

Draft March 29, 2007

**FORENSIC ECONOMICS:
AN INTRODUCTION
WITH SPECIAL EMPHASIS ON PRICE FIXING**

John M. Connor*

*Professor of Industrial Economics
Purdue University
West Lafayette, Indiana
jconnor@purdue.edu

Prepared for delivery at a workshop sponsored by the Amsterdam Centre for Law and Economics, "Forensic Economics in Competition Law Enforcement," Amsterdam, March 17, 2006. ARP No. 2006-17888

INTRODUCTION

I define forensic economics as economic analysis delivered to government authorities in public places. Here, “government” is construed broadly as administrative agencies, regulatory commissions, and judicial bodies. Because regulatory and judicial proceedings are necessarily fact-laden, it follows from this definition that forensic economics is inherently, if not exclusively empirical.

Apart from the occasional best seller, economical writing is directed mainly to other professional economists, eschews emotive language, has little market value, avoids the appearance of taking sides in policy disputes, and is read only out of scientific curiosity. Forensic analyses, on the other hand, are scientific documents written for amateurs, made but not owned by their creators, based on reason but with attention to rhetorical flair, are openly adversarial, and intensely read by a small circle of parties with often large income-transfers at risk.

The adjective “forensic” is derived from the Roman Latin word *forum*. The Roman Forum was the central location for Senatorial oration to the citizens and for the witnessing of contracts. The Forum became emblematic of the structure of ancient civil law. Forensic products – whether delivered orally or in writing – are prepared at the behest of a client and generally support the client’s interest. Forensic analyses are public in the sense that they are prepared with in anticipation that they will be subject to scrutiny and rebuttal by the client’s opponent, and it is often the case that that debate will be carried on in a public setting or be made publicly available later. For that reason, forensic expert opinions are highly strategic documents prepared with an eye to anticipating the opponent’s arguments. They are rhetorical in the best Aristotelian sense of that term, and they are in a curious sense peer-reviewed.

In this paper I aim to explain accepted methods of forensic analysis and how forensic economics is used in the context of competition-law enforcement.¹ I illustrate forensic analysis with examples from antitrust cases involving price fixing.²

¹ Other settings for forensic economics are rate-setting commissions, environmental impact studies, international dumping disputes, and appeals to price controls.

² Fisher (2006) complements this paper by focusing on applications to monopolization and merger cases.

BACKGROUND

Ancient

Forensic economics may be as old a profession as prostitution is alleged to be.¹ In written history it goes back to at least 326 BC (Kotsiris 1988). In that year in Athens a public jury trial was held to convict a collusive ring of wholesale grain dealers (*emporoi*). As a city-state highly dependent on imports, Athenian grain laws were serious business. The case was based on laws instituted 150 years previously that aimed at preventing monopolization of the grain market. The law placed upper limits on the quantity a dealer could store and on the maximum mark-up.³ Detection of price fixing was aided by *sycophants*, informers who received bounties if those they denounced to the Board of Grain Superintendents were successfully prosecuted at trial. During 324-326, military disturbances had caused prices to be especially volatile, and the grain dealers had formed a trade association that was used to bid collusively on purchases from importers and to restrict sales during periods of scarcity thereby generating monopsony and inventory profits.

The history of this trial is preserved by the fact that the prosecutor's oratory was written by Lysias, considered of the greatest orators of Athen's Golden Age. Of course there was no testimony by economists at the trial, but the prosecutor's speech is laced with economic reasoning. In Kotsiris' summary of one passage:

"The [prosecutor] anticipates the defendants' contention based on compensation or 'resistance' (*antistases*), namely that they infringed on the law in good faith in order to keep the prices down and to sell the grain to the people at the cheapest price. Such a contention cannot be sustained: because the grain dealers were charging six times the legal profit; because it is known that the grain dealers avoid contributing to common burdens when a special levy is needed, making poverty their pretext; because of the impudent rapacity of the grain dealers who trade on the misfortunes of the city. The [prosecutor] now emphasizes this point: in bad times the grain dealers store the grain and refuse to sell it so that the people are glad if they can purchase at any price however high, 'and thus in times of peace they become our besiegers.'"

¹ The conscious misrepresentation of consensual economic principles *is* equated with prostitution by practitioners. See the last sub section ("Ethical Considerations") of this Background section.

Note that, if the prosecutor is correct in his facts (to which the grain dealers had admitted), the ring's monopoly profits increased 500%.⁴

The Athenian prosecutor goes on to evoke the principle of general deterrence to sway the jury:

“...[C]onviction is needed not only for what they have done but also as an example for the future, because in their business many prefer to risk their own lives every day than cease to gain illicit profits.”

Plus ça change, plus ça même chose. These are some of the same arguments that were raised by U.S. prosecutors in a well known antitrust trial in Chicago that convicted three officers of Archer Daniels Midland Company for their role in the lysine cartel (Connor 2001: Chapter 15). The three ADM executives received close to the maximum prison sentences under U.S. antitrust law, whereas the Athenian bid riggers paid with their lives. *That* is an antitrust penalty not seen in modern times.

Modern

Now to bring the discussion up to modern times, my survey of the early cartel literature led me to the works of Jeremiah W. Jenks (Connor 2006: Appendix).⁵ Jenks' publications display a strong empirical bent and show a deep interest in gauging the economic effects of cartels. Unusual among academics of the time, his commitment to the study of trusts seems to have been cemented by his extensive work as an advisor for the U.S. Industrial Commission, which held a series of public hearings in 1898-1899 on conditions in several oligopolistic industries. His books contain carefully constructed series of wholesale prices for refined sugar, whiskey, wire nails, barbed wire, steel, and other products controlled by cartels or dominant firms in late 19th century America. Among his analytical advances was the creation of coterminous price series for the principal inputs for the final products (corn for whiskey, steel for nails, etc.). Thus, Jenks seems to be the originator of the cost-based method of calculating overcharges. By correcting for changes in product prices due to input prices, he was able to determine more precisely when and how strongly prices were affected by a cartel.

⁴ Prices probably increased by 20 to 50%.

⁵ Jenks was Professor of Political Science at Cornell University in 1900 when the first of the five editions of his book *The Trust Problem* was published. Many academics who would now be called economists professed “Political economy” at that time. He had already been researching pools, trusts, and monopolies for 20 years by 1900. Jenk's 1888 study of the Michigan salt cartel seems to be the first economic study of cartels to appear in a peer-reviewed English-language professional journal and the first to calculate cartel price effects.

What is interesting about Jenks is his drive to improve methods for calculating cartel overcharges and the fact that he used his experience as a forensic economist to choose topics of policy relevance. This is a theme often echoed by economists with forensic experience (e.g., Scherer 1999, Houthakker 1999), and it has been my personal experience as well.

The Sherman Act became law in July 1890, and Judge (and future President and Chief Justice of the Supreme Court) William Howard Taft wrote the first significant U.S. anti-cartel decision in 1898.⁶ The *Addyston Pipe & Steel (1898)* case involved manufacturers of heavy cast-iron water and sewage pipes in the South and Midwest of the United States that rigged bids to local governments. Judge Taft's decision qualifies as a pioneering American example of forensic economics. It is a remarkably solid, quantitative empirical analysis of a naked bid-rigging conspiracy, which would later be upheld by the Supreme Court.

Taft used what has come to be known as the "yardstick method" in his discussion of the effects of the cartel. He chose to compare the cartel's prices with prices in the more heavily industrialized and competitive Northeast. As far as is known, economists played no role in these path-breaking cartel decisions. The first citation to an economist's work by the Supreme Court is in a 1925 antitrust decision (Kovacic and Shapiro 2000: 47).

In 1914, in the Act authorizing the Federal Trade Commission, the U.S. Congress specifically required the FTC to maintain a Bureau of Economics and endowed it with special data-gathering powers to carry out industry studies. This unit was small until the 1960s but its foundation is apparently the first government recognition of the value of forensic economics in antitrust matters.⁷

The Contemporary Scene

The role played by economic analysis in antitrust policy-making, public-agency prosecutions, and private litigation has greatly expanded in the last 30 years or so (Kovacic 1992, Einhorn 1993, Coate and Klein 1996). Economists have had strong influence on U.S. antitrust enforcement since the mid-1970s. "Chicago School" ideas and the "New IO" movement particularly affected the antitrust analysis of mergers, vertical power, and price discrimination. Stigler's (1964) cartel model

⁶ It was not until 1927 in *Trenton Potteries* that the Supreme Court made a definitive ruling making price fixing *per se* illegal.

⁷ The new FTC absorbed the Bureau of Corporations from another federal Department; this unit had the most competent group of industrial economists in the federal government. Many of the FTC's Bureau of Economics' studies are classics of their type, but few deal with hard-core cartels. The Antitrust Division of the U.S. Department of Justice, which prosecutes criminal violations of the U.S. Sherman Act, appointed its first Chief Economist in 1982 (White 2000). At that time the Division had 40 economists and 300 lawyers. Economists had served in forensic roles in the DOJ for many years before (Kovaleff 1994).

challenged the mainstream's view that overt collusion was a common, stable, or durable arrangement in concentrated industries; indeed, the fragility of cartels in the real world was frequently emphasized by Stigler's followers (Elzinga 1984). However, policy prescriptions regarding price-fixing did not change very as a result of the ascendancy of the Chicago School (Martin 2006).⁸ This was probably a good thing, because the rapid advances of game theory in the 1980s would restore the mainstream industrial-economics positions about the stability and durability of cartels. In particular, repeated games demonstrated that self-enforced collusive agreements can lead to equilibrium outcomes.

The major shift in economists' thinking concerns the issue of whether much observed collusion is achieved tacitly and the role of facilitating practices in collusion (Hay 2000, Gertner and Rosenfield 1998). In the early 1990s the Supreme Court began to cite economics research on game theory to decide conscious parallelism cases. Perhaps the greatest contribution of economics to cartel policies was the use of game-theoretic concepts in the design of the DOJ's revised 1993 Corporate Leniency Program (Kovacic and Shapiro 2000). Defense counsel, plaintiffs' counsel, and public prosecutors have stimulated the economics profession to supply new theories and analytical methods to support litigation. Of these sources of demand, "[t]he largest.... is for theories that exculpate defendants" (Kovacic 1992: 295).

