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# EMPIRICAL METHODS OF IDENTIFYING AND MEASURING MARKET POWER

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## I. INTRODUCTION

During the past decade academic economists have developed a variety of approaches using economic methodologies to measure market power.<sup>1</sup> These approaches are based on observing the way a firm's or industry's price and output respond to changes in the economic environment.<sup>2</sup> Some of these econometric methods make inferences about market power from a firm's or industry's response to variation in cost. Others make such inferences from a firm's or industry's response to variation in the elasticity of demand, or by detecting multiple pricing regimes.

Measuring market power is important because antitrust law protects competition in order to deter or correct the exercise of such power, whether by a monopolist or by firms acting collectively. From an economic perspective, a firm (or group of firms acting collectively) possesses market power if the entity is able profitably to raise price by reducing output.<sup>3</sup> To infer the existence and magnitude of market power, antitrust today relies routinely on market share and market concentration evidence. Accounting measures of markup or profits have also been employed in this task. These existing methodologies are far from perfect, however.

This article describes some of the econometric methods developed to measure market power. To the extent these new approaches can be used

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<sup>1</sup> Econometrics applies statistical methods to measure the real world magnitude of the concepts employed by economic theory.

<sup>2</sup> In the last decade, these methods have become standard in the economics literature. For a technical survey, see Timothy F. Bresnahan, *Empirical Studies of Industries with Market Power*, in 2 HANDBOOK OF INDUSTRIAL ORGANIZATION 1011-57 (Richard Schmalensee & Robert D. Willig eds., 1989).

<sup>3</sup> William M. Landes & Richard A. Posner, *Market Power in Antitrust Cases*, 94 HARV. L. REV. 937 (1981).

by courts and enforcers to cross-check the conclusions reached through a traditional methodology, they promise to increase the precision of the market power inferences likely to emerge in an adversarial setting.

## II. TRADITIONAL METHODS OF MEASURING MARKET POWER

Antitrust law's primary current methodology for identifying market power infers power from market concentration. In a properly defined market, a firm with a high market share is often thought to have market power, and a concentrated industry is often thought susceptible to the collective exercise of market power. This inference may not be correct, however, for many reasons including the following three. First, if entry into a market is easy, no firm can exercise market power, no matter how large its market share. Second, a firm could have a large market share and the market could appear concentrated, not because the firm has market power but because it has low costs or sells superior products.<sup>1</sup> Finally, market definition treats each substitute product as either inside the market or outside the market. This approach does not recognize the competitive discipline exerted by those products just outside the market on the products within, and it does not recognize differences in degree to which firms selling within the market constrain each other.

Because antitrust recognizes these problems with inferring market power from market concentration, the analysis of market power under the traditional approach does not stop with market share. Other information is employed to adjust the inference about market power made from shares. While this analytic process is a familiar one, especially in merger analysis where it is guided by the Merger Guidelines promulgated by the federal antitrust enforcement agencies,<sup>5</sup> it is hard to be confident that these adjustments solve all the problems with the traditional approach.

These analytic difficulties are heightened by the adversarial setting in which market power inferences are typically made in antitrust practice. Litigants first contest market definition, the primary basis for the computation of market share. Then they dispute the inferences about market power that can reasonably be made from concentration in light of, for example, entry conditions or aspects of industry structure that make coordinated behavior more or less plausible. Even when the traditional

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<sup>1</sup> More generally, the economic literature today treats concentration as much the result of the way firms have chosen to invest and interact (including their exercise of market power), than as a cause or indicator of the potential exercise of market power.

<sup>5</sup> U.S. Department of Justice and Federal Trade Commission Horizontal Merger Guidelines (April 2, 1992), *reprinted in* 4 Trade Reg. Rep. (CCH) ¶ 13,104 [hereinafter 1992 Merger Guidelines].

analytic methodology for assessing market power has been carefully elaborated, as in the Merger Guidelines, the substantial room remaining for good faith disputes as to its application highlights the imprecision of the approach.

