

**THE MISUSE OF ECONOMETRICS  
IN ESTIMATING DAMAGES**

Daniel McFadden, Kenneth Wise,  
Susan Guthrie, and Paul Liu

*Forthcoming in  
ABA Econometrics Treatise*

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### INTRODUCTION

Remember those long hours you spent in Chem Lab carefully following the steps of your experiment and making sure you used the proper technique? You knew that if you did not, your experiment would be ruined and your grade would suffer. An econometric damage study is a similar scientific experiment, only the risk from not following proper procedures is that awards may be too high or too low by millions, or even billions, of dollars.

Professor McFadden in the introductory chapter to this volume describes how an econometric experiment must incorporate a number of fundamental elements for the practitioner to arrive at a valid conclusion. These elements relate to the design of the experiment, the structure of the economic model, the data and econometric techniques used to estimate the model, the statistical tests applied to identify significant results, and the economic interpretation of those results. Unfortunately, many damage studies fail to address all of these elements properly.

Attorneys obviously have an incentive to ensure that their economic experts do not misuse econometrics in the preparation of damage estimates. Yet, for those unfamiliar with the theory and practice of econometrics, there is a substantial leap from understanding a fundamental concept to being able to identify fatal shortcomings in an actual analysis. An examination of a few damage studies that failed to make the grade may provide a more concrete understanding of the significance and role of these elements. In the following sections, we discuss the econometric work in three cases: *Conwood v. U.S. Tobacco*; *Merilyn Cook et al. v. Rockwell International Corporation and The Dow Chemical Company*; and *In re Industrial Silicon Antitrust Litigation*. The econometric analysis in each of these cases suffered from at least one fundamental error which, if corrected, would have dramatically affected the damage estimate. In one case the error was not exposed at trial and substantial damages were awarded. In another case, the problems were exposed at trial and the jury awarded no damages. The remaining case still awaits trial.

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\* Professor McFadden, recipient of the 2000 Nobel Prize in Economics, is the E. Morris Cox Professor of Economics at the University of California at Berkeley and a member of *The Brattle Group*. Dr. Wise is a Principal and the West Coast Office Director of *The Brattle Group*. Dr. Guthrie is a Principal in *The Brattle Group*'s Washington, DC office. Dr. Liu is a Senior Associate in the firm's San Francisco office.

## CONWOOD V. U.S. TOBACCO

In *Conwood v. U.S. Tobacco*, Conwood, a manufacturer of moist snuff, alleged that the dominant firm in the moist snuff market, U.S. Tobacco Company, used illegal marketing practices which impeded the growth in market share of Conwood products. These practices included unauthorized removal of display racks for Conwood moist snuff products. Conwood's damages expert estimated the damages incurred by Conwood as a result of these practices. At trial the jury found U.S. Tobacco liable and awarded Conwood \$350 million. This was trebled to \$1.05 billion under antitrust statutes to create the largest antitrust damage award to that time.

The expert asserted that a "foothold" theory of damages applied. According to this theory, the alleged illegal practices by U.S. Tobacco, which intensified after 1990, had a greater impact on the growth of Conwood's market share in states in which Conwood initially had a small market share. The theory held that a larger market share created a "foothold" that would be less susceptible to the alleged illegal practices. This theory was based largely on anecdotal comments from Conwood personnel to the effect that U.S. Tobacco's "bad acts" disproportionately impacted states in which Conwood had a smaller market share.

As a test of his damage hypothesis, the expert used regression analysis. He had state-by-state market share data for the Conwood products in 1984, 1990, and 1997. He specified a model in which he used a constant term and the initial market share to explain the change in market share for each of two periods, 1984-1990 and 1990-1997.<sup>1</sup> The very simple estimated equation is shown below:

$$\text{Change in Market Share} = \alpha + \beta \times \text{Initial Market Share}$$

Ordinary least squares was used to estimate the constant term,  $\alpha$ , and the coefficient for the impact of initial market share,  $\beta$ . The results for the 1984-1990 period showed a small and slightly negative value for  $\beta$  which was not statistically significant.<sup>2</sup> The expert, therefore, concluded that there was no relationship between initial market share and subsequent market share growth in the 1984-1990 period (the "before" period), which preceded U.S. Tobacco's alleged illegal practices. The results for the 1990-1997 period (the period "after" the practices had intensified) provided a statistically significant and positive relationship between initial market share and subsequent market share growth. Contrasting this finding with the results for the "before" period, the expert concluded that a change occurred after 1990 in the relationship between initial market share

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<sup>1</sup> The state-level data included data for the District of Columbia but did not include data for Hawaii or Alaska. The expert estimated several alternate regressions using additional variables, but his damages conclusions are based on the regression with only Conwood's initial market share as an explanatory variable.

<sup>2</sup> The regression approach provides a standard deviation for the estimate which allows one to determine the likelihood that the true value is, in fact, different from zero. Analysts typically want the likelihood of getting a particular estimate, if the true value were actually zero, to be less than 5 percent before concluding that a result is statistically significant.

and subsequent market share growth.<sup>3</sup> His explanation for this change was that the intensification of U.S. Tobacco's alleged illegal practices suppressed Conwood's growth in small market share states but not in states with larger market shares where Conwood had established a "foothold." Thus, the larger the initial market share, the greater the growth.