The Antitrust Division of the U.S. Department of Justice (DOJ), because of its unique authority to prosecute criminal antitrust violations, is the primary agency responsible for federal anticartel enforcement. Since the late 1930s the DOJ has aggressively pursued hard-core cartels as serious, *per se*, criminal acts. In the 1940s it extended its domestic anticartel campaign to scores of prosecutions of international cartels (Wells 2002).

This international campaign, after a hiatus of 50 years, returned with a vengeance in the 1990s, as symbolized by its signal victory over the global lysine cartel in 1996 (Connor 2001). Until 1996 the DOJ had regularly failed to convict most of its international-cartel indictments because of concerns about comity (e.g., *Uranium*) or because of failures to summon key witnesses or subpoena inculpatory documents outside U.S. territory (*Industrial Diamonds*). At the same time, beginning in the mid 1970s other vertical and horizontal restraints began to be treated by the DOJ and the courts under a rule of reason analysis (Kovacic and Shapiro (2000: 53-54). Economists were first embedded in the DOJ in the 1970s and now comprise about 10% of the Antitrust Division's professional resources (ITN 2005). The DOJ and FTC regularly hire outside economists as consultants on specific cases.⁹

⁸ I refer specifically to the Second (post-1945) Chicago School. Martin (2006:41-43) makes a useful distinction between the strong influence of the School as a variety of *antitrust analysis* as opposed to its scant influence on the field of industrial-organization *economics*.

⁹ In the spirit of full disclosure, I have been a consultant to both agencies on cartel and merger cases.

In the prosecution of cartels with sufficient evidence of an explicit agreement, the *per se* rule implies that the role of economic analysis will be limited to three tasks. First, if the appropriate fine mandated by the U.S. Sentencing Guidelines¹⁰ exceeds the statutory limit of the Sherman Act,¹¹ then the DOJ must employ an “alternative sentencing statute” to calculate the fines (Connor and Lande 2005). The alternative fines are calculated using a double damages rule.¹² Therefore, forensic economists on the DOJ staff must prepare rough estimates of the overcharge as a basis for negotiating the fine with the alleged perpetrator prior to a guilty-plea agreement. These estimates have been published in a few sentencing memorandums that can be seen on the DOJ’s web site (www.usdoj.gov).

Second, if a criminal trial is held, defendants will usually engage economists as advisors to provide arguments as to the ineffectiveness of the cartel. Even though evidence on the issue should be irrelevant, defense counsel will try to sow doubt about price effects in the jury. When only circumstantial evidence of an agreement is available, the testimony of economists may be needed to assist a jury in inferring the existence of an explicit agreement.

Third, after guilt at trial has been determined, the prosecution moves to a concluding second phase for sentencing. The government may opt to seek higher fines under the alternative sentencing statute. If so, the size of the monopoly overcharge or dead-weight losses will require economic opinions to guide the jury or presiding judge. The first time that the DOJ sought such elevated fines was in 1999 at the conclusion of the criminal proceedings against three individuals involved in the lysine cartel (*United States v. Michael D. Andreas et al.*) (Connor 2001: 434-440). In 2002, the owner of the art-auction house Christie’s, billionaire A. Alfred Taubman, was required to pay a fine of \$7.5 million for his leading role in the cartel created with Sotheby’s.

The vast majority of the efforts of forensic economists are expended in private antitrust suits. Consulting economists have been witnesses in U.S. antitrust trials since at least 1920, but commonly only since the 1960s (Kwoka and White 2004). **Extensive analysis of defendants’ market shares was a key feature of the government’s great 1911 victory in *U.S. v. Standard Oil Co. of New Jersey* (221 U.S. 1). A monopolization case decided in 1953 (*U.S. v. United Shoe Machinery Corp.* 110 F. Supp. 295) may have been one of the first in which extensive and ultimately persuasive economic analysis was presented. Out of this case came the first memoir I have been able to find that was written by a forensic economist, who was retained full time by the presiding judge to**

¹⁰ The Guidelines have been in force since 1987 and are revised almost annually by the U.S. Sentencing Commission. In early 2005, a ruling by the Supreme Court relegated the Guidelines to advisory only, but it appears that most judges are still following the Guidelines closely.

¹¹ From 1990 to 2004, the corporate limit was \$10 million and the individual maximum was \$350,000 (Connor 2006a). In mid 2004, the limits were raised to \$100 million and \$1 million, respectively.

¹² This rule is used under U.S. federal law for all economic crimes that are felonies, not just antitrust infractions.

serve as the Judge's "clerk" (Kaysen 1956). Scherer's (1999:129) memoir relates that his first job as a forensic economist came in the late 1950s as an assistant to Harvard economist M.J. Peck in a collusion case in the tetracycline market. The first refereed economic journal articles explaining some of the methods used by economists in litigation appeared in the late 1960s and 1970s (Bergstrom 1967, Harris and Sullivan 1979, Fisher 1980). Finkelstein and Levenbach (1983) contained a critical review of regression estimates used in private antitrust cases in the late 1970s. Thus, somewhere in the 1960s or 1970s, forensic economics took off in the United States.¹³

There are about 1000 to 2000 private antitrust suits filed each year in the U.S. federal court system, plus an unknown number of suits in state courts. Private damages suits almost invariably require the services of forensic economists experienced in antitrust legal proceedings. Essays by forensic economists demonstrate the wide array of techniques employed to solve concrete legal questions, the stimulation that law cases provide for new research projects,¹⁴ and the satisfaction that arises from influencing high-stakes legal battles (Slottje 1999). Forensic economics has heuristic value. One of the largest-selling books on law and economics consists almost entirely of chapters written from experiences by forensic economists (Kwoka and White 2004).

In treble-damages class-action cases, the role of forensic economists is often crucial to two issues. The first is class certification, a hearing that requires the plaintiffs to prove that a number of legal conditions are satisfied. The economist's role at this stage is to offer a "formula" or method that can reasonably be expected to produce a reliable estimate of class-wide damages. Second, if class-action status is granted, the size of injuries becomes the main issue to be decided or negotiated. The limited sophistication of juries or non-specialist judges will put a premium on simple analytical approaches and on the persuasive skills of testifying experts. As discussed below, while more advanced theoretical or empirical points will often be presented in expert opinions, these exercises will often serve only to confirm opinions reached by simpler means or to neutralize the weight of the evidence presented by the other side during trials or negotiated settlements. Well over 90% of all private treble-damages cases filed are terminated by settlements.

¹³ Fisher's (2006) claim to have been present at the creation around 1970 seems a bit late.

¹⁴ I can testify to the power of forensic work to drive one's research. My 2001 book and papers cited therein were a direct result of my involvement in a civil and a criminal cartel case. A more recent research project published as Connor (2005) was a consequence of a disputed issue that arose in a 1999-2005 cartel case. I also believe that forensic experiences make for livelier teaching.

Forensic economics is a recognized specialty area of economics. The *Journal of Forensic Economics* began publishing in 1987 and contains numerous articles on the fine points of damages calculations.

Ethical Considerations

Forensic scientists sometimes develop reputations not dissimilar to soldiers of fortune, particularly medical experts testifying in person-injury cases. There is a great temptation for expert witnesses to become advocates for their clients' interests that may involve a loss of scientific objectivity (McKie-Mason and Pfau 1999, Kovacic 1992). Lawyer-clients often make it clear what answer they expect to get from their experts. Plaintiffs' counsel want a large overcharge figure, and defendants' counsel want a small one.¹⁵ The first time such a suggestion arises, an expert needs to remind the client that the economist's first duty is to offer an independent opinion to the fact-finder. Thereafter, the expert ought to educate the client on why the chosen method and outcome is the most appropriate. In the end it is simple professional integrity that dictates an appropriate degree of independence. That is one reason for the U.S. courts' rule that prohibits experts from accepting contingency payments. In addition, testifying experts must reveal their hourly fee.

Economists are not licensed to ply their trade, which means that forensic economists who abuse their science can go on offering tainted opinions. For academic economists, a poorly reasoned written testimony or a blunder in court testimony may become the subject of professional gossip, but other than possibly diminished reputation, other sanctions are unlikely. A high proportion of published empirical work on cartels is now published from data obtained in forensic settings.¹⁶ More formal peer review enters after a case is long over. These sanctions do not apply as forcefully to full-time professional experts.

One check on the quality of forensic analysis is through the exchange of expert opinions and rebuttal reports during the discovery phase of litigation. Models, data, and results can be reexamined in great detail by opposing experts. Another quality check is provided during cross-examination by opposing counsel.¹⁷ Whether during pre-trial depositions or in trial testimony, a well prepared cross examination can uncover analytical flaws of experts. Since 1993 a process known as the *Daubert* challenge has become common in private U.S. antitrust cases. The essence of the decision was to allow experts to be disqualified by a judge if the other side is able to show that the expert's methods are heterodox or untested. This ruling brings into

¹⁵ More experienced litigators are well aware of the professional pride uppermost in the values of their experts and are unlikely to pressure experts. Instead, counsel are likely to interview experts in advance and vet their candidates with previous clients. This process often leads to experts being pigeon-holed as either "plaintiffs' experts" or "defendants' witnesses."

¹⁶ Some of this work does not meet publication quality (e.g., Jeon and Shin 2005).

¹⁷ I am indebted to an anonymous reviewer for reminding me about this point.

forensic economics the idea of peer review and general scientific acceptance, but makes the judge the arbiter. It also means that experts should not introduce untested methods at the frontiers of their science. Some counsels now seek affidavits from experts commenting on their expert witness' qualifications. In some European countries judges can fine experts for testifying about shoddy work (Markoff 2005).

The U.S. Industry¹⁸

Most U.S. forensic economists work in the private sector, but hard data on the size of this industry are difficult to locate.¹⁹ However, there are a few indicators of industry revenues.

The continuing growth of mergers and acquisitions and the surge in cartel prosecutions since the mid 1990s has generated large fees for law firms with expertise in antitrust law. Many of the largest law firms tend to specialize in representing large corporate defendants. Only large enterprises are required to seek merger approval from federal antitrust authorities, and those with foreign assets will also seek approval from the EU or other overseas antitrust authorities. Similarly, corporate defendants in cartel cases tend to be large companies with lots of experience in defending themselves from allegations of many kinds. The global scope of the cartels has stimulated U.S. law firms to expand abroad. Several U.S. law firms have followed their clients abroad and now derive more than one-quarter of their revenues from work outside the United States.