Antitrust law has, at times, also employed accounting profits or mark-ups as an indicator of market power.<sup>6</sup> But this methodology is also far from ideal. For example, high profits or margins might reflect efficiencies, such as low costs or superior product design, rather than market power. In addition, the way accountants spread costs over time and adjust asset values for depreciation frequently causes accounting measures of profit to bear little relation to those underlying economic concepts that might in principle be related to market power. These problems loom so large that antitrust today does not rely heavily on profitability measures in making inferences about market power.

### III. NEW ECONOMETRIC METHODS OF MEASURING MARKET POWER

Econometric techniques for measuring market power can be divided into three classes, each based on a different conceptual experiment. The basic approach of each class of methodologies will be described by sketching the conceptual experiment that underlies one approach in each class.<sup>7</sup> By explaining why the new methods identify market power in principle, this article seeks to help antitrust lawyers evaluate the choice of econometric methodology adopted by an economic expert.<sup>8</sup>

#### A. EMPIRICAL METHODS BASED ON RESPONSES TO VARIATION IN COST

The first class of empirical methods for identifying market power is based on observing the way firms and industries respond to variation in

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<sup>6</sup> For a description of the historical use of accounting data on profits for inferring market power, see Kenneth Elzinga, *Unmasking Monopoly: Four Types of Economic Evidence*, in *ECONOMICS AND ANTITRUST POLICY* 11 (Robert J. Lerner & James W. Meehan, Jr. eds., 1989).

<sup>7</sup> The references in the notes will identify representative technical articles describing related methodologies.

<sup>8</sup> This article focuses on helping lawyers, enforcers, and judges determine whether the empirical approach chosen is appropriate to the industry studied, and suitable for addressing the legal question for which the technique's results are offered. This article does not address the complementary topic of whether the expert economist has correctly isolated the application of the desired conceptual experiment in the data (that is, the important question of how to undertake statistical inference once a methodological approach has been chosen).

marginal cost. The present discussion emphasizes one important tool in the class: residual demand estimation.<sup>9</sup>

The following anecdote will suggest the way residual demand estimation identifies market power.<sup>10</sup> The marketing manager of a firm selling a branded consumer product, termed for convenience firm *A*, was once asked, "Have you ever raised your product's price in one metropolitan area, and discovered that no rival firm went along?" He responded, "That happened once in Chicago, where we had a large market share. When we raised our price, none of our rivals followed. We lost a great deal of market share immediately, and were forced to rescind the price increase."

This anecdote suggests that in Chicago at the time of that incident, firm *A* did not have power over price acting unilaterally. It could not profitably increase price by reducing its own output because it lost so many sales as to make the price increase unprofitable. Even though the firm had a large market share, it did not possess market power in the sense of the economists' definition.

The marketing manager was then asked, "When you lost market share, which rival benefited?" He responded, "Rivals *B* and *C* gained share, but rivals *D* and *E* did not." This observation suggests that firms *B* and *C* constrained the original firm's pricing, while firms *D* and *E* did not. The story provides anecdotal evidence that the merger of firm *A* with firm *D* or *E* likely would not permit the unilateral exercise of market power by *A*.<sup>11</sup>

Although this story is no more than an anecdote, a saying attributed to George Stigler has it that the plural of anecdote is data.<sup>12</sup> The anecdote suggests one way to proceed to obtain systematic statistical evidence on the presence of market power. One could imagine identifying a large number of situations in which firm *A* had an incentive to change its price unilaterally, but no rival firm had an incentive to alter price except perhaps in response to what firm *A* did. It would then be possible to determine whether firm *A* successfully raised price systematically in such

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<sup>9</sup> For examples of statistical tools other than residual demand estimation for identifying market power that rely on the experiment of observing the response of firms to "cost shocks," see John C. Panzar & James N. Rosse, *Testing for "Monopoly" Equilibrium*, 35 J. INDUS. ECON. 443 (1987); Orley Ashenfelter & Daniel Sullivan, *Nonparametric Tests of Market Structure: An Application to the Cigarette Industry*, 35 J. INDUS. ECON. 483 (1987).

