

**PRICE-FIXING OVERCHARGES:
FOCUS ON EUROPE**

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Abstract

This paper surveys hundreds of published social-science studies of private, hard-core cartels that contain 674 observations of long-run overcharges. The primary finding is that the median cartel overcharge for all types of cartels over all time periods is 25%: 18% for domestic cartels, 32% for international cartels, and 28% for all successful cartels. Thus, international cartels have historically been about 75% more effective in raising prices than domestic cartels. Cartel overcharges are skewed to the high side, pushing the mean overcharge for all types of cartels over all time periods to 49%. “Peak” cartel overcharges are typically double those of the long-run averages. These results are generally consistent with the few, more limited, previously published works that survey cartel overcharges.

There is no evidence that convicted cartels are markedly less effective than unpunished ones. The results of a second survey of final verdicts in decided U.S. horizontal collusion cases, only three of which were international cartels, show an average median overcharge of 21% and an average mean overcharge of 30%. Outside the United States, 62 decisions of competition commissions cited median average overcharges of 29% and a mean of 49%.

There are three significant policy implications. First, there is a view among some antitrust writers that there is little evidence that cartels raise prices significantly for a period long enough to justify the height of current U.S. cartel penalties. This survey’s results, which are based upon an extraordinarily large amount of data spanning a broad swath of history of all types of private cartels, sharply contradict these views. In fact, the data suggest that U.S. penalties ought to be increased. Mean overcharges are three times as high as the level presumed by the U.S. Sentencing Commission. Surprisingly, bid rigging was no more injurious than other forms of collusion, which suggests that the USSC should amend its Guidelines that currently treat bid rigging more harshly than other forms of collusion.

Second, the principal antitrust authorities abroad often base their typical or maximum fines on a 10% harm presumption. *Average* fines imposed since 1995 by Canada and the EU on identical cartels have been lower than U.S. government fines, yet overcharges generated by cartels discovered outside the United States are higher than North America-centered cartels. Consequently, anticartel laws and fine-setting practices abroad are in even greater need of strengthening.

Third, cartels with multi-continental effects are the most harmful type. Despite the evident increases in cartel detection rates and the size of monetary fines and penalties in the past decade, a good case can be made that current global anticartel regimes are under-detering. While the recent worldwide trend towards the intensification of cartel penalties has been desirable, global cartels are more difficult to detect, have less fear from entry of rivals, achieve higher levels of sales and profitability, and systematically receive weaker corporate sanctions than comparable domestic cartels. Antitrust sanctions worldwide should be higher for global cartels than for other types.

1. INTRODUCTION

Since at least 1888, hundreds of economists, historians, commissioners, and jurists have labored mightily to assess the “effectiveness” of cartels. Various criteria have been applied to evaluate cartel performance, including longevity, stability, social welfare, and efficiency, but by far the greatest attention has been lavished on market price effects. The increase in transaction prices by a sellers’ cartel is commonly called an overcharge by economists or damages by legal writers. A price-fixing overcharge is a transfer of income or wealth from buyers to the members of the cartel that occurs as a result of a collusive agreement.¹ The overcharge rate is calculated by comparing actual cartel-enhanced prices to some competitive benchmark (Connor 2004a). When a cartel achieves high levels of effectiveness (i.e., longevity, stability, and high overcharges), it generates large customer losses.² Effective cartels are also viewed as destructive of the competitive process in the sense that they weaken the natural effects of demand and supply in price formation and cause deadweight social losses.

Other than in economics textbooks, 103 years has passed since the last dedicated survey of the cartel literature (Bullock 1901). Nearly all quantitative analyses of cartel price effects have been published since 1901. To my knowledge no one else has since published a work aimed principally at surveying and analyzing cartel overcharges.

The size of cartel overcharges is an issue at the empirical heart of a number of legal and economic controversies. First, knowing the size and distribution of cartel overcharges is necessary

¹ The overcharge from a buyers’ cartel is symmetrically defined by a price decrease.

² Customers are direct buyers, most of them industrial buyers, but overcharge pass-on will transfer the losses in whole or in part to final consumers as indirect buyers. If cartels improve technical or dynamic efficiency, this may offset the buyers’ losses.

to justify the underpinnings of U.S. and foreign sanctions for illegal cartel conduct. Second, there is evidence in the economic literature widely varying opinions among experts on the critical legal-economic issue of optimal cartel deterrence.

1.1. Overcharges and Cartel Fines

Twenty years ago the Sentencing Reform Act of 1984 created the U.S. Sentencing Commission (USSC), a judicial-branch unit charged by Congress with devising guidelines for criminal sentencing for the federal judiciary (USSG Advisory Group 2003). The guidelines were made law in 1989. They included sanctions for organizations guilty of horizontal price fixing and bid rigging (Cohen and Scheffman 1989:332). The issue of how high cartels typically raise prices was crucial when the U.S. Sentencing Commission (USSC) established the fine levels for price fixing. The USSC's cartel fine levels followed from its famous conclusion: "It is estimated that the average gain from price-fixing is 10 percent of the selling price."³ The Sentencing Commission opted for greater administrative convenience instead of undertaking a specific inquiry into the actual loss in each case. However, the origin of the USSC's 10% assumption is a bit of a mystery. A prominent analysis of the issue by Cohen & Scheffman (1989) published shortly after the antitrust sentencing Guidelines were promulgated, states that the figure was submitted by the DOJ from an economic evaluation of only three price-fixing conspiracies.⁴

³ The USSC Guidelines start with a *base fine* double the 10% presumed overcharge. They adjust this offense level by a number of factors, such as whether bid rigging and other aggravating factors were involved, and by mitigating factors as well. This adjustment results a pair of "*culpability multipliers*" that are between 0.75 and 4.0. The product of the base fine (20% of the affected commerce) and the culpability multipliers results in the fine range that is to be imposed on a cartel member. Thus, the fine range recommended for convicted cartelists is at its lowest 15% and at its highest 80% of affected sales.

⁴ The USSC's 10% presumption was attacked as unreliable and overstated almost as soon as it was issued. For example, Cohen and Scheffman (1989) concluded that "...there is little credible statistical evidence that would justify the

From 1990 to 1999, a series of record corporate fines were imposed for criminal price fixing by U.S. courts; a similar upswing may be noted for fines imposed by the European Commission from 1995 to 2001 (Connor 2003). Civil treble-damages cases in the United States have seen a parallel response in the size of settlements. Attorneys who have defended companies that have been convicted of collusion have claimed that the Guidelines have resulted in excessive penalties. For example, just as the DOJ's campaign against international cartels was gathering steam, Adler and Laing (1997) assert that "the fines being imposed against corporate members of international cartels are staggering (p.1)", placing the blame on the "uniquely punitive" requirements of the U.S. Sentencing Guidelines. More recently, Denger (2003) too decries the prevalence of excessive price-fixing fines and private settlements. He places the blame for excessive fines on the Corporate Guidelines base fine calculation (p. 3). Denger blames this state of affairs on a gap in the economic-legal literature: "...we have little information on what level of criminal or civil exposure is needed to deter most cartels (p.4)." Concern about the lack of empirical evidence extends to prosecutors as well. DOJ official Graubert (2003) notes that the controversy over whether antitrust payments are excessive is largely attributable to the "...difficulty of gathering useful data (p. 3)."

U.S. antitrust enforcement has been a model for many other countries that have more recently adopted such laws (Wells 2000). After four years of confidential political discussions within the EEC's Commission, Regulation 17 was passed; it lays out the powers of the Competition Directorate General (DG-COMP) to fine companies for competition-law infringements (Goyder 1998, p. 45). That rule sets a maximum corporate fine of 10% of the company's total sales in the year prior to the Commission's decision and specifies that the specific fine will depend on the

Commission's assumptions which underlie the Antitrust Guidelines (p. 333)." "At least in price fixing cases involving a substantial volume of commerce, ten percent is almost certainly too high (p. 343)."

duration and seriousness of the offense.⁵ Harding and Joshua (2003) state that EU fines are supposed to incorporate both compensatory and punitive components, the latter to serve deterrence (p. 240). That is, fines are to be greater than the monopoly profits earned from the price-fixing violation. In practice, the EC rarely needs to worry about breaching the 10% cap (Connor 2003).

Canada is another jurisdiction with relatively tough sentencing for cartels. The Canadian Competition Bureau (CCB) uses a fairly simple standard for setting fines. Although not spelled out in any administrative guidelines, decisions of Canadian courts have, in the absence of aggravating and mitigating circumstances, imposed fines close to 20% of Canadian affected sales (Low 2004, Connor 2003). A former Canadian prosecutor comments that “there has not been any economic or judicial analysis of the assumptions behind this proxy for harm that this represents...” (Low 2004:19). The Canadian 20% rule seems to mimic the base fine of the USSGs.

1.2. Overcharges and Cartel Deterrence

Concerns about the inadequacy or excessiveness of antitrust sanctions are part of the larger issue of the effectiveness of antitrust interventions. To make any headway in assessing empirically the adequacy of anticartel enforcement, it is necessary to have reliable information about the degree of harm generated by private cartels. Cartel injuries to purchasers are positively related to three economic factors: the size of the cartel’s market, the duration of the conspiracy, and the percentage overcharge. Antitrust sanctions should be calibrated to a cartel’s affected sales and overcharge rate.

The U.S. Sentencing Guidelines’ are consistent with the standard optimal deterrence standard promulgated by William Landes (1983). Landes showed that to achieve optimal deterrence the damages from an antitrust violation should be equal to the violation’s “net harm to others”, divided

⁵ Rule 17 was amended in 2004, but these provisions were unaffected.

by the probability of detection (Landes 1983:666-68). In 1986 the Assistant Attorney General for Antitrust estimated that the enforcers catch less than 10% of all cartels (USSG 1986:15). If this is correct, optimal fines for cartels should be tenfold damages. Cohen and Scheffman (1989) argue that U.S. sentencing guidelines, when coupled with civil and marketplace sanctions will cause “a serious overdeterrence problem” (p. 334). That is, they and other critics of the Guidelines believe that there is a disparity between the size of the corporate fines mandated for antitrust violations and the amount of the economic injuries caused by overt price fixing.

In a provocative essay that quickly drew rebuttals, Crandall and Winston (2003) argue that extant empirical evidence demonstrates that U.S. antitrust policy has been ineffective in either raising consumer welfare or in deterring anticompetitive conduct:

“We find little empirical evidence that past [antitrust] interventions have provided much direct benefit to consumers or significantly deterred anticompetitive behavior” (p. 4).

To support their view that the prosecution of overt price fixing is misdirected, they cite five empirical studies of overt collusion that find no upward effects on prices of conspiracies convicted in U.S. courts. While Crandall and Winston later admit that there are some “examples” of successful collusion, no studies are cited that support the positive effect on prices. In his comment on Crandall and Winston, Kwoka (2003) faults them for their “startlingly selective” body of evidence. He suggests that they should have included “... studies from any source with appropriate evaluation of their credibility” (p. 4).

The majority of the overcharges generated by cartels in the past 15 years have been international, even global in membership and geographic spread (Connor 2001, 2003). To assess deterrence in the context of international schemes, non-U.S. monetary sanctions must be considered. To be effective, cartel sanctions must be somewhat punitive. It is clear that for a single-product firm

that participates in a cartel with a 10% overcharge for one year, there can be no punitive component solely with EU fines. Moreover, if the probability of detection and conviction is less than 20%, then any specialized member of a one-year cartel with a 2% overcharge or bigger will not be deterred.⁶ EU and Canadian fines together are usually less than those imposed by U.S. courts for the same violations, and penalties in other parts of the world are practically zero. In general, global monetary sanctions have amounted to less than 10% of estimated global overcharges (Connor 2003). Thus, punitive sanctions are the exception not the rule for illegal international price fixing.

In sum, there does indeed seem to be a broad consensus among legal and economic writers that the question of the optimality of price-fixing penalties turns mightily on the actual degree of harm caused by cartel conduct, and that not enough is known about this issue. Moreover, even if the creators of the USSC Guidelines were correct that in the 1980s cartels generally raised prices by 10%, the harsher cartel sanctions imposed more recently could mean that this presumption is no longer justified. This is a gap in the literature that I hope this paper will remedy.

2. OBJECTIVE

The purpose of this paper is to collect and analyze all serious quantitative estimates of the monopoly overcharges generated by private, hard-core cartels from all areas and eras. Estimates will be taken from published social-science studies and from the decisions of competent judicial bodies. Rather than apply a subjective quality filter, the assembled estimates are examined for patterns that might indicate systematic differences in reliability across types of sources. The results of the survey are used to draw lessons about the ability of antitrust policies to deter cartels.