Most large corporate defendants have in-house counsel for routine matters, but when defending themselves on matters involving large liability they usually retain outside counsel with antitrust law experience. Unless granted amnesty, defendants in cartel cases have to defend themselves in a legal war that had three fronts: prosecution by government antitrust agencies in as many as ten jurisdictions, civil suits by direct buyers in several nations, and civil suits by indirect buyers in federal and state courts.²⁰ Consequently, defendants' antitrust legal costs are often higher than the legal fees awarded plaintiffs' counsel.

Many U.S. forensic economists are members of the Antitrust Section of the American Bar Association, which in recent years has had 15,000 members, most of them lawyers. A conservative indicator of the size of the antitrust industry is the revenues of major law firms. In 1999 the five largest U.S. law firms each had from 110 to 150 antitrust lawyers (Moore 2006). It appears that about 10% of these firms'

¹⁸ In 1992 Canada passed a law making U.S.-style antitrust class actions possible for the first time. Since the late 1990s civil price-fixing damages suits have become almost as common in Canada as they are in the United States (Connor 2007a).

¹⁹ A few hundred economists work on antitrust matters for federal, state, and municipal enforcement agencies.

²⁰ Indirect purchasers may be prosecuted by the attorneys general of about 30 states in *parens patriae* suits, or they may be sued by the indirect purchasers themselves.

total revenues were derived from antitrust training, advice, and litigation. If this ratio also applies to the top 100 law firms, then total antitrust revenues in 2005 would be at least \$5 to \$6 billion.²¹ As the proportion of legal fees used for economic consultants is about 15%, antitrust economic consulting must have exceeded \$800 million per year in the late 1990s (Neven 2006: 749).

The rise of antitrust class actions has also stimulated the growth of law firms that focus on representing plaintiffs, most of which are small or medium size partnerships. Formerly derided for drumming up business in a manner akin to that of personal-injury lawyers, antitrust plaintiffs' attorneys are now increasingly accorded somewhat greater respect for their skills, methods of operation, and size of recoveries. Instead of being pejoratively referred to as "ambulance-chasers," they are now more often described as entrepreneurial firms assisting social justice. The elevated stature of antitrust plaintiffs' counsel is illustrated by flattering profiles of attorney Michael Hausfeld and his antitrust class-action law firm in leading business publications.²² Nevertheless, critics of plaintiffs' class-action law firms can continue to find negative information about their conduct.²³

Plaintiffs' law firms almost inevitably represent buyers on a contingency basis, which implies that the firms must bare the costs of prosecuting a case for up to three or four years for uncertain future rewards. Contingency fees may be negotiated by the clients, but most antitrust plaintiffs join a federal class whose legal fees will be determined by a supervising judge. The traditional system of contingency fees rewards plaintiffs' counsel with a fixed percentage of the settlement amounts won by the plaintiffs. This system encourages attorneys to settle for the highest amount that defendants can be persuaded to pay yet also provides incentives to economize by settling prior to a drawn out court battle. However, court rules do not permit experts to be rewarded on a contingency basis.

An incomplete accounting of class-action rewards gives a partial indication of the size of the revenues of plaintiffs' firms (Lande and Davis 2006). Their preliminary survey of 27 completed private damages suits against cartels found

²¹ The annual survey of top law firms by *American Lawyer* (October 2006) found that the top U.S. firms had \$51 billion in gross revenues and that the top 100 world wide had \$59 billion. The top 100 accounted for 6.2% of all U.S. law firms' revenues, but the proportion of all firms' revenues from antitrust activity is highly speculative.

²² One article in the *Wall Street Journal* noted that his firm, Cohen Milstein, has been involved in high profile and successful civil lawsuits against handgun manufacturers, German companies that enslaved workers during World War II, Swiss banks that did not return the assets of victims of the Nazi holocaust, and oil companies accused of causing pollution (Barrett 2000). Hausfeld calls these actions "social reform" class-action suits because they can mitigate injuries not being addressed by legislatures or regulatory agencies. Hausfeld's firm with other co-counsel led the civil treble-damages lawsuit against the vitamins cartels. More recently, Hausfeld has been a leader in trying to export the U.S. class-action model to other jurisdictions (Freedman 2004).

²³ More conservative opinion pieces have referred to Hausfeld as a "corporate shakedown artist" (Segal 1999). In 2006 allegations were made about ethical and possibly legal lapses at the prominent law firm Milberg Weiss, a specialist in securities class actions (Elkind 2006).

total recoveries from 1990 to 2006 to be \$16.7 to \$18.1 billion.²⁴ The legal fees earned by plaintiffs' firms ranged from 33% to 5% of recoveries and totaled about \$2.3 billion or \$150 million per year.²⁵ It appears that the fees/recovery ratios have declined in the past few decades and that there are fixed costs in representing a civil treble-damages case, or at least some threshold level under which most law firms choose not to accept this type of legal action.²⁶

Many forensic economists are academics for whom forensic activities are a part-time activity. While most forensic experts are members of small firms, some are employees of the consulting divisions of large accounting or law firms. Recent decades have seen the rise of economic consulting firms that specialize in regulatory or antitrust matters. One of the largest and best known is LECG (formerly Legal Economic Consulting Group), which is now a publicly traded company. In 2006 LECG had revenues of more than \$300 million, and revenues have grown by 75 to 90% per annum in recent years.²⁷

Some legal writers and judicial opinions have expressed concerns about excessive legal fees in class action cases. The decline in the percentage of settlement awards paid out as legal fees probably represents in part a reaction against perceived overly generous awards in the past. Doubtless many will regard such enormous sums as sad evidence of a hyper litigious society. To some extent they *are* wasteful expenditures in the sense that many were incurred simply to cancel the effects of expenditures by parties on the other side of the dispute. However, legal expenses also a consequence of constitutionally guaranteed rights to due legal process. And as high as they were, these legal transactions costs may be low when compared to the economic costs of the alternatives.

Forensic Economics in Europe

It is notable that of the 18 authors that contributed to an edited volume of advanced methods in forensic economics, not one is located at a European institution (Slottje 1999). In fact, 16 were affiliated with U.S.-based institutions, and the other two

²⁴ Only class actions with recoveries of \$50 million or more were surveyed. Legal fees were known for 23 of the 27 cases, and the weighted average fee was 13.2% of the recoveries..

²⁵ This is a minimum figure because of the \$50-million-dollar cutoff and because several cases launched several years before 2006 are still incomplete.

²⁶ In a sample of class-action suits from the 1970s and 1980s, Elzinga and Wood (1988) found that legal fees and costs averaged \$190,000 per case. While these fees may seem rather modest, so were the average values of the settlements – only \$640,000 per case. That is, on average legal fees represented about 30 percent of the total awards made to private treble-damages recipients. Connor (2001: Table 18.1) contains a list of more recent civil antitrust price-fixing cases for which information is available on attorney fees. These data show that the larger the size of a recovery, the smaller the ratio of legal costs to recovery amount. Moreover, the largest settlements tend to have been made in more recent years. Lande and Davis (2006) also find that fee rates are lower for larger recoveries.

²⁷ See <http://ir.lecg.com/phoenix.zhtml?c=147770&p=irol-sec>. Few other consulting firms are publicly traded.

worked in Australia. I believe that this is anecdotal evidence of an undeveloped forensic-economics industry in Europe.²⁸

Neven (2006:748-752) dates the beginning of the European based forensic-economics industry from 1984. By 1995 the three largest economic consultancies had annual revenues of \$4 million. Growth in numbers of such firms and their revenues was exponential, reaching a conservative \$44 million by 2004 and supporting at least 150 fully trained economists. Moreover, the share of antitrust legal fees spent on economic consulting rose from about 5% in 1995 to 15% around 2004. Competition-law cases increasingly incorporate economic reasoning. For example, nearly one-third of the 1991-2005 merger-control cases decided by the EU had references to significant economic analyses, and the proportion was rising (ibid. p. 751).

There are also relatively few government positions for forensic antitrust economists in Europe. In 2005 the European Commission's Directorate General for Competition Law (DG-COMP) had 20 of its expert positions filled by Ph.D. economists, as compare to about 100 such positions in the two U.S. antitrust agencies (Neven 2006: 752). Ph.D. economists comprised 7 to 8% of the fully qualified professionals in all three antitrust authorities.

One of the reasons for the paucity of such work in Europe may be traced to taste or status in respect to economic research in general.²⁹ In my survey of about 500 publications looking for cartel overcharges, I was struck by the small proportion written by scholars outside of North America.³⁰ Nearly all economic articles are written by North American academics using cartel episodes that affected commerce in the United States or Canada.³¹ The absence of empirical cartel studies by

²⁸ The terms "forensic economics" and variants hardly ever turns up in the European press (LexisNexis search). One recent article asserted that consultant's rates in Europe are roughly the same as those in the United States (Markoff 2005)

²⁹ Martin (2007) notes that despite considerable harmonization, the goals and philosophical foundations of EU competition law are different from U.S. antitrust law. The former embraces more of a political economy tradition that may not lend itself so readily to quantification.

³⁰ Admittedly, limiting my survey to works in English probably exaggerated this impression, but I did attempt to locate books in German and French also. German legal-economic scholars did dominate cartel studies before 1914, but faded thereafter. I examined books, journal articles, working papers, government reports, court and commission decisions, and other short analyses of cartel price effects. Many were written primarily as historical case studies and mention price effects only in passing; most such papers contain no references to price changes but are valuable because they are based on primary documents that give details about internal organization. The majority of the short cartel studies were written by economists; the focus in these studies is on testing hypotheses or an improved estimation method for overcharges; many are so focused on their method that they do not contain enough information to derive point estimates of the overcharge rate.

³¹ Several historical studies of cartels were authored by European or Japanese economic historians. Contributors to two or three conferences on cartels sponsored by the League of Nations in the 1930s were from various nations of Western Europe. The greatest evidence of empirical interest in cartels is from the dozens of studies of industries issued by the UK Monopolies Commission beginning in the late 1940s. A few recent economic studies of cartels were written by UK or Australian economists with strong ties to U.S. research institutions (Evenett 2003, de Roos 2004).