<sup>10</sup> This anecdote is taken from the authors' experience in reviewing a proposed merger on behalf of the acquiring firm.

<sup>11</sup> The unilateral exercise of market power is one potential adverse competitive effect resulting from merger. See 1992 Merger Guidelines, *supra* note 5, § 2.21.

<sup>12</sup> Ernst Berndt attributes this saying to George Stigler in ERNST BERNDT, *THE PRACTICE OF ECONOMETRICS: CLASSIC AND CONTEMPORARY*, inside front cover (1991).

situations. This conceptual experiment is performed by residual demand estimation.<sup>13</sup> The residual demand elasticity measures the extent to which a firm would be able to raise price by reducing output, after taking into account the demand responses of buyers and the supply responses of rivals.<sup>14</sup>

It is also possible to determine whether some specific rival, such as firm *D*, provided on average a significant constraint on firm *A*'s behavior. This experiment is performed by estimating a partial residual demand function.<sup>15</sup> The partial residual demand elasticity measures the extent to which a particular rival constrains the ability of a given firm to exercise market power. This information is relevant to determining whether a merger between sellers of differentiated products would permit the merged firm to exercise market power unilaterally.

The primary statistical problem confronting econometricians attempting to estimate residual demand functions is isolating the individual moments—the many anecdotes in the data—at which firm *A* alone had an incentive to raise price. The solution to this problem involves identifying variables that shifted firm *A*'s costs without altering the costs of any other firm in its industry.<sup>16</sup> By isolating situations in which firm *A*'s costs rose, while no other firm's costs changed, the econometric technique collects situations in which firm *A* had an incentive to alter price alone, permitting a systematic examination of whether it could successfully do so. If firm *A* has power over price, it will raise price (although not necessarily by the full amount of the cost increase). But if the firm recognizes that it would lose too much business to its rivals were it to raise price (whether because the products of its rivals are too close demand substitutes or because its rivals would respond too aggressively in competition), and thus if the firm chooses not to raise price despite the increase in its costs, then the firm does not have market power. Moreover, when firm *A* loses sales, if firm *B* is systematically a major beneficiary, then it is reasonable to conclude that firm *B* plays an important role constraining the potential exercise of market power by firm *A*.

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<sup>13</sup> Jonathan B. Baker & Timothy F. Bresnahan, *Estimating the Residual Demand Curve Facing a Single Firm*, 6 INT'L J. INDUS. ORG. 283 (1988). For an application to identifying monopsony power, see Daniel Sullivan, *Monopsony Power in the Market for Nurses*, 32 J.L. & ECON. S135 (No. 2, Pt. 2 1989).

<sup>14</sup> This market power is available to the firm even if it does not take full advantage of it; in this sense, the market power revealed by residual demand estimation is "potential" market power.

<sup>15</sup> Jonathan B. Baker & Timothy F. Bresnahan, *The Gains from Merger or Collusion in Product-Differentiated Industries*, 33 J. INDUS. ECON. 427 (1985).

<sup>16</sup> In the econometric jargon, these variables are the "instruments" that "identify" the residual demand function in a simultaneous equation setting.

The cost-variation experiment that identifies market power under the residual demand methodology raises a particular firm's costs without raising the costs of its rivals. This experiment induces the firm to exercise power over price if it can, permitting the measurement of market power.

No small part of the applied econometrician's art involves identifying situations in which an individual firm's costs have increased while no other firm's costs have changed. In one residual demand study of the brewing industry during the 1970s,<sup>17</sup> for example, three variables were employed. First, each firm's costs were thought to depend in part upon a variable related to firm-wide capacity utilization, on the view that firm marginal costs were the lowest when excess capacity was the greatest. Second, changes in the wage rate for brewery workers in Colorado not reflected in the wage rate for the United States as a whole affected the marginal cost of production for Coors, but not the costs of any other brewer. Finally, for multiproduct brewers, average capacity of all firms' plants was thought to be related to the exploitation of plant-level scale economies, and thus to marginal cost.