⁶ However, most companies that engage in cartel behavior are large diversified firms; for them, EU fines can come closer to optimal deterrence levels. If the cartelized product line accounts for 10% of total company sales, then the duration or the overcharge level can be 10 times greater to achieve compensation or deterrence.

3. LITERATURE SURVEY

This paper was prepared by checking more than 500 social-science publications.⁷ The major portion of the overcharge estimates included in this paper is taken from books, book chapters, conference proceedings, or papers published in economic, historical, and legal journals whose readers and contributors are mainly academics. The great majority of these publications are peer reviewed. A minority of the estimates are taken indirectly from newspapers, magazines, and similar journalistic outlets; from reports issued by governments; from academic working papers; and from decisions rendered by courts or antitrust commissions. This section focuses on the evolution of social-science concepts about cartels and their price effects.

3.1. Early Monographs on Cartels

Interest in collusive organizations began well before industrial-organization economics was recognized as a distinct discipline. Prior to World War II, fewer than a dozen archival articles⁸ treat the economics of cartels, but scores of books were published on the economic and political aspects of “pools,” “trusts,” “combines,” “syndicates,” and all the other terms that were used at the time to encompass various monopolistic business arrangements. Consistent use of these terms was not well established until the mid 20th century. Bullock’s (1901) seminal paper tends to regard all of them as roughly equivalent terms for monopolistic business entities with market power over price (p. 183).⁹

⁷ The References section of Connor (2004 b) lists about 350 sources with useful information about the private cartels in this paper’s sample. About 200 contained usable quantitative overcharge estimates.

⁸ Academic journals of politics and economics were generally inhospitable to articles critical of cartels or supportive of antitrust policies. Orthodox economists from the 1880s to 1920s generally supported collusive conduct as an antidote to “ruinous competition” in industries with substantial fixed costs (Clark 1887, Hovenkamp 2001).

⁹ In a footnote on p. 184, Bullock quotes with approval Jenks observation that trusts and cartels also aim “to check competition,” that is, prevent market entry.

By 1916 Ripley could differentiate these phenomena using terms that became commonly accepted jargon by the 1940s.

Pools or corners were contractual joint-profit-increasing agreements by independent sellers over prices or quantities; today these are called cartels (Ripley 1916: xiv).¹⁰ Ripley cites the U.S. cordage cartel, formed in 1860, as the first documented U.S. pool. Other 19th century cartels include cotton bags, distilling, iron pipes, steel, salt (Jenks 1888), wire nails (Edgerton 1897), and a patent pool for porcelain bathtubs.¹¹ Trusts proper were legal instruments used in the United States from about 1879 to 1902 for combining companies under a single board of directors; beginning in the late 1890s trusts were supplanted as a means of industrial merger by the holding company (Ripley 1916). Thus, trusts, combines, and holding companies refer more to the outcomes of mergers and acquisitions than to cartels. Yet the word “trust” was used loosely and popularly throughout the early 20th century to cover both cartels and mergers intended to increase market power. As late as the 1930s, several terms were often used interchangeably for cartels (Plummer 1936, Curtis 1931). Curtis considered cartel to be a term used mainly in Europe. His preferred terminology was pools for more informal and unstable cartels and trusts for cartels with strong central direction and control.

Bullock (1901), a professional economist and author of an early American economics textbook, wrote the first English-language survey of cartels and trusts in the social-science literature. After noting that there was a near absence of publications on the topic during 1890-1896, he finds an astonishing outpouring of 34 books and 48 serious articles in 1897-1900. Interest in the subject continued in the early 20th century, with most of the cartel literature from 1900 to 1940 appearing in

¹⁰ “Cartel,” from the German cognate *Kartell*, came into general use in British newspaper writing in 1902 (Connor 2001:20). Cartels do not usually endow a joint venture with capital contributions, though they may set up a sales office or secretariat. The first work in the United States that refers indirectly to cartels is to German “combinations” that “regulate” industries (Bullock 1901:207). Sayous (1902:381), a French economic historian, appears to be the first academic writer in a U.S. journal to use the word cartel in its economic sense. Ripley (1916: xiv) cites German *kartells*.

¹¹ Other early examples (1908-1915) of convicted cartels based upon patent pooling are paper (1908), electrical equipment (1911), umbrella frames (1907), bicycle coasters (1912-13), shoe machinery (1914), cash registers (1915), harvesters (1914), and watch cases (1915) (Ripley 1916: 604-605).

books.¹² Some of these works were written by historians and others by some of the earliest practitioners of the emerging field of industrial economics. Most of these studies contain little or no quantitative data. Bullock opines that the quantitative measurement of the market-price effects of cartels and trusts is not possible.

Liefmann (1897) published one of the first economic monographs that contained the word *Kartell* in its title.¹³ The book appeared in five editions in German from 1897 to 1929. The last edition was updated, translated into English, and published in London in 1932; the Oxford University economist who wrote the book's Introduction hailed it as the best known study of cartels and trusts "from a German perspective." In many ways Liefmann was leagues ahead of his contemporaries in the analysis of the cartel phenomenon. He coined one of the most cited and pithy definitions of cartels: "free [voluntary] associations of producers for the monopolistic control of the market (Liefmann 1932: ix)." By this definition he meant to include only arrangements by independent companies linked by formal or informal contractual agreements; compulsory commodity schemes enforced by government decrees or parliamentary statutes are not true cartels by his definition, though international agreements voluntarily negotiated between compulsory national cartels would qualify if the negotiated agreement did not require statutory enforcement. Today, cartels that conform to Liefmann's definition are called "private." Private cartels may contain state-owned companies or legal export cartels as members, but if the arrangement is fostered by national governments, protected by national sovereignty, or the result of international treaties, they are termed "public."

¹² Among the earlier post-Bullock monographs in English with significant economic content are books by Liefmann (1897, 1932), Jenks (1900, 1907, 1911), Jenks and Clark (1917, 1929), Hirst (1905), Jones (1914, 1921), Levy (1927, 1968), Michels (1928), Seagar and Gulick (1929), Domeratsky (1928), Notz (1929), von Beckerath (1930), Piotrowski (1933), and Plummer (1934, 1951). Levy (1968), a careful historian, cites about 30 books on cartels and closely related subjects published before 1927, the great majority in German.

¹³ The first appears to be Kleinwächter (1883), but this author was not as influential as Liefmann. Hirst (1905) seems to be the first book in English to have *Kartell* or *Cartel* in its title.

Liefmann dismisses the widely accepted view of the time that cartelists are merely aiming to achieve a “reasonable profit,” insisting that cartels are instruments for maximizing profits. Liefmann assembles a great deal of information on German cartels and limited information on cartels outside Germany, but with one exception he includes no useful price series that could be used to compute price effects. Liefmann (1932) has no doubts that cartels frequently raise prices (or prevent them from falling during recessions), but he is a bit of a perfectionist, insisting that “...it is impossible to say what the prices would have been if there had been no cartel (p. 104).”

Liefmann’s positions continued to influence German economists for decades to come, but his views on price effects did not go unchallenged. Beckerath (1930), for example, opined that cartels were motivated primarily by a desire to reduce fluctuations in output or prices. To do so, durable cartels typically used their power to raise prices during slumps and restrain prices during booms. While he admits that raw-materials cartels and patent pools were successful in raising prices above competitive levels in the long run, he believed that for other types the evidence was lacking (p. 262). “...[I]t can only rarely be proved that a cartel is the only reason behind a price rise” (p. 263). However, Beckerath undercuts his agnostic position by noting that most cartels have members with varying costs and set their common price so as to allow its highest-cost member to make a profit (p. 265); it follows that at such a price all the others are making economic profits.

Herman Levy was a contemporary of Liefmann. Levy was a prolific writer of books on economic history. Not counting revised editions, he authored ten books between 1900 and 1927, eight in German and two in English. While indebted to Liefmann’s concepts and definitions, Levy covers different ground than Liefmann. Unlike Liefmann, Levy is eager to quantify the economic impacts of cartels and trusts. Levy (1968) is a reprint of the second (1927) English-language edition of his book on British cartels, monopolies, and oligopolies. This work is concerned about why the

British cartel movement was weaker and slower to develop than on the Continent of Europe. It contains unique information on 18th and 19th century British cartels.

Another early European writer who was concerned about the lack of concrete measures of market power is a then young lawyer and economics lecturer, Hirst (1905). His book grew out of an 1899 Oxford essay that attempted to develop price-based indicators of the price effects of cartels. Noting that German cartels frequently exported surplus output to other countries at lower prices than their fixed domestic prices, he proposes using the export prices as a yardstick. Although there is some danger of overstating the domestic overcharge if the cartel is dumping product at predatory prices, he applies this method to six German cartels using 1900-1902 prices.

Jeremiah W. Jenks was a political science professor at Cornell University in 1900 when the first of his five editions of *The Trust Problem* was published, though he had already been researching pools, trusts, and monopolies for 20 years by that time. Jenk's 1888 study of the Michigan salt cartel seems to be the first economic study of cartels to appear in a peer-reviewed professional journal. His 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. 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.). 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.

Harvard University was the leading campus for economic and legal studies of cartels in the early 20th century. One indication of its preeminence is the publication of what is probably the first textbook on cartels, mergers, and monopolies in 1905. The revised edition is a huge (872 pages of small print) compilation of reprints from professional journals of law and economics, excerpts from briefs and court decisions, and legal commentary (Ripley 1916). Ripley aimed at applying the case-study method pioneered by Harvard Law School into advanced economics courses. Perhaps the most important U.S. study of cartels to appear in the 1930s was a long monograph on seven international cartels or dominant firms in markets for nonferrous metals: nickel, platinum, aluminum, tin, copper, lead, and zinc (Elliott *et al.* 1937). This book was the result of a multiyear project by a team of economists working at Harvard University and Radcliff College.

Eliot Jones wrote a Ph.D. dissertation at Harvard University on several episodes from 1871 to 1914 of cartelization of the U.S. anthracite coal industry, the largest U.S. mineral industry of the early 20th century. His dissertation won a University prize and was published by Harvard University Press in 1914. Jones' first book is for its time one of the best analyses of the economic history, market structure, collusive conduct, and price effects in any industry. It may be one of the first books to combine an empirical interest in industrial concentration with attention to the antitrust laws. In addition to detailed ownership and price data from industry trade sources, Jones had available testimony and exhibits from one of the early U.S. antitrust trials. This industry case study illustrated how a concentrated, technologically dynamic industry with extensive network economies, the railroads, could leverage its market power in transportation through backward vertical integration and collusion in the coal-mining industry; after the Sherman Act was passed, the railroads adopted

new strategies (mergers, cross-ownership, and interlocking directorships) to maintain their market power in coal. Along with papers in the *Quarterly Journal of Economics*, his writings received extensive peer review that was unusual for the period. Jones' interest in competition and antitrust laws was extended in his 1921 book. Jones was a contemporary of Jenks, but better versed in the still-emerging concepts of industrial-organization economics. Despite his evident interest in the price effects of cartels, in his second book quantitative data were presented on price effects for only three cartels.

An issue among European writers is when and why *kartells* first appeared. Piotrowski (1933) delves into pre-Christian, Roman, and medieval history to find many examples of organizations that appear to resemble private cartels, but in most cases details about their conduct and the degree of government support are lacking. However, Sayous (1902) makes a well documented case for the existence of cartels in the strict sense of the term in 17th century Holland.¹⁴ The Dutch Company of the North was chartered in 1614 to exploit the Greenland whale-oil industry; by 1618 the Company had adopted a supply-restraint objective to keep domestic prices above competitive levels. However, the company of the North became a public cartel when in 1622 the States-General of Holland granted it a long-lasting monopoly for whale-fishing.¹⁵

Nevertheless, it is Germany that has the best claim as the birthplace of contemporary industrial cartels. Liefmann (1932) believes that the first domestic German cartel was the Neckar Salt Union, an 1829 combination of salt mines in three German states. Five more were formed prior to 1870. However, Liefmann and other writers point to the German depression of the mid 1870s as a

¹⁴ He clearly distinguishes private cartels from government-run schemes, trusts, holding companies, and the like. The more famous Dutch East India Company, he argues, was a government-supported monopoly. Sayous believes that a cattle-procurement monopoly by butchers of Anvers, France in the 16th century also qualifies as an early European cartel.

¹⁵ However, the government refused repeated appeals by the Company of the North to impose import barriers on whale oil or bone. The Company of the North became weakened by the entry of three other Dutch companies that required a reallocation of market shares and by the growth of the Danish whale-fishing fleet in the 1630s.

peak for cartel formation. A 1905 German government survey found 385 industrial cartels operating; the number rose to 3000 by 1925. Liefmann (1932) notes that these numbers do not count hundreds of local German price-fixing agreements among hair dressers, hotels, and other service providers. As for *international* cartels, he identifies the 1867 merger of the Neckar Salt Union in Germany with the Eastern French Salt Works Syndicate as the first of its kind. By 1897 there were at least 40 international cartels with German companies as members, most of them in chemical or nonmetallic minerals product markets. Notz (1920) cites a German book that found 114 international cartels in 1912; by 1920 he could identify 11 international cartels with participation of U.S. companies.

