are required to justify a finding of monopoly power in a small market, then a lower share should suffice in a large market. Conversely, if a very high market share is required for a finding of monopoly power in a large market, then in a small market a finding of monopoly power might never be appropriate.

The second factor that ought to affect the market power requirement in an antitrust case is the nature of the violation alleged. The relevance of the violation is twofold. First, it affects the costs of litigation because it determines both the amount of proof required for liability and the nature of the remedy.<sup>33</sup> Second, as a matter of law rather than economics, the degree of market power necessary to establish liability is different for different antitrust violations. For example, market power is not an element in a suit alleging illegal price fixing, although no damages could be proved if the conspirators have no market power. Conversely, not only is market power a necessary element of the monopolization offense under section 2 of the Sherman Act,<sup>34</sup> but the power must be substantial.

One could imagine a "sliding scale" approach in which the size of the market, as in Table I, would be combined with some ranking of offenses by the amount of market power

<sup>33</sup> For example, divestiture, the standard remedy sought (though rarely granted) in a government monopolization case, is a more costly remedy than a simple injunction or an award of damages. The costs are both administrative and incentive. See R. POSNER, *ANTITRUST LAW* 78-95 (1976).

<sup>34</sup> 15 U.S.C. § 2 (1976).

required. For example, in a tie-in case, where some market power is required,<sup>35</sup> but less than in a monopolization case, one could recompute Table I using a smaller deadweight loss as the basis for deriving threshold market shares in different sizes of industries. To do this, however, as to construct Table I itself, would require antitrust courts to think far more systematically about market power than they are accustomed to do. Accordingly, we think it premature to formulate a family of Table I's specifying thresholds of market power for each of the antitrust offenses. And we stress that the numbers used in Table I itself are arbitrary, as is the simplifying assumption that the elasticity of supply of the competitive fringe is zero. More thinking about the social costs of monopoly and market power is necessary before concrete deadweight loss minima can be specified for use in antitrust litigation and translated into market share thresholds.

Furthermore, to use some version of Table I either as an enforcement guide or actually to decide a case (rather than just for conceptual clarification) would require, besides agreement on deadweight loss minima for invoking antitrust remedies, information about demand and supply elasticities. And unfortunately, as noted earlier, these elasticities will rarely be known and are not easily determinable (at least by the methods of litigation), yet are indispensable to quantitative measures of market power. It may, however, be possible to estimate them in some cases; but then another difficulty arises, relating to the choice of the period of time in which to estimate the elasticity of demand and of supply. This problem is illuminated by Lester Telser's studies of brand elasticities of demand.<sup>36</sup> Telser estimated the elasticity of demand for various brands of frozen

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<sup>35</sup> The market power requirement in a tie-in case, which had seemed on the way out of antitrust law after *Fortner I*, was restored, though not clearly specified, in *Fortner II*. Compare *Fortner Enterprises, Inc. v. United States Steel Corp.*, 394 U.S. 495, 502-04 (1969), with *United States Steel Corp. v. Fortner Enterprises, Inc.*, 429 U.S. 610, 620 (1977).

There is a growing authority for requiring proof of substantial market power in a § 1 Rule of Reason case. See, e.g., *Gough v. Rossmoor Corp.*, 585 F.2d 381, 388-89 (9th Cir. 1978), cert. denied, 440 U.S. 936 (1979); *Northwest Power Prods., Inc. v. Omak Indus.*, 576 F.2d 83, 90-91 (5th Cir. 1978), cert. denied, 439 U.S. 1116 (1979); *Oreck Corp. v. Whirlpool Corp.*, 563 F.2d 54, 56 (2d Cir. 1977), *aff'd on rehearing en banc*, 579 F.2d 126, 130 n.5 (2d Cir.), cert. denied, 439 U.S. 946 (1978); *George R. Whitten, Jr., Inc. v. Paddock Pool Builders, Inc.*, 508 F.2d 547, 562 (1st Cir. 1974). But see *Eiberger v. Sony Corp. of Am.*, 622 F.2d 1068, 1081 (2d Cir. 1980); *Harold Friedman Inc. v. Thorofare Markets Inc.*, 587 F.2d 127, 143 (3d Cir. 1978). How substantial, as in the case of tie-ins, has not been specified clearly.

<sup>36</sup> These are summarized in L. TELSER, *COMPETITION, COLLUSION AND GAME THEORY* 274-306 (1972).

orange juice, coffee, beer, and other products. He estimated brand elasticities of between 1 and 15, with the majority falling in the 2.5 to 5 range. If Telser's figures were plugged into equation (1), which shows the ratio of price to marginal cost as a function of the firm elasticity of demand, they would imply that the sellers in the 2.5 to 5 range were charging prices between 25% and 67% greater than their marginal costs. Yet the modest rates of return and small market shares of these sellers suggest that they do not have such market power. Telser points out that the brands in his sample are the more successful ones, and hence the profits on them may offset the costs of unsuccessful brands developed by these same firms, with the result that overall each firm earns a modest rate of return. Another possible reconciliation of these facts with the Lerner index is that each seller in Telser's sample may have had an average cost greater than its marginal cost, and possibly equal to its price, because each may have incurred (fixed) costs to develop brands that would enjoy the strong consumer preference reflected in Telser's elasticity estimates. Even if firms succeed in reducing the elasticity of demand for their brands in this way, they will not have any monopoly profits if there is competition among the firms, and consumers will benefit from the better quality and greater variety of products. In these circumstances, mechanical application of the Lerner index would incorrectly suggest the existence of a monopoly problem.

In light of the problems involved in using elasticity estimates to measure market power, alternative approaches to measuring market power must be considered carefully. First, one might estimate the firm's marginal cost and compare that to the price it is charging. But, as mentioned earlier, the measurement difficulties of this approach are probably as great as those of estimating demand and supply elasticities. Another approach would be to use multiple regression techniques to determine the impact of market share on price. This approach would require that the firm in whose market power we are interested operate in different markets, or that its market share have changed over time. By regressing price on market share and other variables, it may be possible to ascertain the effect of a change in market share on price, holding other factors affecting price constant. But a complication is that market share is also determined by price. (More formally, market share and price are simultaneously determined.) For example, a firm whose costs fall relative to those of its competitors will tend to increase its market share. At the same time industry output will increase and price will fall. Hence we would

observe a negative relationship between price and market share, implying, incorrectly, that the firm has no market power. Nevertheless this technique of estimating market power is promising, but to explore and evaluate it would carry us beyond the feasible scope of the present Article.

2. *Adjusting Market Share to Infer Market Power.* — Assuming the only “hard” number in an antitrust case is likely to be the market share, is there still some way to use the basic approach illustrated by Table I? One possibility is not to define market power in terms of specific market shares at all, but instead to *interpret* the market share statistics in each case by reference to qualitative indicia of the market elasticity of demand and the supply elasticity of the fringe firms. If either the market elasticity of demand or the elasticity of supply were high (although no precise numbers could be attached to them), different inferences would be drawn from the defendant’s market share than if either or both of these elasticities were low.

Table II illustrates this approach. Suppose (purely hypothetically) that it has been decided that a firm operating in a market that has \$100 million in sales will be deemed to possess market power for purposes of some provision of antitrust law if the firm’s profit-maximizing price is at least 20% above the competitive price. What market share must it possess in order to charge such a price, under different assumptions concerning the market elasticity of demand and the supply elasticity of the competitive fringe? For illustrative purposes only, we define a high market elasticity of demand as 2.5 and a low one as 1, and a high elasticity of supply as 3 and a low one as .5; and we further assume (contrary to an earlier point) that the elasticities of market demand and supply are invariant to the market share of the competitive fringe. Now consider four cases: high market elasticity of demand — high supply elasticity (HH), high market elasticity of demand — low supply elasticity (HL), and so forth. Table II indicates for each of

TABLE II  
MARKET SHARE NECESSARY FOR FIRM TO  
CHARGE PRICE 20% ABOVE MARGINAL COST

Elasticities*	Share
HH	61%
HL	46%
LH	44%
LL	23%

\* See text for definition of terms in this column.

these cases what market share the firm must possess in order to have sufficient market power to charge a price at least 20% above marginal cost. When the elasticities of demand and supply are both high, a market share well above 50% is necessary to confer appreciable market power. When either demand or supply elasticity is low, a smaller market share confers the same power.

Before relating the numbers in Table II to specific provisions of antitrust law, we must specify the period over which we are estimating the elasticity of demand or of supply, because both elasticities vary with the time period under consideration. Both are higher in the long run than in the short run, because producers and consumers can adjust to changes in relative prices more completely if they have ample time to make the adjustment than if they are being asked to adjust instantaneously. The welfare effects of the elasticity measures that feed into Table II thus depend on the period for which the elasticity is computed. An elasticity of supply of .5 has quite different implications if the relevant period is one month than if it is ten years. In the former case, the social costs of monopoly pricing will be much less; indeed, they may be zero, because the expected profits of monopolizing may be less than the costs of changing price, in which event monopoly pricing will not be attempted.

The relevant period to be used in estimating the elasticity of demand and of supply is partly a function of the antitrust statute in issue. Section 7 of the Clayton Act,<sup>37</sup> for example, is primarily concerned with heading off long-term adverse trends in market structure. Therefore, in a section 7 case the relevant elasticities will be long-run elasticities, except in the rare case where a very large market share, implying a problem of supracompetitive pricing in the short as well as long run, is created by a (horizontal) merger (and such mergers can equally well be attacked under section 1 or 2 of the Sherman Act<sup>38</sup>). Similarly, the large costs and long delays involved in structural relief in monopolization cases argue for using long-run rather than short-run elasticities in section 2 monopolization cases. In other antitrust cases, a shorter run perspective seems appropriate, but rarely would the social costs of very short-run supracompetitive pricing be great enough to justify computing an elasticity of demand or supply for a period of less than a year from the date of the challenged conduct or transaction.

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<sup>37</sup> 15 U.S.C. § 18 (1976).

<sup>38</sup> *Id.* §§ 1-2.



Another possible approach to determining market power when elasticities are unknown is to use "guesstimates" of elasticities in defining the market in the first place. Here the adjustment for elasticities comes not after a market share is calculated but when the market is defined. This approach, illustrated in some of the examples in Part I, is further illustrated in our discussion of the definition of the geographical market below. It is in fact the dominant judicial method of taking account of elasticities of demand and supply.

### B. *The Definition of the Market*

As mentioned at the outset of this Article, the usual legal procedure in an antitrust case in which market power is at issue is first to define a relevant market, then to compute the defendant's market share, and finally to infer the presence or absence of market power from that share. It may seem that our formal analysis would provide no assistance with regard to the first step, since it takes for granted that a market has already been defined in which both the share of the firm alleged to have market power and the share of the competitive fringe can be calculated. In fact, the analysis illuminates several important issues in the definition of the market, which we discuss in this Section and the next.

1. Our approach helps expose the ambiguity of the Supreme Court's decision in the *Cellophane* case to define the market as flexible wrapping materials on the basis of evidence of a high cross-elasticity of demand<sup>39</sup> between cellophane and other flexible wrapping materials.<sup>40</sup> If high cross-elasticity of demand meant to the Court that the substitutability by consumers of other flexible wrapping materials for cellophane was so great that the demand elasticity faced by du Pont for cellophane was very high, then the Court was correct in defining the market as all flexible wrapping materials, because under these assumptions du Pont's market power was small.<sup>41</sup> This result

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<sup>39</sup> "Cross-elasticity" of demand refers to the effect on the quantity demanded of one product of a small change in the price of another product. A high cross-elasticity of demand implies that the products are good substitutes at the current price.

<sup>40</sup> See *United States v. E.I. du Pont de Nemours & Co.*, 351 U.S. 377, 399-400 (1956). For criticism, see R. POSNER, *supra* note 33, at 128; Turner, *Antitrust Policy and the Cellophane Case*, 70 HARV. L. REV. 281, 302, 309 (1956). Although our discussion focuses on the ambiguity in the Court's use of the concept of cross-elasticity of demand to determine du Pont's market power, other evidence in the case — in particular the relationship between the price of cellophane and its cost — indicates that du Pont did have monopoly power. See 351 U.S. at 420-21 & n.15 (Warren, C.J., dissenting). This is one case where the alternative approach to measuring market power of comparing price to marginal cost would have made sense.