A critical part of damage model estimation and testing is showing that the results do not substantively change with reasonable alternative choices of specification or the data used to estimate the model. In other words, the results must be robust. A result which is not robust is in some ways worse than no result at all, for it has high potential to be misleading.

In this case the exclusion of a single data point would have changed completely the expert's results and conclusion. The District of Columbia (DC) represented, by far, the smallest market for moist snuff in each of the years 1984, 1990, and 1997, ranging from one one-thousandth of a percent of total moist snuff sold in the United States in 1984 to three one-hundredths of a percent of total moist snuff sold in the United States in 1997.<sup>4</sup> Consequently, relatively small changes<sup>5</sup> in the pounds of moist snuff sold by Conwood in DC could easily translate into large changes in the DC market share. It is, therefore, not surprising that in DC there was a far greater variance across years in the change in Conwood's market share than in any other state. The unique behavior of Conwood's DC market share relative to that of other markets considered can be seen in Figure 1. The DC market share declines dramatically from 21.0 percent in 1984 to 7.2 percent in 1990, followed by a similarly dramatic increase from 7.2 percent in 1990 to 17.6 percent in 1997, while the market shares for the other 48 markets generally increase and exhibit reasonably consistent behavior. The actual values for market share and change in market share are shown in Figure 2, along with the relationship predicted by the expert's regression. Figure 2 shows that the DC data point is at a substantial distance from the others and from the predicted line. A data point such as this is known as an outlier and can have a great impact on the regression result.<sup>6</sup>

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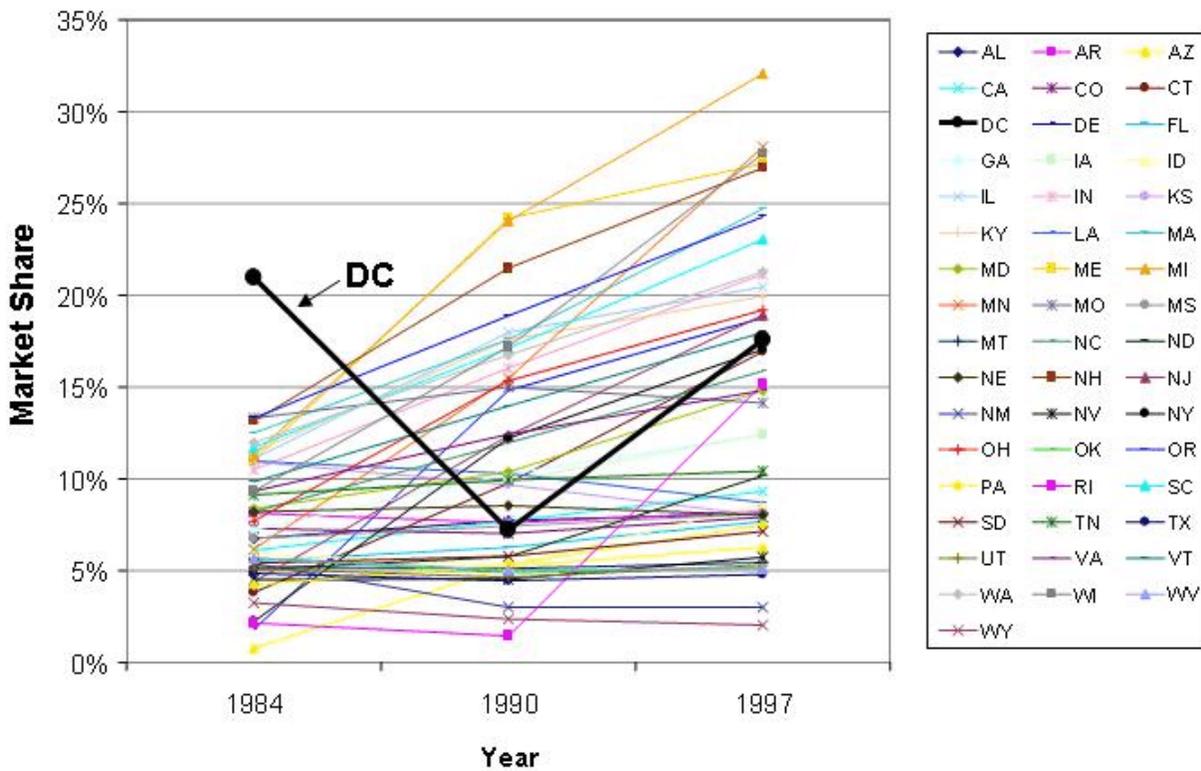
<sup>3</sup> This is, in fact, a testable hypothesis. The estimate of  $\beta$  in each period has an associated standard deviation that measures the precision of the estimate. The standard deviations and the estimated values of the two estimates can be used in a statistical test to determine if the difference in the estimated values is statistically significant. This test was not performed by the expert. Had it been, it would *not* have indicated a significant difference in the relationship between initial market share and subsequent share growth between the two periods.

<sup>4</sup> These figures are based on the expert's data, which exclude Alaska and Hawaii. The pounds of moist snuff sold in DC ranged from 3,617 pounds in 1984 out of a total market of 36.5 million pounds to 17,219 pounds in 1997 out of a total market of 53.1 million pounds.

<sup>5</sup> Caused, for example, by the plaintiff's moist snuff being added or dropped at a few stores.

<sup>6</sup> Influence statistics commonly used in econometrics show that the DC data point has the greatest influence on the regression results of any of the 49 markets included in the expert's regression.