The 1870s were also a formative period for U.S. cartels. Seagar and Gulick (1929) trace the earliest documented U.S. pools to the cordage industry, which began making agreements on prices at least as early as 1861, but cordage manufacturers did not begin formal association until 1878. The Michigan Salt Association, formed in January 1876, may be the first recorded formal U.S. cartel. Because of the high costs of transporting salt, an elaborate organizational structure, and the highly inelastic demand for salt, this cartel was successful in dominating the Midwest market for 25 years.

Two lengthy reports from analysts in the U.S. Department of Commerce presage the triumph of the more precise German usage of the term cartel (Domeratsky 1928, Notz 1929). Notz (1929) accepts Liefmann's classic definition of a private cartel: a voluntary association of two or more independent business organizations in the same line of business with the aim of increasing joint profits by controlling markets or reducing competition. Essential is an overt agreement to divide market territories, set or stabilize prices, limit or allocate industry supply, establish a common sales agency, pool intellectual property, or some combination of these five strategies. If the organizations are registered in at least two countries, then it is an international cartel. While the Department of

Commerce reports are strong in detailing cartel membership and industry supply conditions, they have little to offer by way of price effects.

Cartels, mergers, trade, and foreign direct investment were major concerns of the League of Nations, which sponsored a major conference on the subjects in 1927. Papers prepared by some of the leading European cartel scholars of the day were published as part of the conference proceedings (de Rousiers 1927, MacGregor 1927, Wiedenfeld 1927, Economic and Financial Section 1927). These papers dwell on conceptual and organizational issues surrounding cartels and contain little of interest on price or welfare impacts. Indeed the near absence of empirical detail in these reports and other studies by European scholars active in the interwar period provide a striking contrast with the industrial analyses emerging in the United States. The final report of the 1927 conference revealed a deep split between those participants who believed that cartels harmed national economies and international trade and those who believed that cartels stabilized prices, investment, and employment. Perhaps to rectify these ambiguities, the League later sponsored cartel studies with more empirical content (Benni *et al.* 1930, Oualid 1938).

Relatively few books were written about cartels in the 1930s, a period during which antitrust was in eclipse in the United States and cartels took on distinctly political roles as tools of economic planning in Europe and Japan. In this decade cartels were often embraced because they were perceived as antidotes to the world wide depression and, in some industries, deflation. Indeed, the Brookings Institution sponsored a series of books during this time to assist policy makers in implementing the National Recovery Act (e.g., Pribram 1935). U.S. Supreme Court decisions quickly restored the antitrust laws by 1938 (Wells 2002). When President Roosevelt and his advisors became apprised of the intimate connections between national socialism and compulsory cartels in Germany in the 1930s, they rejected using cartels to foster economic recovery.

Although most books written prior to 1945 lacked empirical analyses of cartel performance, a small number of U.S. economists published a few well documented case studies of price effects. Many were written during the heady times (1885-1920) during which state and federal antitrust laws were being debated and first enforced; these years bracket what is generally called the Progressive Era in American history. Indeed, the absence of cartel studies in professional journals in the 1920s and 1930s is striking. Among the most useful papers for overcharges are Jenks (1888), Andrews (1889), Edgerton (1897), Hudson (1890), Walker (1906), Stevens (1912), Tosdal (1916), and Allen (1923). U.S. judges were groping for reasonable standards of guilt in price-fixing cases, but few of these publications suggested methods that had forensic value.

Jenks's study of the Michigan Salt Association of the 1880s is a classic example of a well researched history of the methods used by a mining cartel to control a market that incorporates substantial information on costs and prices. Andrews (1889) drew upon contemporary business publications to recount what is quite possibly the world's first *global* cartel, the infamously scandalous Secrétan copper syndicate of 1887-1889. Edgerton's paper on the U.S. Wire Nail Association is a superb analysis of the evolution, operation, and price effects of a short-lived but tightly structured, highly effective manufacturers' cartel which was written with the help of insider interviews just a year after the cartel dissolved. This study is notable because the conspiracy is the first U.S. work on a U.S.-based *international* conspiracy.¹⁶ Stevens' 1912 study of the gunpowder trust is notable for focusing on what was believed to be the longest-running discovered cartel in the Nation's history; Stevens carefully delineated three distinct phases of the cartel, and he drew upon

¹⁶ The paper contains an intriguing hypothesis about the optimality of price fixing. The cartel's organizers were well aware that most U.S. pools at the time were ephemeral because most manufacturing processes permitted quick entry, about six months in this industry. To discourage entry, the perpetrators consciously decided to raise prices *higher than the monopoly level* within a few months. They reasoned that potential entrants would view such unsustainable prices as evidence that the members were irrational and that the pool would quickly crash before the outsiders could start production. This information-obfuscation tactic worked because initial large-scale entry was thwarted for a year, which allowed the cartel to operate successfully for 19 months, about 12 months longer than if a more moderate pricing policy had been adopted.

the records of a 1911 antitrust trial to document the final episode. Tosdal (1916) and Walker (1906) provide competent analyses of the earlier episodes of two highly durable domestic German cartels, potash and steel, respectively; subsequent scholars have repeatedly returned to these cases. Ripley (1916) reprints a fascinating court decision of the U.S. enameled bath tub cartel, which used patent licenses on a new machine to achieve effective collusion. Allen's (1923) account of the 18th century English copper-smelting cartel is the first quantitative assessment of cartel effectiveness by a European economist to appear in a peer-reviewed academic journal.

3.2. Post-World War II Cartel Studies

During and immediately after World War II, after a hiatus of 25 years, a surge in publications examined the roles of cartels in international trade and in war production. Ervin Hexner (1946) produced the most comprehensive economic study of international cartels yet published. Hexner had an insider's knowledge of cartels (Barjot 1994:65). Louis Marlio (1947), a French economist who wrote a detailed account of the international aluminum cartel, had a similar background (*ibid.* p. 66). Both of these authors found much to admire in the performance of international cartels, whereas post-war works by American authors tended to be distinctly more skeptical, if not hostile concerning the economic and political effects of the interwar cartels (e.g., Berge 1944, Edwards 1946).

Although they may overstate the issue, Harding and Joshua (2003) draw sharp a distinction between the views toward cartels of North American lawyers and lawmakers and those in Europe:

“...the North American approach has been, since the end of the nineteenth century, one of categorical censure [and] recourse to criminalization of antitrust violations as a central plank of legal control... On the other hand, the general European approach ...has been altogether

more tentative, more agnostic...and only in recent years moving towards an uncompromising condemnation of cartel activity...” (p. 40).

One finds these disparate but converging views reflected in the social-science literature on cartels.

Perhaps the first publications to attempt to quantify systematically the price effects of cartels were a pair of books produced by a team of economists (Stocking and Watkins 1946, 1948). These books set a new standard for rigor and detail in the economics literature on cartels, because they were the first to apply rigorous modern concepts of the emerging field of industrial economics; because of access to the information spawned by numerous Congressional investigations and to more than 40 criminal court proceedings; and because they were among the first to focus on the market effects of international cartels.¹⁷ Numerous and continuing citations to their books by leading scholars attest to their status as classics in the field.

The negative impacts of cartels during 1920-1945 began to bring about a reappraisal of the welfare impacts of cartels among Europeans just after World War II. In Germany there was a healthy parliamentary debate over its cartel laws in 1951-57 (Wells 2002:165-74). Germany was the prime mover behind the adoption of tough anticartel provisions in the Treaty of Rome, which solidified the antitrust tradition in the EU and its Member States.¹⁸ Through the early 1950s, a majority of the UK’s manufacturing output was affected by cartels (Symeonidis 2002, Swann 1974). The reconsideration of the benefits of cartels in the UK began around 1950 with a series of empirical studies by the Monopolies Commission, which investigated the structure and performance of British industries and made recommendations to the government about restrictive practices, dominant firms and mergers. By the late 1950s, anticartel legislation had been adopted that placed the burden of

¹⁷ Technically, the 1911 conviction of American Tobacco *et al.* was the first U.S. prosecution of an international cartel, but the international aspect of the case was a minor aspect of the case.

¹⁸ Just how tough EU enforcement would become held in the balance until Regulation 17 was passed in 1962. Until then some of the Member States thought that Articles 85 and 86 were merely advisory, but in 1962 the German view that the law was prescriptive prevailed (Julian 2005).

proof on cartels to prove the economic benefits of their price fixing and related conduct. In 1972, UK companies became subject to EU competition law. However, the UK's national enforcement regime was one of the weakest in Europe, partly because it did not permit cartel fines until 1998.

Relatively few books were written about the empirical economics of cartels after about 1950, but there have been three brief periods of interest.¹⁹ First, there was a short lived U.S. interest in domestic cartels when the “Great Electrical Equipment Conspiracy” burst onto the Nation’s consciousness in 1960-1961. When the guilty pleas were made in 1961, nearly every daily newspaper in the United States placed the events on their front page. The great electrical equipment conspiracy resulted in the release of more publications in a few years than any other single historical event in the cartel literature. The scope of the conspiracy, the fame of the leading companies involved, and the U.S. Government’s aggressive prosecution of the violators – all these factors lead to a degree of public fascination and publicity about an antitrust action not seen since the Supreme Court decisions against the Standard Oil and American Tobacco trusts in 1911.²⁰ Several trials provided unusually detailed pictures of the cartel’s organization. The books written about the heavy-electrical-equipment conspiracy include at least six monographs documenting the complex organizational details of these long-lasting and widespread bid-rigging conspiracies (Herling 1962, Smith 1963, U.S. Congress 1965, Sultan 1975, Epstein and Newfarmer 1980, and Bane 1973). Sultan’s books are by far the most quantitative. In addition, three journal articles were devoted to the cartels (Kuhlman 1972, Finkelstein and Levenbach 1983, and Lean *et al.* 1985). These studies have become staples in textbooks in industrial organization (e.g., Carlton and Perloff 1990).

¹⁹ Overcharge estimates were available in about 50 books and chapters in edited books, of which 30 were published after 1950. Compared to the total number of economics books printed after 1950, the share of them devoted to cartel studies is smaller than those written during 1900- 1949.

²⁰ The conspiracies are notable for their duration (up to 40 years), the as yet unsurpassed size of the sales involved (\$7 billion per year in the late 1950s), the large number of well known companies involved (General Electric, Westinghouse, etc.), the then record fines imposed (over \$2 million), the size of the damage awards in three trials and private settlements (\$400 to \$500 million) from more than 1900 suits, and the imposition for the first time of significant prison sentences for several top executives.

Second, there was a brief revival of focus on international cartels after 1973 when the Organization of Petroleum Exporting Countries (OPEC) first used its power to raise crude petroleum prices. Many books and articles were written about the cartel, and two economic studies tried to predict OPEC's staying power by developing and analyzing data sets on more than 50 international cartels. A chapter in a book by Eckbo (1976) is notable for its effort in classifying cartels according to a large number of potentially significant economic dimensions. One dimension is a binary variable that separates cartels with significant price effects from those that were less effective in this respect. Griffin (1989), who has several cartel studies to his credit, specifies a formal cartel model which allows for a fringe of competitive, non-cooperating producers outside the cartel. From this theoretical model, Griffin tests cross-sectionally a simple empirical model that explains variation in the Lerner Index²¹ of market power.

Third, four books may be traced to high profile U.S. and EU prosecutions that began in late 1996. Three were prompted by a well publicized 1998 criminal trial of three executives involved in the lysine cartel, the record of which provided a degree of testimonial evidence which is unique for international cartels discovered after World War II (Lieber 2000, Eichenwald 2000, and Connor 2001). Harding and Joshua (2003) provide a legal overview of mainly EU cartel enforcement. Only Connor (2001) contains empirical overcharge data.

After 1973 most empirical analyses of cartel effects began to appear in professional academic journals. The shift away from monographs as the preferred outlets is remarkable. Of

²¹ Like the overcharge rate, the Lerner Index also measures the price effect of collusive conduct, except that it is measured by dividing the market price by the monopoly price instead of the competitive price. That is, the Lerner Index is a *margin* on the collusive selling price, while the overcharge is a *mark-up* on the competitive price. Thus, for the same cartel the Lerner Index is a smaller number than the overcharge, though the difference is small for small overcharges.