<sup>41</sup> Using the Court's figure of a 17% share for du Pont in the flexible wrapping

is a variant of our example in Part I involving widgets and gidgets that were such good substitutes in demand that a widget producer's share in a market consisting of both products was a more accurate measure of market power than its share of the market for widgets alone. If, as seems more likely, the Court meant by a high cross-elasticity of demand only that there was some substitution between cellophane and other flexible wrapping materials *at the current price of cellophane*, the Court was making an economic error. Because every monopolist faces an elastic demand ( $\epsilon_i^d > 1$ ) at its profit-maximizing output and price,<sup>42</sup> there is bound to be some substitution of other products for its own when it is maximizing profits, even if it has great market power. If the Court's reference to the "high" cross-elasticity of demand between cellophane and flexible wrapping materials meant only that the demand elasticity *faced by du Pont* was greater than one, this high cross-elasticity, far from proving a lack of market power, was a necessary condition of market power.<sup>43</sup>

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material market, assuming a market demand elasticity ( $\epsilon_m^d$ ) equal to 1 and a fringe supply elasticity also equal to 1, and assuming du Pont behaved as a "passive" dominant firm,  $\epsilon^f$  would equal 10.8 ( $=1(1/.17) + 1(.83/.17)$ ), implying a price about 10% greater than marginal cost.

<sup>42</sup> See p. 942 & note 11 *supra*.

<sup>43</sup> The relationship between the demand elasticity for a product ( $x$ ) and the cross-elasticity of demand of other products with respect to a change in the price of  $x$  (holding real income constant) is given by

$$-\alpha_x \epsilon_x^d + \sum_{k=1}^n \alpha_k \epsilon_{kx}^d = 0,$$

where  $\alpha_x$  and  $\alpha_k$  ( $k = 1, \dots, n$ ) equal the share of products  $x$  and  $k$  in income,  $\epsilon_x^d$  is the demand elasticity for  $x$ , and  $\epsilon_{kx}^d$  is the cross-elasticity of demand for  $k$  with respect to a change in the price of  $x$ . See J. HENDERSON & R. QUANDT, *MICROECONOMIC THEORY* 31-33 (3d ed. 1980). Rewriting the above equation yields

$$\epsilon_x^d = \sum_{k=1}^n \alpha_k^* \epsilon_{kx}^d,$$

where  $\alpha_k^* = \alpha_k / \alpha_x$ . Thus the higher the cross-elasticities of demand, the higher the demand elasticity for product  $x$ , holding the  $\alpha_k^*$ 's constant. This provides an economic justification for the use of cross-elasticity of demand in discussions of market power: a high cross-elasticity does imply a high market demand elasticity for the product (unless  $\alpha_k^*$  is trivial) and therefore low market power. But no cross-elasticity was computed in *Cellophane*. Also, it is possible for  $\epsilon_x^d$  to be relatively high even though the various cross-elasticities are low (only if the  $\alpha_k^*$ 's are large). Since the effects of cross-elasticities and of the relevant weights ( $\alpha_k^*$ 's) ultimately show up in the market elasticities of demand, we prefer to focus our analysis on the latter elasticity. We recognize that courts frequently though loosely refer to the cross-elasticity of demand in discussions of market power. But this leads to the type of ambiguity noted in our discussion of *Cellophane*, which could be avoided by using elasticity of demand instead of cross-elasticity of demand as the ruling concept in antitrust cases.

2. From Part I we know that market definition is important in determining whether a firm has market power (and how much it has) only because of the difficulty of measuring elasticities of demand and supply reliably. If we knew the elasticity of demand facing firm *i*, we could measure its market power directly, using equation (1), without troubling ourselves about what its market share was. Less obviously, if we could readily determine market elasticities of demand (but not firm elasticities of demand), we would not have to worry about how broadly or narrowly the market was defined for purposes of using equation (2) to determine the firm elasticity of demand and hence the firm's market power. If the market were defined broadly — that is, if distant as well as close substitutes for firm *i*'s product were included in the market — *i*'s market share would tend to be small, but the market elasticity of demand would also tend to be low; so many substitutes would be included in the market that consumers would have difficulty substituting away from the market if market price rose. Hence a smaller number would be divided by a smaller number in the first term on the right-hand side of equation (2). If instead the market were defined narrowly, the firm's market share would be larger but the effect on market power would be offset by the higher market elasticity of demand; when fewer substitutes are included in the market, substitution of products outside of the market is easier.

Similar considerations come into play when we look at the market from the standpoint of substitution in production. If the market is defined without regard to the possibility of entry into the market by firms not now making the same product as firm *i*, then the market share of the competitive fringe will tend to be low but the elasticity of supply will tend to be high. This is because a slight price increase will not only stimulate additional production by the fringe, but also attract into the market any firm that can readily substitute this product for its current output.<sup>44</sup> Conversely, defining the market broadly to include producers of different products who could and would

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<sup>44</sup> A good example of products that are good substitutes in production is the copper and aluminum conductor involved in *United States v. Aluminum Co. of Am.*, 377 U.S. 271 (1964) (the *Rome Cable* case). The Court's failure to notice this is criticized in R. POSNER, *supra* note 33, at 130. The failure is all the more striking because the Court's opinion was by Justice Douglas, who writing the same year for the Court in *United States v. El Paso Natural Gas Co.*, 376 U.S. 651 (1964), included in the California natural gas market a firm not actually selling there, but that had made attempts to sell there.

There is a danger of defining the market so narrowly that *i* has 100% of it, in which event the effect of fringe producers on *i*'s market power would not register in an analysis of market power that utilized only equation (2); there would be no fringe.

make the product in question if its price rose even slightly will yield a higher market share for the competitive fringe but a lower elasticity of supply, again producing offsetting effects in equation (2). A price increase will now have a smaller effect in bringing in production from firms outside the market — the market is already defined to include those firms.

3. A potential pitfall should be noted: the market might be broadly defined from the consumer standpoint and then another product included in the market because its producers could make one of the products within the market as originally defined. Suppose that, for the purpose of estimating the market power of a manufacturer of office furniture, the relevant market is defined as office desks, tables, and filing cabinets. Firms that manufacture home furniture could easily manufacture office desks and tables but not filing cabinets. If the output of these manufacturers were included in the office equipment market, it would exaggerate the protection that consumers in that market obtain from the high cross-elasticity of supply between office and home desks and tables. Therefore, the courts should include in the market the output of products that are good substitutes in production but not in consumption only if the included manufacturers are capable of producing something like the full range of products included in the product market as originally defined.

### *C. The Definition of the Geographical Market*

1. *The Diversion Approach.* — Here we apply the principles discussed above to the definition of relevant geographical market in antitrust cases, arguing for a “diversion” theory of geographical market definition. We argue that if a distant seller has some sales in a local market, *all* its sales, wherever made, should be considered a part of that local market for purposes of computing the market share of a local seller. This is because the distant seller has proved its ability to sell in the market and could increase its sales there, should the local price rise, simply by diverting sales from other markets.

The formal analysis that leads to this result is somewhat complicated, and hence relegated to the Appendix. It involves showing that the supply response of the competitive fringe (here consisting of the distant sellers that have some sales in the local market in question) is an increasing function of the ratio of the distant sellers’ sales in their other markets to their sales in the local market. The higher that ratio, the higher their supply response will be, because it is easier for distant sellers to divert a small fraction of their output to the local

market should price rise there than it would be to divert a large fraction of their output to the local market. The simplest way to take account of the relationship between the distant sellers' sales in other markets and their supply response in the local market is to include those sales in the relevant market — in other words, to include in the local market the entire output of any seller who has some local sales.

This idea — that once a seller is included in the market because he makes some sales there, all his sales, wherever made, should be included — is not a new one, either in the cases (as we shall see in Part III) or in the scholarly commentary.<sup>45</sup> But we make the novel claim that a local seller's market power often can be estimated without examining the costs of transportation or other distance-related costs that sellers located in another state or country bear. The intuitive reason is as follows (the reader is again referred to the Appendix for a formal analysis). If the domestic producer has a net cost advantage over foreign producers whose total production is substantial relative to his own, his best strategy is to set a price just below the cost of those foreign producers in his market and thereby keep them out entirely. If he sets a price at which they can enter, they may flood the market and the domestic producer will lose so many sales that the higher price will be less profitable than a price at which foreign firms would not enter. If those firms can sell one unit of the product in the domestic market, they ought to be able to sell many units there at no appreciably higher cost, since they have only to divert output from other markets. It follows that if the domestic producer cannot keep foreign production out, then he cannot raise price without being inundated by such production.

What is important is thus not any transportation cost or other barrier that foreign producers may face but (1) the fact that they sell some output in the local market and (2) the size of their total output, wherever sold, relative to the size of the local market in question. The fact that they sell some output in the local market indicates that any transportation cost or other distance-related barrier has been overcome so far as that output is concerned. The size of their total output relative to the size of the local market indicates the probable ease with which they can expand their output in the local market without incurring substantially higher costs of production. This rela-

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<sup>45</sup> See, e.g., 2 P. AREEDA & D. TURNER, *ANTITRUST LAW* ¶ 523a (1978); R. POSNER, *supra* note 33, at 133; Elzinga & Hogarty, *The Problem of Geographic Market Delineation in Antimerger Suits*, 18 *ANTITRUST BULL.* 45 (1973).

tion is automatically captured by including their total output in the local market.<sup>46</sup>

Strictly speaking, the above analysis holds only if the foreign and domestic products are perfectly identical. Even slight differences might induce the domestic monopolist to set a price at which some imports occurred. For example, suppose that the domestic and foreign producers both have costs of production of \$100 per unit, but transportation and tariff barriers raise the foreign producers' costs of selling in the United States to \$150. Our analysis implies that the optimal strategy for the domestic monopolist would be to set its price a shade under \$150, since at that price the foreign producers are totally excluded whereas at any price above \$150 imports would flood into the market. But suppose that five percent of U.S. consumers are willing to pay \$3 more for the foreign product. To exclude foreign producers completely, the domestic monopolist would have to set a price below \$147. It may be more profitable for him to set a higher price (one just below \$150) and give up five percent of the market.

There are two ways to deal with this problem. One is to require, in the case of a differentiated product, that imports cross some percentage threshold of the domestic market before the entire output of importing foreign producers may be included in that market. The idea is that it would probably not be optimal for a domestic monopolist to set a price that surrendered a large market share to foreign competitors. The second response would be to allow the plaintiff to exclude foreign production upon a showing of very large transportation and/or tariff barriers not offset by lower costs of foreign production, implying that such imports as occur are due to consumer preference for a differentiated foreign product. Under either approach, even in the case of a differentiated product, foreign output would be presumptively includable in the domestic market upon a showing that foreign imports were occurring.

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<sup>46</sup> If the rule advocated in this subsection is adopted, domestic firms may be induced to set a price that just attracts slight imports into the market, so that the entire output of foreign producers will be included in the relevant market for purposes of determining the market shares of the domestic firms. Any legal rule creates a danger of strategic behavior. If 70% is the accepted threshold for a finding of monopoly power based on market share evidence alone, firms will have an incentive, as they approach that threshold, to raise price in order to avoid reaching it. Raising price to induce importation is just one way of staying below the threshold. We think it unlikely that firms would risk giving imports a foothold in their market merely to improve their litigating position in the event that a monopolization suit was brought against them.

The logic of including the distant sellers' total output in the local market implies the appropriateness of another step: including in the local market the total capacity (wherever located) of the distant sellers rather than their actual output. The justification for this procedure is identical to that given in Part I for including capacity in market share calculations. Unused capacity implies a high supply elasticity of the competitive fringe because such capacity can be brought into production promptly and with no increase in production costs; hence it is an effective constraint on the pricing of the local seller. (Of course, as noted earlier, it will not always be easy to determine what portion of a firm's unused capacity is really "excess" and so available to meet an increase in demand, as distinct from capacity that is needed as reserve capacity or that is obsolete and could be brought back into service only at high cost.)