The empirical methodology of residual demand estimation, developed for identifying the market power of a single firm, has also been applied to define markets.<sup>18</sup> The experiment proposed by this application raises cost simultaneously for all the firms selling in the proposed market—for example, all the manufacturers of carbonated soft drinks—without raising costs for firms selling possible demand substitutes excluded from the proposed market, such as juice, coffee, milk and other beverages.<sup>19</sup> If the soft drink producers collectively would respond to a soft drink industry cost increase by raising price, despite the threat of lost sales to the producers of other beverages, it is likely that a soft drink cartel would raise price<sup>20</sup> and, thus, likely that soft drinks form a product market.<sup>21</sup> Although the 1992 Merger Guidelines propose a different experiment for defining markets than the estimation of the residual demand elasticity

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<sup>17</sup> Baker & Bresnahan, *supra* note 13.

<sup>18</sup> David T. Scheffman & Pablo T. Spiller, *Geographic Market Definition Under the U.S. Department of Justice Merger Guidelines*, 30 J.L. & ECON. 123 (1987). See also Jonathan B. Baker, *Why Price Correlations Do Not Define Antitrust Markets: On Econometric Algorithms for Market Definition* (Working Paper No. 149, FTC Bureau of Economics 1987).

<sup>19</sup> Although a product market definition example has been chosen, the methodology applies equally to geographic market definition.

<sup>20</sup> A cartel would find it profitable to raise price if soft drink demand is more inelastic than some threshold level. The relevant threshold elasticity will depend upon existing price-cost margins.

<sup>21</sup> The application of residual demand estimation to market definition makes clear that residual demand elasticities identify potential market power, not necessarily fully exercised, as discussed above in note 14.

for an aggregate of products and geographic locations, this elasticity remains relevant to the ultimate question of measuring market power, toward which market definition is aimed.<sup>22</sup>

An example from academic research of the application of residual demand estimation suggests the value to antitrust of developing new methodologies for measuring market power. In the brewing industry in the 1970s, measures of market power based upon market share did not strongly distinguish Pabst and Coors. These two brewers had comparable national market shares, and each had high market shares in certain regions of the country (the mountain states for Coors, and the upper Midwest for Pabst).

Perhaps a careful application of the traditional methodology of inferring market power from market share would have identified significant differences between the competitive role played by these firms (from which differences in market power would be suggested), but any such distinctions would likely have been strongly contested in an adversarial proceeding. Yet application of the residual demand methodology revealed that Coors possessed a great deal of market power, most likely because of its unique product niche, while Pabst possessed little market power.<sup>23</sup> The advantage to antitrust enforcers and judges of employing more than one approach to identifying market power is evident.

#### B. EMPIRICAL METHODS BASED ON RESPONSES TO VARIATION IN THE ELASTICITY OF DEMAND

The second class of statistical tools relies on the idea that a firm (or group of firms) exercising market power will raise price the most above cost at times or in markets in which buyers do not have good demand

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<sup>22</sup> The 1992 Merger Guidelines require that market definition be performed while "assuming the terms of sale of all other products are held constant." 1992 Merger Guidelines, *supra* note 5, at § 1.0. This assumption suggests that market definition proceed through the estimation of a structural rather than a residual demand elasticity for a group of products and locations. A structural demand elasticity (the familiar "own-price elasticity" from microeconomic theory) accounts for the role of demand substitution in limiting the exercise of market power, but, unlike the residual demand elasticity, the structural demand elasticity does not also account for the competitive or cooperative responses of the rivals selling demand substitutes. The 1992 Merger Guidelines account for the responses of rivals in assessing the competitive effects of mergers rather than in market definition. Accordingly, when the two elasticities differ significantly (because supply responses of firms outside the proposed market strongly affect the behavior of firms within the market), the structural demand elasticity is the more relevant for defining markets under the Merger Guidelines methodology, but the residual demand elasticity is the more relevant for directly assessing the combined influence of demand and supply substitution on the potential exercise of market power. As with residual demand elasticity estimation, instrumental variable techniques are employed to estimate a structural demand elasticity.