The Lerner Index is $L = (P-C)/P$, where P is the observed market price and C is the but-for or competitive price. Because C is equal to marginal cost in competitive equilibrium, L is also a profit margin on sales. L is zero in perfectly competitive markets and has a maximum value of one. The monopoly overcharge is: $MO = (P-C)/C$. Because P is always greater than or equal to C , MO is greater than L whenever L is positive. Simple algebraic substitution allows one to express MO as a function of L , viz., $MO = L/(1-L)$.

about 80 papers with useful overcharge information, 66 were published after 1973. While a few are historical narratives, these articles tend to focus on statistical tests of theoretical hypotheses or demonstrations of the superiority of a novel estimation technique. They form a small subset of the vast literature in economics that measures the price effects of market power, because external information is needed to identify markets in which sellers overtly colluded from the much larger number of markets characterized by presumptively tacit collusion. Perhaps the first published work that uses econometrics to estimate a cartel overcharge is Sultan's (1974) analysis of the U.S. electrical equipment conspiracy of the 1950s. Fisher (1980) and Finkelstein and Levenbach (1983) show that econometric evidence was being presented by experts in U.S. civil, price-fixing trials as early as 1970. Econometric evidence on monopoly overcharges was published to critique government-enforced compulsory cartels; Kwoka (1977) is the first of many analyses of the price effects of agricultural marketing orders. However, quantitative analyses of the size of buyers' cartels' undercharges are rare; Daggett and Freedman (1985) seem to be the first to publish such a study. Sophisticated econometric modeling has spread into cliometric studies of cartels: a notable pair of studies by Hausman (1980, 1984) examines two UK coal markets from 1699 to 1845 and Levenstein (1997) the century-old bromine cartel.

A new development in the cartel literature was the statistical analysis of auctions and bid rigging, much of it inspired by the urge to test game-theoretic notions (Porter 2001 surveys this literature). Howard and Kaserman (1989) study collusion in public tenders for sewer construction; Froeb *et al* (1993) federal-government procurement of frozen fish; Brannman and Klein (1992) state road-building contracts; and Lee (1999), Porter and Zona (1999), and Pesenforfer (2000) school-milk procurement. These studies were made possible by U.S. laws that mandate public access to bids for public project tenders, a policy that is uncommon outside of North America.

Novel methods continue to be applied to estimating cartel mark-ups. There is substantial work focused on understanding cartel stability from which price effects can be derived. Grossman (1996) looked at the 1851-1913 railroad express delivery market, and several have studied the 19th century Joint Economic Committee railroad cartel (Porter 1983, Briggs 1989, and Ellison 1994). Bajari and Yi (2003) applied the Bayesian method to a U.S. seal-coating conspiracy. Clarke and Evenett (2002, 2003) apply a trade model to importing countries to estimate price increases during the 1990's bulk vitamins cartel.

In addition to journal articles, this study draws upon nine 2000-2004 working papers of economists, many of which will become journal papers. One major source is a working paper that compiles data on the price effects of about 40 of 167 private international cartels that were discovered by antitrust authorities only since 1990 (Connor 2003). Other important sources of scores of overcharge estimates are the decisions of courts and competition-law commissions, most published since 1990.

3.3. Previous Surveys of Cartel Overcharges

Given the importance of the topic for legal-economic discourse, there have been surprisingly few compilations of empirical findings of cartel overcharges. Of the leading textbooks in industrial organization, Carlton and Perloff (1990) devote more space to cartels than most – almost 50 pages out of 852 total pages. This work mentions by name 60 cartels, most of them interwar, international cartels. Other textbooks have far fewer numbers of cartels cited.

I have been unable to find any research that has as its principal aim collecting or analyzing information on the price effects of overt collusion. However, I have found six works that mention a

significant number of studies of mark-ups due to overt collusion. The overcharges are assembled as a prelude to scholarly research, not as an end in themselves; none claims to be a comprehensive survey.

Cohen and Scheffman (1989) recognize that the average size of price-fixing overcharges generated by overt collusion is a critical issue in evaluating cartel fines. Their paper cites five to seven estimates for price-fixing cases. A working paper by Werden (2003) cites 14 studies of cartel overcharges. All of his sampled studies were published since 1991, because he wished to study conspiracies that operated after 1974, the first year in which cartels could be prosecuted as felonies; three studies examined international cartels prosecuted by the DOJ in 1996-97. Posner's (1975, 2001) treatise on antitrust law is an avowedly economic treatment of the subject. To illustrate the social costs of cartelization, Posner assembles data on 12 "cartel price increases" in "...industries having well-organized (mainly international) private cartels" (Posner 2001:303), which he admits are "crude and probably exaggerated" (*ibid.* p.304). Given that Posner is an avatar of the Chicago School of economics, it is noteworthy that his estimates are among the highest of the six studies.

Levenstein and Suslow (2002) focus on the determinants of success for both the interwar and more modern cartels. This paper provides a total of 21 estimates of price effects for international cartel episodes. The OECD (2003) report on private, hard-core cartels contains a summary of a 2001-2002 survey of national governments on the economic harm caused by cartels recently prosecuted by the European Commission and national antitrust authorities. While not all of the survey responses can be converted to overcharge percentages, the usable responses represent an unusually authoritative compilation of data on mark-ups by contemporary cartels that have been prosecuted by courts or commissions. The six surveys just discussed are summarized in Table 1.

Table 1. Summary of Six Selective Economic Surveys of Cartel Overcharges

Reference	Number of Cartels	Average Overcharge	
		Mean	Median
		<i>Percent</i>	
1. Cohen and Scheffman (1989)	5-7	7.7-10.8	7.8-14.0
2. Werden (2003)	13	21	18
3. Posner (2001)	12	49	38
4. Levenstein and Suslow (2002)	22	43	44.5
5. Griffin (1989), private cartels	38	46	44
6. OECD (2003), excluding peaks	12	15.75	12.75
Total, simple average	102-104	30.7	28.1
Total, weighted average	102-104	36.7	34.6

4. DATA SOURCES AND COLLECTION METHODS

I have made every attempt to identify and collect all useful information on *private, hard-core* cartel overcharges available from public sources. A private, hard-core cartel is one that by contemporary U.S. standards could be criminally indicted under the Sherman Act.²² Hard-core or “naked” cartels are those that made explicit agreements to control prices or limit quantities to be produced or sold. Price agreements may cover list prices or transaction prices; the transactions prices may be floor prices, target prices, or, if a common sales agency is employed, actual transactions prices. Prices

²² Restricting criminal indictments to only hard-core cartels is a matter of custom, not law. The 5 to 10% of U.S. DOJ horizontal or vertical conspiracy cases handled through civil indictments are the result of prosecutorial discretion.

may refer to sales of goods or services, procurement of inputs, or bids in auctions or tenders.

Quantity restrictions most commonly involve fixed market shares for each participant, but may also include territorial exclusivity, customer allocations, or production-capacity agreements. Cartels that focused exclusively on advertising, patent pooling, setting technical standards, R & D, and the like are excluded.

I have examined hundreds of journal articles, working papers, and other short analyses of cartel price effects. Many were written primarily as historical case studies and mention price effects only in passing. The majority of the short cartel studies were written by economists. Nearly all economic articles are written by North American academics using cartel episodes that affected commerce in the United States or Canada.²³ The absence of empirical studies by academics working in Europe or Asia is striking. One might speculate as to why this is so. The supply of well trained industrial economists in Europe is unlikely to be an explanation.²⁴ 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. Perhaps a more important factor is the inability of academics to obtain access to the structural and price data needed to calculate overcharges. Civil cases are unusual in Europe, so the little work being done on cartel overcharges is done in-house by antitrust authorities. Unlike North America, there is little mobility between the staffs of European antitrust authorities and universities or think tanks. Finally, a survey of European and North American industrial-organization economists reveals that there are very few

²³ Several historical studies of cartels were authored by Europeans or Japanese scholars. A few economic studies of cartels were written by UK or Australian economists (Evenett, de Roos).

²⁴ 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.

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).

Classifying these cartels at times requires judgment. Some cartels operated prior to 1890 when passage of the Sherman Act made participation by U.S. companies illegal, but many cartels headquartered in Europe predate the beginnings of effective European anticartel laws. If these cartels were not formed by means of a legally enforced government monopoly, they are generally considered *private* schemes.²⁵ However, if a government simply required registration or chartering of a cartel but left its management in corporate hands, they are included in the data set. Beginning in 1918 in the United States and in most European countries in the interwar period, domestic producers were permitted to register and operate export cartels with no or minimal supervision; I consider these private cartels. Similarly, if a government-owned national monopoly or commodity association voluntarily joins an international cartel, that too may be a private cartel. Thus, the mere fact that governments tolerated or turned a blind eye to cartels does not disqualify them from inclusion in the data set. However, commodity agreements known to have been initiated, actively sponsored, or overtly protected by national sovereignty are not included. In these “public” cartels the active involvement of governments are signaled by the signing of a treaty, government ownership of stocks, or the appointment of civil servants to cartel-management positions. There are many fine studies of such agreements, but the inclusion of government-sponsored or -enforced cartels would tend to bias upward the overcharges in the sample (Suslow 2001). Where judgment was required procedures were followed that would result in conservative overcharge statistics.

In general, I aimed at collecting the largest possible body of quantitative estimates of monopoly overcharges, and avoided applying some sort of quality screening. In the vast majority of

²⁵ Wallace and Edminster (1930: Appendix A) provide a convenient chronology of most government-sponsored export-control monopolies: the Japanese camphor monopoly of 1899, the Italian citric acid monopoly of 1910, the Greek currant monopoly of 1895, and the New Zealand kauri-gum monopoly of 1927 are examples of clearly public cartels.

cases, the writers themselves provided the overcharge calculations. In a small minority of cases, I made inferences from price data contained in the works.²⁶ Few overcharge claims appearing in newspapers, magazines, and newsletters are included because such assertions are usually from anonymous sources who may not be disinterested parties in an ongoing law suit or in some public policy debate, roles that may color their assertions. In some cases, overcharge estimates may originate from articles in industry trade journals, but if they were cited by economists, historians, or legal scholars with some background in cartel studies, such estimates are reported in the present survey. We did include estimates appearing in a few book-length cartel studies by journalists, public servants, or other professional writers of nonfiction.

Clearly this catholic approach to data-gathering will create concerns in the minds of many readers about the reliability and precision of the overcharges. There may be substantial variation in the quality of the price data, the methods used, degrees of judicial scrutiny, and the professional orientation of the sources that could affect reliability as perceived by any individual. I noted above the lack of clarity among professional writers about the essential characteristics of the cartels until at least the 1920s. Consequently, some readers may wish to dismiss scholarship before that decade, while others will be untroubled by semantic differences. Economists may well give greater weight to writings by professionals in their own field than to opinions reached by judges, commissions, or juries, whereas legal scholars will often give greater credence to the latter. Legal professionals may have strong preferences for high court decisions over state or district courts, or they may have strong opinions about European versus American antitrust jurisprudence. Similarly, many economists might trust results published in refereed scientific journals more than other publication outlets that

²⁶ If a credible study of a cartel concludes that it was “ineffective,” I have coded this comment as a zero price effect and included this observation in the averages. Likewise, conclusions that the impact of collusion was “overwhelmed” by natural market forces are interpreted as a zero overcharge. However, vague assertions that a cartel episode was “effective” are not tabulated.

receive less peer scrutiny, prefer modern quantitative methods to deep historical case studies, or express skepticism about the analyses of economists writing before the Age of Game Theory.

To contend with the disparate preferences of readers, I have chosen to cast my net widely, but look across the sources for evidence of systematic bias. Indeed, the analysis of these data by source, time period, or method may provide useful insights in itself. I hope to provide the interested reader with enough information to make up his or her own mind about reliability

4.1. Social Science Studies

The first of three major sources consists of books, monographs, reports, and refereed journal articles written by specialists in many fields: economists, historians, political scientists, lawyers, and in a few instances journalists. I have confined journalists' accounts of cartels primarily to book-length treatments of cartels, in the belief that such monographs are in-depth accounts of a cartel collected from many sources, some of them anonymous, over a period of time sufficient for the author to provide a balanced account of conflicting claims. Newer publications were located by using various bibliographic search engines, by noting the references cited by authors in the works themselves, and by searching on-line library catalogs. These studies vary substantially in terms of depth and the degree of professional commitment to the study of cartels. Some economists and historians have spent substantial portions of their careers specialized in cartel analysis, but most of the publications quoted herein are by social scientists for whom cartels were just a passing interest. Other sources of information include the Web pages of scores of antitrust agencies, lists of court and commission decisions, and multilateral organizations.