European is striking, as is an abundance of works that contribute to advances in theories of collusion. In other words, in cartel publications the empirical/theoretical ratio is high in North America and low on Continental Europe.³²

One might speculate as to why this is so. The supply of well trained industrial economists in Europe is unlikely to be an explanation.³³ However, the structure of academic departments at European and Asian universities may explain the paucity of useful studies. Compared to U.S. departments of economics, European departments tend to be smaller (perhaps falling below the threshold necessary for collaborative teamwork on large-scale data sets), more focused on IO theory, and have different expectations for Ph.D. dissertations. A survey of European and North American industrial-organization economists reveals that there are very few attitudinal differences between the two groups on economic theory, but the former were less likely to expect economists to influence competition policies (Aiginger *et al.* 2001).

The legal profession and antitrust authorities in Europe have been slow to embrace the idea that they must employ fully trained industrial-organization economists who are prepared to testify in the courts of appeal on the finer points of empirical studies of market effects of alleged antitrust violations or anticompetitive mergers (Van den Burgh 2002). In the case of the European Commission, we know that in *Dyestuffs*,³⁴ one of the earliest contested cartel cases, a large number of economists testified around 1970 when the EC's decision was appealed to the European Court of Justice (Joshua 2006: 8-9). However, these testimonies seem not to qualify as forensic economics in its present incarnation, because the substance of those testimonies was confined to the realm of oligopoly theory.³⁵ The first example of forensic economics proper in an EC cartel case occurred around 1990 in an appeal to the Court of First Instance of the EC's decision in the precedent-making *Polypropylene*³⁶ case. Unlike *Dyestuffs*, the Commission alleged the existence of an overt cartel agreement. Moreover, several large defendants in *Polypropylene* had submitted an econometric study that their expert claimed proved

³² The UK is in an intermediate situation, but even in the UK *academic journal* publications are heavily weighted toward contributions to the microeconomics of collusion and away from empirical studies of cartel conduct and performance. Indeed, prior to the 1950s I was able to locate only one overcharge estimate in a British economics journal.

³³ The principal European organization for industrial economists (EARIE) was more active in sponsoring meetings the past decade than its U.S. counterpart (IOS), and the EARIE meetings had a good proportion of empirical and legal-economic papers.

³⁴ *ICI v. Commission [1972] ECR 619*. There are several academic and historical studies of the international dyestuffs cartel that demonstrate that from the early 1920s it was one of the world's first effective price-fixing conspiracies with nearly global effects (Connor 2006a).

³⁵ This is not to say that these testimonies were inappropriate. Because the Commission had alleged that the cartel was guilty of a "concerted practice" (tacit collusion or conscious parallelism), the usual allegation that the cartel had formed and carried out an explicit agreement was not an issue before the Court.

³⁶ *Hercules Chemicals v. Commission [1990] ECR II-1711*. It is possible that forensic economists have been employed in proceedings of older national antitrust authorities, such as Germany's Federal Cartel Office, before the 1990s. Some of the UK Monopolies Commission decisions of the late 1950s and early 1960s bear the signs of economic reasoning.

that the pattern of polypropylene prices was explained exclusively by “natural forces of demand and supply” (Joshua 2006: 9). The testimony of the Commission’s sole in-house economist, which highly critical of the econometric model, apparently neutralized any impact the model may have had on the Court’s decision.³⁷ Besides, as in the United States, the Commission would from about that time come to rely on a conspiracy theory of cartel harm. Under that theory it is the agreement itself that is the violation; evidence on the market effects of the cartel is largely irrelevant for the determination of guilt.

Perhaps a more important factor explaining the weak status of European the near absence of private antitrust suits (Ashurst 2004). Because private civil cases are unusual in Europe, so the little work being done on cartel overcharges is done in-house by antitrust authorities. This inhibits the ability of academics to obtain access to the structural and price data needed to calculate overcharges using advanced statistical methods. Unlike North America, there is little mobility from the staffs of European antitrust authorities to universities or think tanks.

Methods

The major role played by economic analysis in horizontal price-fixing cases is the calculation of the *overcharge* on buyers in markets affected by a cartel. The overcharge is the value of purchases of a cartelized product actually made minus what the sales would have been for the same volume of product absent the cartel. The overcharge can be measured as a percentage of affected commerce (this is the familiar Lerner Index of market power) or as a percentage of sales *absent overt collusion* (this is the mark-up on the but-for price). Accurate estimates of conspiracy-induced overcharges are important not only because of recovery of civil damages, but also because overcharges can be the basis for the calculation of government fines. Under the U.S. antitrust laws, a successful plaintiff is entitled to treble the dollar overcharge, which is then multiplied by the number of unit’s purchased.³⁸

Information on actual transaction prices and quantities sold is usually readily available from the parties in such cases, and defendants may reveal proprietary cost data as well. See Figure 1 for an example. But the unobserved “but-for” price must be inferred using economic reasoning.³⁹ The principal challenge for forensic

³⁷ Around 2003, in response to a series of critical comments in decisions of the EU courts, the DG-COMP established the office of the Chief Economist who oversees a significant number of fully credentialed economists. Joshua (2006: 15) shows that these economists were activated in their first year to critique a cartel’s defendants’ forensic studies.

³⁸ Equivalently, one may compute the *percentage* increase in price for each time period during the conspiracy, and then multiply these percentages by the *value* purchased in each period.

³⁹ Single damages under the law in most court circuits are precisely equivalent to the income transfer due to the exercise of market power. Single damages are slightly higher than the stream of monopoly profits accruing to the cartel members, because operating the cartel requires the expenditure of some management resources. In some circuits, the dead-weight loss may be permitted as an additional

economists is to calculate the relatively competitive benchmark price for each collusive sub period. Reasonable economists will often arrive at different benchmarks for the same set of facts.

Two features of estimating cartel damages help simplify the analytical task. First, the market-definition problem so critical in monopolization and merger cases, is usually not an issue. For effective hard-core conspiracies, cartelists self-define the appropriate product and geographic market.⁴⁰ Second, the time period for *intended* cartel price effects is usually an admitted fact. Actual market price changes often will lag by several weeks the starting date and by several months the ending date. It is possible that the cartelists achieved no pricing power in the market. However, in most cases the collusive period is treated as parametric information.⁴¹

There are five generally recognized methods of calculating an overcharge (Page 1996, Hovenkamp 1998). Proving an antitrust injury in U.S. courts depends on the preponderance of the evidence in the case, but the *amount* of damages is decided according to a lower standard, that of reasonableness. As I understand the term, reasonableness requires a “formula” (a precise method of calculation) that can be applied to data likely to be available to the analyst. Each of the five methods of computation below will meet the legal standard of reasonableness, and forensic economists often will examine more than one method to see if they are mutually supporting.

The Before-and-After Method

This method has been used to calculate antitrust damages in U.S. civil cases since at least the 1920s (Hovenkamp 1998:661), and it was one of the methods used in the treble-damages lysine case. “Before-and-after” is something of a misnomer; it should be called the “with-and-without (collusion) method.” The “before” period is

source of damages (Page 1996). Some legal theorists argue that a buyer’s lost profit is a conceptually superior measure of damages (Hovenkamp 1998, p. 658).

⁴⁰ Under U.S. law prior criminal convictions are *prima facie* evidence for follow-on civil damages cases. An anonymous referee rightly pointed out that market definition could become a forensic issue if the alleged agreement must be proven from circumstantial rather than direct evidence. Market definition will also require analysis if the alleged cartel conduct was a facilitating practice rather than an overt agreement on price or output.

⁴¹ In the lysine case, the length of the time period of the affected period was an issue that divided experts for the two sides (Connor 2001). It is usually uncontroversial to use the conspiracy period for the affected sales period, but in the lysine case the defendants had not yet agreed to plead guilty. Consequently, the opt-out plaintiffs had to depend on press reports to define the affected period. Plaintiffs chose August 1992-December 1995 to be the affected sales period. In fact court testimony would later reveal that the lysine cartel had two episodes divided by a brief price war in the spring of 1993. Defendants’ experts decided that only the second episode was effectively cartelized. (White 2001) refers to an “unusual and suspicious” pattern of “uncharacteristic stability” in lysine transaction prices from September or October 1993 to February or March 1995 (see Figure 1).

really any nonconspiracy period -- whether before, after, or during an intermediate pause in price-fixing. It is important that the "before" period be one that is quite comparable to the conspiracy period with respect to demand and supply conditions. Shifts in buyer preferences, appearance or the disappearance of substitutes, or changes in the cost of production of the cartelized product during the affected period can cause overstatement or understatement of the overcharge.

A pre-cartel price is often presumed in legal settings to be the competitive price. "Cartel members . . . enjoy no presumption that they already had market power before the illegal act was committed" (Hovenkamp 1998, p. 660). However, even if a pre-cartel period was arguably one of oligopolistic tacit pricing conduct, the pre-cartel price is still a reasonable benchmark so long as the competitive determinants of pricing conduct did not change when the cartel was formed. That is, the before-and-after method is free of assumptions about the nature of the industry's non-cartel, noncooperative conduct; it may be purely competitive or tacitly collusive. Prices during the post-cartel period or during an intracartel price war might also serve as reasonable benchmarks. However, post-cartel benchmarks may be affected by learning during the conspiracy; that is, when a cartel is formed in a competitive industry, its members may learn how to price tacitly after the cartel breaks up. If true, the overcharge would be understated. If prices fall to short-run marginal cost levels during a price war, the overcharge may be overstated.

Choosing the months to employ for the before price requires judgment. If real prices were fairly constant for one to three years before a cartel began, then averages of these one, two or three years' prices might serve well as benchmarks. One problem often encountered is that cartel formation frequently occurs after a recessionary period in the industry; if so, then the benchmark price might be understated and the damages overstated. A predatory episode prior to cartel formation will strongly overestimate the overcharge, as happened in lysine. On the other hand, older pre-cartel prices could have been generated by a previous cartel episode unknown to plaintiffs. This seems to have been the case in the vitamins cartels in 1985-1989 (Figure 8-2).