<sup>23</sup> Baker & Bresnahan, *supra* note 13.



substitutes. More technically, for a firm exercising market power, the percentage markup of price over marginal cost will be the greatest when demand is the most inelastic.

The significance of the market demand elasticity in discriminating between firms that are exercising market power and those that are not can be indicated by an example. Suppose that most aluminum buyers would readily switch to steel in the event of a small rise in the price of aluminum above the competitive price. Here the market demand for aluminum is highly elastic. Under such circumstances, it does not matter to the performance of the aluminum industry how few or how many sellers of aluminum compete. Even an aluminum monopolist would find itself constrained by the threat of buyer substitution, and would refrain from raising price above the competitive level.

The point is a general one: when industry demand is highly elastic, firms with market power behave similarly to those without market power. In contrast, if steel is not a close demand substitute for most buyers of aluminum at current aluminum prices, so that the market demand is not highly elastic, then there is room for the aluminum sellers to exercise market power if they possess it. In such a situation, firms with market power will behave differently (by charging higher prices) than firms that lack such power.<sup>24</sup>

In an industry in which demand is not highly elastic, it would be possible in principle to detect the exercise of market power directly if the competitive price or competitive industry output were observable. Firms charging higher than the competitive price, or an industry selling less than the competitive output, would be exercising power over price. Unfortunately, it is rarely if ever possible to know what the competitive equilibrium would look like. The main problem is determining marginal cost with precision from accounting data, according to an economist's definition of marginal cost. Instead, it is necessary to infer market power from those experiments performed by history which distinguish firms exercising market power from those that do not. The idea that the industry demand elasticity constrains the exercise of market power provides the basis for a second class of empirical methodologies for identifying and measuring market power.<sup>25</sup>

<sup>24</sup> Another remark attributed to George Stigler is that price discrimination (in the economists' sense) is the best evidence of the presence of market power. Empirical approaches to identifying market power based on responses to variation in the demand elasticity can be thought of as generalizing this remark.

<sup>25</sup> Representative studies inferring market power from response to variation in the elasticity of demand include: Timothy F. Bresnahan & Valerie Y. Suslow, *Oligopoly Pricing with Capacity Constraints*, 15/16 ANNALES D'ECONOMIE ET DE STATISTIQUE 267 (1989) (homogeneous product industry); Timothy F. Bresnahan, *Competition and Collusion in the American*

To see how this approach works, suppose that the aluminum industry's costs neither vary with the volume produced (constant returns to scale) nor change over time (presumably because input prices and the production technology do not change). Suppose further that in the recent past, the price of steel, a demand substitute, increased. After the steel price rise, more aluminum users than before have no close substitutes. The demand for aluminum increases at every aluminum price and, most likely, aluminum demand becomes more inelastic.<sup>26</sup> As a result, the potential gains to the exercise of market power will rise.

This hypothetical example provides an experiment that will reveal whether the aluminum industry exercises market power.<sup>27</sup> If the aluminum industry is competitive, the reduced elasticity of aluminum demand will not affect the price of aluminum. Competition will keep price at the competitive level, close to cost,<sup>28</sup> even though the potential gains to the exercise of market power have increased. But if the firms in the industry are able to exercise market power, they will take advantage of the reduction in the demand elasticity to raise price further.<sup>29</sup> Here an industry exercising market power is distinguished from one that is not exercising market power by observing industry response to variation in the elasticity of market demand.<sup>30</sup>

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*Automobile Industry: The 1955 Price War*, 35 J. INDUS. ECON. 457 (1987) (differentiated product industry); Matthew D. Gelfand & Pablo T. Spiller, *Entry Barriers and Multiproduct Oligopolies*, 5 INT'L J. INDUS. ORG. 101 (1987) (differentiated product industry); Steven T. Berry, *Airport Presence as Product Differentiation*, 80 AM. ECON. REV. 394 (Papers and Proceedings, May 1990) (differentiated product industry); Valerie Y. Suslow, *Estimating Monopoly Behavior with Competitive Recycling: An Application to Alcoa*, 17 RAND J. ECON. 389 (1986) (dominant firm).