The analysis in this Section applies, as our choice of terms suggests, to the case where the distant seller is foreign as well as to the case where it is located in another part of the United States. With the growing importance of foreign trade in the U.S. economy,<sup>47</sup> this point has fundamental importance for antitrust litigation. It suggests, as other economists have noted,<sup>48</sup> that in many industries market shares are systematically exaggerated because of exclusion of the output of foreign producers selling in the United States. To be sure, it is possible to argue that foreign imports are less certain than "imports" from another state or region of the United States. The reason is not that transportation costs are apt to be higher or that foreign imports are subject to tariffs while the states are forbidden to impose tariffs — transportation costs and tariffs are automatically reflected in our market power calculation — but that interruptions of foreign supply may be more likely than interruptions of domestic supply. While current tariff rates may allow foreign producers of a product to export it to the United States, an increase in those rates might price the foreign producers out of the market. Or the United States

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<sup>47</sup> Imports relative to GNP rose from a little over 3% in 1946 to more than 10% in 1978. The same phenomenon is observed even if one excludes the dramatic increase in the nominal value of oil imports that occurred after 1973. For example, by 1973 imports had already increased to more than 7% of GNP, and in real terms (*i.e.*, 1972 dollars) imports excluding oil increased from 3% to 7% of GNP between 1946 and 1978. See ECONOMIC REPORT OF THE PRESIDENT (1979) (tables B-1 and B-2). These tables also show that U.S. exports as a fraction of GNP increased only slightly between 1946 and the 1973-1978 period.

<sup>48</sup> See, *e.g.*, L. THUROW, *THE ZERO-SUM SOCIETY* 146 (1980); Weston, *International Competition, Industrial Structure, and Economic Policy*, in *WESTERN ECONOMIES IN TRANSITION* ch. 10 (I. Leveson & J. Wheeler eds. 1980).

might impose a quota that, by limiting the amount of foreign exports to the United States, prevented foreign producers from responding to a higher U.S. price by increasing their exports to the United States. But domestic supply is not so certain either. For example, a rise in fuel costs could, by increasing the cost of transportation, prevent domestic producers in one region from selling in another region of the country. Antitrust litigation would be unduly encumbered if it were a litigable issue whether distant sellers who are currently in the defendant's market will be there in the future.<sup>49</sup>

We suggest two qualifications to our proposal for including in the relevant market all of the (actual or potential) output of distant sellers who have some sales in the market, besides our earlier qualification concerning differentiated products. The first is to require that they have had nonnegligible sales in the market for a continuous period of several years. This is necessary to deal with the case where distant sellers make sporadic or insignificant sales in the market in question because of unusual perturbations of demand or supply (*e.g.*, the distant sellers might be dumping in the U.S. market as a byproduct of a cartel in their home market). This qualification would apply equally to distant sellers within the United States and in foreign countries.

The second qualification is important mainly for foreign sellers. Sometimes a foreign product will, at least in its initial distribution, reach just one of the coasts of the United States (the west coast, for Japanese and other Asian producers; the east coast, for European producers); domestic U.S. transportation costs will prevent it from reaching the interior markets of the United States or the other coast. These sellers should not be included in measuring the market power of firms selling to the interior markets or the other coast. This pitfall can be avoided simply by recognizing the two steps in defining any market: identification of a group of consumers large enough to be entitled to the protection of the antitrust laws, and identification of the sellers who can readily supply *this* group of consumers, which may not be a group located within easy reach of foreign suppliers. This point is similar to the earlier discussion of differentiated products.

The approach sketched in this Section will still tend to overstate market power in those cases where out-of-state or foreign producers do not sell in the market at present but could do so if price were even slightly above marginal cost.

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<sup>49</sup> On similar grounds Areeda and Turner conclude that foreign producers should in many cases be included in U.S. markets. We discuss their specific proposal at pp. 969-70 *infra*.



Their ability to sell in the market will not be registered in our market share computation.

2. *The Case of Exports.* — So far we have limited our analysis to the case where distant or foreign firms are selling in the local market; local firms were assumed not to sell abroad. This assumption allowed us to focus on the economic rationale for including foreign production in computing the domestic firm's market share. Suppose this restriction is removed, and the domestic firm is assumed to be selling abroad while foreign firms are no longer exporting to the United States. One can show that to derive the domestic firm's demand elasticity and hence its market power, (1) its exports and the production of foreign firms (provided the domestic firm sells in their markets) should be included in the denominator of the market share calculation, and (2) the domestic firm's exports should be part of the numerator of this calculation. The proof is in the Appendix; the intuitive explanation is as follows. Foreign production still constrains the domestic firm's market power<sup>50</sup> because an increase in foreign production would reduce the domestic firm's exports, which would in turn induce it to divert supply to its domestic market, thereby reducing price in that market. The domestic firm's exports also enhance its power in the local market. By reducing exports it could raise the price of its product abroad, and this would make diversion by foreign producers to the U.S. market less attractive and so make it easier for the domestic firm to maintain a high price in that market.

We noted earlier that concentration ratios could in some circumstances be treated as market shares for the purpose of obtaining an upper estimate of industry market power. Two studies of concentration suggest that existing methods of computing concentration ratios tend to be misleading because they fail to adjust for foreign trade.<sup>51</sup> The authors point out that concentration ratios are based on domestic production or shipments, but that some shipments are exported and hence not sold in the domestic market while some goods sold in the

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<sup>50</sup> If import controls in the U.S. market prevent foreign firms from exporting to the United States (e.g., there is an embargo on foreign goods), firm *i* might be able to set a monopoly price at home and export to foreign countries at a lower price. In this case, price in the domestic market is largely independent of variations in foreign production, and therefore the argument in the text regarding the inclusion of foreign production does not apply.

<sup>51</sup> See Marfels, *The Impact of Foreign Trade on Concentration Levels: Empirical Findings for Canadian Manufacturing Industries and for the Steel Industries of Four Countries*, 24 ANTITRUST BULL. 129 (1979); Sichel, *The Foreign Competition Omission in Census Concentration Ratios: An Empirical Evaluation*, 20 ANTITRUST BULL. 89 (1975).

domestic market are imported and thus not counted in domestic shipments. The authors recompute concentration ratios by eliminating domestic exports and including foreign imports. For example, if the four leading firms are shipping ten units abroad and there are twenty units being shipped in from foreign countries, they deduct the ten units from the four leading firms and add the twenty foreign units to the denominator to compute the four-firm concentration ratio. This procedure involves two errors. Exports of leading firms should not be excluded in calculating their U.S. market share, and foreign production of firms shipping to the United States (and possibly other foreign firms as well) should be included in the U.S. market. The ability of leading firms to export enables them to maintain a higher price in the domestic market, and the ability of foreign firms to divert supplies to the United States reduces the market power of the domestic firms.<sup>52</sup>

3. *The Areeda-Turner Approach Compared.* — In this subsection we compare our approach to the definition of the geographical market with that of Areeda and Turner in their influential treatise.<sup>53</sup> They would include the total output of a foreign producer who makes some sales to the United States — as we would — unless (and here is where their test differs from ours) (1) the product is regularly exported from the United States as well as imported, and (2) the sum of the foreign price and the transport and tariff costs of exporting it to the United States exceeds the domestic price. Areeda and Turner are concerned that the domestic and foreign products may differ in important respects although classified as one product for purposes of defining the relevant product market. If the domestic and foreign product were really identical, it would not be simultaneously exported and imported, because transportation costs would be minimized by having domestic demand satisfied to the extent possible by domestic producers, and foreign demand to the extent possible by foreign producers, before any exporting or importing occurred. Thus, if 1,000

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<sup>52</sup> This discussion has a bearing on the empirical studies of the relationship between profit rates and concentration ratios in the United States. (These studies are reviewed in F. SCHERER, *supra* note 6, at 267–95.) A serious problem in these studies is the use of concentration ratios based on domestic shipments only, but some of these studies have included a variable, such as imports, to approximate the degree of foreign competition. The most sophisticated, Marvel, *Foreign Trade and Domestic Competition*, 18 *ECON. INQUIRY* 103 (1980), uses a simultaneous equation technique to estimate the impact of foreign trade on U.S. rates of return and finds significant effects of foreign trade in constraining domestic rates of return. Our analysis indicates that it is not imports per se but foreign production (given a positive level of imports) that constrains domestic producers.

<sup>53</sup> See 2 P. AREEDA & D. TURNER, *supra* note 45, ¶ 523.

Rolls Royces are shipped to the United States from England, and 1,000 Cadillacs to England from the United States, Rolls Royces and Cadillacs cannot be perfect substitutes; if they were, the total costs of production and sale would be minimized by domestic consumption of each car. Similarly, if the foreign and domestic products were really identical, the delivered price of the foreign product in the United States could not exceed the price of the domestic product.

There are two ways of interpreting the Areeda and Turner proposal. The first is that they are unwilling to define a market as including a product plus its close substitutes unless the latter are perfect substitutes. But in our opinion the existence of some differences across brands does not warrant the exclusion from the market of distant sellers who have proved their ability to overcome the barriers of transportation costs and tariffs, especially since the producer of one brand of a product can often tailor the brand to the slightly different preferences of foreign consumers; the success of the Japanese automobile industry in serving the American market demonstrates this. If brand differences are so substantial, from the standpoint of both producer and consumer substitutability, that they warrant excluding foreign sellers, this can be done more directly by defining a narrower product market.

The second interpretation of their proposal is that they are concerned with the problem, discussed earlier, that even small brand differences can weaken or destroy an inference from the existence of positive imports that the domestic producers do not have market power. If this is their concern, however, then for reasons stated earlier foreign output should be excluded only if transportation and tariff barriers create a very large difference between the domestic and the foreign price, as in the numerical example we gave in discussing the problem of differentiated products.<sup>54</sup> If the difference is small, including the foreign output in the domestic market because there are some imports will not disguise the presence of substantial market power in the domestic producers. Thus, we consider our own proposal more responsive to the only serious problem of including foreign output that product differentiation creates.

4. *Comparison to Product Market Analysis.* — Our analysis of geographical market questions may seem inconsistent with our earlier criticism of the *Cellophane* decision.<sup>55</sup> If it was improper in that case to include in the market substitutes

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<sup>54</sup> See p. 965 *supra*.

<sup>55</sup> See pp. 960-61 *supra*.

that may have been attractive to consumers only because the market price was far above the competitive level, why is it proper to include imports that might likewise be attractive only because the local price is far above the competitive level?

In the geographical case, we reasoned that a rational profit-maximizing monopolist that had a cost advantage (whether due to transportation costs or other factors) over an out-of-state or foreign producer would normally not charge a price at which entry was possible. This was because if distant producers could sell one unit of output in the local market, they could sell a much greater quantity there simply by diverting output from their other markets and expanding their production slightly (assuming that the local market is small relative to their total sales). If distant sellers are selling in the local market, the demand elasticity faced by the local producer is likely to be high, and consequently there will be little market power.

The key to this conclusion, however, is the assumption in our model that the distant sellers are sellers of the *identical* product. That is why only a cost disadvantage can keep them out of the market. When the question is instead whether to include different products in the same product market, merely observing that a different product is a good substitute at the current price for the product of firm  $i$  does not necessarily warrant a conclusion that the demand elasticity faced by firm  $i$  is high. Du Pont may have charged such a high price for cellophane that some consumers switched to aluminum foil or even coarse wrapping paper, but for many other consumers, having different demands, these substitutes must still have been poor even at the high price of cellophane. The monopolist who charges a single price necessarily loses marginal customers, those for whom other products are pretty good substitutes at prevailing prices. But so long as his other customers do not regard other products as good substitutes, the monopolist will face a demand curve having a low elasticity (though still greater than 1), and price will be substantially above the competitive price.

In the case of distant sellers of the same product, there is no distinction between the marginal and intramarginal purchaser; since the products are identical, each purchaser is as satisfied with the distant as with the local seller's good. While the seller of the substitute product may be competing only for the marginal purchaser, the distant seller of the identical product is competing for *all* the local seller's customers. When the foreign and domestic products are not identical, then a *Cello-*

*phane*-case type problem can arise in geographical market definition cases, and we have suggested a method of adjusting our approach to deal with the problem there.

