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Using Simulation Models in Estimating Lost Profits

By John M. Gale

Simulation models, which originally were developed to predict the competitive effects of mergers, can be used to estimate damages due to lost profits in patent infringement and price discrimination cases. Past attempts to estimate lost profits in these cases have suffered because they have not taken account of firms' strategic responses to patent-infringing output or discriminatorily high prices. Because simulation models take account of those responses, they can lead to more accurate damages estimates.

Traditionally, in a patent infringement analysis, the patent holder's lost profits are determined according to the market share rule described in the *Mor-flo* decision. Under this rule, the output of the infringer is allocated among the patent holder and all non-infringing substitutes based on their market shares. The patent holder is then assumed to earn the same margin on the additional allocated sales as it did on actual sales. This methodology ignores the likelihood that the patent holder and other non-infringing producers responded to the infringing production by cutting price, which would cause industry sales to increase and profit margins to fall. Thus, there likely would be both price erosion and quantity accretion, both of which could significantly affect lost profits.

In price discrimination cases, lost profits often are estimated as the difference between the actual price paid and the but-for non-discriminatory price times the number of units purchased by the plaintiff. This methodology assumes that the plaintiff would not have changed its sales price or quantity. But a firm that pays a lower price for an input will have a lower marginal cost and thus is likely to reduce its selling price and increase its sales. Ignoring these changes will cause an incorrect estimate of lost profits.

During the last decade, government antitrust agencies have used simulations to predict the likely effects of proposed mergers. Simulations start with a theoretical model of how firms compete in the market and how consumers react to changes in prices. The model is then calibrated to reflect actual market shares and prices and consumer demand. Once the model is calibrated, likely post-merger market equilibria can be calculated and new market prices and shares determined. The advantages of using a merger simulation are well known: quantitative information is drawn from the actual market, assumptions about firm and consumer behavior are explicitly stated and supported, and a quantified prediction of the merger's effects is produced. In addition, efficiencies and the effects of entry can be explicitly modeled.

Merger simulation models can be adapted for use in estimating lost profits. The aspect of these models that is most promising when applied to damage analysis is the ability to account for the strategic responses of firms to the infringement or discriminatory prices.

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Economic Analysis and Sampling of Populations

By Stuart D. Gurrea

Appropriate sampling provides statistically reliable information about a population when gathering information about the entire population would be impractical. For example, a government agency investigating whether a manufacturer engaged in predatory pricing will want information on the prices the manufacturer charged. One alternative would be for the manufacturer to produce records showing the price for every single transaction. If the number of individual records is very large, it may be too costly in terms of time and resources for the manufacturer to produce–and for the agency to review–every single record. Another alternative is to obtain a representative sample of all records from which to make inferences about the entire population of prices. While this second alternative is cost effective, the reliability of the inferences will depend on how well the sample is chosen and how well the measurements are made. In our example, an inference about the manufacturer's prices could be biased against it if the sampling methods were incorrect, leading to the erroneous conclusion that it had engaged in predatory pricing.

Recently, in *Farey-Jones v. Integrated Capital Associates, Inc. et al.,* the District Court fined Farey-Jones several thousand dollars for proposing a subpoena found to be overbroad and unlawful. Farey-Jones had insisted on obtaining over a million email messages after it received an inadequate sample of a few hundred e-mails. On the one hand, this case provides a good example of how sampling may be necessary to conduct a lawful discovery, since production of the complete population (all e-mails) may be too burdensome and overbroad. On the other hand, the case also shows that a sample (the few hundred e-mail messages selected by the respondent) may not be sufficient to make reliable inferences.

Inappropriate sampling may introduce a variety of errors. First, given the random differences across individual observations, a sample may not be representative even if it is randomly selected. Second, the population could be misspecified if observations are not taken from the true population of interest. Suppose some of the goods were damaged and so were sold at very low prices. A sample that includes sales of damaged goods will indicate lower prices and hence may lead to incorrect inferences about the sales of undamaged goods. Finally, nonresponses can introduce errors. For example, if it is difficult to obtain records for high price transactions, results will be biased towards lower prices. In our example, we may end up with an estimated average price substantially lower than the true average price.

Optimal sample design is driven by considerations of cost and by the goals of the research. The simplest method of conducting a survey is to take a simple random sample, one where all elements of the population have the same probability of being included in the sample. If inferences about specific subgroups in the population are needed, this method may become too costly. In our example, the government agency may want to examine the manufacturer's pricing conduct across regional manufacturing plants. A simple random sample would have to be very large to ensure that it has sufficient observations to make reliable inferences about each subgroup. A more cost–effective methodology is to take a stratified random sample that consists of a random sample within each subgroup of the population. In our example, a separate random sample would be taken for each regional plant.