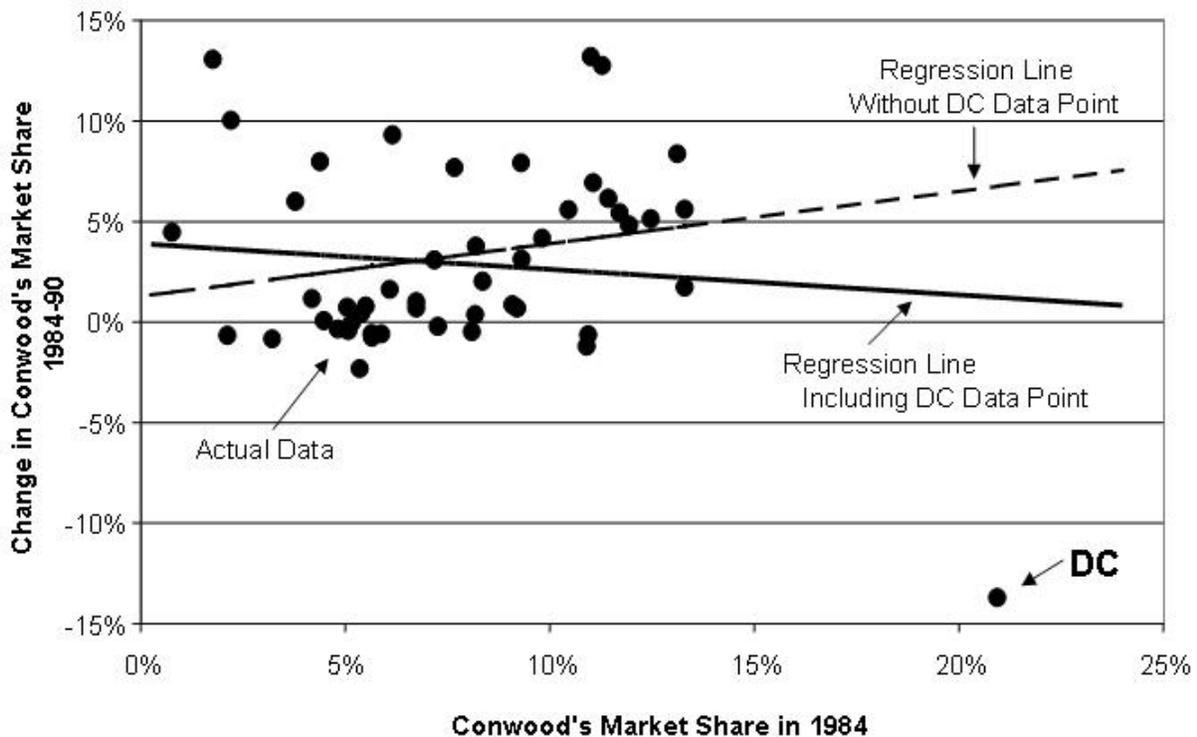
Figure 1: The Pattern of Change in Conwood's DC Market Share Differs Significantly from that in Other Markets



If the model in this case were robust and reliably represented the behavior of the entire market, then dropping the observation for DC from the analysis would make no substantive difference. However, the results change completely with the exclusion of the DC data point. Without the DC data point, the coefficient on initial market share in the “before” period increases substantially from -0.13 to 0.26. The coefficient on initial market share in the “after” period changes only slightly from 0.22 to 0.24. The 0.26 coefficient in the “before” period exceeds, but is statistically indistinguishable, from the 0.24 coefficient in the “after” period.<sup>7</sup> Therefore, excluding just the DC data point would have changed the regression results completely and the expert would have had no basis to conclude that the relationship between initial market share and subsequent market share growth had changed between the “before” and “after” periods. Absent that conclusion, there would have been no support for his foothold theory and no indication of damages.

<sup>7</sup> The statistical test to determine whether the entire relationship (coefficients on both the intercept and initial market share) had changed would also find no statistically significant difference.

**Figure 2: The Regression of the Change in Conwood's Market Share from 1984 to 1990 as a Function of Conwood's Market Share in 1984 is Greatly Influenced by the DC Data Point**



The identification of the DC data point as an outlier could have been achieved easily through visual inspection of data plots such as those shown in Figures 1 and 2. More sophisticated statistical approaches, such as the use of influence statistics, would have achieved the same end, but should not have been necessary. The failure of the plaintiff's expert to investigate the data allowed him to conclude that significant damages had been experienced. The failure of the defendant's expert to investigate the same data allowed that conclusion to survive. Looking at the data is one of the most basic elements of any analysis, yet in this case the failure to identify a single egregious outlier led to a billion-dollar judgment.<sup>8</sup>

**MERILYN COOK ET AL. V. ROCKWELL INTERNATIONAL CORPORATION  
AND THE DOW CHEMICAL COMPANY**

In June 1989, the FBI raided the Rocky Flats Nuclear Weapons Plant in search of evidence of possible mishandling of hazardous materials. Local property owners alleged that negative publicity surrounding the raid led to a decrease in the value of their properties. A class of plaintiffs representing more than 10,000

<sup>8</sup> Subsequent to the trial Dr. McFadden, who was not an expert at the trial, submitted an *amicus* brief concerning whether the testimony of the plaintiff's damages expert should have been excluded under the *Daubert* criteria.

houses was formed. That class currently seeks damages estimated to be \$131 million in a case that still awaits trial.