#### D. Merger Cases

In some merger cases, proof of (a low level of) market power plays the same role as in a tie-in, monopolization, attempted monopolization, or section 1 Rule of Reason case: it is a threshold condition. This is true in vertical, conglomerate, and potential competition cases as well as horizontal merger cases, but the effect of such mergers is not to alter market shares. (In the potential competition category, the effect, if any, is to alter the elasticity of supply.) A horizontal merger alters market shares, and this effect can be analyzed by our formal apparatus. The analysis focuses not on the market power of the firms as such, but on the increase in market power caused by the merger.

To show the incremental effect on market power of a change in market shares brought about by combining two previously independent competitors, we write

$$\frac{P_1 - P_0}{P_0} = \frac{S_1 - S_0(\epsilon_m^d + (1 - S_1)\epsilon^s)/(\epsilon_m^d + (1 - S_0)\epsilon^s)}{\epsilon_m^d + (1 - S_1)\epsilon^s - S_1}. \quad (4)$$

The subscripts "0" and "1" indicate the before-merger and after-merger states respectively — *e.g.*,  $P_0$  and  $P_1$  refer to the market prices before and after the merger.<sup>56</sup>  $S_0$  is the share of the larger of the two firms and  $S_1$  indicates the combined share of the two firms after their output has been adjusted to reflect the merger. Since the competitive fringe will expand output in response to the price increase and the merged firm will reduce output, the market share of the merged firm will be less than the combined market share of the two firms before the merger. Thus  $S_1$  cannot be computed simply by summing the premerger shares. To illustrate, suppose that the acquiring firm has 20% of the market and the acquired firm 10%, the market elasticity of demand is 2, and the elasticity of supply

<sup>56</sup> Equation (4) is derived as follows. We showed earlier that the equilibrium ratio of price to marginal cost,  $P/C'$  is  $\epsilon^d/(\epsilon^d - 1)$ . Assuming  $C'$  is unaffected by the merger,  $C'$  cancels out and we have

$$\frac{P_1 - P_0}{P_0} = \frac{\epsilon_1^d/(\epsilon_1^d - 1) - \epsilon_0^d/(\epsilon_0^d - 1)}{\epsilon_0^d/(\epsilon_0^d - 1)}$$

Assuming that the market demand elasticity and the fringe firm supply elasticity are unchanged and constant, we then substitute these elasticities and market shares for  $\epsilon_1^d$  and  $\epsilon_0^d$  and simplify to obtain equation (4).

of the other firms in the market is 1. Plugging the values into (4) yields the result that the merger will enable the acquiring firm to increase the amount by which its price exceeds its marginal cost by 4.5%. This overstates the percentage increase in price made possible by the merger, however, because the market share of the merged firm will be less than 30% at the new equilibrium. But if we assume that  $\epsilon^s = 0$  (in a short-run analysis, fringe firms might not be able to expand output), the market share of the merged firm would equal 30%; equation (4) would simplify to  $(S_1 - S_0)/(\epsilon_m^d - S_1)$ ; and our estimate of the increase in market power would rise to 5.9%. We could elaborate a counterpart to Table II showing the conditions under which a merger involving given market shares generated an increase in market power that would be deemed substantial under the applicable legal standard.

There are two limitations to the use of our formal apparatus in this way. First, we have assumed that marginal cost and competitive price remain unchanged; but a merger could lower both by enabling economies of scale (or other efficiencies) to be achieved more rapidly than would happen without the merger. There is a simple test, in principle, for comparing an increase in efficiency with an increase in market power. When economies of scale dominate, the market shares of the firm resulting from the merger will be greater than the sum of the shares of the acquiring and acquired firms. When an increase in market power dominates, the resulting firm's share will be smaller.<sup>57</sup> Of course, this test cannot be used in a proceeding to enjoin a merger before it takes place; and its use even in cases involving consummated mergers is of doubtful utility since the merged firm may deliberately keep price low during the pendency of the merger case in order to pass the test.

A more important limitation of the use of equation (4) is that it assumes (as we have generally done in this Article) that the firm resulting from the merger does not collude with the other firms in the market; that any market power it exercises is strictly unilateral. But a horizontal merger is more likely to facilitate collusion by reducing the number of firms that must agree for collusion to be effective, and thus the transaction costs of agreement, than it is to create a dominant firm or to enhance the power of such a firm; and this effect is not cap-

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<sup>57</sup> If economies of scale dominate, price will fall and quantity sold will increase. Since a lower price will induce fringe firms to reduce their output (or possibly to leave it unchanged in the short run), the merged firm must expand its output; hence its market share will rise. If an increase in market power dominates, price will increase and quantity sold will decrease. Since fringe firms will expand (or at least not contract), the acquired firm will reduce its output and its market share will fall.

tured in our formal apparatus. The omission is particularly significant when a merger enables a market to move from competition to collusion. Imagine that before our 20% firm acquired a 10% competitor, the market was competitive and there was accordingly no deviation of price from marginal cost, but that the merger enabled the firms in the market to collude — and so effectively that now they act as a single firm. Then the relevant market share, so far as application of equation (4) is concerned, is zero before the merger and 100% after, and the merger brings about an increase in the market price from the competitive level to twice the competitive level.

Our analysis may still be useful in the horizontal merger context. First, some horizontal mergers may be so large that they create market power in the sense captured by our analysis: the power to raise price without collaborating with (or intimidating) other firms. Indeed, when a firm is accused of monopolizing and the only significant monopolizing practice alleged is mergers (as in the old U.S. Steel monopolization case<sup>58</sup>), our analysis, or something akin to it, is a necessary foundation for a finding of violation. Second, the analysis is useful in suggesting that in the ordinary merger case, involving moderate market shares, the legal inquiry should be directed to the probable effect of the merger (if any) in facilitating collusion; it is unlikely to have a substantial effect on the unilateral market power of the resulting firm.

### *E. Injury and Damages*

In private antitrust cases, particularly when damages are sought, the plaintiff must prove that he was hurt by the antitrust violation, and (in a damages case) he must actually quantify his damages. The formal apparatus elaborated in this paper provides a mechanism for establishing the fact and amount of injury in any case where the injury is alleged to occur through the exercise of market power. Thus, if a buyer complains that his seller violated section 2 of the Sherman Act<sup>59</sup> by monopolizing, he is alleging implicitly that the seller did something to increase his market share, to reduce the market elasticity of demand, or to reduce the elasticity of supply of fringe firms. If the effect can be quantified, the resulting overcharge to the buyer can be “read off” from equation (4).<sup>60</sup>

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<sup>58</sup> See *United States v. United States Steel Corp.*, 251 U.S. 417 (1920). Some price fixing was also alleged, but had ended before suit was brought. See *id.* at 444-46.

<sup>59</sup> 15 U.S.C. § 2 (1976).

<sup>60</sup> Since equation (4) is used to measure the effect on price of a change in market

Similarly, in a case where the plaintiff is complaining about a price-fixing conspiracy, damages can be computed by assuming that the members of the conspiracy act as a single firm and then applying equation (3); the combined market share of the members would be the market share of the "firm" whose market power we were measuring. But in this case, as noted earlier,<sup>61</sup> our approach will tend to exaggerate the market power of the conspiracy, and hence the damages to buyers. To the extent that conspirators act not as a single firm, but one or more "cheats" on the others by shading price and raising output, the conspiratorial group will produce more than the profit-maximizing output and the overcharge will be lower than equation (3) will estimate. This is a serious problem, but it can be overcome by using equation (3) only to place an upper bound on the damages from a price-fixing conspiracy. Suppose, for example, that the plaintiff claims that the price fixers doubled the market price, but application of equation (3) shows that even if the conspirators had acted as a single firm the market price would have increased by only 10% because of their small combined market share, a high market elasticity of demand, a high elasticity of supply of the fringe firms, or a combination of these conditions. Then we would know that the plaintiff's damage claim was excessive.

#### F. Market Power in Regulated Industries

In view of the growing importance of antitrust enforcement in regulated industries, we shall note briefly the significant limitations of our formal analysis when applied to a market in which rates are regulated by a government agency. To the extent that regulation is effective, its effect is to sever market power from market share and thus render our analysis inapplicable. This is obviously so when the effect of regulation is to limit a monopolist's price to the competitive price level. A subtler effect should also be noted, however. Regulation may increase a firm's market share in circumstances where only the appearance and not the reality of monopoly power is

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shares ( $S_1$  compared to  $S_0$ ), it would have to be modified slightly to estimate the effect on price of changes in market demand elasticity ( $\epsilon_m^d$ ) or the fringe supply elasticity ( $\epsilon^s$ ). For example, if firm  $i$  is accused of reducing  $\epsilon^s$ , then

$$\frac{P_1 - P_0}{P_0} = \frac{S - S(\epsilon_m^d + (1 - S)\epsilon_i^s)/(\epsilon_m^d + (1 - S)\epsilon_0^s)}{\epsilon_m^d + (1 - S)\epsilon_i^s - S}$$

where  $\epsilon_0^s$  and  $\epsilon_i^s$  denote the fringe firm supply elasticities before and after the alleged act. If  $S = .3$  and  $\epsilon_m^d = 2$ , and it is alleged that  $\epsilon^s$  has been reduced from 1 to 0, then price would increase by about seven percent.

<sup>61</sup> See p. 951 *supra*.



created thereby. For example, in many regulated industries firms are compelled to charge uniform prices in different product or geographical markets despite the different costs of serving the markets.<sup>62</sup> As a result, price may be above marginal cost in some markets and below marginal cost in others. In the latter group of markets, the regulated firm is apt to have a 100% market share. The reason is not that it has market power but that the market is so unattractive to sellers that the only firm that will serve it is one that is either forbidden by regulatory fiat to leave the market or that is induced to remain in it by the opportunity to recoup its losses in its other markets, where the policy of uniform pricing yields revenues in excess of costs. In these circumstances, a 100% market share is a symptom of a lack, rather than the possession, of market power.

Notice in this case that the causality between market share and price is reversed. Instead of a large market share leading to a high price, a low price leads to a large market share; and it would be improper to infer market power simply from observing the large market share. This problem of reverse causality is not limited to the regulated industries. The firm that by dint of cutting costs and price obtains a large market share should not be condemned as an unlawful monopolist. It should always be open to a defendant in an antitrust case to rebut an inference of market power based on market share by showing that its market share is the result of low prices. Otherwise the approach suggested in this paper could lead to perverse results.

### III. THE CONGRUENCE OF THE LEGAL AND ECONOMIC APPROACHES

In Part II we tried to show how the formal apparatus for the analysis of market power developed in Part I could be used concretely in resolving antitrust issues and cases. It might be argued, however, that the approach sketched in Part II is so remote from existing judicial approaches to questions of market power that it could be adopted only by amending the antitrust laws. We disagree. While no court has explicitly used the formulas developed in Parts I and II, the approach taken to market power questions in the leading cases suggests that the courts may welcome the assistance that our analysis can provide.

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<sup>62</sup> See, e.g., Posner, *Taxation By Regulation*, 2 BELL J. ECON. & MANAGEMENT SCI. 22 (1971).

The first point to be noted is the extreme fluidity of anti-trust doctrine because of the Supreme Court's willingness to reexamine precedent and because of the explicit invitation to use economic analysis to guide antitrust decision that the Court recently extended in the *Sylvania* decision<sup>63</sup> — itself a case overruling a recent and important Supreme Court precedent.<sup>64</sup> The second point to be noted, and the one we shall develop here, is that the approaches to market power and related issues in the principal judicial decisions dealing with market power questions are compatible with the analysis in this Article. This is not to say that all or even most antitrust decisions turning on market power questions have analyzed those questions correctly or reached the correct results; but the broad doctrines laid down by the courts to deal with these questions are consistent with our suggested approach.

We begin with the authoritative judicial definition of market power set forth in *Cellophane*: "the power to control prices or exclude competition."<sup>65</sup> The first part of this definition seems equivalent to the economic definition of market power, which formed the first step in our formal analysis. The second is puzzling. The Court may just have been making the corollary point that any firm that has and exercises the power to raise price above the competitive level must also be able to exclude entrants; otherwise it would not be able to maintain the higher-than-competitive price. Or the Court may have been making the point that the firm with market power could, by reducing its price to the competitive level, exclude firms whose costs were higher than the competitive price — inefficient firms that might be attracted into the market by the "umbrella" that a monopoly price holds over the competitive fringe in the market. Finally, the Court may have had in mind the exclusion of equally or more efficient competitors through predatory pricing or other exclusionary practices — a dimension of the monopoly problem to which our analysis does not speak directly.