Similarly, post-cartel prices can be equally problematic benchmarks. Ideally, conduct may be a reversion to noncooperative equilibrium. However, defendants may enter into a period of unsustainably low pricing to mollify their angry customers. Alternatively, the cartel experience may allow its participants to form more stable conjectures than were possible before the cartel existed, in which case even uncooperative conduct inflates post-cartel prices because a sort of carry-over effect of cartel behavior. Harrington (2004) developed a model in which former cartelists keep prices high in order to reduce their liabilities in follow-on civil suits.

Most commonly, the analyst draws a straight line from the before price forward until the end of the cartel or backward from the after price to the beginning of collusion. A slightly more sophisticated approach is to draw a straight line from the

before price to the after price. If it has an upward slope costs probably increased and vice-versa. Figure 12-1 illustrates this approach from a damages analysis prepared for the U.S. vitamin E cartel suit. Plaintiffs alleged that most of the vitamins cartels had organized cartels in 1985-1989, an allegation that complicated the calculation of damages. Bernheim (2002) judged that there was a brief period of pricing in late 1999 that would serve as a relatively noncooperative benchmark; also, he decided that collusive carry-over effects on prices had dissipated after about 12 months.

Seasonality of demand is a difficult issue to deal with in a before-and-after analysis, especially when there are few non-cartel period price observations. Later, evidence came to light that seasonality of demand for lysine was well recognized by the managers of the cartel (Connor 2001: 211-212). It arises from swine feeding practices of producers in the temperate zones. Demand for animal feed rises in the winter months, which results in an increase in the derived demand for lysine in the fall of each year. Econometric methods are better equipped to handle seasonal shifters than the simple before-and after method. Because collusion is best timed to begin when seasonal demand rises, ignoring this factor will lead to an overestimate of damages.

The Yardstick Method

The *yardstick* approach involves the identification of a market similar to the one in which prices were fixed but where prices were unaffected by the conspiracy. A yardstick market should have cost structures and demand characteristics highly comparable to the cartelized market, yet lie outside the orbit of the cartel's influence. Typically, the yardstick method is most useful when applied to cases of geographically localized price fixing or bid rigging. Markets with nonstorable products, with high transportation costs relative to price, and for localized services are good candidates for the yardstick method. The yardstick method has been used in markets for bread (Mueller and Parker 1992), fluid milk (Porter and Zona 1999), and construction services. With global cartels like lysine and vitamins, the yardstick method could not be applied.

In principle, yardsticks can be sought for analogous *product forms* sold in the same geographic market as the cartelized product. One might search for a good that is made using a similar major input, similar technology of production, and sold to customers with similar demand characteristics as the cartelized good. There is, however, a logical problem with product-form yardsticks in cartel cases. Cartels can only work if they sell a well-defined product, and such products by definition have no close substitutes. A good product yardstick is likely to be a close substitute for the cartelized product over a wide range in observed prices.⁴² Thus, it appears to

⁴² Of course, the Cellophane Fallacy demonstrates that above a certain price, any cartelized product will run into product substitutes. In the fermented-lysine cartel, the cartel's managers were well aware that when the price of soybean meal was low enough, its natural lysine content would become price-competitive with the fermented version.

be a hopeless task to find a good product-form yardstick that has a price unaffected by the alleged conspiracy.

Choosing an analogous market requires judgment that is best informed by a deep study of the market and cartel practices. It is best justified by examining price movements in the affected market and the analogous market before and after the cartel period. If monthly prices for two or three years are highly correlated, then the analyst has some assurance that the analogous market was a proper choice. The overcharge is then calculated by the differences in prices between the affected market and the yardstick market.

The Cost-Based Approach

During the 1998 criminal trial of three ADM executives for lysine price fixing, prosecutors introduced the confidential production and sales records of ADM's lysine department as exhibits. These internal records (now public documents) provided ADM managers with monthly plant output and several costs (labor, energy, dextrose, other chemicals, overhead expenses, transportation, storage, and sales-office expenses) during the five years 1991-1995. Figure 2 plots these costs of manufacturing and distribution against monthly physical plant output using regression analysis.

The plot appears to show considerable "scale economies" for levels of output up to 10 or 11 million pounds. In fact, the diagram really captures strong learning-by-doing effects, because all of the observations below 11 million pounds are drawn from the pre-cartel period (February 1991-June 1992). Abundant testimony and the manufacturing records themselves support the fact that nearly all of the high-cost months were ones with "yield failures" due to contamination of fermentors.⁴³ As ADM learned how to sanitize its plant's fermentation reactors, contamination episodes ceased and the costs of spoiled-product disposals disappeared. To a minor extent, unit costs also declined with increasing levels of output because fixed costs were being spread over larger units of production.

The most important feature of the average-total-cost curve shown in Figure 2 is the portion above 10 or 11 million pounds per month. During the conspiracy, plant output always exceeded 10 million pounds. Statistically, this portion is completely flat. It is true that manufacturing costs were affected by short run changes in the price of dextrose, which in turn was closely related to the market price of corn. Nevertheless, total manufacturing costs hewed quite closely to the average of \$0.63 per pound whenever production exceeded 10 million pounds. As plant output edged closer to the maximum 18-million-pounds level, unit fixed costs dropped a

⁴³ In every case when costs jumped above about \$0.80 per pound, the lysine/dextrose yield ratio dropped below 30%. Such episodes became rare after June 1992 or when production was above 10 or 11 million pounds.

bit. However, the decline in fixed costs was nearly perfectly balanced by higher selling costs incurred as ADM shipped higher shares of its U.S. production to overseas destinations. Thus, after June 1992 (the likely cartel period), average total accounting costs of manufacturing and sales varied only within the \$0.73 to \$0.78 per pound range and were statistically unrelated to the quantity produced. Adding a fairly generous return on investment of 6% of sales brings the average total *economic* costs to \$0.77 to \$0.83 per pound of lysine.⁴⁴

In competitively structured industries, profit-maximizing firms accept prices that are equal to their long run marginal costs. Because ADM's total costs were effectively constant during the cartel period, it follows that the but-for competitive price would have been just about \$0.80 during the affected period. This observation is reinforced by the fact that ADM's costs of production were equal to or lower than all four of its rivals in the lysine industry (Connor 2001: 217). The full-cost price of \$0.80 seems like a decent but-for price.

The Constant-Margin Approach

The constant-margin approach is a variation on the before-and-after and cost-based methods. Instead of analyzing prices, variable costs become the focus of the analysis. It assumes that the cartel members earned profit margins from noncooperative conduct prior to and after the cartel; the "but-for" benchmark is an implicit gross margin that remains constant for the affected period.

The forensic economist must study production methods intensely. Costs of production are collected for the pre-cartel, cartel, and post-cartel periods. It is desirable to use input prices drawn from competitive markets. Relying on costs from the internal records of participating firms is perilous, especially for durable cartels because of X-inefficiencies that may develop during collusion.

An example of this approach is illustrated for the vitamin E conspiracy in Figure 12-5. The results are not too different from the straight-line before-and-after method (Figure 8-2). Indeed, the damages estimates from the two methods are quite close.

Using Game-Theory to Check Results

The defendants in the lysine cartel provided a second rebuttal to the plaintiffs' before-and-after analysis. They asserted that a noncooperative form of collusion was more probable than perfect competition had the cartel not operated (Warren-Boulton 1995). Further, the defendants specified the homogenous Cournot model as the most appropriate one, because of its long-standing acceptance and widespread analytical use economics. Over certain ranges of market conditions,

⁴⁴ This is generous because it is ADM's own rate of return during fiscal 1990-1995 when its profits were bloated by several commodity cartels (Connor 2000: Appendix A). It is also well above the average return earned by publicly traded companies in similar industries.

that model predicted equilibrium prices that fell within the range of actual market prices observed during the cartel period. That is, the Cournot model implied that the cartel had been ineffective raising prices by *explicit* collusion above prices generated by *implicit* (and legal) pricing coordination. Thus, the overcharge was zero.

Predictions from specific oligopoly models require structural parameters. In particular, the Cournot formula for calculating the profit-maximizing price needs three pieces of market information: the Herfindahl index of concentration, the own-price elasticity of demand, and the marginal cost of production. About the first item there was no disagreement; the Herfindahl index for three domestic manufacturers and two importers during the conspiracy was about 3,500.⁴⁵ The other parameters were borrowed from the plaintiffs' own opinion, namely that document's assertion that \$0.70 was the marginal cost (or close to it) and that the elasticity was around -0.5 to -1.0 during the cartel period.⁴⁶

One problem with the Cournot model is that the formula can, under some ranges of parameters, predict impossible prices. In layman's terms, the model can "blow up." For example, if the demand for lysine is highly inelastic (less than -0.35), then Cournot oligopolists would be predicted to set negative prices, no matter what the cost of production. Negative prices are rarely observed in natural markets, because prices generally must be set above the variable costs of production, and these costs are always nonnegative. Another problem with Cournot is that it is only one of many plausible oligopoly models; its popularity with economists rests more with its mathematical tractability than its consistency with the organization of natural markets. Given the lysine parameters just discussed, other equally plausible models such as price leadership by ADM produce equally untenable market price predictions. Moreover, the model that many economists would agree is the second most popular, the homogeneous Bertrand model, predicts *competitive* prices when there are two or more sellers. Finally, although possibly allowable as evidence in antitrust cases, the degree of econometric literacy required to comprehend formal oligopoly models greatly restricts their use in forensic settings.

Econometric Modeling

With sufficient time and access to detailed price and cost information, statistical modeling is often the preferred analytical approach of forensic economists in

⁴⁵ Implicitly this assumes that a global cartel was viewing the U.S. market as geographically distinct from others. Internal records of the cartel's pricing decisions and its efforts to prevent geographic arbitrage tend to support this view. Global concentration was about 2,500 in 1994 (Connor 2001a, tbl. 8.A.3).