Another problem often encountered in drawing samples is that it may be costly to draw a sample based on all elements of a population because the population is scattered geographically or because a list of all elements of the population is not available or is too costly to compile. Suppose the government does not suspect any variation across plants in pricing practices, but the manufacturer cannot list each record without a very costly effort. In this case, cluster sampling could be an appropriate methodology. First, the population is divided into clusters–for example each cluster might be the transaction records from a specific production plant–and then a sample of clusters is selected at random. Second, in each of the sampled clusters (plants), each transaction record is identified and each price from the transaction records is retrieved. This method avoids incurring the high cost of identifying every record.

Once the sample methodology has been chosen, the next step in sampling a population is to determine the sample size. Sample size is driven by the inherent variability of the data, and the an acceptable bound on the error of estimation. For a fixed degree of accuracy, the larger the variability of the data, the larger the required sample size. Conversely, for a given variability of the data, the higher the degree of accuracy desired, the larger the required sample size.

An important determinant of the validity, reliability, accuracy and cost of deriving estimates in an economic analysis is careful sample design. This crucial step may be overlooked when producing information in the context of litigation or a government investigation. Yet the statistical or econometric analysis relies on the sample as an essential input. To ensure that bias and error do not compromise the validity of the results, careful attention must be paid to sampling methodology.

Stuart D. Gurrea, an EI Senior Economist, has worked on industry studies involving sampling of populations.

The Many Uses of Critical Loss Analysis

By Barry C. Harris

Critical Loss Analysis, an analytical technique first developed for use in defining markets in merger investigations, also has a wide range of other uses within antitrust. Critical Loss Analysis is a way to determine if a given price increase would be profitable. Typically, a price increase will cause a loss of some sales and the profits earned from them, while higher profits are earned on retained sales. Critical Loss Analysis determines when the loss of profits from the foregone sales will be larger than the gain in profits due to the higher prices. The Critical Loss for any given price increase is the amount of sales that can be lost before the price increase becomes unprofitable.

The concept of Critical Loss flows from the definition of an antitrust market contained in the Department of Justice/ Federal Trade Commission Horizontal Merger Guidelines. A market is the smallest group of producers that could profitably impose at least a small but significant and nontransitory increase in price. Critical Loss Analysis is a way to determine if this price increase would be profitable. Calculating the Critical Loss is the first step of a two-step process. The second step considers whether or not the likely level of sales lost due to the price increase will exceed the Critical Loss. Lost sales are estimated using traditional tools of antitrust market definition analysis, such as estimating demand elasticities, other statistical analyses, document review, and customer reactions and surveys.

The Critical Loss depends on the hypothesized price increase and the contribution margin of the producers before the price increase. The contribution margin is defined as the difference between price and average variable cost stated as a percentage of the price. Variable cost is a proxy for the actual costs saved because of the reduction in sales. Variable cost should be measured in a way that is consistent with the level of lost sales and the associated time period. In some cases, this formula must be adjusted to take account of such factors as demand and supply relationships between different products or the ability of a firm to charge different prices to different customers.

Critical Loss was first presented at a 1986 merger trial in which the FTC attempted to enjoin a merger between two producers of polyvinyl chloride (PVC). The FTC and the merging parties agreed on the product market, but disagreed on the geographic market. The FTC contended that the geographic market was the United States. Analysis showed that if U.S. producers raised price by 5%, the sales that they would lose to imports would exceed the Critical Loss. Based in part on these results, the District Court decided that the U.S. geographic market was inappropriately small. Since that decision, Critical Loss Analysis has been used in a number of merger investigations involving a wide variety of industries, including hospitals, tobacco, computer disaster recovery services, and cruise lines.

Critical Loss Analysis is also used in addressing a number of other issues in antitrust. For example, within the context of merger analysis, Critical Loss Analysis can be used to assess the likelihood of post-merger anticompetitive behavior. It can also be used to determine whether entry would be sufficient to prevent a post-merger price increase by identifying the level of sales new entrants would have to capture to make a price increase by incumbents unprofitable. That amount is compared to the level of sales the entrant is likely to actually attract.

Another use of Critical Loss Analysis is to determine the competitive effects of "most favored nation" (MFN) clauses. These clauses, which require that no other customer receive a lower price than those offered under the contract, have become common in contracts between health insurers and health care providers. The antitrust agencies have alleged that these agreements may be anticompetitive. Specifically, they claim that a dominant health insurer can force a large number of providers to accept an MFN, because providers who refuse to contract with the insurer will lose significant patient volume. Under this theory, as a result of the MFN, providers will be less willing to

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EI News and Notes

Ziebart Arbitration

Ziebart prevailed on the antitrust issues in an arbitration that resolved a lawsuit brought by some of its franchisees on antitrust and other grounds. Phillip B. Nelson and Robert D. Stoner testified for Ziebart. Their testimony was directed at showing that the plaintiffs did not have a sound antitrust theory and did not introduce the facts needed to support their antitrust theory. The arbitrator agreed.