We noted earlier that in applying its market power criteria to the facts of *Cellophane*, the Court stumbled by not recognizing that a monopolist will maximize profits by operating in that region of its demand curve (elasticity greater than 1) where substitutes will tend to be available.<sup>66</sup> That aspect of the

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<sup>63</sup> *Continental T.V., Inc. v. GTE Sylvania, Inc.*, 433 U.S. 36 (1977), discussed in Posner, *The Rule of Reason and the Economic Approach: Reflections on the Sylvania Decision*, 45 U. CHI. L. REV. 1 (1977).

<sup>64</sup> *United States v. Arnold, Schwinn & Co.*, 388 U.S. 365 (1967).

<sup>65</sup> *United States v. E.I. du Pont de Nemours & Co.*, 351 U.S. 377, 391 (1956).

<sup>66</sup> See pp. 960-61 *supra*.

decision is no longer authoritative. The Court subsequently explained that within the kind of broad market found in the *Cellophane* case there might be narrower submarkets that were also relevant markets for antitrust purposes.<sup>67</sup> The concept of submarkets has been criticized, but the problem is more with the application of the concept than with the concept itself. Viewed merely as a corrective to the Court's excessively broad market definition in the *Cellophane* case, the submarket concept is harmless. Indeed, it is consistent with the analysis of market definition and market power in Part II of this paper. We pointed out that there is a range of possible markets of varying breadth that can be used in an antitrust case. A broad market is one in which distant substitutes for the product of the firm whose market power we are trying to measure are included. A narrow market is one where only close substitutes are included. The choice is largely immaterial<sup>68</sup> so long as it is recognized that the market elasticity of demand varies inversely with the breadth of the market. If all the submarket approach signifies is willingness in appropriate cases to call a narrowly defined market a relevant market for antitrust purposes, it is unobjectionable — so long as appropriately less weight is given to market shares computed in such a market. This qualification is vital and has unfortunately escaped the explicit attention of the courts. It could be incorporated into their analysis without fundamentally altering their approach, and it should be. When the only fact known about market power in a particular case is market share, the danger is acute that if a submarket approach is used the finder of fact will exaggerate the defendant's market power. But if the elasticity of demand and supply can be estimated (even if only roughly), then, as emphasized repeatedly in this Article, it is unimportant whether the market is defined broadly or narrowly.

The qualification has long been implicit in the better reasoned judicial decisions on market power. An example is Judge Hand's opinion in *Alcoa*, which contains a prescient discussion of how foreign production of aluminum — even the foreign production not sold in the United States — nevertheless constrained the market price of aluminum in the United States.<sup>69</sup> Hand decided not to include that production in the

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<sup>67</sup> See, e.g., *Brown Shoe Co. v. United States*, 370 U.S. 294, 325 (1962). The submarket approach is applicable not only to merger cases such as *Brown Shoe*, but to any antitrust case in which market power is in issue. See *United States v. Grinnell Corp.*, 384 U.S. 563, 572-73 (1966) (Sherman Act).

<sup>68</sup> But it is not entirely immaterial, for the reason explained in note 44 *supra*.

<sup>69</sup> See *United States v. Aluminum Co. of Am.*, 148 F.2d 416 (2d Cir. 1945). Judge Hand noted the following

U.S. market.<sup>70</sup> But earlier in the opinion he had announced a stringent market share criterion for monopoly power, remarking that while 90% would suffice to show monopoly power, even a share as high as 64% might not suffice.<sup>71</sup> He may have realized — though this is pure conjecture on our part — that since he was defining the market narrowly, the market share criterion of monopoly power had to be higher than if a broad definition of the market had been employed. If so, his opinion is in the spirit of our analysis.

So is the recent trend toward regarding market share statistics in merger cases as providing merely presumptive evidence of market power, which can be rebutted by bringing in other factors.<sup>72</sup> As our analysis shows, market share is only one factor bearing on market power. The others — the market elasticity of demand and the elasticity of supply of the competitive fringe — may not be precisely determinable by the methods of litigation, but it does not follow that they should be ignored. The presumption approach that has been gaining increasing judicial favor provides a technique by which the weight given to market shares can be adjusted upward or downward in response to evidence (mainly qualitative) regarding the critical elasticities.

An alternative to the presumption approach that is more in keeping with this Article's emphasis on trying to find the economically most meaningful method of market share calculation for the particular case is illustrated by the facts of *General Dynamics*.<sup>73</sup> The case involved the acquisition by the defendant, a coal producer, of a competing coal producer, United Electric. The combined market shares of the two firms

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distinction between [Alcoa's] domestic and foreign competition: the first is limited in quantity, and can increase only by an increase in plant and personnel; the second is of producers who, we must assume, produce much more than they import, and whom a rise in price will presumably induce immediately to divert to the American market what they have been selling elsewhere.

*Id.* at 426.

<sup>70</sup> Hand's remark "we must assume" suggests he may not have had the necessary data for computing Alcoa's market share on the assumption that all foreign production of aluminum, and not just that imported into the United States, should be included in the market. As a detail, we note that 90% of the aluminum imported into the United States was produced by a Canadian firm one-half of whose common stock was owned by 11 shareholders who also owned one-half of Alcoa's common stock. See M. PECK, *COMPETITION IN THE ALUMINUM INDUSTRY, 1945-1958*, at 9, 19-20 (1961).

<sup>71</sup> 148 F.2d at 424.

<sup>72</sup> The leading cases are *United States v. Citizens & Southern Nat'l Bank*, 422 U.S. 86, 120 (1975); *United States v. Marine Bancorporation*, 418 U.S. 602, 631 (1974); *United States v. General Dynamics Corp.*, 415 U.S. 486, 497-98 (1974). See generally 4 P. AREEDA & D. TURNER, *supra* note 45, ¶¶ 908-915 (1980).

<sup>73</sup> *United States v. General Dynamics Corp.*, 415 U.S. 486 (1974).

ranged from 11% to 23% in the various allegedly relevant geographical markets, with United's share ranging from 4% to 9%. However, "[a] more significant indicator of a company's power effectively to compete with other companies" than its current sales, the Court pointed out, "lies in the state of a company's uncommitted reserves of recoverable coal."<sup>74</sup> United had less than 1% of the reserves held by coal producers in Illinois, Indiana, and western Kentucky, and many of these reserves "had already been depleted at the time of trial."<sup>75</sup> For these and other reasons the Court refused to infer market power from the market shares of the merging firms. An alternative approach would have been to compute market shares in terms of reserve holdings, on the ground that these were more significant indicators of competitive potential than current sales. Had the Court followed this approach, it would have decided the case the same way, but without having to go beyond market shares.

Similarly, in the *El Paso* case,<sup>76</sup> an alternative to treating the acquired pipeline company as a potential competitor would have been to include in the California market all pipeline companies that had bid for contracts to supply natural gas to that market even if, like the acquired firm, they had been unsuccessful. The bidders defined the universe of firms capable of supplying that market, and the market shares (presumably large) of the acquiring and acquired firm so computed would have been a fair indication of the market power created by the merger. A nebulous "potential competition" merger would have been converted into a standard horizontal case.

The consistency of the economic and legal approaches is further illustrated by the *Tampa Electric* case, an influential decision on definition of the geographical market.<sup>77</sup> The Court held that the relevant geographical market included the entire output of all sellers to whom buyers could practicably turn for supplies. The buyers in question were purchasers of coal in Florida. The evidence showed that all coal purchased in Florida originated in the Appalachian region. The Court proceeded to include in the Florida market all coal produced in that region, which resulted in a negligible market share for the

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<sup>74</sup> *Id.* at 502.

<sup>75</sup> *Id.*

<sup>76</sup> *United States v. El Paso Natural Gas Co.*, 376 U.S. 651 (1964); see note 44 *supra*.

<sup>77</sup> *Tampa Elec. Co. v. Nashville Coal Co.*, 365 U.S. 320 (1961). The test announced in *Tampa* is the standard test stated in geographical market cases. See, e.g., *United States v. Connecticut Nat'l Bank*, 418 U.S. 656, 666-68 (1974). It is not always followed, however.

defendant. The Court was using the approach to market definition involving distant sellers advocated in this Article: including the entire output of the distant sellers in the market once it is shown that they sold at least some of their output in the local market in question.

The basic principle of *Tampa Electric* has been extended to the product market, and it has been held that products that are good substitutes in production even if not in consumption are in the same market. For example, in *Twin City Sportservice, Inc. v. Charles O. Finley & Co.*,<sup>78</sup> the issue was whether Twin City had monopolized a market consisting of concession services provided at major league baseball stadiums. The court held that the product market could not be defined so narrowly. Very much in the spirit of our analysis, the court stated:

The evidence before the trial court strongly suggests that there is a high degree of "substitutability in production." That is, the evidence was sufficient to support a finding that many aspects of the concession operations at the various facilities presenting leisure time events other than major league baseball are the same or similar enough to each other and to those existing at major league baseball parks to be considered substitutable or transferable. Moreover, some concessionaires utilize the same employees, stands and equipment to sell concession items at different events in a given facility and, at the higher managerial level, also employ the same purchasing agents and supervisory personnel. There exists evidence of inter-facility transferability as well.<sup>79</sup>

Finally, in the area of injury and damages, the Second Circuit's recent *Berkey* decision<sup>80</sup> invites an analysis explicitly linking an increase in market share to a higher price and resulting damages to the plaintiff. In the words of the court:

The wrongful conduct rule indicates that a purchaser can recover for an overcharge paid to a violator of § 2 only to the extent that the price he paid exceeds that which would have been charged in the absence of anticompetitive action. An intermediate step in the analysis may be an attempt to estimate what the monopolist's market share would likely have been but for the illegitimate conduct; it would then be possible

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<sup>78</sup> 512 F.2d 1264 (9th Cir. 1975).

<sup>79</sup> *Id.* at 1273. For similar cases, see Note, *The Role of Supply Substitutability in Defining the Relevant Product Market*, 65 VA. L. REV. 129, 136-46 (1979). These cases ignore the contrary precedent of *Rome Cable*. See note 44 *supra*.

<sup>80</sup> *Berkey Photo, Inc. v. Eastman Kodak Co.*, 603 F.2d 263 (2d Cir. 1979), *cert. denied*, 444 U.S. 1093 (1980).

to gauge approximately what price the defendant would have been able to charge with that degree of market control.<sup>81</sup>

Equation (4) in Part II of this paper provides a method for translating an increase in market share due to exclusionary conduct into an increase in price harmful to purchasers. The analysis is similar to that in a merger case, since the focus is on *increments* of power rather than power as such. Whether the information required to apply equation (4) will be available, and assimilable in a lawsuit, is another question.

This observation demonstrates, incidentally, the relevance of our analysis to cases where the alleged monopolist is not passive. Our analysis begins at the point where the monopolist has acquired monopoly power; it does not address directly the question of how he acquired it. But assuming he acquired it unlawfully, through exclusionary practices, nevertheless his objective must be eventually to use his market share to charge a high price and recoup, at a profit, the losses he incurred from the exclusionary conduct. Stated differently, at some time the monopolist will "turn passive," cease trading profits for market share, and set a high price in order to cash in on his market position.<sup>82</sup> At that stage, our analysis can be used to predict the price that he will charge and to compare that with what he would have charged had his market share been smaller because he did not use exclusionary practices. Damages to purchasers are then readily computed.

To summarize the discussion in this Part, the standard legal approach in cases involving issues of market power — an approach that involves defining a market, computing market shares, and then inferring market power — seems sufficiently flexible, especially in light of recent precedents, to accommodate the approach proposed in this Article. The basic legal definition of market power is close to the economic; the economist too is interested in market shares; economic and legal methods of market definition are converging; and increasingly the judge, like the economist, is wary of inferring market power from market shares that are not computed in a way that reflects the economic characteristics of the market in question. These elements in the judicial approach provide a basis for courts to adopt the approach suggested in this Article without thereby creating an unacceptable discontinuity with conventional legal thinking about market power.

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<sup>81</sup> *Id.* at 298.

<sup>82</sup> If he never does this, no purchasers will ever have a good cause of action against him.