The plaintiffs' expert sought to show that the value of properties owned by class members had suffered from being situated near the Rocky Flats facility. To accomplish this, he performed a hedonic analysis of house prices from 1988 through 1995.<sup>9</sup> For his analysis, the expert used houses inside the class boundary as well as a sample of houses drawn from other counties within the Denver metropolitan area.

The expert's model related house prices to features of the house and 15 composite location variables that were generated from 40 original locational variables using factor analysis. House features included square footage of living space, number of bathrooms, size of garage, age of the structure, and number of bedrooms. The purpose for including the location variables was to quantify the proximity and quality of various local amenities and disamenities that are capitalized in house prices.<sup>10</sup> The hedonic analysis also included annual variables to measure the yearly percentage effect of being inside rather than outside the class boundaries. These annual variables were the key variables used to determine if an impact had occurred.

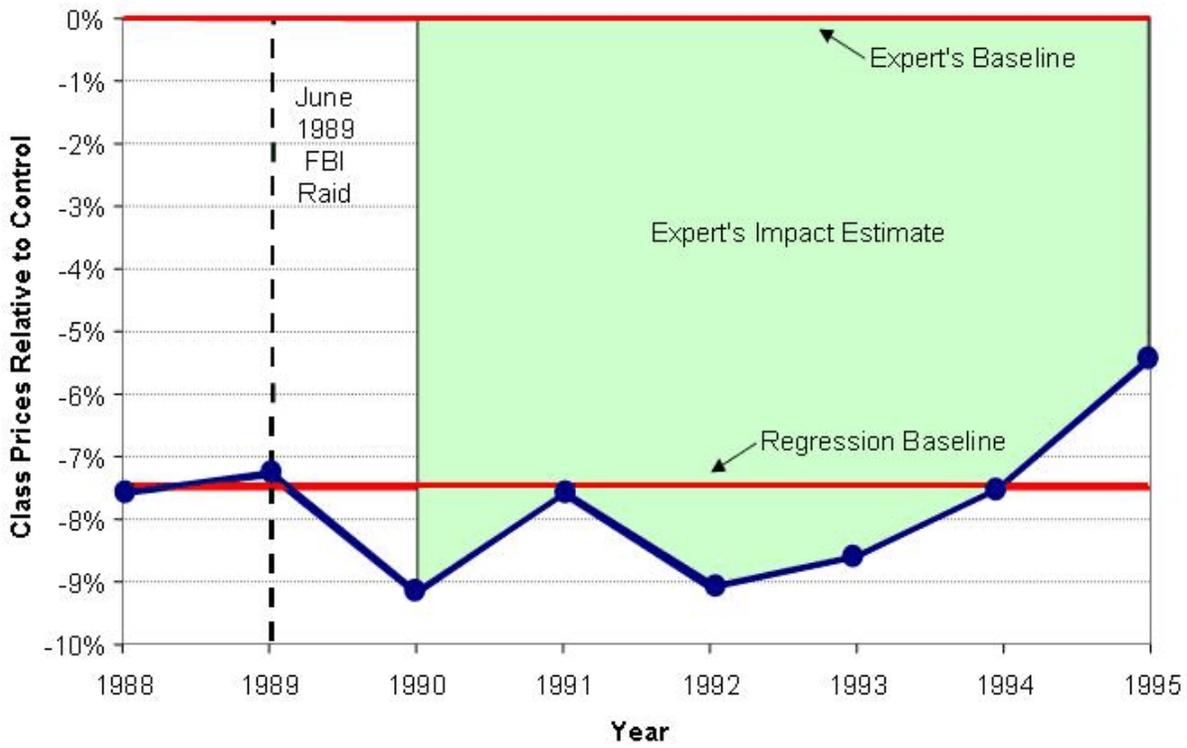
The results of the hedonic analysis indicated that properties inside the class area, other features equal, had sales prices that were lower by about 8 percent than properties in the rest of the sample for all years in the analysis, including 1988. The relative differences are shown in Figure 3. This figure also shows that, despite the consistency of the relative difference throughout the period, the expert concluded that the difference in values of the class properties relative to the control area properties from 1990-1995 was due entirely to the FBI raid.

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<sup>9</sup> Hedonic analysis is a method of estimating the contribution of particular attributes of an object to its total value.

<sup>10</sup> The amenities and disamenities considered by the expert include such factors as education, view, access to open spaces, crime, traffic, overall income levels, racial composition, and age of the neighborhood.

**Figure 3: The Expert's Damage Calculation Assumed that All Relative Differences in Property Values in the Class Area Were Due to Negative Publicity from the Raid**