⁴⁶ Connor (1996) opined that feeds were manufactured under fixed proportions, which implied poultry, swine, or meat elasticities of -0.10 to -0.50 . These are retail-level elasticities calculated from precartel, more competitive periods; at the higher cartel-period prices, the elasticity will be higher in absolute value. This discussion took place in the context of his analysis of the dead-weight loss from cartel pricing.

estimating antitrust damages (see, e.g., Slottje 1999). When all the necessary data have been received from defendants during discovery and cross-checked for accuracy and completeness, the econometric analysis itself could take as little as six months or as long as a year. Two or three years' time is not unusual.

With a rigorous model that is shown to fit the market's actual performance over time, the legal goal of isolating the effects of a defendants' illegal conduct from all other market forces would appear to be achievable. Econometrics seems ideally suited to identifying “. . . the only casual factor accounting for the difference between plaintiff's actual experience in the damage period and its but-for period. . .” (Page 1996: 36). Law journals and handbooks for lawyers in the antitrust field frequently include material on regression analysis for damages calculations (e.g., Fisher 1980, Page 1996, and Hovenkamp 1999). Baker and Rubinfeld (1999) and Brander and Ross (2005) provide nice surveys of the method.

Econometric estimation employs reduced-form equations using multiple regression methods.⁴⁷ The structural model assumes that both the quantity demanded and the quantity supplied are dependent simultaneously on the market price. One of two econometric approaches regresses market price on observations from collusive and noncollusive periods. The right-hand side of the equation contains variables representing variable input costs (wages, materials, energy, inventories, and possibly exchange rates⁴⁸) and variable that will capture sources of demand (customer incomes, buyer output levels, seasonal dummies, and prices of substitutes). The key variable is a dummy variable taking a value of one for each period during which the cartel is assumed to have effectively raised prices. If the model has a good fit, even if the coefficient of the time dummy is not highly statistically significant, the coefficient is the unit mark-up overcharge. Such models are in essence elaborations of the before-and-after method, but they are better able to handle exogenous shifts in demand and supply.

If the analyst believes that price fixing may have influenced costs of production, then the dummy variable for time will underestimate the price effect of collusion. In this case the appropriate approach is to fit a reduced-form regression to only the pre-cartel period. The regression coefficients on all the independent variables are then used to *forecast* the but-for price during the cartel period. In this approach, all the demand and supply variables can vary during the cartel period. Figure 12-1 shows the results of such analysis for the vitamin E cartel. Alternatively, if insufficient numbers of observations are available in the pre-cartel era, one can fit a

⁴⁷ NEIO methods could be used to measure price effects from a simultaneous equation system built upon Cournot or Bertrand pricing assumptions. The greatest advantage is the fact that data only from the cartel period would suffice. The main disadvantages are that it is more time-consuming, relies on accounting costs supplied by the defendants, is more difficult to explain to lay audiences, and is quite demanding with respect to data on market structure. Such models are unusual in forensic settings.

⁴⁸ Bernheim (2002) makes the interesting point that overcharge estimation in the U.S. bulk vitamins market need not adjust for exchange rates even though imports account for the majority of supply. He asserts that the raw materials used to produce vitamins, many of them petroleum derivatives, are denominated in U.S. dollars.

model to post-cartel data and *backcast*. Froeb *et al* 1993) illustrate this method for a U.S. bid-rigging scheme in frozen fish.

Econometric modeling has become the world standard for proving cartel damages. Yet, econometric estimation has some disadvantages compared to the other four methods mentioned. It is data-hungry; dozens of demand or cost variable may have to be collected, and less than 40 or 50 non-cartel observation periods may produce statistically fragile estimates. The mathematical form of the equation is not specified by theory, and the specification of independent variables may become issues too abstruse for the fact-finders to comprehend. Biased estimates may result if post-cartel pricing conduct does not return to pre-cartel conduct. From a rhetorical stance, it is advisable to apply statistical methods but supplement with other approaches and hope that they are mutually consistent.

Simulation Modeling

Simulation is another way to create a but-for market scenario. The economist starts with a structural model of oligopoly and calibrates key parameters in the model using observations from the natural market of interest; frequently econometrics is employed to estimate parameters like the own-price and cross-price elasticities of demand (Froeb and Werden 1996). When the analyst makes relatively few strong assumptions about the market, the models can become computationally quite complex (Froeb and Werden 2000). However, the effort may be worthwhile when a policy analysis needs to go beyond unidirectional comparative-statics and weigh the net effects of multiple opposing forces.

An outgrowth of the assimilation of numerical methods into economics in the early 1990s, simulation has become an increasingly important tool of industrial economists in assessing questions of competition policy. “The first major use of simulation in applied industrial organization was, and the most important use still is, in predicting the effects of mergers” (*ibid.*, p. 134). Simulation affords the opportunity to judge the net effects on prices and efficiency of horizontal mergers. Werden (2000) summarizes a simulation of a proposed merger between two leading U.S. bread makers that was developed in 1995; had the case been litigated, it would have been the first time that a merger simulation was used in an antitrust case.⁴⁹

I am not aware of simulation techniques being employed to estimate the size of damages in cartel litigation, perhaps because a comparative-static framework is not inappropriate. However, there are a few academic studies that may point to the potential for forensic applications. Raper *et al.* (2000) use simulation to determine the degree of monopsony power exercised by cigarette manufacturers in the U.S.

⁴⁹ The DOJ decided to challenge the merger in July 1995, but a consent decree involving divestiture of assets was finalized in January 1996 (Werden 2000:139). However, the simulation became public in 1999 when a party to the consent decree tried to reacquire the assets.

market for leaf tobacco; they also determine the absence of countervailing monopoly power by sellers in that market.⁵⁰ De Roos (2004) provides an example of how well dynamic simulation can fit the facts of a cartel, in this case the global vitamin C conspiracy. This method holds promise for proving the fact of injury and might some day help in the calculation of damages, but because it is so novel in applications to cartels, it would probably face Daubert challenges in U.S. courts.

CONCLUSIONS

One of the hallmarks of a rigorous scientific discipline is the ability to measure parameters of interest with precision. From this perspective, the highly variable estimates often presented of cartel overcharges could be interpreted as reflecting badly on empirical economics. For example, the lysine-cartel overcharge estimates varied by as much as ten-to-one when the first civil suit was being resolved. A more sanguine view than that of progressive analyses often show a movement toward greater precision, a movement made possible by additional information and the time to apply more complex analytical methods. At the very least testimony by opposing experts may yield a range of damage estimates within which parties will settle or a fact-finder will choose a compromise.

Modern cartel enforcement is a paradox. The stated goal of antitrust laws of most nations is deterrence, and optimal deterrence requires that cartel penalties be based on multiples of economic injuries. Yet antitrust authorities are typically reluctant to calculate fines on the basis of damages because of perceived analytical challenges (ICN 2005). In my experience rough but reasonable estimates can be quickly prepared using one of several methods delineated in this paper, especially when investigations collect appropriate economic data. More often than not, alternative estimates of cartel overcharges tend to be mutually supportive. Econometric modeling is more time- and skill-intensive but does not necessarily yield a superior estimate (Connor and Bolotova 2006). The reluctance of antitrust authorities to base fines on seems to be based on an abundance of caution.

⁵⁰ In the early 2000s, cartel fines were imposed on buyers of leaf tobacco in Spain and Italy; in the United States, tobacco farmers won \$1.2 billion in a civil price-fixing suit against cigarette makers (Connor and Helmers 2006).

REFERENCES

Aiginger, Karl et al. Do American and European Industrial Organization Economists Differ? *Review of Industrial Organization* 19 (2001): 383-405.

Ashurst. Study on the Conditions for Claims for Damages for Breach of Competition Rules in Europe. Ashurst Consulting (2004).

Baker, Jonathan B. and Daniel L. Rubinfeld. Empirical methods in Antitrust Litigation: Review and Critique. *American Law and Economics Review* 1 (1999): 368-435.

Barrett, Paul M. Civil Action: Why Americans Look To the Courts to Cure The Nation's Social Ills. *The Wall Street Journal* (January 4, 2000).

Bergstrom, Robert B. The Role of the Expert in Proving and Disproving Damages in Antitrust Claims. *Antitrust Bulletin* (1967): 677-706.

Bernheim, B. Douglas. Expert Report of B. Douglas Bernheim, In Re Vitamins Antitrust Litigation, MDL No. 1285, U.S. District Court for the District of Columbia (May 24, 2002a).

Blair, Roger D. and Jill Boylston Herndon. "Inferring Collusion from Economic Evidence." *Antitrust* 15 (Summer 2001): 17-21. ["Comment" and "Reply" in *Antitrust* 17 (Spring 2003): 44-47.

Blair, Roger D. and David L. Kaserman. *Antitrust Economics*. Homewood, Ill.: Irwin (1985).

Brander, James A. and Thomas W. Ross. Estimating Damages from Price Fixing. Manuscript (May 6, 2005).

Coate, Malcolm B. and Andrew N. Kleit (editors). *The Economics of the Antitrust Process*. Boston: Kluwer Academic (1996).

Connor, John M. Private International Cartels: Effectiveness, Welfare, and Anticartel Enforcement, Staff Paper 03-12. W. Lafayette, IN: Department of Agricultural Economics, Purdue University (November, 2003).
[<http://agecon.lib.umn.edu/cgi-bin/view.pl>]

_____. Global Antitrust Prosecutions of Modern International Cartels. *Journal of International Competition and Trade* 4 (September 2004a): 239-267.

_____. Global Cartels Redux: The Amino Acid Lysine Antitrust Litigation (1996), in John E. Kwoka and Lawrence White (editors), *The Antitrust Revolution* (Fourth Edition). Oxford: Oxford University Press (2004b).

_____. Collusion and Price Dispersion. *Applied Economics Letters* 12 (May 2005): 335-338.

_____. The Great Global Vitamins Conspiracy: Sanctions and Deterrence: AAI Working Paper No. 06-02. Washington, DC: American Antitrust Institute (February 22, 2006a), 88 pp. [<http://www.antitrustinstitute.org/recent2/485.pdf>]

_____. The Great Global Price-Fixing Conspiracy: Sanctions and Deterrence. *Concurrences: Revue des droits de la concurrence* (October 2006b) 4: 17-20.

_____. Global Price Fixing: 2nd Updated and Revised Edition: Studies in Industrial Organization No. 26. Heidelberg, Germany: Springer (2007a).