## IV. CONCLUSION

This Article has sketched an approach to the issue of market power and to the included issue of market definition that so pervade antitrust law today. The Article emphasizes the dependence of market power on the elasticities of demand and of supply in the market in question, as well as on the defendant's market share. When those elasticities are known or knowable, our analysis provides a method of estimating market power in quantitative terms. The analysis thus should be helpful to enforcement agencies in setting priorities and allocating their resources, and to courts in those cases, which may be few, where estimates of the elasticity of demand and supply are obtainable in a form usable in the litigation process. But even when no quantitative measure of elasticity is available, our analysis is helpful in two ways: it points out common pitfalls in using market shares alone to estimate market power; and it suggests adjustments to simple market share calculations whereby those calculations can be made to yield a truer, though still rough, picture of the defendant's market power. And our analysis can be implemented without doing violence to accepted antitrust principles, for we find that the courts have been groping for the kind of assistance that our analysis can, we believe, provide them.

## APPENDIX

The Lerner index plays an important role in the analysis in Part I of this Article. Here we attempt to "demystify" it by deriving it, using simple mathematics, from the fundamental assumption that the firm seeks to maximize its profits. We then similarly derive equation (2), the formula for indirectly determining the elasticity of demand facing a dominant firm. We also present a formal analysis of the geographical market discussion of Section II.C of the Article. In the last part of the Appendix we analyze the relationship between the Lerner index and another possible measure of market power, the deadweight loss resulting from a smaller-than-competitive output.

As a preliminary step in the derivations, we set forth the formulas for the price elasticity (hereinafter simply elasticity) of demand facing the firm, and the supply elasticity of the competitive fringe.

The formula for the elasticity of demand (expressed as a positive number) is

$$\epsilon^d = - \frac{\partial Q}{\partial P} \div \frac{Q}{P},$$



where  $\partial$  signifies a change in the value of the variable it precedes so that the expression  $\partial Q/\partial P$ , the derivative of  $Q$  with respect to  $P$ , denotes the change in quantity demanded per unit change in price at a particular point on the demand curve. The reason for dividing the ratio of the changes in quantity and price (*i.e.*,  $-(\partial Q/\partial P)$ ) by the ratio of quantity to price is to enable the relationship of price and quantity changes to be expressed in percentage terms. For example, suppose an increase in price from 100 to 101 piastres would result in a fall in quantity demanded of some firm's product from 200 to 198 bushels. The ratio of the change in bushels to the change in piastres is 2, but if piastres were suddenly devalued so that they were worth only half of what they were formerly, a price change of only one piastre would have a smaller effect on the quantity demanded and the ratio would be different. To get rid of the arbitrary effect of the units in which price and quantity happen to be measured, we divide the ratio of the changes in price and quantity by the ratio of quantity to price (or, what is the same thing, we multiply by the ratio of price to quantity). This makes the previous equation

$$\epsilon^d = -\frac{-2}{1} \times \frac{100}{200} = 1,$$

and we are back to a ratio of percentage changes, which is independent of the units of measurement.

Elasticity of supply equals, roughly, the percentage change in quantity supplied for a 1% change in price. Since the quantity supplied by firms usually increases with an increase in price, elasticity of supply will be a positive number (*e.g.*, a supply elasticity of one means a 1% increase in price leads to a 1% increase in supply). Formally, elasticity of supply is

$$\epsilon^s = \frac{\partial Q^s}{\partial P} \div \frac{Q^s}{P},$$

where  $\partial Q^s/\partial P$  denotes the derivative of quantity supplied with respect to a change in price. In the text and in the derivation of the dominant firm demand elasticity, we refer to the supply elasticity of the competitive fringe (denoted by  $\epsilon_f^s$ ). This equals the percentage increase in their supply for a 1% increase in price.

#### *A. Derivation of the Lerner Index*

The Lerner index can now be derived as follows. The firm's total profits ( $\pi$ ) are given by:

$$\pi = P(Q) \times Q - C(Q), \quad (5)$$

where  $P$  is price (and  $P(Q)$  means that price is a function of quantity),  $Q$  is quantity produced or sold, and  $C$  is cost (and  $C(Q)$  means cost is also a function of quantity). Profits ( $\pi$ ) are therefore the difference between total revenue and total costs. Notice that price is a negative function of quantity, whereas costs will rise with quantity and are therefore a positive function of quantity. Assuming the firm desires to maximize profits, its optimal output and price are obtained by differentiating  $\pi$  with respect to  $Q$  and setting the resulting expression equal to zero. This yields

$$(\partial P/\partial Q)Q + P - \partial C/\partial Q = 0. \quad (6)$$

Substituting  $C'$  for  $\partial C/\partial Q$  and using the definition of elasticity given above yields

$$P(1 - 1/\epsilon^d) - C' = 0. \quad (7)$$

This, in turn, can be rewritten as

$$(P - C')/P = 1/\epsilon^d, \quad (8)$$

which is the Lerner index given in the text (to simplify our derivation we have deleted the subscript  $i$ ). We assume that the second-order conditions for profit maximization are also satisfied in the above equations.

### *B. Elasticity of Demand of a Dominant Firm*

Equation (2) in the text, a formula for the elasticity of demand facing (and hence the market power of) a dominant firm, can be derived as follows. The demand for the output of firm  $i$  at a given price ( $Q_i^d$ ) is simply the market demand  $Q_m^d$  minus the amount supplied by competing firms ( $Q_j^s$ ). That is

$$Q_i^d = Q_m^d - Q_j^s. \quad (9)$$

$Q_i^d$  is sometimes referred to as the "residual" demand faced by  $i$ . Since we are interested in deriving the elasticity of demand facing firm  $i$ , and since elasticities of demand relate small changes in quantity to small changes in price, we ask how a small change in price would affect the demand for firm  $i$ 's product — which is to say the demand for the market's product minus the amount supplied by the fringe firms. To do this, we differentiate  $Q_i^d$  with respect to price:

$$\partial Q_i^d/\partial P = \partial Q_m^d/\partial P - \partial Q_j^s/\partial P. \quad (10)$$

Multiplying the above equation by  $-(P/Q_i^d)$  and noting that  $\epsilon_i^d = -(\partial Q_i^d/\partial P) \times (P/Q_i^d)$  yields

$$\epsilon_i^d = -(\partial Q_m^d/\partial P)(P/Q_i^d) + (\partial Q_j^s/\partial P)(P/Q_i^d). \quad (11)$$

Multiplying the first group of terms on the right-hand side of the above equation by  $Q_m^d/Q_m^d$  and the second group by  $Q_j^s/Q_j^s$  and noting that the amount demanded in the market equals the amount supplied and the amount demanded from the fringe equals the amount they supply, yields

$$\epsilon_i^d = \epsilon_m^d(Q_m^d/Q_i^d) + \epsilon_j^s(Q_j^s/Q_i^d). \quad (12)$$

Since  $Q_i^d/Q_m^d = S_i$  and  $Q_j^s/Q_i^d = (1 - S_i)/S_i$  (because  $(1 - S_i)$  is simply the market share of the fringe), we have

$$\epsilon_i^d = \epsilon_m^d(1/S_i) + \epsilon_j^s(1 - S_i)/S_i, \quad (13)$$

which is equation (2) in the text of the Article.

### C. Geographical Market Analysis

Imagine a case where 90% of product  $x$  sold in region  $A$  is manufactured by firm  $i$ , which is located in  $A$ . The other 10% is manufactured in region  $B$  and shipped into  $A$ . Assume initially that firm  $i$  has no production or sales outside  $A$ ; there is no direct measurement of the market elasticity of demand or the elasticity of supply of the competitive fringe (*i.e.*, the manufacture of  $x$  in  $B$ ), but there are also no good substitutes in consumption for  $x$ , which allows us to infer that the market elasticity of demand is low. Hence firm  $i$  will have monopoly power unless the elasticity of supply is very high.

We can get an idea of the supply response of the competitive fringe (manufacturers of  $x$  located in  $B$ ) by determining what fraction of their total production of  $x$  is "exported" to region  $A$ . We first write  $Q_i^d$ , the quantity demanded of  $x$  from firm  $i$ , as

$$Q_i^d = Q_A^d - M, \quad (14)$$

where  $Q_A^d$  is the quantity demanded in region  $A$  (*i.e.*, the market demand for  $x$  in  $A$ ) and  $M$  is the quantity of  $x$  "imported" from region  $B$  (alternatively,  $B$ 's "exports"). (We use the terms "import" and "export" loosely, to include shipments between different areas of the United States as well as across national boundaries.) Equation (14) states that firm  $i$  faces a residual demand equal to the market demand in  $A$  minus the amount supplied by fringe firms located in  $B$ . Taking the first derivative of (14) with respect to price and converting to elasticities yields

$$\epsilon_i^d = \epsilon_A^d(1/S_i) + \epsilon^m(1 - S_i)/S_i, \quad (15)$$

where  $\epsilon_i^d$  and  $S_i$  are defined as before,  $1 - S_i$  is the share of sales in  $A$  accounted for by firms in  $B$ ,  $\epsilon_A^d$  is the market demand

elasticity in  $A$ , and  $\epsilon^m (= (\partial M / \partial P)(P/M))$  is the (positive) import elasticity, *i.e.*, the percentage change of imports into  $A$  supplied by the competitive fringe (located in  $B$ ) in response to a one percent change in price in  $A$ .

Although  $\epsilon^m$  measures the supply response of imports, it is not a supply elasticity. To obtain a supply elasticity, we first observe that

$$M = Q_B^s - Q_B^d. \quad (16)$$

That is, exports to  $A$  equal the difference between the quantity produced in  $B$  ( $Q_B^s$ ) and the quantity demanded by consumers in  $B$  ( $Q_B^d$ ). The elasticity of  $M$  with respect to a change in price in  $A$  is

$$\epsilon^m = \epsilon_B^s r_B + \epsilon_B^d r_B^*, \quad (17)$$

where  $\epsilon_B^s$  is the supply elasticity of firms in  $B$ ,  $\epsilon_B^d$  is the demand elasticity of consumers in  $B$ , and  $r_B$  and  $r_B^*$  are respectively the ratio of production and of consumption in  $B$  to  $B$ 's exports (= imports to  $A$ ). For example, if 100 units of  $x$  are produced in  $B$  and 10 are exported, then  $r_B$  and  $r_B^*$  equal 10 and 9 respectively. Substituting (17) into (15) yields

$$\epsilon_i^d = \epsilon_A^d (1/S_i) + (\epsilon_B^s r_B + \epsilon_B^d r_B^*) (1 - S_i)/S_i. \quad (18)$$

Equation (18) can be simplified by assuming  $\epsilon_B^d$  is zero (which tends to understate  $\epsilon_i^d$  and thus exaggerate  $i$ 's market power). We then have

$$\epsilon_i^d = \epsilon_A^d (1/S_i) + \epsilon_B^s r_B (1 - S_i)/S_i. \quad (18a)$$

Equation (18a) is similar to our expression for the firm's elasticity of demand (equation (2) in the text), with one difference: the supply elasticity of the competitive fringe in (18a) is multiplied not only by  $(1 - S_i)/S_i$ , the ratio of the fringe's to firm  $i$ 's market share in  $A$ , but also by  $r_B$ , the ratio of total fringe production to the amount exported to  $A$ . Thus, if only 10% of  $B$ 's production is exported to  $A$ , the weight accorded to the supply elasticity of the fringe firms will be ten times greater than if the fringe consisted entirely of sales by firms located in  $A$  and selling their entire production in  $A$ .<sup>83</sup> The

<sup>83</sup> Assume that firm  $i$  faces competition from both a competitive fringe located in  $A$  ( $= Q_f$ ) and producers located in  $B$ . Then

$$Q_i^d = Q_A^d - Q_f^s - M,$$

which can be rewritten as

$$\epsilon_i^d = \epsilon_A^d (1/S_i) + \epsilon_f^s (S_f/S_i) + \epsilon^m (S_m/S_i),$$

where  $S_f$  and  $S_m$  denote the share of fringe sales and imports in  $A$  respectively. Assuming the demand elasticity in  $B$  is zero ( $\epsilon_B^d = 0$ ) yields

$$\epsilon_i^d = \epsilon_A^d (1/S_i) + \epsilon_f^s (S_f/S_i) + \epsilon_B^s r_B (S_m/S_i).$$

intuitive explanation of this result is simple. If the supply elasticity of the producers in  $B$  is, say, 1, a 1% increase in price will lead them to expand output by 1%. Assuming the amount purchased in  $B$  remains constant, a 1% expansion in production in  $B$  translates into a 10% expansion in the output of the fringe located in  $B$  but selling in  $A$ , simply because the producers in  $B$  produce ten times as much as they sell in  $A$ . In contrast, if the fringe is both located and selling in  $A$ , a 1% supply elasticity can lead to only a 1% increase in output in  $A$ . In sum, the constraint placed on  $i$ 's market power by a competitive fringe selling a given number of units in region  $A$  but located in  $B$  is greater the greater the ratio of their production to the amount they sell in  $A$ .