There are varying methods used to derive the effects of cartels on prices. Older studies tended to use a rather informal method of price analysis that now comes under the rubric of the “before-and-after method” (Connor 2004a). That is, armed with knowledge of when overt collusion occurred, the author would compare prices during the affected period with prices before the cartel began or after it ended; in some cases, the basis of comparison would be a price war that erupted during the affected period. The base price was typically assumed to be the long-run competitive equilibrium benchmark price (now termed the “but-for price”). Although some were careful to take such factors into account, in many cases the possibility that shifts in demand or supply conditions could have caused the benchmark price during the affected period to depart systematically from the before or after price was ignored; moreover, the idea that price wars could generate unsustainably low prices was not often recognized,

A second way of calculating a benchmark price is the yardstick method. In this type of analysis, an economist would collect prices for otherwise comparable markets that were believed to be free from cartelization. For a localized conspiracy, the competitive yardstick could be prices in a nearby city or an adjacent state with similar demand or cost conditions; the trend in cartel prices could then be compared to the trend in the yardstick during the collusive period. Yardstick price movements can also be constructed for a noncartelized product made in the same region that is made with the same inputs, utilizes a similar technology, and is consumed by the same customers. If a cartel colludes against only some of its customers, then the discounts offered to other similarly situated customers could yield a yardstick.

Third, sometimes the costs of production and the margins earned by firms in the relevant lines of business may provide collateral indicators of variations in the degree of competitiveness of a firm or market. Cost-based estimates are relatively uncommon because detailed internal business

records are needed. Both the before-and-after and yardstick methods require expert judgments about the market in question, but both remain the leading methods used in courts of law or commission hearings to determine the fact of injury or the amount of damages.

Fourth, driven by developments in oligopoly theory and the increasing availability of detailed company and market data, increasingly it is econometric models of the alleged collusive market that are specified and fitted to the available data. Game theory has influenced contemporary concepts of collusion, the design of competition policies, and empirical modeling of oligopolies (Werden 2004). These models usually specify the demand and supply conditions in the relevant market, and then investigate through statistical tests whether and to what extent changes in prices or output fail to respond to normal, competitive market forces. Because these models can simultaneously incorporate multitudinous factors, economists tend to regard overcharge estimates from such models as more credible than analyses that depend on more informal ways of accounting for such factors.

Consistent with most previous studies of cartel effectiveness, each cartel episode is treated as a unique observation. Most cartels are organized and fall apart only once; not counting brief disciplinary price wars, this describes one episode. However, many cartels are formed, disband, reform, and disband several times; each cycle is an episode. Each time a new collusive episode begins, chances are that the methods and membership composition have changed; pauses between episodes are often quite lengthy. Because the agreement and the players are different, in effect a new cartel is launched.

4.2. U.S. Antitrust Court Verdicts

In theory one should be able to determine how high cartels raise prices by a straight-forward examination of a statistically significant sample of the thousands of antitrust cases that involved cartels. However, the amount that prices changed, or even whether prices were affected at all, is not relevant to the issue of criminal guilt under U.S. antitrust law (Sullivan and Grimes 2000:165-233). It therefore is unnecessary for a U.S. court in criminal antitrust cases to calculate the extent of any overcharges or undercharges. In civil cases, however, the damages awarded to a successful plaintiff are equal to three times the overcharges, so in these cases plaintiffs must demonstrate how much prices increased or decreased due to the actions of the cartel. The necessary research has proven to be extremely difficult to undertake, however, because almost every private antitrust suit for damages settles or is dismissed before an overcharge can be calculated by a neutral observer and made part of the public record of the case. As a consequence, final verdicts involving cartels where a judge or jury calculated an overcharge are surprisingly rare. Announced negotiated settlement amounts also are rare and are poor guides to actual overcharges (Connor and Lande 2004).

Data collection aimed at obtaining the largest possible sample of verdicts in collusion cases, namely, final decisions in United States antitrust cases involving horizontal collusion, broadly defined to include bid rigging and related practices, where a judge, jury, or commission calculated the damages. Three sources were explored: computer assisted searches of data bases, reading through a large number of articles and treatises on cartels and on antitrust damages, and messages to groups of knowledgeable antitrust professionals. Every qualifying final collusion verdict is included, but the small sample size of 24 final U.S. decisions is disappointing.

4.3. Decisions of Other Antitrust Authorities

Table 1 summarizes 16 percentage overcharge estimates of hard-core cartels that were reported to the OECD (2003) by nine antitrust authorities. In the jurisdictions employing Common Law, most cartels are sanctioned after government negotiations that result in guilty pleas or by monetary settlements with private parties out of court. When this is the method of resolution, the authorities' press releases practically never mention the degree of harm caused by the cartel. Very few cartels defend themselves in court, and very few of the trials result in published decisions that reveal the overcharges.

In other legal systems, antitrust commissions hold confidential hearings to determine guilt and impose sanctions. These decisions are announced in press releases that seldom mention the extent of cartel damages. However, in some jurisdictions a detailed report is released a year or two after the decision, and some of these reports have prices that can yield useful overcharge information.²⁷ Additionally, commission decisions can be appealed to a court that renders a decision with a recitation of the facts of the case. Additional non-U.S. decisions are reported below.

5. GENERAL DESCRIPTION OF THE SOCIAL SCIENCE DATA ²⁸

With very few exceptions, this paper reports on every scholarly or serious social science study that contained quantitative information on the price effects of hard-core private cartels.²⁹ While no time

²⁷ I read about 80 EC decisions that imposed fines on cartels (Burnside 2003: Annex 1). The UK Monopolies Commission also released detailed reports, and I read about 40 of these.

²⁸ The subsequent tables in this report are constructed from spreadsheets that incorporate data collected as of October 10, 2004.

²⁹ See Connor (2004 b: Appendix Table 5) for the few excluded studies and the reason for their exclusion.

limit was placed on the literature search, the majority of the sources consulted were written after 1945. Unless available in translation, this survey is confined to English language sources.

The data are organized according to three levels of analysis: markets, episodes, and overcharge estimates. By “market” is meant the industry or product that was subject to price fixing. *Markets* are precisely self-identified by the participants in the conspiracy, though occasionally there are alternative names for the same market. The name of the market is eponymous for the cartel. *Episodes*, discussed more fully below, are distinct periods of collusion separated by price wars, temporary lapses in agreements, or changes in cartel membership or methods. Episodes may be adjacent in time or may be separated by significant gaps of time. The markets marked by adjacent multiple episodes will typically be regarded by antitrust law as one infraction, but as economic phenomena as multiple cartels. Most of the analyses in this paper will use *overcharges* as the units of observation. Each episode will in principle have one true “average” (episode-long) overcharge and one “peak” overcharge. However, because there are sometimes multiple publications about the same episode and because a single analyst will sometimes apply alternative methods of estimation, this paper often records several estimates for a single episode.

5.1 Markets

Publications from economists, historians, and related sources yielded useful overcharge or undercharge information on cartels that operated in 237 markets (Table 2). If one group of sellers decided to fix prices of a product in one geographical region and another group colluded on the same product in a separate geographical region, these will be viewed as two markets. Of the 237 markets, 39% were cartelized by international agreements, where “international” describes the membership

composition of the cartel and not necessarily the geographic spread of the cartel’s effects. Some international cartels affected directly the commerce of only one nation, though the vast majority was international in both senses. National cartels account for the remaining 61% of the cartelized markets. In this category I count some purely national cartels that were formed for the sole purpose of controlling a nation’s export sales; in the United States, these are called Webb-Pomerene Associations. In addition, some domestic cartels had agreements with international cartels that often protected their domestic market from exports from the international cartel’s members. A few markets were cartelized by both types; typically, a domestic cartel was expanded to respond to foreign competition.

Table 2. Number of Cartel Markets, by Type

Type	Number	Percent
International membership	88	37.1
National or regional	149	62.9
Bid-rigging schemes	73	30.4
Classic cartels	164	69.6
Cartel found guilty or liable	140	59.1
Currently under investigation (presumed “illegal”)	6	2.5
Known to have been operating legally	54	22.8
No record of sanctions (presumed “legal”)	37	15.6
Total	237	100.0

Source: Connor (2004 b: Appendix Table 1) (version of 10/14/04)

Almost one-third of the sample consists of markets affected by bid-rigging cartels. Although most cartels have some sales to government entities or industrial customers that purchase by tenders, these cartels are explicitly indicated by the authors to have substantially or exclusively engaged in bid rigging. This proportion is certainly an underestimate because the sources did not always provide

enough detail on the cartels to be certain of the degree of bid rigging. It is widely believed that bid rigging leads to higher overcharges than otherwise identical conspiracies. The remaining 70% of the cartelized markets may be called “classic” cartels, those that set market selling prices and/or market quotas for each or its members.

Three-fifths of the cartels were found to be in violation of antitrust laws by at least one legal body. Sometimes these are called “discovered” cartels. The determination of guilt or liability may take the form of guilty pleas, of a decision at trial by judge or jury, of a commission decision to impose fines or other sanctions, of the payment of civil penalties, or of negotiated settlements by defendants in a suit. The remaining 39% of the cartelized markets are known or believed to be “legal” or extra-legal because they operated prior to the enactment of antitrust laws in the jurisdictions in which they functioned, because they were never discovered by an antitrust authority. Other legal cartels were organized and registered under antitrust exemptions, such as export cartels or ocean shipping conferences.

5.2. Episodes

Although I have collected data on 237 cartelized markets, there are multiple overcharge estimates for a large minority of the markets. There are more estimates than cartelized markets for three reasons. First, about half of the markets experienced multiple phases or “episodes” for which the price effects differed. The sources have distinguished a total of at least 512 episodes (Table 3). This term, which might better be called an observational time period, requires some additional explanation.

If a cartel had more than one episode, then each episode is marked by changes in membership composition, the terms of the collusive agreement, method of management, geographic

focus, or other major change. In other words, when a cartel is re-formed, it enters a new phase. Between episodes, pricing discipline often breaks down; in some of the cartels the interregnum is a period of contract renegotiation. The aluminum market, for example, went through six distinct phases that sometimes were adjacent in time and sometimes were several years apart. This heavily researched cartel has 28 overcharge observations.

One study from which I obtained a dozen observations summarized the results of 109 bid-rigging convictions in the fluid milk markets of the Southeastern United States within a few years (Lanzillotti 1996). I count each conviction as an episode. If one prefers to count the Lanzillotti summary and two other “group studies” as a three episodes, then the total becomes 332. However, some studies that I count as one episode incorporate multiple temporal phases (e.g., Ellison’s study of the Joint Executive Committee). Thus, there are reasons to believe that the number of episodes is an undercount. Second, for a few episodes, more than one study has been published. For example, for the various aluminum cartels I drew on nine studies written by eight authors. Third, for a given episode, alternative methods of estimation are sometimes available, in a few instances by the same author writing in the same publication.

In general the distribution of episodes across types of cartels (Table 3) is quite similar to the distribution of cartelized markets (cf., Table 2). The major difference is that international cartels tended to have a larger number of multiple episodes than did domestic ones. The 88 international markets in the sample that were cartelized had on average 1.6 episodes, whereas national cartels had only 1.3 episodes on average. As a result, a larger share (44%) of the cartel episodes had international membership. The number of episodes per market does not vary significantly across other type categories.

Table 3. Number of Cartel Episodes, by Type

Type	Number	Percent
International membership	145	43.7
National or regional	187	56.3
Bid-rigging schemes	98	29.5
Classic cartels	234	70.5
Cartel found guilty or liable ^a	196	59.0
Known to have been operating legally	84	25.3
No record of sanctions (presumed “legal”)	52	15.6
Total	332 ^b	100.0

Source: Appendix Table 1 (version of 10/26/04).

^a Episodes that were sanctioned by a court or commission or through a settlement.

^b Counts three “group” observations of 206 cartels (numbers 15, 38, and 55) as single episodes.

5.3. Overcharges

Two kinds of cartel mark-up data are available. First, researchers usually report the *average* price increases over the whole episode (Table 4). This is the measure most relevant for forensic purposes and is the one that will be the focus of most analyses in this paper. I have collected 635 of these estimates; 94% of all episodes report average overcharges. In some cases, the averages are carefully weighted by the sales in each year or month of the episode, but in most cases the authors give equal weights to the price changes in each sub period during the total affected period. Sometimes it is not clear from the source whether the averages are weighted or unweighted; if the conspiracy period is marked by steady slow market growth, it matters little which is reported. Some of the overcharge

estimates are said to be *minimum* estimates. To be conservative, all such minimum estimates are counted as averages. Some averages are given as ranges.

Second, 210, one-fourth of all the 845 overcharge figures that were assembled, are *peak* price effects. Thirty-one percent of the episodes have peak estimates. In some cases the peak price was reached for only one day during a cartel period of several years; in other cases, the peak may be the highest one of several years. Peak price changes indicate the potential for maximum harm when a cartel is at its most disciplined. Classifying a particular estimate as an average or peak figure in a minority of cases required judgment. If the original source is unclear about which type of estimate is being presented, in order to be conservative I have assumed it is a peak estimates.