<sup>26</sup> The assumption that the demand for aluminum becomes more inelastic is tantamount to assuming that the demand for aluminum increases more at high aluminum prices than at low aluminum prices.

<sup>27</sup> This example is based upon Bresnahan & Suslow, *supra* note 24. In their article, Bresnahan and Suslow employ business cycle fluctuations rather than variation in the price of a demand substitute as the primary source of intertemporal variation in the elasticity of demand for aluminum.

<sup>28</sup> Were returns to scale decreasing (rising marginal cost), the competitive price would equal marginal cost. With constant returns to scale, the price in free-entry equilibrium (the competitive price) will exceed marginal cost by enough to just cover an entrant's fixed costs; the relevant measure of cost that defines the competitive price is entrant's marginal cost, or, equivalently, incumbent's average cost.

<sup>29</sup> The markup varies with the elasticity of demand, not with the level of demand. It is well known, for example, that the profit-maximizing markup of price over marginal cost for a monopolist is directly related to the inverse elasticity of demand. This result is extended from monopoly to oligopoly industries in Timothy F. Bresnahan, *The Oligopoly Solution Concept Is Identified*, 10 ECON. LETTERS 87 (1982).

<sup>30</sup> Another way to make this point is to imagine plausible differences in the way a firm's marketing executives would approach their task if they are able to exercise market power. When demand substitution or market competition constrains firms from raising price above the competitive level, marketing executives are likely to conceive of their function solely in

The example shows that the extent to which an industry exercises market power can be measured by observing the effect on price of a change in the elasticity of industry demand, so long as costs do not change. If costs are known not to vary with volume or over time (and if other aspects of industry structure such as the number of firms and entry conditions do not change over time), the most plausible explanation for any observed variation in the market price is that the demand elasticity has altered while firms are exercising market power. But if costs may vary with volume or over time, price variation may have an explanation other than the exercise of market power. For example, higher prices may result from an increase in the cost of important inputs into aluminum production such as bauxite, electricity, or labor. Or demand may have increased, leading to higher prices without the exercise of market power if costs increase as production volume rises. These events could occur simultaneously with demand growing more inelastic. So price increases cannot be attributed to the exercise of market power, even if price rises at the same time demand grows more inelastic, unless the possibility of variable cost increases is taken into account.

Controlling for cost variation is thus the primary econometric problem raised by the class of methodologies that infers market power from the price response to variations in the elasticity of market demand. Given the technology of aluminum production, cost is largely invariant to output fluctuations that fall short of hitting capacity constraints, but marginal cost becomes very high when firm output reaches capacity. This phenomenon makes it easy to confuse market power and high marginal cost explanations for price rises if demand simultaneously increases (to approach capacity) and becomes more inelastic (facilitating the exercise of market power).<sup>31</sup>

Accounting measures of cost are not helpful in discriminating between these explanations for price increases because accounting cost measures do not rise sharply when capacity becomes constrained. But the output response to variables that increase demand changes dramatically when capacity constraints are reached. This observation was exploited by one

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terms of cost-based or competitor-based pricing. But when firms are able to take advantage of more inelastic demand by raising price, marketing executives are likely also to consider customer value in making pricing decisions, and to speak in addition of value-of-service pricing.

<sup>31</sup> Firms can exercise market power only when output falls short of capacity; if demand exceeds capacity and firms produce to the limit, the market price is determined by the way demand rations a fixed supply and not by the exercise of market power.

study of market power in the aluminum industry to exclude from the analysis periods during which capacity was constrained.<sup>32</sup>

### C. EMPIRICAL METHODS BASED ON DETECTING MULTIPLE PRICING REGIMES

The final class of new statistical tools for identifying and measuring market power relies on the idea that firms may behave differently when cooperating than when they compete. If firms are always cooperating or always competing in the data we are able to observe—if there is no variation in their behavior—these methods cannot be employed. Indeed, many economic models of coordinated behavior imply stable cartel pricing; under such circumstances, methods based on the detection of multiple regimes will not be useful. But other models of coordinated behavior suggest that when firms cannot perfectly monitor rival actions, the degree of cooperation will vary across markets or over time.