As a further illustration, imagine that 10% of sales of  $x$  in  $A$ , which amounts to \$10 million, come from firms located in  $B$ , and total sales in  $A$  and  $B$  are \$100 million and \$190 million respectively. Therefore firms in  $B$  are selling only 5% of their output in  $A$ . This implies a very high supply response ( $\epsilon_m$ ) in  $A$  — though how high we cannot know without a detailed investigation of supply and demand conditions in  $B$ .  $\epsilon_m$  might be as high as 25, for that would mean only that if the price of  $x$  rose by 1% in  $A$ , the outside producers would increase their shipments into  $A$  by 25%, which could amount to a \$2.5 million increase in imports — a negligible fraction of their current production. The increase in shipments into  $A$  could be accomplished by diverting output from  $B$ , which would be relatively less profitable if price in  $A$  rose, or by increasing overall production in  $B$ . (Of course, if demand is highly inelastic in  $B$ , a diversion of output from  $B$  will cause the price in  $B$  to rise sharply, and this will limit the amount diverted. But as we showed in equation (17), the elasticity of imports into  $A$  would still be high.) Suppose the elasticities of supply ( $\epsilon_B^s$ ) and demand ( $\epsilon_B^d$ ) in  $B$  are both 1, and the market elasticity of demand in  $A$  is also 1. Then even though firm  $i$  has a 90% market share in  $A$ , it will set a price in  $A$  only 22.5% above its marginal costs. If we ignored elasticity of supply of shipments from  $B$  to  $A$ , this number would be 1,000%! If we assume that there is no diversion of demand from  $B$  to  $A$  (*i.e.*,  $\epsilon_B^d = 0$ ), but that producers in  $B$  can expand their output in response to a higher price in  $A$ , then  $\epsilon_i^d = 3.333$  and price is 42.9% greater than marginal cost.<sup>84</sup> Although this is still a

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Assuming that  $\epsilon_i^s = \epsilon_B^s$  and that the share of fringe firms and imports is equal ( $S_i = S_m$ ), the effect on  $i$ 's demand elasticity of imports is  $r_B$  times greater than that of an equal amount of fringe production in  $A$ .

<sup>84</sup> Substituting the relevant values into equation (18) and noting that  $r_B = 20$  and  $r_B^* = 19$  yields

big increase in price over marginal cost, it is much smaller than the 1,000% estimate obtained when supply factors are ignored.

The alternative and much simpler approach used in the text of this Article involves arguing that the ease with which outside producers can expand sales in  $A$  if price rises there means that *all* of their output should be included in the relevant market. If we do this in the previous example (and having done so assume the elasticity of supply to be zero), firm  $i$ 's market share will be 31% (its sales are \$90 million, and the foreign producers who sell in  $A$  sell a total in all their markets of \$200 million). Assuming a market elasticity of demand of 1 and a supply elasticity of zero, firm  $i$ 's optimal price will be 45% above its marginal cost. This result is close to the one we reached when we took account of the foreign producers' sales (outside of  $B$ ) in the elasticity of supply rather than in the denominator of the market share calculation.<sup>85</sup>

$$\epsilon_i^d = 1(1/.9) + (20 + 19)(.1/.9) = 5.444.$$

The Lerner index equals .1837 (=  $1/5.444$ ) and the ratio of price to marginal cost equals 1.225 (=  $5.444/4.444$ ). If we ignore the response of imports, we have  $\epsilon_i^d = 1(1/.9) = 1.111$  and hence the ratio of price to marginal cost equals 1.0. Notice that if we assume a completely inelastic demand in  $B$  ( $\epsilon_B^d = 0$ ), then  $\epsilon_i^d = 1(1/.9) + 20(.1/.9) = 3.333$  and the ratio of price to marginal cost is 1.4286.

<sup>85</sup> The formal difference between the two approaches is as follows. We have shown that

$$\epsilon_i^d = \epsilon_A^d(1/S_i) + (\epsilon_B^d r_B + \epsilon_B^d r_B^*)(1 - S_i)/S_i. \quad (18)$$

If we assume for simplicity that the market demand elasticities are the same in region  $A$  and  $B$ , then (18) can be rewritten as

$$\epsilon_i^d = \epsilon_m^d(1 + r_B^*(1 - S_i))/S_i + \epsilon_B^d r_B(1 - S_i)/S_i. \quad (18b)$$

Observe that

$$\begin{aligned} (1 + r_B^*(1 - S_i))/S_i &= (1 + (Q_B^d/M)(M/Q_A^d))/(Q_i^d/Q_A^d) \\ &= (Q_A^d + Q_B^d)/Q_i^d. \end{aligned}$$

Since  $Q_A^d + Q_B^d$  equals the sum of the demands in  $A$  and  $B$ , which alternatively equal total production in  $A$  and  $B$ ,  $Q_i^d/(Q_A^d + Q_B^d)$  equals firm  $i$ 's share in total production in  $A$  and  $B$ . Similarly,

$$\begin{aligned} r_B(1 - S_i)/S_i &= (Q_B^d/M)(M/Q_A^d)/(Q_i^d/Q_A^d) \\ &= Q_B^d/Q_i^d. \end{aligned}$$

If we multiply  $Q_B^d/Q_i^d$  by  $(Q_A^d + Q_B^d)/(Q_A^d + Q_B^d)$ , then  $Q_B^d/Q_i^d$  equals the ratio of region  $B$ 's share in total production to firm  $i$ 's share in total production. We now write (18b) as

$$\epsilon_i^d = \epsilon_m^d(1/S_i^*) + \epsilon_B^d(1 - S_i^*)/S_i^*, \quad (18c)$$

where  $S_i^*$  is firm  $i$ 's market share of total production in  $A$  and  $B$ . Note that  $S_i^* < S_i$  since  $S_i$  is defined as  $i$ 's share in total sales in  $A$  (which is less than sales in  $A$  plus sales in  $B$ , the sum of which equals total production).

If we ignore the supply elasticity (assuming  $\epsilon_B^s = 0$ ), then we can write  $\hat{\epsilon}_i^d =$

This is as it should be. The approach taken should not affect the conclusion with regard to the amount of market power possessed by the firm under scrutiny.<sup>86</sup>

The above analysis assumed that domestic firms were not selling abroad. Suppose we remove this restriction and assume that firm  $i$  is selling to region  $B$ . To simplify, also assume that foreign firms are no longer exporting to the United States,<sup>87</sup> transportation costs are zero, and there are no differences in comparability between U.S. and foreign products. The latter two assumptions imply the same price for  $x$  at home and abroad.

Recall from equations (14) and (16) that  $Q_i^d = Q_A^d - (Q_B^s - Q_B^d)$ , *i.e.*, that the demand faced by firm  $i$  at every price equals the domestic demand minus the difference between foreign (region  $B$ ) supply and demand. Earlier, foreign exports (= imports to  $A$ ) were positive and equal to  $(Q_B^s - Q_B^d) = M$ . It was the link between imports to  $A$  and the excess of foreign production over foreign demand that provided the justification for calculating firm  $i$ 's market share as a percentage of world production. Now, since foreign demand is greater than foreign

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$\epsilon_m^d(1/S_i^*)$ . The bias from ignoring supply elasticity but incorporating production in  $B$ , and not just exports into  $A$ , in the market share calculation is

$$\epsilon_i^d - \hat{\epsilon}_i^d = \epsilon_B^s(1 - S_i^*)/S_i^*,$$

which will be greater the higher the supply elasticity and the smaller firm  $i$ 's market share. In the short run, if firms in  $B$  are operating near capacity,  $\epsilon_B^s$  will be approximately zero and therefore the bias will disappear.

<sup>86</sup> We argued in the text that transportation costs did not substantially change our conclusion that foreign production should be part of the market provided imports were positive, and the foreign and domestic products were the same. Another way of putting this point is to recognize that distance-related costs are implicitly taken into account by our measure of market power. Recall from note 85 *supra* that  $\epsilon_i^d$  can be written in terms of firm  $i$ 's share in the combined output of the local ( $A$ ) and the distant ( $B$ ) market. This market share ( $S_i^*$ ) depends on transportation costs in the following way: the greater these costs, the smaller is  $B$ 's total production relative to  $A$ 's (which is firm  $i$ 's production). Therefore,  $S_i^*$  will be an increasing function of transportation cost ( $t$ ). That is,  $S_i^*(t_2) > S_i^*(t_1)$  where  $t_2 > t_1$  and hence  $L(t_2) > L(t_1)$ . If in the short run  $\epsilon_B^s = 0$ , then the above becomes

$$L(t_2)/L(t_1) = S_i^*(t_2)/S_i^*(t_1),$$

where the increase in  $i$ 's market share resulting from increasing transportation costs is an exact measure of the change in  $i$ 's market power. Two other points should be noted: (1) if  $\epsilon_B^s > 0$ , then  $S_i^*(t_2)/S_i^*(t_1)$  understates the change in  $i$ 's market power, since

$$(\epsilon_m^d + (1 - S_i^*(t_1))\epsilon_B^s) > (\epsilon_m^d + (1 - S_i^*(t_2))\epsilon_B^s);$$

and (2) market power may not change if  $\epsilon_m^d$  and  $\epsilon_B^s$  are also positive functions of  $t$ .

<sup>87</sup> The analysis can easily be extended to the case of both positive imports into  $A$  and positive exports by firm  $i$ . This creates no problem since the variable  $M$  is the net difference between imports and exports.

supply,  $M$  is negative. But the derivation of  $i$ 's demand elasticity does not depend on the sign of  $M$ . The link between  $B$ 's production and  $A$ 's demand is maintained and  $\epsilon_i^d$  can be written as  $(1/S_i^*)(\epsilon_m^d + (1 - S_i^*)\epsilon_b^s)$ , where  $S_i^*$  is  $i$ 's share in total production in  $A$  and  $B$ .

#### D. The Lerner Index and the Deadweight Loss from Monopoly<sup>88</sup>

Here we show that the Lerner index and deadweight loss are positively related; *i.e.*, an increase in the demand elasticity reduces *both* the Lerner index and deadweight loss.<sup>89</sup>

Deadweight loss is illustrated by the shaded area in Figure 2. Since price measures the dollar value consumers attach to the marginal unit of output, an excess of price over marginal cost implies a loss in value equal to the difference between price and marginal cost. The sum of these losses when output falls from  $Q^c$  to  $Q^m$  is termed the deadweight loss. From Figure 2 it appears that the greater the excess of price over marginal cost at the monopoly output, the larger the shaded area of deadweight loss, holding other things constant. This suggests in turn that the Lerner index and deadweight loss are positively related because a reduction in the elasticity of demand (*e.g.*, a clockwise rotation of the demand curve in Figure 2 around the competitive price-output point) increases both the

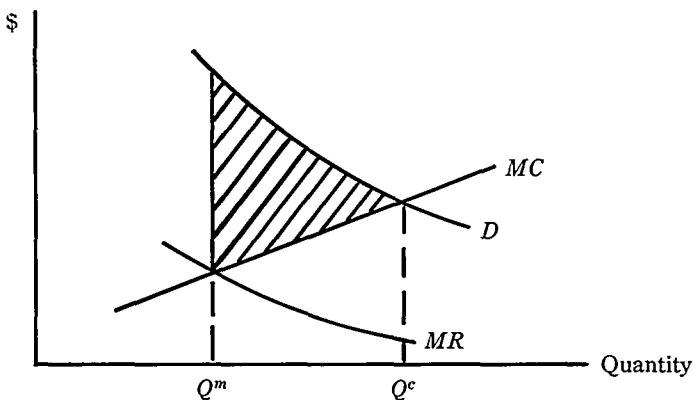


FIGURE 2

<sup>88</sup> We thank Dennis Carlton and Gabrielle Brenner for helping us with the analysis presented here.