Table 4. Number of Average Overcharge Observations, by Type of Cartel

Type	Number	Percent
International membership	365	54.2
National or regional	309	45.8
Bid-rigging schemes	185	27.4
Classic cartels	489	72.6
Cartels found guilty or liable ^a	384	57.0
No record of sanctions (“legal”)	290	43.0
Total	674	100.0

Source: Appendix Table 1 (spreadsheet dated 10-14-04).

^a Included are six cartels still being investigated by authorities.

6. SOCIAL SCIENCE STUDIES: RESULTS

6.1. Number of Overcharge Observations

The number of average overcharge estimates is shown in Table 5 arranged by the cartel episode's end year and three types. To summarize the main types, there are total of 845 useful estimates of overcharges and undercharges drawn from nearly 200 publications.³⁰

The six periods distinguished in this and subsequent tables were selected to represent different antitrust regimes in the United States and abroad. In addition, the periods correspond roughly to the major changes in the relationship of antitrust jurisprudence to economics Kovacic and Shapiro (2000). The era up to 1890 is an obvious choice because of the enactment of the Sherman Act in the United States and the 1889 Anti-Combines Act in Canada. During the early decades of the 20th century, numerous U.S. court decisions made the scope and power of the U.S. anticartel law apparent to lawyers, enforcement officials, and business persons (Wells 2002).³¹ The year 1919 is chosen as a break point because it represents the end of a period of U.S. antitrust activism and, because of World War I, a date by which nearly all international cartels, a few of them with U.S. corporate members, had ceased operating. Many of the prewar cartels were re-established after 1919, but in the majority of instances without the active participation of U.S. firms. The years 1945-1946 are another logical break point. During 1939-1945 nearly all of the interwar international cartels were disbanded, and wartime price controls made cartels superfluous. Scores of U.S. criminal prosecutions of international cartels during 1940-1945 clarified the illegality of many more subtle forms of cartel participation, such as patent pools and cross-licensing of technologies.

³⁰ The same estimates sometimes appear in multiple publications. Here I count only the total number of books, articles, and reports that contain one or more original estimates. The very few undercharges are entered as positive numbers.

³¹ But few economists. The first time the Supreme Court took notice of economists was in the 1925 *Maple Flooring* decision (Kovacic and Shapiro 2000:47).

The post-World War II era is characterized by the emergence of industrial-organization as a separate discipline within economics, of rapid advances in empirical methods of analysis, and of the adoption of effective anticartel laws outside of North America. Kovacic and Shapiro (2000) note that in the United States by the 1940s “...there was considerable consistency between judicial decisions and economic thinking...” (pp. 51-52). Moreover, the vast expansion of higher education in North America and Europe brought about a parallel expansion of the economics profession as a whole and, consequently, an acceleration in the total resources devoted to theoretical modeling (particularly after 1980) and related empirical testing on collusion. Beginning in the 1960s, economists in North America began to work more closely with prosecutors and the private bar in antitrust cases, and many of them began to analyze and write about those activities. This is a major factor responsible for the fact that nearly 80% of the estimates of “national” cartels (most of them prosecuted in North America) are drawn from the post-1945 time period.

The post-war era is divided into three sub periods. The transition years 1945-1973 correspond with three relevant changes in anticartel enforcement. First, the antitrust idea became firmly implanted in the laws of countries outside North America for the first time: Germany and Japan in 1947, the United Kingdom in 1956, and the European Economic Communities (EEC) in 1958. Second, the European Commission (EC), the administrative arm of the EEC, after a decade of registering cartels, successfully prosecuted its first cartel in 1969. Third, U.S. price-fixing enforcement penalties became significantly more severe in 1974. Class action suits became far more common by the mid 1970s because of changes in federal court rules, a change that permitted plaintiffs to attract better lawyers and economic expertise (White 1988:Table 1.1). Another milestone in U.S. anticartel legislation was the 1974 law that made price fixing a felony, thereby

lengthening maximum individual prison sentences and strengthening the bargaining power of the DOJ.

Although the prosecution of price-fixing of relatively inconsequential domestic conspiracies was at a high level in 1974-1990, the DOJ did not give a high priority to investigating international cartels, nor did it have any success in the courtroom in the few international cases it did pursue (Connor 2001a). Kovacic and Shapiro (2000) identify 1973-1991 as the years during which the Chicago School of economics had its greatest influence on antitrust law and enforcement.

By 1990 criminal sanctions with high limits were available to the U.S. government. In 1990, penalties for corporations rose from \$1 million to \$10 million.³² Moreover, in the early 1990s, the DOJ had in place three devices that improved detection and prosecution of cartels: the U.S. Sentencing Guidelines for corporations (1989), the automatic amnesty policy for corporate whistleblowers meeting certain criteria (1993), and a demonstrated ability since 1994 to impose fines above the \$10-million statutory cap by means of an alternative sentencing provision. These devices were in some cases adopted by the EU and other antitrust authorities, which significantly improved the investigation and prosecution of international cartels. Both U.S. and EU prosecutions of international cartels increased markedly. After 1990 the influence of the Chicago School of Economics on antitrust waned.

Several features of the data set are apparent in Table 5. The number of observations per year has generally grown over time, and the primary factor that explains the trend is the growth in the number international cartels with usable data. Although there is a dip in 1946-1990, the correlation between the number of observations per year and a linear time trend is $r = +0.98$. The first cartel for

³² Raised to \$100 million in April 2004; maximum prison sentences rose from 3 to 10 years.

Table 5. Number of Average Overcharge Observations by Year and Type

Cartel Episode End Date	Membership		Legal Status		Bid Rigging	
	National	Inter- national ^a	Found Guilty ^b	Legal or Unknown	Primary Conduct	Classic Cartel
	<i>Number</i>					
1770- 1890	59	5	9	55	4	60
1891 -1919	61	36	38	59	9	88
1920 - 1945	9	147	45	111	1	155
1946- 1973	72	20	63	29	39	53
1974- 1990	59	20 (1 EU)	60	19	40	39
1991- 2004	49	137(11 EU)	169	17	92	94
Total	309	365	384	290	185	489

Source: Appendix Tables 1 and 2 (spreadsheet dated 10-7-04)

^a The companies in the cartel were headquartered in two or more countries.

^b One or more members of the cartels pleaded guilty, were fined or otherwise sanctioned by an antitrust authority or a parliamentary committee, agreed to payments to settle a private antitrust suit, or (in a very few cases) were in 2003 currently under price-fixing investigation by a government agency.

^c The earliest cartel is the Newcastle Vend, an English coal cartel that was formed in 1699 and first collapsed in 1770. Although highly unstable, it persisted until 1845.

which price effects can be found is the Coal Guild of northeastern England (also known as the “Newcastle Vend”), which made its first collusive agreement in 1699. Up until 1890 when price-fixing was legal everywhere in the world, only one estimate is available about every six months on average. There were large numbers of cartels extant in the late 19th century; but the small size of the fledgling economics profession, a literary approach to writing in economics, and inevitable destruction of most business records over time doubtless accounts for the fewness of quantitative

overcharge observations for 19th century cartels. During this early period, the vast majority of price effects are reported for domestic cartels operating in the United States, the United Kingdom, and Germany.

From 1891 to 1945 most data are drawn from studies of international cartels. The proportion of international schemes is especially high during the interwar period and after 1990 and especially low during 1946-1990. It is likely that there were more domestic cartels operating legally in Europe in the early 20th century than there were international cartels, but the latter were given more contemporaneous publicity because they appeared to be novel forms of business organization. The increasing awareness of the illegality of price fixing in the United States may also account for the absence internal records of domestic cartels in the United States after 1890. Moreover, because the penalties were so low (a maximum of \$5000 per count), relatively few court decisions bothered to give details about sales or prices during the conspiracy.

During 1891-1919, there are 3.1 price observations per year; the rate rises to about 6.2 per year in the interwar period. More data are available for international cartels during 1891-1945 than for cartels composed of companies from a single nation. About 75% of the observations are drawn from international cartels. One reason is the international cartels mostly were based in Europe, where they operated with legal impunity. That is, they had freedom to set prices. In a few European countries, cartels were required to register with the government. In others, cartel contracts were enforceable in the courts.

Many of the interwar international cartels were organized as federations of national cartels and were aimed primarily at controlling export sales. As nearly all of them were believed by their members to be legal at the time, their activities often were openly reported by the business press.

Members of these cartels did not attempt to hide their activities; indeed they often publicized their operations, particularly if they achieved putatively efficiency-enhancing industry rationalization, protected national markets, increased national employment during stressful economic times, or achieved increases in price stability. During this period, many countries passed legislation specifically authorizing cartels that controlled national exports, even if that meant agreements on prices in various overseas markets. In a few cases, including the United States, these cartels were used as cover organizations for domestic price-fixing.

In the early and mid 1940s, many of the interwar cartels were investigated by the U.S. Congress, indicted by the DOJ, and sued by private parties. Combined with the expanding size of the economics profession and the growing interest of economists in imperfect competition, the transparency of non-U.S. cartels led to a large number of empirical cartel studies. For 50 years after the end of World War II, the number of known international cartels declined markedly. Perhaps because of the aggressive prosecution of cartels by the DOJ in the early 1940s, it appears that international cartels were by and large driven underground for decades after 1945. Few international cartels were discovered or prosecuted until the early 1990s -- less than one international cartel episode every two years.

Several explanations have been offered for the hiatus in international cartel formation in the decades following the War. The destructiveness of World War II left the United States with as much as 65% of world industrial capacity in the late 1940s. As a result, manufacturers in Europe and Japan were oriented mainly toward rebuilding their domestic markets; not only were few industrial partners available for international agreements, it seems that U.S. firms were less prone to form cartels than firms from countries with no or weaker antitrust cultures. In the 1950s and accelerating in subsequent decades, U.S. firms embarked on a period of rapid foreign direct investment as the

preferred means of entering overseas markets; leading European and Asian firms adopted this strategy increasingly after the late 1960s. Until the early 1980s, most United States markets were subjected to little import competition, but by the 1990s imports were exerting a powerful influence on price competition across a wide spectrum of commodity markets. Most international cartels have arisen only in industries with internationally traded merchandise and populated by multinational corporations with strong leading positions. For all these reasons and probably several others as yet unknown, international-cartel formation was seemingly at an historically low level until the 1980s. On the other hand, the large number of overcharges available for the data set after 1990 is attributed to the launching of an historically high number of international cartels since the early 1980s; most of these cartels could not have been contemplated without the direct participation or passive cooperation of leading U.S. companies that still tend to be among the leaders in most cartelized markets. The number of overcharge observations exceeds 14 per year, which is more than double the rate of the interwar period.

A second important trend is that most cartel data now arise from prosecuted cartels. Prior to 1946, less than 5% of the observations refer to cartels known to have been prosecuted. Prior to the 1940s, U.S. anticartel sanctions were weak by today's standards, but increasingly after 1911 or so businesspersons became aware of the legal dangers of overt collusion in the domestic market. However, until the early 1970s national and international cartels comprised of European companies could form cartels subject only to registration requirements in most European countries (and the EEC after 1960). The European Commission began imposing fines on unregistered cartels that affected EEC trade beginning in 1969 (Harding and Joshua 2003:121). During 1974-1990, U.S. corporate sanctions on cartels became significantly harsher, and the European Union's prosecutions moved in the same direction (Connor 2003). Both jurisdictions imposed historically unprecedented

penalties on international cartels beginning in the late 1990s. After 1990, virtually all the observed cartels in the sample were prosecuted or fined by one or more antitrust authority. This pattern does not necessarily mean that the probability of discovery by prosecuting bodies has gone up, but it probably does represent a heightened aggressiveness in anticartel enforcement as well as a shift in research methods by social scientists.

A third trend manifest in Table 5 is the prominence of estimates derived from bid-rigging conspiracies since 1945. From few recorded examples prior to 1946, in the post-War era almost half of all the overcharge observations in the sample were primarily bid-rigging conspiracies. The large majority of national cartels, most of them local milk or construction conspiracies in the United States, rigged bids. The immediate victims of most bid-rigging conspiracies were governments. Relatively few international cartels rely primarily on rigging auctions or tenders for public projects. What may seem like a surge in this practice may in fact be a reflection of changes in data availability. Most of the articles on bid rigging have drawn on public records of state or federal agencies that have been the objects of these conspiracies. It is possible that the increase in bid-rigging cases seen in the data is simply due to the advent of open-records laws at the state and municipal levels similar to the federal Freedom of Information Act.