_____. Price-Fixing Overcharges: Legal and Economic Evidence, Chapter 4 in John B. Kirkwood (editor), Volume 23 of *Research in Law and Economics*. Oxford, Amsterdam and San Diego: Elsevier (2007b).

_____. Effectiveness of Sanctions on Modern International Cartels. *Journal of Industry, Competition, and Trade* (forthcoming 2007c).

Connor, John M. and Yuliya Bolotova. A Meta-Analysis of Cartel Overcharges. *International Journal of Industrial Organization* 24 (2006): 1109-1137.

Connor, John M. and C. Gustav Helmers. Statistics on Modern Private International Cartels: Working Paper #06-11. West Lafayette, Indiana: Purdue University (November 2006), 63 pp.
[http://papers.ssrn.com/sol3/papers.cfm?abstract_id=944039]
[http://www.agecon.purdue.edu/working_papers/workingpaper.connor.11.10.06.pdf]

Connor, John M. and Robert H. Lande, "How High Do Cartels Raise Prices? Implications for Optimal Cartel Fines," *Tulane Law Review* 80 (December 2005): 513-570.

Einhorn, Henry A. "The Use of Economic Analysis in Establishing Market Collusion," in *Litigation Economics* (Patrick A. Gaughan and Robert J. Thornton, editors). Greenwich, Conn.: JAI Press (1993).

Elkind, Peter. The Fall of Milberg Weiss. *Fortune* 154 (November 13, 2006).

Elzinga, Kenneth G. New Developments on the Cartel Front. *Antitrust Bulletin* 29 (Spring 1984): 3-26.

Elzinga, Kenneth G. And William C. Wood. The Costs of the Legal System in Private Antitrust Enforcement, in Private Antitrust Litigation: New Evidence, New Learning, Lawrence J. White (editor). Cambridge, Mass. and London: MIT Press (1988).

Evenett, Simon J. Can Developing Economies Benefit from WTO Negotiations on Binding Disciplines for Hard Core Cartels? New York: UNCTAD (2003).

Finkelstein, Michael O. and Hans Levenbach. Regression Estimates of Damages in Price-Fixing Cases. Law and Contemporary Problems 46 (1983): 145-169.

Fisher, Franklin M. Multiple Regression in Legal Proceedings. Columbia Law Review 80 (1980): 702-736.

_____. Economic Analysis and "Bright-Line" Analysis. Paper prepared for delivery at a workshop sponsored by the Amsterdam Centre for Law and Economics, "Forensic Economics in Competition Law Enforcement," Amsterdam (March 17, 2006).

Freedman, Michael. Can You Say Tort? A Washington Attorney is on a Crusade to Export America's Legal System around the World. Forbes Magazine (December 27, 2004).

Froeb, Luke M., Robert A. Koyak, and Gregory J. Werden. What Is the Effect of Bid-Rigging on Prices? Economics Letters 42 (1993): 419-423.

Froeb, Luke M. and Gregory J. Werden. Simulating the Effects of Mergers among Noncooperative Oligopolists, in Computational Economics and Finance: Modeling and Analysis with Mathematica, Hal Varian (editor). New York: Springer (1996).

_____. An Introduction to the Symposium on the Use of Simulation in Applied Industrial Organization. International Journal of the Economics of Business 7 (2000): 133-137.

Harrington, Joseph E. Post-cartel Pricing during Litigation. Journal of Industrial Economics 52 (2004): 517-533.

_____. Optimal Cartel Pricing in the Presence of an Antitrust Authority. International Economic Review 46 (2005): 145-169.

Harris, Robert G. and Lawrence A. Sullivan. Passing On the Monopoly Overcharge: A Comprehensive Policy Analysis. University of Pennsylvania Law Review 128 (1979): 269-354.

Houthakker, Hendrik S. "Expert Testimony by Economists: What Makes it Effective?" Chapter 1 in Slottje (1999).

ICN. Defining Hard Core Cartel Conduct, Effective Institutions, Effective Policies: Vol. 1: Report Prepared by the ICN Working Group on Cartels. Bonn, Germany (June 2005). [www.internationalcompetitionnetwork.org]

Jenks, Jeremiah W. The Michigan Salt Association. *Political Science Quarterly* 3 (1888): 78-98.

Jeon, Seonghoon and Kwanshik Shin. Economic Analysis of Competition Effects of International Electrodes Cartel on Korean Import Market. Paper at the 3rd International Industrial Organization Conference, Atlanta, April 2005.

Joshua, Julian. Supermodels, Geeks, and Gumshoes: Forensic Economics in EC Cartel Investigations. Amsterdam Center for law and Economics conference "Forensic Economics in Competition Law Enforcement," Amsterdam, March 17, 2006.

Kaysen, Carl. *United States v. United Shoe Machinery Corporation: An Economic Analysis of an Anti-Trust Case: Harvard Economic Studies Vol. 99*. Cambridge: Harvard Univ. Press (1956).

Kotsiris, Lambros. An Antitrust Case in Ancient Greek Law. *The International Lawyer* 22 (1988): 451.

Kovacic, William E. The Influence of Economics on Antitrust Law. *Economic Inquiry* 30 (1992): 294-302.

Kovacic, William E. and Carl Shapiro. Antitrust policy: A Century of Economic and Legal Thinking. *Journal of Economic Perspectives* 14 (2000):43-60.

Kovaleff, Theodore P. (Editor). *The Antitrust Impulse: Volume 1: An Economic, Historical, and Legal Analysis*. Armonk, NY: Columbia University Seminar Series, Sharpe Publication (1994).

Kwoka, John and Lawrence J. White (editors). *The Antitrust Revolution* (Fourth Edition). Oxford: Oxford University Press (2004).

Lande, Robert H. and Joshua P. Davis. An Evaluation of Private Antitrust Enforcement: 29 Case Studies, Interim Report submitted to the Antitrust Modernization Commission. (November 8, 2006)
[<http://www.antitrustinstitute.org/recent2/550b.pdf>]

Mackie-Mason, Jeffery K and Richard A Pfau. Inducements to Advocacy: The Economist as Independent Expert, Chapter 13 in Slotte (1999).

Markoff, John. A Boom in Expert-Witness Firms. *The New York Times* (October 3, 2005).

Martin, Stephen. *The Goals of Antitrust and Competition Policy*, Chapter 1 of Collins et al. (2007) [draft of November 2006].

_____. Remembrance of Things Past: Antitrust, Ideology, and the Development of Industrial Economics, Chapter 2 in Ghosal and Stennek (2007).

Moore, W. John. For Antitrust Lawyers, the Best of Times. *National Journal* 32 (July 15, 2000): 2286-2287.

Mueller, Willard F. and Russell C. Parker. Bakers of Washington Cartel: Twenty-Five Years Later. *Review of Industrial Organization* 7 (1992): 75-82.

Neven, Damien J. Competition Economics and Antitrust in Europe. *Economic Policy* (2006): 741-781.

Page, William H. (editor). *Proving Antitrust Damages: Legal and Economic Issues*. Chicago, Illinois: Section of Antitrust Law, American Bar Association (1996).

Porter, Robert H. and J. Douglas Zona. Ohio School Milk Markets: An Analysis of Bidding. *RAND Journal of Economics* 30 (1999): 263-288.

Raper, Kellie Curry, H. Alan Love and C. Richard Shumway. Determining Market Power Exertion Between Buyers and Sellers. *Journal of Applied Econometrics* 15 (2000): 225-252.

de Roos, Nicolas. Collusion with a Competitive fringe: An Application to Vitamin C. *International Journal of Industrial Organization* (forthcoming 2006).
[<http://www.mgmt.purdue.edu/centers/ijio/Accepted/2266.pdf>]

Scherer, F. M. "Economic Consulting, Fire Fighting, and Similar Adventures," Chapter 8 in Slottje (1999).

_____. The Toys-R-US Case, in Kwoka and White (2004).

Segal, David. Washington Hearsay. *The Washington Post*. (November 8, 1999).

Slottje, Daniel J. (editor). *The Role of the Academic Economist in Litigation Support*. Amsterdam: North-Holland (1999).

Stigler, George. A Theory of Oligopoly. *Journal of Political Economy* 72 (1964): 44-61.

Van den Burgh, Roger. The Difficult Reception of Economic Analysis in European Competition Law, in Antonio Cucinotta et al. (Editors), Post-Chicago Developments in Antitrust Law. Cheltenham, UK: Elgar (2002).

Warren-Boulton Fredrick R (1995) An Evaluation of "The Cost to U.S. Animal Feeds Manufacturers of an Alleged Price-Fixing Conspiracy by Lysine Manufacturers, 1992-1995," In Re Amino Acid Lysine Antitrust Litigation, Master File 95-C-7679, U.S. 7th District Court, Eastern Division (1995).

Wells, Wyatt. Antitrust and the Formation of the Postwar World. New York: Columbia Univ. Press (2002).

Werden, Gregory J. Expert Report in United States v. Interstate Bakeries Corp. and Continental Baking Co. International Journal of the Economics of Business 7 (2000): 139-148.

White, Lawrence J. Present at the Beginning of a New Era for Antitrust: Reflections on 1982-1983. Review of Industrial Organization 16 (2000):131-149.

Figure 1. Lysine Transaction Prices, U.S. and EU Markets, 1991-1996.