Cooperation might be punctuated by occasional price wars, for example, if firms cannot be certain whether unexpected declines in the market price reflect rivals' cheating rather than unexpected declines in market demand.<sup>33</sup> The result that the degree of cooperation may vary over time also requires that firms lack any other information from which rival cheating can be identified: the firms cannot, for example, observe the output of their rivals. Under such circumstances, one might suppose that coordinated behavior would be impossible. When firms observing an unexpected decline in the market price cannot be confident that cheating rather than an unexpected decline in demand is the cause, they may be unwilling to engage in costly punishment behavior.<sup>34</sup> Recognizing this, each firm will have an incentive to take advantage of the uncertainty to steal their rivals' business through cheating while their rivals are puzzling over the cause of the resulting decline in the market price.

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<sup>32</sup> These periods were identified through application of a methodology for detecting multiple regimes, similar to those described in Section III.C. Bresnahan & Suslow, *supra* note 25. Had marginal cost risen on the approach to capacity constraints, this methodology could not have been employed. To distinguish cost from market power explanations for price increases, it was also necessary to control for fluctuations in the price of key inputs.

<sup>33</sup> This description of the relevant economic theory is a loose adaptation of Edward J. Green & Robert H. Porter, *Noncooperative Collusion Under Imperfect Price Information*, 52 *ECONOMETRICA* 87 (1984).

<sup>34</sup> This theory focuses upon unexpected changes in price rather than predictable price variation. If a price decline were to occur coincident with an observable decline in demand (an economy-wide recession, perhaps), industry members would correctly conclude that it did not result from rival cheating and, thus, that it does not threaten the stability of their cartel.

Contrary to the above supposition, some coordination is in fact possible in this setting. To make coordination work, the firms must engage in a price war whenever price falls unexpectedly, without pausing to identify the cause; they must “shoot first and ask questions later.” After a short-term price war, the firms will return to the high price equilibrium. No firm will find cheating worthwhile because such behavior will automatically trigger a competitive response by its rivals. But price wars will occur on occasion, whenever demand declines unexpectedly.

The empirical significance of this model is its prediction of multiple pricing regimes. Much of the time, the firms will be engaged in supracompetitive pricing, but on occasion price wars will occur. Industry participants would likely recognize that their industry is susceptible to price wars. For example, industry participants might decry in the trade press the sudden breakdown in prices. They might call for industrial statesmanship in maintaining output and pricing discipline, with such comments followed by increasing prices shortly thereafter.

The third class of econometric techniques for measuring market power works by asking whether the data are better explained by two regimes—two types of behavior—rather than one.<sup>35</sup> In the academic literature involving these techniques, the two regimes are typically cooperative pricing and occasional price wars, as suggested by the economic model described above.<sup>36</sup> Similar techniques have also been used to identify the members of a bidding ring in an auction setting in which some firms did not participate in the price-fixing arrangement.<sup>37</sup>

Several academic studies that identify market power by detecting multiple pricing regimes investigate the behavior of certain midwestern railroads during the 1880s, before the Sherman Act prohibited cartels or the Interstate Commerce Commission set rail fares.<sup>38</sup> The trade press of that era recognized that the industry was prone to short but steep price wars. The studies demonstrate that this pricing behavior is consistent

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<sup>35</sup> More technically, these techniques ask whether the regression errors are better understood as one normally distributed variable (hence one regime) or as the combination of two such variables (hence two regimes).