6.2. Trends in Average Overcharges over Time

Table 6 displays the medians of all average overcharges.³³ Median percentages are displayed because nearly all the cells contain positively skewed prices. That is, a few very high overcharges in any particular category tend to overwhelm the larger number of low-to-medium percentages when calculating the more common type of average, the mean. Moreover, while there is no upper limit on

³³ The numbers of observations in each cell can be determined by reference to Table 5.

overcharge estimates, they are not allowed to fall below zero. In such situations the means are larger than the medians, and the median is a better representation of central tendency.

The median cartel overcharge for all types and time periods is 25.0% and for successful cartels 27.5%. Among the “successful” cartels (those with nonzero overcharges), median overcharges were 10% to 20% higher (Connor 2003b: Table 6A). There is a strong downward trend in overcharges by international and sanctioned cartels, but there is a weaker downtrend for the other types.³⁴ Mark-ups are above average for all types of cartels that were formed in the pre-modern era of antitrust (i.e., before about 1911 in the United States and before World War II in other parts of the world). In the period after 1990 when anticartel sanctions were the highest, the overcharges of discovered cartels are below the all-period averages for each type. The distinct decline in average overcharges of cartels that ended after 1990 is most evident among international cartels.³⁵ Somewhat surprisingly, it appears that the interwar cartels, nearly all of them Eurocentric international legal agreements, attained only slightly higher than average levels of price effectiveness. Perhaps the steadiest overcharges may be seen in the column of legal cartels where the average overcharges hover near the 30% to 35% range.

It is difficult to know what to make of the downward trends for some types of cartels. Besides the possible influence of the spread of effective anticartel enforcement, several alternative hypotheses may be put forward. Perhaps the application of more sophisticated quantitative methods by researchers in recent decades systematically yield lower estimates of price effects than the earlier studies that relied on simpler before-and-after comparisons. Perhaps expected profit rates in

³⁴ The correlation of median overcharges of international cartels to a linear time trend is $r = -0.57$; similarly, among cartels found guilty, the coefficient is $r = -0.38$; for all cartels $r = -0.20$. Data from Table 6; time is the midpoint year. The downward time trends are similar but slightly stronger among the successful cartels (Connor 2004b: Table 6A).

³⁵ It is rather odd that the notable surge in discovered international cartels after 1990 came at a time when the profit incentives for cartel formation were at an historic low (Connor 2003). Of course, if profits declined in the 1980s and 1990s, it is possible that the *percentage increase* in expected cartel profits may have been at an historic high point. Uctum (1998) presents evidence of just such a decline in the USA, Canada, Germany, and Japan from the 1950s or 1960s.

cartelized industries have declined as an effect of globalization, and those companies that join cartels are satisfied with smaller percentage increases from collusion. Industry mix could provide an explanation. The sample drawn from the earlier periods tends to contain more minerals and metals conspiracies, whereas the later estimates have a higher proportion of chemical, construction, and services firms represented. Because the most recent periods contain a higher proportion of cartels that were caught by antitrust authorities, the more recent estimates may be drawn from a population of cartels that is relatively incompetent in hiding their activities; similarly, the greater antitrust scrutiny in the United States from 1940 and from Europe since the 1960s could prompt cartelists to refrain from full monopoly pricing increases so as to reduce the chances of detection. Some of these hypotheses will be investigated below.

Table 6. Median Average Overcharges, by Year and Type

Cartel Episode End Date	Membership		Legal Status		Bid-Rigging		All Types
	National	Inter- national	Found Guilty	Legal	Primary Conduct	Other	
	<i>Median percent^a</i>						
1780-1891	22	41	32	22	16	24	23.5
1891-1919	21	48	25	35	37	28	30.4
1920-1945	18	36-37	45	32	34	34	34.0
1946-1973	14	26	13	23	13	15	15.0
1974-1990	18-20	40-43	22	25	21	25-26	24.0
1991-2004	17-18	25	24-25	20	22	25	24.0
ALL YEARS	17-19	30-33	23-25	28	21	25-29	25.0

Source: Appendix Table 2 (spreadsheet dated 10-21-04).

^a Medians of the lower bounds or the upper bounds of ranges, where appropriate.

Includes many zero estimates. See Table 5 for the numbers of observations in each cell.

6.3. Average Overcharges across Types

Table 6 shows that in every period since 1890 international cartels have been more injurious than domestic (mostly U.S.-based) cartels. In general, international cartels are roughly 50% more effective in raising prices than “national” cartels (cartels that fixed prices in one country and export cartels comprised of firms from single countries). Indeed, from 1891 to 1990, international cartels were twice as effective as domestic ones. This is not so surprising in the pre-World War II era because international cartels were formed without concern about prosecution, and even in the interwar period U.S. companies may have believed that they had structured their participation in ways that would not run afoul the Sherman Act. But the fact that the differences persisted in the postwar period is somewhat unexpected. The clearly greater effectiveness demonstrated by international agreements may reflect a greater degree of freedom from threat of entry than for geographically more localized cartels. International cartels in all eras tended to attract members that controlled the lion’s share of production in all the regions of the world with modern production facilities. Also, international cartels by their very nature deal with internationally tradable commodities, homogeneous producer intermediates with relatively low long-distance transportation costs.

Another pattern noted in Table 6 is the inferior price effects of bid-rigging cartels compared to conventional conspiracies that set selling prices or allocate market shares. Bid rigging cartels often were organized to exploit tenders for government public-works projects. Relatively few international cartels engage primarily in bid rigging, so this distinction may be confounded with the geographic types just discussed above. Nevertheless, this finding directly contradicts Cohen and Scheffman (1989), the prior beliefs of many economists, and the U.S. Sentencing Guidelines that

impose higher penalties for bid rigging. It also challenges a rationale of the U.S. Government's policy shift in the 1980s that overtly targeted bid rigging against governments.

An examination of the columns that contrast cartels according to their legal status sheds light on sample selection bias, an important methodological issue in cartel studies. Many such studies depend on samples of *convicted* cartels, and critics of these studies have asserted that cartels discovered through government investigations or sued by private plaintiffs are as a group inept compared to cartels that either had no fear of sanctions or remained clandestine. "...[I]t is not known whether cartels that find themselves in court are unsuccessful or merely unlucky" (Carlton and Perloff 1990:216-217). In particular, an influential study by Asch and Seneca (1976) finds that price fixers that were caught in 1958-1967 were significantly less profitable during collusion than a control group of unprosecuted firms.³⁶ Lower profitability ought to be reflected in relatively low overcharges. Table 6 suggests a resolution of this paradoxical finding. Cartels punished in the time period covered by the Asch and Seneca study were indeed relatively inept: their median overcharges of 13% are the lowest by far of "guilty" cartels in any of the six time periods. Moreover, their sample appears to have been drawn disproportionately from domestic bid-rigging conspiracies, the categories that throughout history have generated the lowest overcharges. While a more precise analysis is needed, it appears that the Asch and Seneca study may itself be flawed by sample selection bias.

Finally, it is worth noting that there are few unsuccessful cartels in the data set. Only about 6% of the overcharges indicate that an analyst judged an episode to have produced no significant effect on market prices. I do not wish to make too much of this result, because it may represent

³⁶ The authors interpret their results in two ways. Firms are more likely to collude when industry conditions cause profits to decline, or cartels that are relatively ineffective at raising prices are also inept at hiding their illegal conduct and, consequently, the most likely to be detected and indicted by the antitrust authorities.

selection bias by the authors of the studies relied upon. Injurious cartels may be inherently more interesting or publishable than incompetent cartels.

6.4. Size Distribution of Overcharges

Given the interest in the factual foundations of the U.S. Sentencing Guidelines applied to cartel sanctions, it is logical to examine the size distribution of the estimates. Table 7 classifies the average estimates into nine size categories. Because the Guidelines are predicated on the assumption that the average cartel has a 10% overcharge, that break point is of special interest.

Because of the interest in prosecutable cartels, the discussion of Table 7 will focus on the effective cartels (non-zero overcharges). Perhaps the most striking result is that 62% of the cartel episodes have overcharges above 20%. Recall that each episode is an indictable offense. The mean overcharge of the 38% of the episodes in the two lowest size ranges (0.1 to 19.9) is 10.3%. *These are the cartels imagined to be typical by the creators of the U.S. Sentencing Guidelines.* The 62% of the cartel episodes with overcharges of 20% or higher have a mean overcharge of 55.3%, more than five times the level assumed by the Guidelines' authors. If the Guidelines were truly designed to deter recidivism, even if the probability of detection is 100% five-eighths of the cartels will be under-deterred.

Table 7. Mean Average Overcharges by Size Category

Percentage Range ^a	Number of Observations	Distribution of Observations		
		Mean	Total	Non-Zero
	<i>Number</i>		<i>Percent</i>	
Zero or less ^b	46	0	7	0
0.1-9.9	90 ^c	6.3	14	15
10.0-19.9	122	14.1	19	21
20.0-39.9	182	28.6	29	31
40.0-59.9	99 ^d	47.9	16	17
60.0-79.9	39	67.8	6	7
80.0-99.9	13	88.6	2	2
100.0-199.9	25	129.0	4	4
200 or greater	19	429.8	3	3
Total	635	49.4 ^e	100	100

Source: Appendix Table 2 (spreadsheet dated 10/7/04).

^a Overcharges of 10% or higher are rounded to the nearest whole number. Midpoints of ranges.

^b Four negative numbers are converted to zero.

^c Four estimates of “weak cartels” are assumed to be 1% overcharges.

^d Fifteen estimates of 50% are from Eckbo (1976).

^e Excluding zeros, the mean is 78.4%.

6.5. Peak Overcharges

So far only the “average” overcharges have been examined – those that refer to the mean price change over all or most of an episode. Tables 8 and 9 explore the peak price effects attained by cartels – the maximum mark-ups observed for one week, one month, one quarter, or one year of an episode, depending on the price series available. It is well known that oligopolistic arrangements typically generate price changes that fall short of what a pure monopolist in a blockaded market would set in order to obtain maximum profits. Tacit collusion generally results in mark-ups above but closer to competitive levels than monopoly levels. While overt collusion should be somewhat more effective than tacit collusion at raising prices *ceteris paribus*, information failures, potential competition, and cheating also typically result in sub-monopoly price effects. Because the peak periods are generally too brief for significant changes in the structure of the industry to change, the observed peak overcharges are measures of the short-run market power exercised by cartels when the discipline of the members is at its most cohesive.³⁷ Thus, the peak price effects are instructive about the potential harm that cartels can cause when they are unfettered by coordination problems.

Table 8 shows the median peak overcharge over time and across types of cartels.³⁸ Unlike the average overcharges discussed above, there are few notable trends in peak effectiveness over time. Ignoring cells with few observations, the only temporal pattern is a decline in peak overcharges by international cartels. The pattern of peak overcharges across cartel types is similar to

³⁷ However, peak price changes could be affected by short-run shifts in demand, such as exogenous, unanticipated shifts in demand. However, in some cases these shifts are endogenous. One scenario is when a well financed cartel feels free to announce a new agreement that buyers perceived as likely to be effective and “panic buying” (speculative purchases) can ensue, which leverages the purely collusive effect on prices.

³⁸ These data are over-weighted by observations taken from the interwar period. Approximately one-fourth of the 210 observations available for Table 8 refer to interwar cartels, which have been well studied by economic historians who often had available public commodity-exchange prices.

that for the average overcharges. In all time periods, international cartels were able to reach higher levels of peak price effectiveness than the “national” cartels – on average 100% higher. Peak mark-ups were not consistently related to whether the cartel was prosecuted. And, consistent with the earlier findings, cartels that fixed prices or production levels were significantly more harmful than bid-rigging agreements.

Table 9 provides calculations of how *much* higher peak overcharges were compared the longer run averages for given episodes. Unlike Table 8, Table 9 calculates ratios for the 173 pairs of median overcharges for which *both* an average and a peak estimate are available. Generally speaking, the peaks were about 50% higher than the longer run average mark-ups. A high peak/average ratio is a rough indicator of price stability during a conspiracy; low ratios may be interpreted as cartels that achieved few operational problems. There are few strong trends in these ratios over time.

Table 8. Peak Cartel Overcharges, by Year and Type

Cartel Episode End Date	Membership		Legal Status		Bid Rigging	
	National	International	Found Guilty	Legal	Primary Conduct	Other
	<i>Median percent</i>					
1770 - 1891	51	100 ^b	77 ^b	56	19 ^b	80
1891 - 1919	20	78	34	40	--	34
1920 - 1945	45	69	53	67	50 ^b	67
1946 - 1973	38	38 ^b	43	21	43	37
1974 - 1990	35	64 ^b	35	39 ^b	35	46
1991 - 2003	25	57	53	25 ^b	49	56
ALL YEARS	33	61	50	53	40	55

Source: Appendix Table 2 (spreadsheet dated 10-23-04)

^b Fewer than four observations.