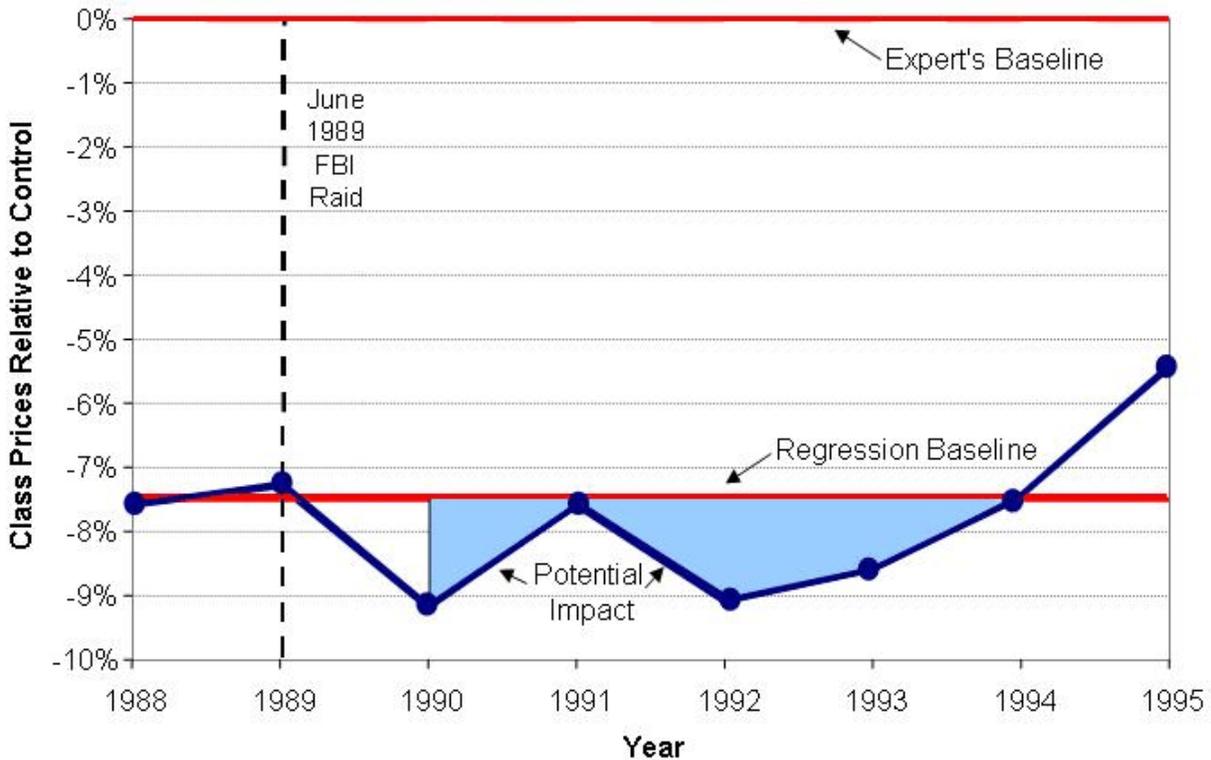
The principal purpose of a damage study is to determine the difference between the actual outcome and the outcome that would have occurred “but for” the event that may have affected property values in the affected area. In this case, the determination of the “but-for” outcome relies on the use of the unaffected control area. A key element in establishing the “but-for” outcome is to consider the relative values between the control and class areas in the period before the event. Only a post-event change from this relationship would suggest damages. In other words, any measure of damages must net out differences between control and class area groups that preceded the alleged activity from differences that exist during the damage period.

A critical error made in this case was the failure to design a proper economic experiment.<sup>11</sup> The proper experiment compares the relationship of prices in the two areas after the raid to the baseline level that would have existed “but for” the negative publicity, in this case the relationship before the raid. The expert’s own analysis indicated that the same 8 percent differential existed before and after the raid, yet he viewed the entire difference after the raid as damages. As shown in Figure 4, the expert should have netted out the roughly 8 percent difference in value that existed prior to the raid in 1989, leaving only incremental

<sup>11</sup> Other econometric issues raised by the specification and estimation of the model are not discussed here.

differences that occurred after the raid.<sup>12</sup> Furthermore, the expert should have conducted statistical tests to determine if any of the post-event differences between class area and control area values were significantly different from those that pre-dated the potential impact period. In this case, the expert's own results would have indicated that none of the annual differences after the raid were significantly different from the approximately 8 percent difference before the raid.

**Figure 4: The Appropriate Baseline for Calculating Damages Accounts for the Fact that Relative Property Values in the Class Area Were also Lower before the Raid**



In summary, had the expert performed his analysis correctly, using a proper experimental design and conducting appropriate statistical tests, he would not have been able to conclude that the FBI raid and the ensuing negative publicity had affected the value of houses near the Rocky Flats facility.

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<sup>12</sup> By including the total difference in value between the class and control houses in his estimate of damages for the period 1990-1995, the expert effectively attributes the cause of the 8 percent value differential in 1988-1989 to a raid which occurred in 1989.

## IN RE INDUSTRIAL SILICON ANTITRUST LITIGATION

The *In re Industrial Silicon Antitrust Litigation* case involved allegations of price-fixing in “industrial grade” silicon and ferrosilicon metal in the 1980s and early 1990s. Following a Department of Justice criminal investigation, three producers were charged with violating Section 1 of the Sherman Act. By 1996, two producers had signed plea agreements and the third was subsequently found guilty at a criminal trial. There were subsequent civil lawsuits brought by a class and by opt-out groups against the three companies and additional parties. All but two of the defendants, Globe Metallurgical and American Alloys, settled with plaintiffs before the trials. At each trial the jury found that there had been no damages.

The expert for the class identified what he called “anomalous” price movements in the 1988-1989 time frame and performed a price/cost margin analysis.<sup>13</sup> The expert’s analysis assumed that “but for” the conspiracy, the ratios of product prices to production costs during the “anomalous” price period and the earlier baseline period should have been similar. The expert reasoned that any evidence of larger margins during the anomalous price period was consistent with price-fixing. Indeed, the analysis produced \$24 million in estimated damages for silicon and ferrosilicon metals. However, the expert conceded that the margin analysis did not control for market factors that might influence product prices and margins. The expert conducted a regression analysis to determine the implications of this omission.