<sup>89</sup> F. SCHERER, *supra* note 6, at 460, derives an expression showing that the deadweight loss rises with the demand elasticity, *i.e.*, the Lerner index and deadweight loss measures of market power are inversely related. We show later in this Appendix the error in Scherer's analysis.



Lerner index and deadweight loss. Output will not remain constant as elasticity declines, however. And if the resulting output is greater than  $Q^m$ , the effect on the deadweight loss will be uncertain. To determine the precise relationship between deadweight loss and elasticity (or the Lerner index) therefore requires a formal analysis. This is done below for two cases: (1) a constant elasticity and (2) a linear demand curve.

1. *Constant Elasticity Demand Curve.* — Assume the demand curve is of the form  $Q = P^{-\epsilon}$ , where  $\epsilon$  is the (constant) demand elasticity, and marginal cost ( $C'$ ) is constant and normalized to equal 1. Observe that the inverse demand function (*i.e.* price as a function of quantity) is  $P = Q^{-1/\epsilon}$ , and since  $P = C'$  at the competitive output, both the competitive price ( $P^c$ ) and competitive output ( $Q^c$ ) will equal 1. The monopoly output is determined by setting  $C'$  equal to marginal revenue ( $Q^{-1/\epsilon}(\epsilon - 1)/\epsilon$ ) and this yields a price of  $\epsilon/(\epsilon - 1)$  and quantity of  $(\epsilon/(\epsilon - 1))^{-\epsilon}$ . The various equilibrium values are shown in Figure 3. We now seek to measure the deadweight loss and determine how it responds to changes in the value of  $\epsilon$ .

Deadweight loss ( $D$ ) is given by

$$\begin{aligned} D &= \int_{Q^m}^{Q^c} P dQ - (Q^c - Q^m) \\ &= \frac{\epsilon}{\epsilon - 1} Q^{1-1/\epsilon} \Big|_{Q^m}^{Q^c} - (Q^c - Q^m) \\ &= \frac{\epsilon}{\epsilon - 1} \left[ 1 - \left( \frac{\epsilon}{\epsilon - 1} \right)^{1-\epsilon} \right] - \left[ 1 - \left( \frac{\epsilon}{\epsilon - 1} \right)^{-\epsilon} \right]. \quad (19) \end{aligned}$$

The effect of variations of  $\epsilon$  on the deadweight loss can be obtained by substituting explicit values for  $\epsilon$  in the deadweight

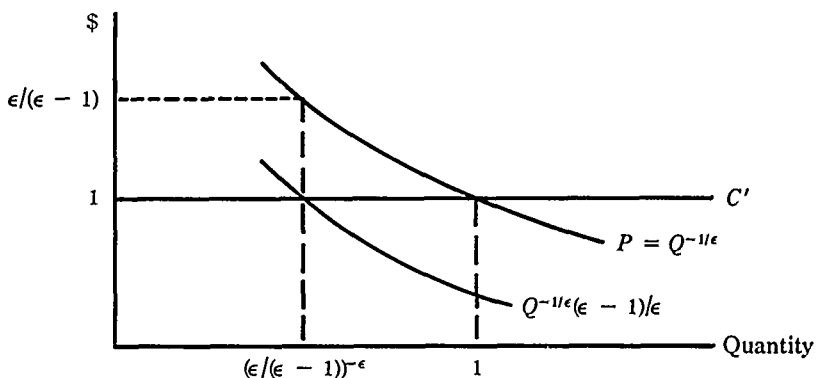


FIGURE 3

loss formula above.<sup>90</sup> Our simulation is presented in Table III:

TABLE III

$\epsilon$	D	$\epsilon$	D	$\epsilon$	D
1.01	3.5	9	.032	70	.0038
1.1	1.14	10	.029	75	.0035
1.2	.92	11	.026	80	.0033
1.3	.69	12	.024	85	.0031
1.4	.55	13	.022	90	.0029
1.5	.46	14	.02	95	.0028
1.6	.39	15	.018	100	.0026
1.7	.34	20	.0139	150	.0017
1.8	.30	25	.011	200	.0013
1.9	.27	30	.009	300	.00088
2	.25	35	.0077	400	.00066
3	.129	40	.0067	500	.00052
4	.087	45	.0060	600	.00044
5	.065	50	.0053	700	.00031
6	.052	55	.0048	1000	.000126
7	.043	60	.0047	10000	.000026
8	.037	65	.0041	20000	.000013

Notice that the deadweight loss  $D$  declines continuously as  $\epsilon$  increases from 1.01 to 20,000.<sup>91</sup> Thus, for elasticity values between 1.01 and 20,000, both the deadweight loss and the Lerner index ( $= 1/\epsilon$ ) decline as elasticity increases.

2. *Linear Demand Curve.* — Let  $Q = a - bP$ , where  $a > 0$  and  $b > 0$ , and assume as before that marginal cost ( $C'$ ) equals 1. The competitive outcome is  $P^c = 1$  and  $Q^c = a - b > 0$ . The monopoly outcome is  $P^m = (a + b)/2b$  and  $Q^m = (a - b)/2$ . Both solutions are shown in Figure 4 on the next page.

Deadweight loss is given by

$$\begin{aligned}
 D &= \int_{Q^m}^{Q^c} PdQ - (Q^c - Q^m) \\
 &= \frac{a}{b} Q - \frac{Q^2}{2b} \Big|_{Q^m}^{Q^c} - \frac{(a - b)}{2} \\
 &= (a - b)^2/8b. \tag{20}
 \end{aligned}$$

<sup>90</sup> The most direct method of determining the relationship between  $\epsilon$  and  $D$  is to sign the derivative of  $D$  with respect to  $\epsilon$ . We could not, however, sign the derivative.

<sup>91</sup> We start with a value of 1.01 because a monopolist always operates in a region where the elasticity is greater than 1.

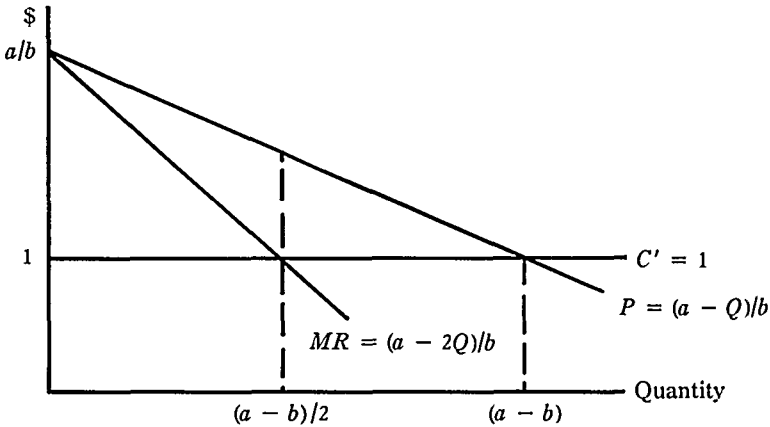


FIGURE 4

Elasticity of demand ( $\epsilon$ ) is given by  $b(P/Q)$ , which equals  $b/(a - b) > 0$  at the competitive output. The total differential of  $\epsilon$  at the competitive output is

$$d\epsilon = \frac{a \cdot db - b \cdot da}{(a - b)^2}, \quad (21)$$

(where  $d$  denotes the differential). To determine the effect of a change in  $\epsilon$  on  $D$ , we assume that the competitive output,  $a - b$ , remains constant, and therefore that  $\epsilon$  changes by rotating the demand curve around the output. With  $a - b$  constant, we have  $da = db$ . Substituting into  $d\epsilon$  yields

$$\frac{d\epsilon}{db} = \frac{1}{a - b}, \quad (22)$$

so that the elasticity increases as  $b$  increases. The change in  $D$  with respect to a change in  $\epsilon$  (holding  $a - b$  constant) is given by

$$\frac{dD}{db} \frac{db}{d\epsilon} = -(a - b)^3 / 8b^2 < 0. \quad (23)$$

Hence as  $\epsilon$  increases the deadweight loss declines.

Our result differs from that presented by Scherer in his well-known industrial organization text.<sup>92</sup> Scherer writes  $D$  in the linear case as

$$D = (1/2)\Delta P \Delta Q, \quad (24)$$

where  $\Delta P = P^m - P^c$  and  $\Delta Q = Q^c - Q^m$ . Since  $\epsilon = (\Delta Q/Q^c)(\Delta P/P^c)$  at the competitive output,  $D$  can be rewritten as

$$D = (1/2)P^c Q^c (\Delta P/P^c)^2 \epsilon. \quad (25)$$

<sup>92</sup> See F. SCHERER, *supra* note 6, at 460.

From this equation Scherer concludes that  $D$  rises as a linear function of the demand elasticity  $\epsilon$  — the opposite conclusion. The error in Scherer's analysis is his failure to recognize explicitly that as  $\epsilon$  increases,  $\Delta P/P^c$  will fall because the elasticity at the monopolist's profit-maximizing output will rise.<sup>93</sup> And as we showed earlier, the net effect of increasing  $\epsilon$  is to reduce  $D$ .

This result can also be derived geometrically. In Figure 5, the demand curves are labeled I and II, and curve II has a greater elasticity than curve I at the competitive output. The corresponding marginal revenue curves are given by the dotted lines, and the deadweight losses by the shaded area. In the linear case, marginal revenue is exactly one-half the distance between the demand curve and the vertical axis. Hence the marginal revenue curves corresponding to the two demand curves intersect  $C'$  at the same point. In Figure 5, both the monopoly markup and the deadweight loss are lower for demand curve II than curve I. In contrast, Scherer assumes that the monopoly markup ( $P^m - P^c$ ) can be held constant, and hence that the relevant deadweight loss comparison is between the area labeled  $abc$  for demand curve II and the shaded area

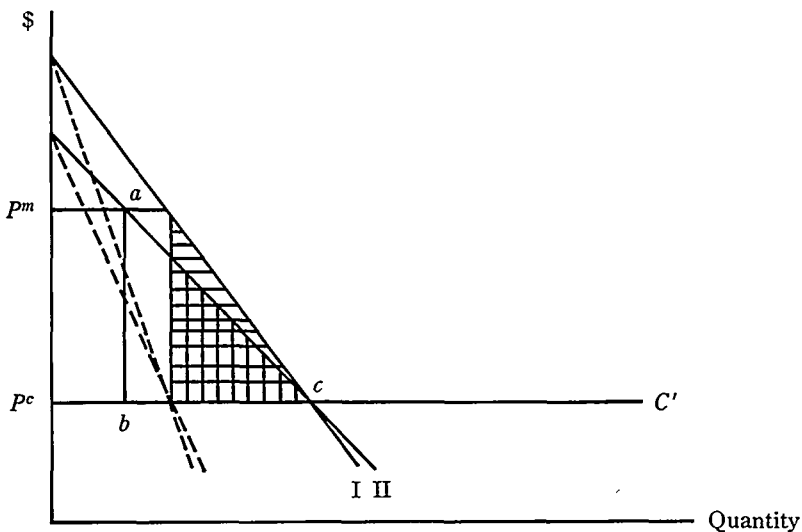


FIGURE 5

<sup>93</sup> More formally, the derivative of  $D$  with respect to  $\epsilon$  is

$$\frac{\partial D}{\partial \epsilon} = (1/2)P^cQ^c(\Delta P/P^c)^2 + (1/2)P^cQ^c\epsilon_2(\Delta P/P^c)\partial(\Delta P/P^c)/\partial \epsilon,$$

where the first term is positive but the second negative. Scherer ignores the second term and thus reaches the incorrect conclusion that  $(\partial D/\partial \epsilon) > 0$ .

associated with demand curve I; in Figure 5, the former exceeds the latter area. This comparison, however, is invalid because the output implied by area *abc* is not a profit-maximizing output; marginal revenue exceeds marginal cost. The profit-maximizing monopolist would move from that output to the one given by the intersection of the marginal revenue and marginal cost curves. And at that profit-maximizing output, the deadweight loss is lower for II than for I.