<sup>36</sup> Robert H. Porter, *On the Incidence and Duration of Price Wars*, 33 J. INDUS. ECON. 415 (1985); Robert H. Porter, *A Study of Cartel Stability: The Joint Executive Committee, 1880–1886*, 14 BELL J. ECON. 301 (1983); Jonathan B. Baker, *Identifying Cartel Policing Under Uncertainty: The U.S. Steel Industry 1933–1939*, 32 J.L. & ECON. S47 (No. 2, Pt. 2 1989); Robert J. Town, *Price Wars and Demand Fluctuations: A Reexamination of the Joint Executive Committee* (Economic Analysis Group Discussion Paper 91-5, Department of Justice 1991).

<sup>37</sup> Robert H. Porter & J. Douglas Zona, *Detection of Bid Rigging in Procurement Auctions* (NBER Working Paper No. 4013, March 1992).

<sup>38</sup> Porter, *On the Incidence and Duration of Price Wars*, *supra* note 36; Porter, *A Study of Cartel Stability*, *supra* note 36; Town, *supra* note 36.

with cartel behavior under incomplete monitoring, where the degree of cooperation varies over time in response to unexpected changes in cost or demand.

The primary inferential problem raised by this methodology is in demonstrating that when multiple pricing regimes are observed, coordination is the explanation. In principle, after all, high and low price regimes could be explained by other factors, such as the output of some or all firms rising to capacity. One academic article attempts to accomplish this by showing that unexpected demand declines, unrelated to observable changes in the business cycle or the price of substitutes, led firms to act more competitively for a time.<sup>39</sup> Not only was there a high-price regime and a low-price regime, the regimes switched for a reason connected with the theory. This result suggests that the firms were jointly exercising market power when prices were high, although in the study the difference in prices between the two regimes was not large.

#### IV. CONCLUDING COMMENTS

With the invention of these new econometric tools for identifying and measuring market power, antitrust can aspire to more precise analyses of the competitive effects of business practices than ever before. These statistical tools provide evidence on the extent of market power that complements what can be inferred from market concentration.

Three classes of statistical methodologies have been described, each based on a different conceptual experiment: cost variation, demand elasticity variation, and the detection of multiple types of behavior. These methodologies are unbiased: they neither favor plaintiffs nor defendants. They have been employed by private litigants and the federal enforcement agencies. Moreover, they often provide, as a byproduct, an estimate of the cost to buyers of the exercise of market power by sellers.

As with other approaches to identifying market power, these tools are not perfect. They typically require a great deal of data.<sup>40</sup> Perhaps for this reason, they have most often been employed in antitrust enforcement in studies involving branded consumer products, where point-of-sale scanner data are often available. In addition, there are typically a number

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<sup>39</sup> Baker, *supra* note 36.

<sup>40</sup> Data availability is not just a matter of the number of observations on the variables of interest, although that factor is important. If the data does not contain within it examples of the conceptual experiment addressed by the methodology, the econometric tool will not permit market power to be measured. For this reason, no statistical methodology can account for the effects of, for example, changes in market structure, or prices of inputs and substitutes vastly different from those currently seen, unless similar situations that have occurred in the past appear in the data.

of reasonable alternatives that an expert might adopt in applying any specific econometric approach to analyze the data in a particular industry, and results might vary significantly across alternative specifications. Two expert economists could have different views as to the reasonableness of the alternatives, and could in consequence interpret the same set of statistical studies differently. This possibility may lead to an econometrics tournament among competing experts, comparable in scope and significance to the battle over market definition that often arises when the traditional market share approach to inferring market power is employed in an adversarial setting.

The choice of econometric methodology itself may be a difficult one. It will depend on data availability and quality, on the structure of the particular industry under study, and on the very legal question that the statistical work seeks to answer. Moreover, the difficulties of preparing an expert witness to support statistical work under cross-examination are well known. Perhaps for this reason, these methodologies have most often been employed in merger review, where the decision-maker is an antitrust enforcement agency rather than a court.

Because market power is a central concept in antitrust, the development of new approaches to its identification is important news. These econometric methodologies are already well-established among academic economists. Antitrust lawyers today may not have done all they can for their clients unless they investigate what such econometric methods imply about the market power of the firms and industries they represent.