The regression analysis performed by the expert was seemingly straightforward and reasonable. He selected a pre-collusion baseline period from 1980-1987 and estimated an equation using supply, demand, and other factors to explain ferrosilicon metal prices:<sup>14</sup>

Ferrosilicon metal prices = function (supply factors, demand factors, other factors)

Factors for domestic demand included steel industry production and ferrosilicon imports. Supply factors included input costs as measured by producer price indices for electricity, scrap metal, coal, and labor. Additionally, the expert included inventories as a proxy for capacity utilization, and the number of domestic producers as a proxy for competition.

The expert also investigated his results for some of the fundamental problems that occur in regression analysis. One basic test is for autocorrelation which occurs when the residuals (the difference between actual and fitted values) in different periods are statistically related to each other. He found that residuals for any period were strongly related to residuals in the preceding two periods. This type of error may indicate a deficiency that causes the model to systematically forecast high or low for long periods of time. However,

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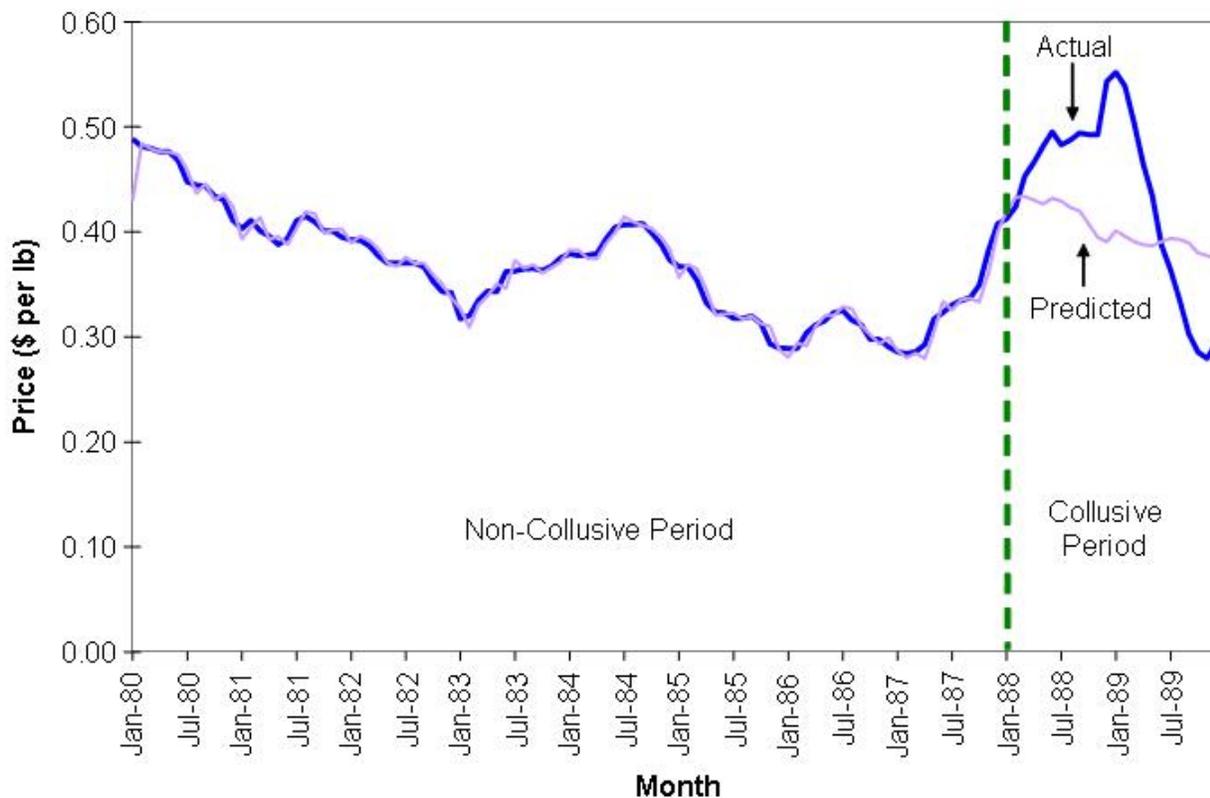
<sup>13</sup> These occurred prior to any known meetings between the defendants but after the complaint alleged a conspiracy could have begun.

<sup>14</sup> The expert conducted his analysis on silicon metal and 50% and 75% ferrosilicon metals separately. However, the approach, the findings, and the conclusions for each of these metals are similar, so for simplicity we restrict our discussion to ferrosilicon metal only.

the expert attempted to correct this problem by estimating a second-order autoregressive-error model. Among other things, this correction uses prices in the preceding two periods to predict the current period price.

Parameter estimates from the expert's regression analysis for 1980 to 1987 were used to predict "but-for" prices in the 1988-1989 alleged damage period. Figure 5 shows the fitted and actual prices by month from 1980-1987, and the predicted and actual prices from 1988-1989. Based on the close fit of predicted prices to actual prices from 1980-1987, the expert concluded that the model was doing a reliable job of explaining price movements and could be used to forecast accurately what prices in other periods should be absent collusion. Consequently, he concluded that the significant divergence between actual prices and the out-of-sample predicted prices from 1988-1989 must have resulted from the successful collusive activities of the defendants rather than from other economic factors.