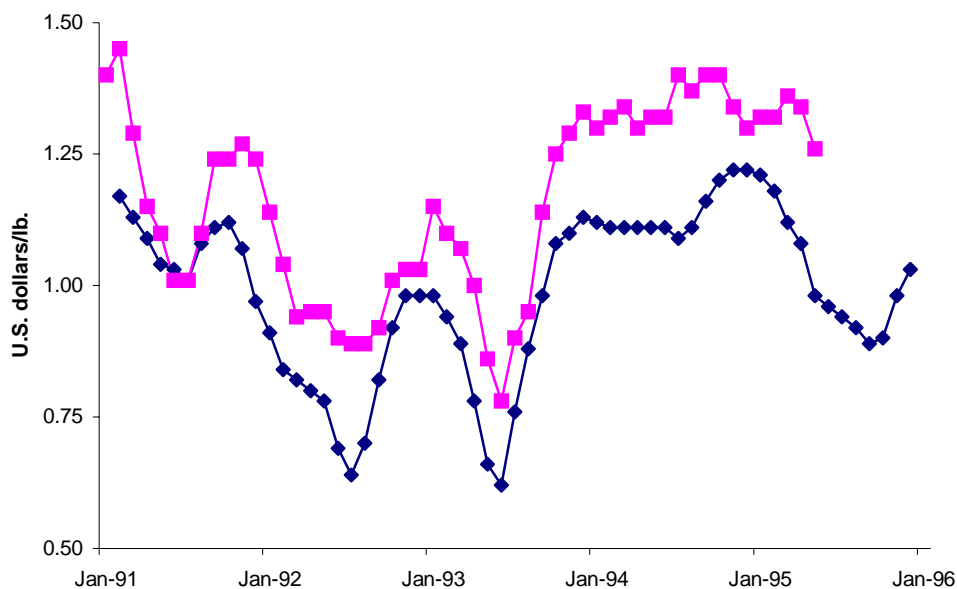
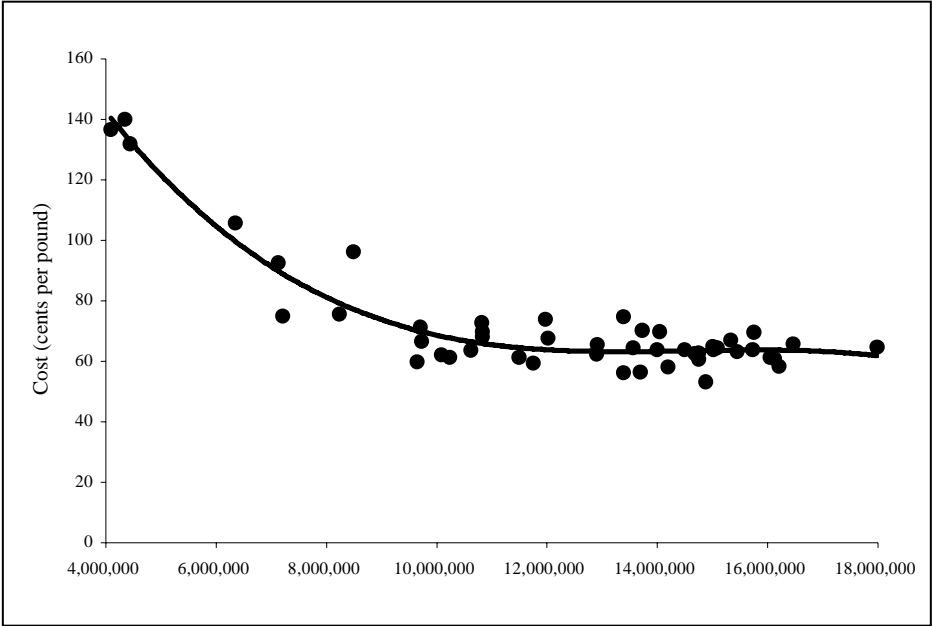


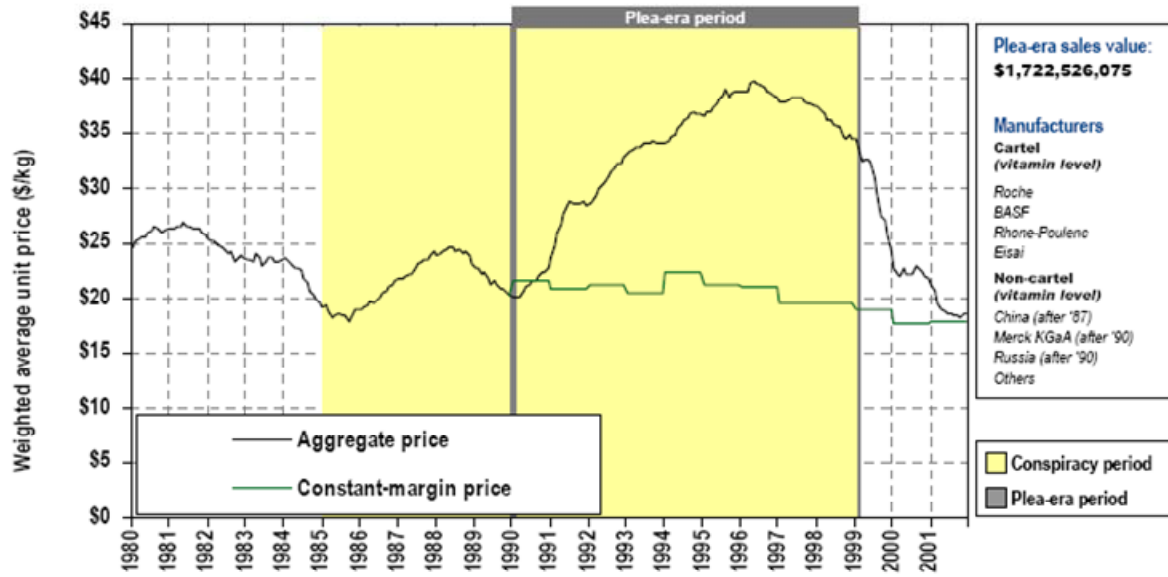
Figure 2. ADM's Lysine Manufacturing Costs, 1991-1995.



Monthly production (lb.)

Source: *U. S. v Michael D. Andreas et al. (1998) Tr. Ex. 60-67.*

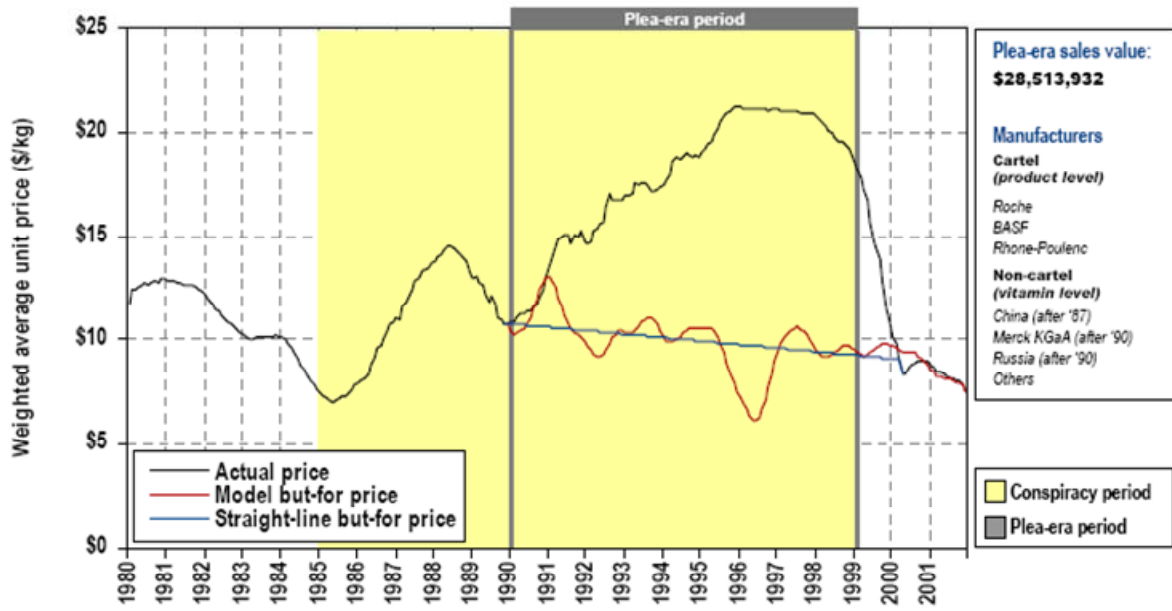
Figure 12-5: Vitamin E aggregate 100 percent basis price with constant-margin price



Source: 7-month centered moving average for U.S. "tel quel" feed, food, pharma, and cosmetic price from Roche ROVIS data and contribution margin data from Roche Data Books

Source: Bernheim (2002).

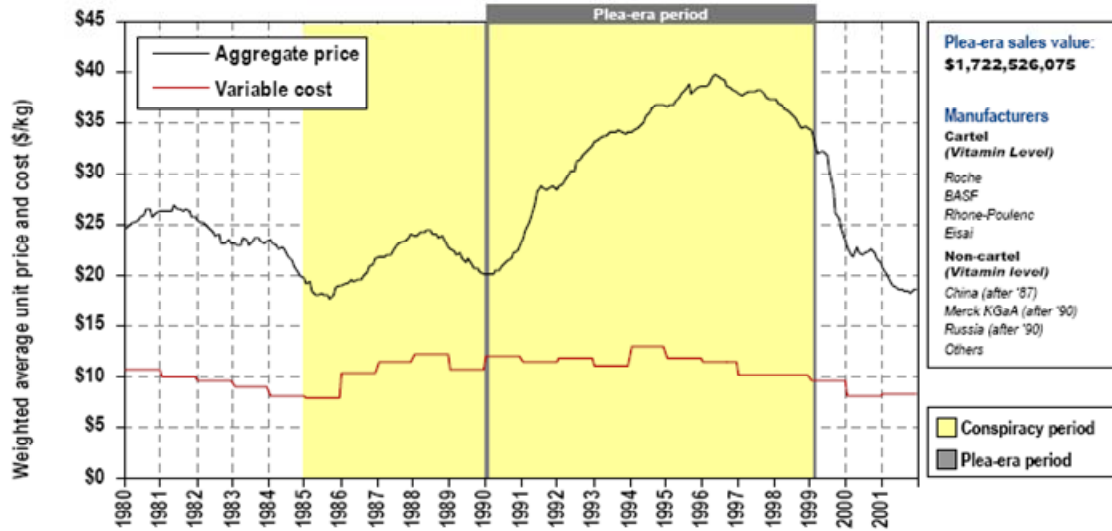
Figure 12-1: Vitamin E Acetate 50% Spray-Dried Feed Grade price and but-for price



Source: 7-month centered moving average for U.S. "tel quel" feed price from Roche ROVIS data

Source: Bernheim (2002).

Figure 9-1: Vitamin E aggregate price at 100 percent basis and variable cost



Source: 7-month centered moving average for U.S. "tel quel" price from Roche ROVIS data and contribution margin data from Roche Data Books

Source: Bernheim (2002).