Consolidated Stores Decision

A U.S. District Court granted summary judgment to Consolidated Stores Corp. in a discrimination suit involving its check acceptance policy. Jonathan L. Walker submitted expert reports on Consolidated's behalf and testified at deposition about his statistical analysis of Consolidated's policy. He also submitted a declaration supporting Consolidated's Daubert challenge to plaintiffs' statistical expert. The Court relied on Walker's analysis in its summary judgment order and excluded portions of plaintiffs' expert's proposed testimony.

The Stop & Shop Supermarket Company and Walgreen Inc. v. Blue Cross Blue Shield of Rhode Island and CVS

Barry C. Harris testified for defendant CVS in this case where plaintiffs alleged restraint of trade in the sale of prescription pharmaceuticals covered by health insurance plans. At issue was defendants' contract that required plan subscribers to fill their prescriptions at certain pharmacies to obtain maximum reimbursement. Plaintiffs' allegations were dismissed. Harris testified that plaintiffs had failed to support their alleged antitrust markets, that exclusive contracts in general can help reduce costs and that defendants' contract had reduced pharmaceutical prices. The court's decision tracked Harris's testimony.

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These models also account for the consumer responses to the firms' actions. A damage simulation begins with the same models and data as a merger simulation. The model is calibrated to the actual market shares, prices, and consumer demand.

Once the simulation model has been properly calibrated to the market being analyzed, the results in a but-for world can be determined under different scenarios. For example, in a patent infringement case, often the infringing firm would not have produced any output in the but-for world. This condition would be modeled by setting the infringing firms marginal cost high enough that its profit maximizing output level is zero. The patent holder and other non-infringing competitors then set profit maximizing prices based on their calibrated marginal cost and consumer demand. After but-for equilibrium prices and quantities are determined, damages to the patent holder can be calculated. This analysis allows for different closeness of substitutes, price erosion, and quantity accretion.

In the case of input price discrimination, a similar analysis would be done. The marginal cost of the plaintiff but-for the price discrimination would be calculated, then the model would be used to estimate the prices and quantities sold by the plaintiff and its competitors given the lower marginal cost. But-for profits then can be calculated using those prices and quantities.

Simulations also provide a better way to deal with entry. In patent cases, defense counsel often argue that the higher prices in the but-for world would induce entry by additional non-infringing competitors. That entry would depress market prices and drive down the but-for profits of the plaintiff. The simulation methodology allows the introduction of new competitors to the model. Therefore, the effect of entry can be explicitly calculated.

Damages simulation is more difficult than merger simulation in one respect; unlike merger simulation, damages simulation often requires a dynamic analysis. If the patent covers a process innovation, as opposed to a product innovation, and the market is fairly stable, then a dynamic analysis may not be required. When the market is rapidly changing and early differences can have long lasting effects, however, dynamic effects must be considered. Dynamic effects can be included in several different ways, for instance by modeling each period separately and then imposing changes on consumer demand and prior-period market shares.

The application of merger simulation models to damages cases promises to bring additional rigor and clarity to the analysis. As with any economic analysis, the assumptions must fit the market and appropriate data must be available. If those conditions are met, simulation will significantly improve estimates of damages.

John M. Gale, an EI Senior Economist, worked on a number of matters requiring estimation of market responses to determine damages. This article is taken from his recent presentation at an American Bar Association seminar.

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discount to other plans. Thus, other health insurers become less effective competitors, entry of new plans is thwarted, and competition is harmed.

The acceptance of an MFN clause does not eliminate the provider's ability to offer discounts greater than the MFN discount to other medical plans, but it becomes more expensive for the provider to do so. The extent to which an MFN affects a provider's incentive to offer discounts can be calculated through a Critical Loss Analysis. An MFN with a small effect on the incentive to offer discounts will not have a significant anticompetitive effect.

The basic logic of Critical Loss applies to most analyses concerning allegations of anticompetitive behavior leading to the exercise of market power. Put simply, a Critical Loss Analysis shows whether an exercise of market power has been or will be profitable. If an attempted exercise of market power is not profitable, it is not likely to be attempted. The inability to raise price or otherwise exercise market power profitably ultimately means that there is no ability to harm competition.

Barry C. Harris, Chairman of EI's Board of Directors, has written extensively on Critical Loss Analysis. This article is based on a presentation he gave at the Competition in Health Care Forum at the Northwestern University Law School.

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