**Figure 5: The Good Fit of the Model in the Non-Collusive Period Gave the Expert Confidence that the Model Could Predict "But-For" Prices in the Collusive Period**

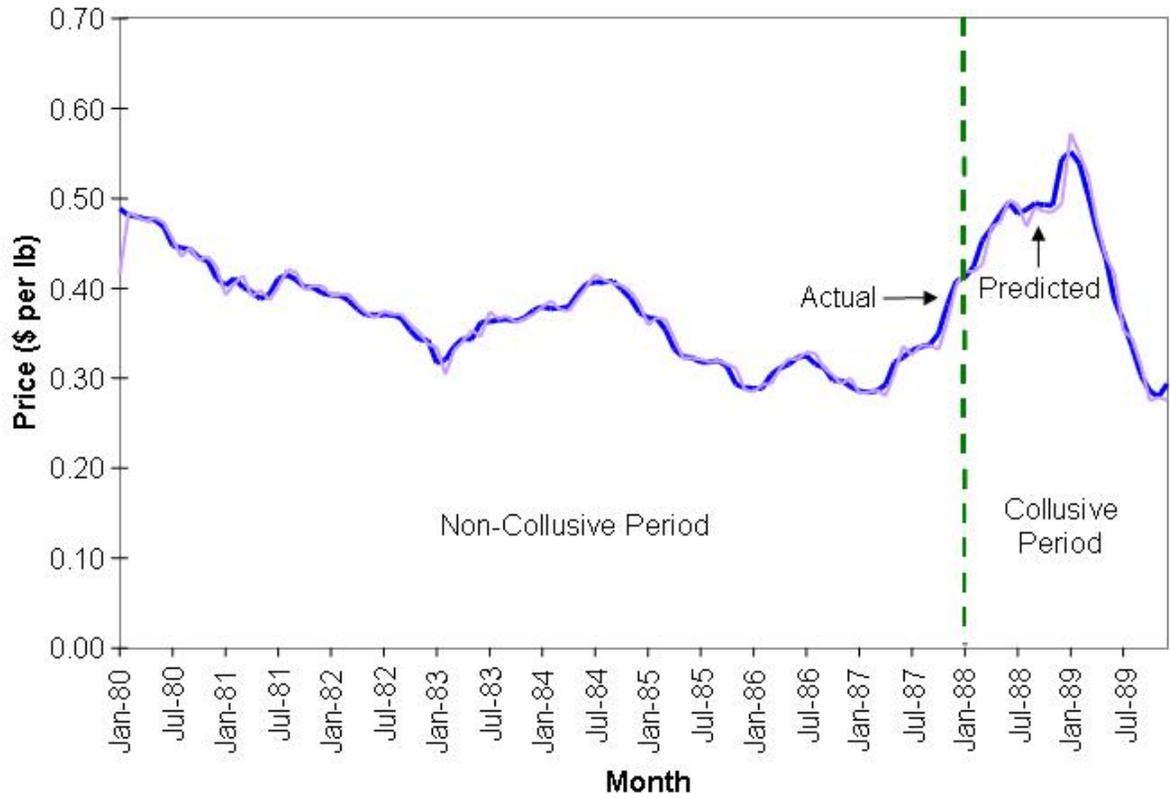


The error in this case is more subtle than those in the other cases we have discussed and derives from experience in understanding that models that fit data well may not predict well. The conclusion that prices departed from "but-for" levels hinges critically on the belief that this model can accurately forecast prices absent collusion. The expert assumed, but did not establish, that this was the case. If the model were reliable and there was an impact from collusion, then two results would be expected; (1) the model, if estimated over the entire "non-collusive" and "collusive" period, should not fit well during the collusive period, and (2) the

model, if estimated during a sub-period of the “non-collusive” period, should be able to accurately predict prices in the rest of the “non-collusive” period.

Figure 6 shows the results obtained by estimating the model used to fit the “non-collusive” period over the entire period from 1980 to 1989. The results indicate that the model fits the actual data for the “collusive” period very well, certainly providing no indication of a departure from market conditions in the preceding period.

**Figure 6: When a Sample from the Entire Period Is Used, the Model Fits the Collusive and Non-Collusive Periods Equally Well, Suggesting No Impact during the Collusive Period**

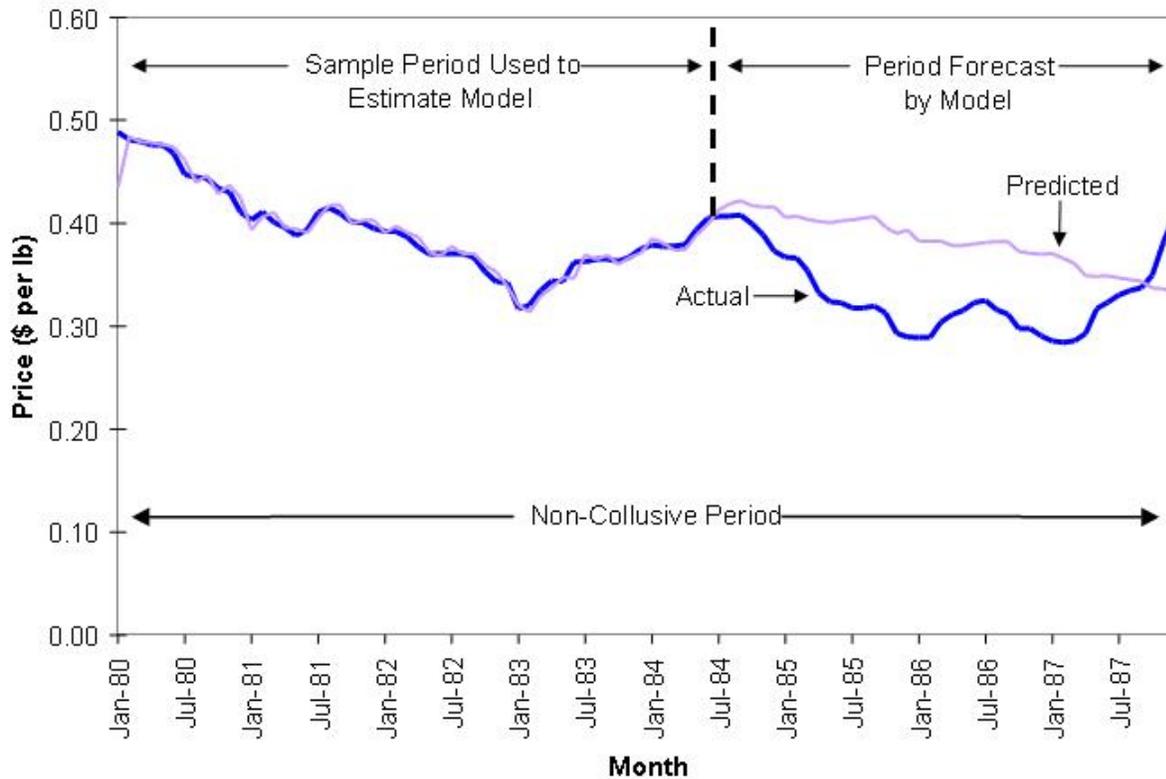


The results when the expert’s model was estimated from 1980 through mid-1984 and used to predict prices from mid-1984 through 1987 are shown in Figure 7. The graph contains the in-sample fit from 1980 through mid-1984, as well as the predictions for the “non-collusive” period from mid-1984 through 1987. The results show clearly that the model is not capable of producing accurate ferrosilicon price predictions within the “non-collusive” period.

This particular model, therefore, is capable of fitting prices but not predicting prices. The primary reason for this is the autoregressive structure of the model. In this particular model, the explanatory power does not

derive from the variables representing supply and demand factors.<sup>15</sup> Instead, current ferrosilicon prices are primarily explained by the prices in the previous two months. Therefore, within the sample the fitted values track changes to new price levels with a short lag and generally track price movements very well. However, outside of the sample, forecasts from this type of model will gradually approach an equilibrium level that may be a very poor predictor of actual prices. The expert failed to recognize, as shown by Figures 6 and 7, that this type of model will lead to poor out-of-sample predictions but excellent within-sample fit.

**Figure 7: When Fit to a Sample from 1980 through Mid-1984, the Model No Longer Accurately Predicts Prices in the Remaining Non-Collusive Period**



This example indicates the importance of checking the in-sample and out-of-sample properties of a model. Had the expert tested his model’s in-sample predictive ability and out-of-sample fitting ability, he would have seen that there was no statistical basis for concluding that ferrosilicon prices in the “collusive” 1988 and 1989 period behaved differently from those in the preceding “non-collusive” period.

<sup>15</sup> When a variant of the model that omits those factors altogether is estimated, the in-sample fit is basically unchanged. In other words, lagged prices account for almost all the explanatory power of this model.

## CONCLUSION

Econometrics is a powerful and often essential tool in considering economic liability and measuring damages. However, apparently sophisticated econometric analyses can be invalidated due to the failure to consider basic analytic issues. While one would hope that these occurrences would be rare among practitioners of econometrics in the litigation arena, they are not. The examples discussed herein demonstrate that damage estimates in the tens or hundreds of millions of dollars can hinge critically on such fundamental activities as checking for outliers, designing a proper experiment, or checking the properties of a model. These are problems that can be explained easily to a jury or a judge. The failure to catch these problems before putting forth an affirmative damage estimate can be fatal. The failure to expose these problems in rebuttal can be enormously costly.

The fact that studies are often undermined not by econometric subtleties but by the failure to carry out fundamental analytical steps means that attorneys need not delegate totally the analytical responsibility to their experts. Attorneys need to make an investment to understand the basic elements of a proper econometric analysis to be in a position to challenge their experts to ensure that obvious problems have not been overlooked. A small investment of time can pay big dividends for the attorney, the expert, and the client.

# *The Brattle Group*

353 Sacramento Street Suite 1140  
San Francisco, CA 94111-3657  
Voice 415.217.1000 Facsimile 415.217.1099

6<sup>th</sup> Floor 15 Berners Street  
London W1T 3LJ  
Voice 020.7907.1180 Facsimile 020.7907.1181

1133 Twentieth Street NW  
Washington, DC 20036  
Voice 202.955.5050 Facsimile 202.955.5059

44 Brattle Street  
Cambridge, MA 02138  
Voice 617.864.7900 Facsimile 617.864.1576

email [office@brattle.com](mailto:office@brattle.com)  
[www.brattle.com](http://www.brattle.com)