Table 9. Peak/Average Ratios of Cartel Overcharges, by Year and Type

Cartel Episode End Date	Membership		Legal Status		Bid Rigging	
	National	International	Found Guilty	Legal	Primary Conduct	Other
	<i>Ratio of Medians^a</i>					
Before 1891	1.30	2.58	1.10	1.80	1.46	1.56
1891 - 1919	2.24	1.94	1.93	2.32	--	2.11
1920 - 1945	1.75	1.22	1.05	1.66	1.47	1.23
1946 - 1973	1.55	1.43	1.58	1.43	1.58	1.46
1974 - 1990	1.82	1.72	1.80	1.25	1.93	1.66
1991 - 2003	1.48	1.82	1.78	2.30	1.82	1.69
ALL YEARS	1.72	1.45	1.40	1.75	1.77	1.42

Source: Appendix Table 2 (spreadsheet dated 10-30-04)

-- = Not available

^aThe ratio of the median peak overcharges to the median full-period overcharge for those cases when both are known and positive.

These data are relevant for assessing whether cartels intended to maximize price increases or gave greater weight to controlling *variation* in their collusive prices. Apologists for cartels, particularly those writing about international cartels during the Great Depression, tended to assert that cartels did not aim to raise prices so much as stabilize prices. As prices were generally falling in the 1930s, “stabilization” may in fact have been equivalent to preventing weak demand from causing prices to decline (see, for example Plummer 1934). Although the difference is not large, international cartels that ended between 1920 and World War II achieved greater price stability than those before and after. Classic international cartels that were not sanctioned are the types that

displayed greater stability in fixing prices. These results are consistent with the positions of Marlio (1947), Pyndyck (1979), and some other scholars about cartel stabilization objectives.

6.6. Overcharges by Location of Cartel

Law-makers and antitrust enforcement officials may be interested in the locus of decision-making by the cartels in the sample. Table 10 classifies the cartels according to the location of the cartel's headquarters or the place of residence of the great majority of the cartel's corporate members. Location may not correspond to the cartel's field of operations, because export cartels are categorized in their country of origin. Cartels may be composed of member companies with headquarters in only one country or one continent or may establish secretariats with professional staffs in London, Zurich, or similar locations. In these cases the geographic locus is easy to identify. Cartels with corporate members from multiple regions are more difficult to classify, but if a supra-majority of the companies were headquartered in North America, Western Europe, or Asia, the cartel is categorized in that continent. Global cartels are those with a diverse mixture of participants from two or more continents.

There are some significant differences in average cartel overcharges across geographic regions. Those managed in single European countries have the highest overcharges, but curiously those organized across national boundaries in Western Europe were as a group the least successful. North American conspiracies were also quite low. Median overcharges for global conspiracies were relatively high.

Table 10. Average Overcharges by Cartel Headquarters Location

Principal Location of Cartel Managers	Number of Estimates	Average	Overcharge
		<i>Median percent</i>	<i>Mean percent</i>
USA and Canada	242	21.0	28.7
Single nations in W. Europe	132	43.0	55.8
Multiple nations in W. Europe	107	16.3	37.0
Asia	34	30.0	76.5
Global	136	27.5	55.8
Australia, Africa, So. America, E. Eur.	22	21.5	23.9

Source: Appendix Table 2 (spreadsheet dated 10-12-04).

7. THE RELIABILITY ISSUE

Many readers may have prior beliefs about the most appropriate data and methods to be used to derive estimates of the price effects of cartels. Some might regard a lengthy historical investigation with access to the internal communications of a cartel's managers as the surest path to the truth.

Others might give greater credence to such communications only where the cartelists had reason to believe that their activities were legal or where the managers are writing about an illegal cartel years after the statute of limitations had passed. Some might assume that disinterested social scientists are likely to be closer to the mark than prosecutors, plaintiffs' counsel, defendants' counsel, or other interested parties. Indeed, the cross checks of a more global retrospective analysis might contradict delusions of cartel managers about their power over markets. Among economists, ever cognizant of the march of progress in quantitative research methods, there may be a tendency to find peer-reviewed studies applying methods of the most recent vintage to highly disaggregated, detailed data

the most reliable. Among legal scholars, many will regard criminal trials or guilty pleas as the gold standard of fact-finding, relegating civil commission hearings and other processes with skepticism.

Three approaches are taken to learn whether the various overcharge estimates are sensitive to the methods, data sources, time period, or disciplines of the authors. These analyses are reported in detail in Connor (2004b: 56-67). More formal analysis of the variation in the estimates have begun (Connor and Bolotova 2004).

7.1. Sources of the Estimates

Confidence in the estimates may be judged in part by the sources from which the overcharge estimates were derived. The majority of the estimates are drawn from the traditional end-product outlets of academic research: academic books, book chapters, and peer-reviewed journals account for 65% of the total (Connor 2004b: Table 11). In addition, 15% of the estimates were taken from economist' working papers, most of which were distributed since 2000, examined modern international cartels, and appear to be intermediate versions of book chapters and journal manuscripts. Peer-reviewed publications appear to have slightly lower overcharges (Connor and Bolotova 2004).

The majority of the government reports (4% of the estimates) were authored by civil servants with specialized training in economics, and some were written by academics commissioned by the agency; typically these reports would be vetted by a panel of experts. Similarly, the legal decisions of the UK Monopolies Commission were reviewed and approved by panels that contained a couple of leading professors of industrial economics working alongside senior civil servants attached to the Commission. Much the same process was used for the Congressional committee reports on cartels.

In sum, four-fifths of the estimates are drawn from the formal or informal writings of academic social scientists, and most of the remainder was the product of professionally trained individuals subject to the checks and balances of internal reviews. Court and competition-law commissions accounted for 12% of the estimates.

7.2. Sensitivity to Publication Dates

Here the hypothesis examined is whether there are systematic differences between the average overcharges across time, using the date of publication of the study as a proxy for analytical advances. The intuition here is that the authors of more recent empirical studies of cartels have learned to avoid the methodological pitfalls of their predecessors. Among the economic studies that dominate the sample, there is an undeniable trend away from mere narrative historical case studies sometimes embellished with simple graphical illustrations towards more formal statistical modeling. In industrial economics there is a trend away from evaluating cartels from the point of view of the theory of pure monopoly toward a more sophisticated and nuanced view informed by game theory and other conceptual advances.

The results of a temporal analysis are displayed in Connor (2004b: Table 12A). The publications are classified according to four periods that correspond roughly to milestones in social-science analysis of cartels (before 1891, 1891-1945, 1946-1989, and 1990-2004). It is not obvious that overcharges vary systematically over time. For example, in the case of cartels that ended in the pre-antitrust era, one sees that both contemporary and early writers arrived at moderate estimates of cartel price effects – median estimates of 22 to 30%. Studies published prior to 1990 tended to calculate relatively low median price effects. As the methods of scholarship presumably improved,

the estimated price effects of cartels active in the most laissez-faire of economic environments actually rose to a median of 30%. Nevertheless, simple correlations of overcharges over time do show downtrends for some types of cartels, but this trend could be confounded with a greater proportion of peer-reviewed publications in current research.

7.3. Intra-Episode Comparisons

The third check on reliability of estimates across various analytical methods controls for changes in the composition of the sample by focusing on pairs of estimates applied to identical cartel episodes. Recall that a cartel episode refers to a single market, time period, and form of cartel organization. There are 291 pairs of observations available for this analysis of reliability, which examines six general methods of estimation. The most widely used is the so-called before-and-after method in which the price during the episode is compared to one of three “but-for” or base prices. The “method unspecified” estimates are on average quite close to the before-and-after price method. . The second most popular method is statistical modeling, which accounts for 20% of the estimates. The yardstick methods accounts for about 10% of the sample. Overcharges derived from costs of production or profits are the least frequently employed method (about 3%). These five methods have been sanctioned by U.S. courts for determining damages in price-fixing trials (Connor 2004a). Sixth, approximately 10% of this study’s estimates are quotes from or interpretations of decisions made by antitrust authorities.

By and large, different authors and different methods applied to identical cartel episodes do not result in markedly different estimates. The correspondence among the three before-and after methods is quite close. Nevertheless there are three differences worth commenting on. One

somewhat surprising result is that the before-and-after method produces cartel-overcharge estimates that are quite a bit *higher* than econometric model applied to the same data. To be specific, the pre-cartel but-for prices are typically double estimates derived from econometric models and post-cartel prices are triple. Econometric techniques offer the opportunity to the analyst to make precise allowances for several sources of shifts in demand and supply, for seasonality, for trends in technology, and for feedback effects. If in fact econometric techniques are the most accurate, what this result seems to suggest is that authors of traditional before-and-after analyses are failing to adjust for all the competitive factors that might drive up the competitive benchmark price. Second, compared with the before-and-after, the cost-based and yardstick techniques yield relatively high overcharge estimates. This suggests that the methods that use costs or profits fail to fully account for all competitive industry costs, perhaps those related to product marketing or overhead. Similarly, as most of the yardsticks are prices in regions in which the cartel did not attempt to fix prices, this result suggests that indirect geographic spillovers from cartel activity may be more common than most analysts anticipate. If the yardsticks are product substitutes, analysts may have underestimated quality differences.

8. U.S. COURT VERDICTS

An intensive search of all federal and state antitrust trials found only 25 final verdicts that met two criteria: plaintiffs proved horizontal collusion and the opinion contained information on both the size of damages and affected sales. Only verdicts of judges or juries are counted; negotiated settlements are excluded. The results are that the conspiracy periods had a median average overcharge of 21.6% and a mean average overcharge of 30.0% (Connor 2004b: Appendix Table 4). All but five decisions

concluded that the cartel had raised average prices by more than 10%. Due to the small number of final verdicts it would not be meaningful to analyze sub groups of these verdicts.

9. DECISIONS OF OTHER ANTITRUST AUTHORITIES

Table 11 extracts overcharge data from the “social science” data set that derived from cartel decisions by authorities other than U.S. courts. There are 62 such observations – almost three times the number of observations that were available from U.S. courts.

Table 11. Cartel Overcharges from Decisions of Other Antitrust Authorities

Antitrust Authority	Number of Observations	Median Percentage	Mean Percentage
UK	31	20.0	64.1
EU	17	33.3	36.8
Japan FTC	6	28.4	26.3
Taiwan FTC	3	238.0	237.7
Korea FTC	3	38.4	39.5
Other	2	49.4	49.4
Total	62	28.5	49.1

Source: Connor (2004b: Appendix Table 2).

The median overcharge is almost 29%, and the mean is 49%; both of these figures are more than one-third larger than the averages from U.S. court decisions. Half of the non-U.S. observations come from decisions about mostly domestic schemes made by the UK Monopolies Commission in the 1950s and 1960s, whereas the remaining decisions are from other commissions that mostly fined international cartels discovered since 1990. The median overcharges from decisions of the EU, Taiwanese, and Korean authorities are relatively high.

Perhaps the best documented global cartels are the bulk vitamins cartels of 1990-1999.³⁹ The full decision of the European Commission (EC 2003) reveals many details about 12 of the 16 vitamins cartels.⁴⁰ Information from the EC report has been combined with revelations surrounding the U.S. and Canadian prosecutions to reveal a magnificent portrait of the inner workings and market effects of these cartels (Connor 2005).

The 16 vitamins cartels were probably the largest, most harmful, and harshest sanctioned international cartels of the last twenty years. A total of 22 chemical manufacturers were fined, but the median number of colluding firms was only three. The size of affected commerce was most impressive: somewhere in the range of \$35.4 to \$47.4 billion. (Expressed in 2004 currency the total is about \$51.6 billion or €43.8 billion). Sales during the conspiracies ranged from \$13 billion to \$125 million. Four of the cartels accounted for 77% of the total affected commerce: vitamins A, E, and C and feed premixes.⁴¹ The sales of these global cartels occurred in vitally every county of the world, but were concentrated in North America (20%), the European Economic Area (29%), and Asia (about 55%).

The structural and market conditions were quite favorable to the formation of these cartels. First, the degree of seller market concentration was very high; at the start of formal collusion around 1990, the mean degree of *global* market control by the members of the cartel was 93%⁴²; the range was from 70% for vitamin B6 to 100% for carotinoids. The mean four-firm concentration ratio was

³⁹ There is evidence that Hoffmann-La Roche had significant monopoly power in EU markets in the 1960s, but it lost market share from that time to the early 1990s (EC 1976). Thereafter Roche began to cooperate with BASF, Rhône-Poulenc, and some Japanese vitamin manufacturers in at least two cartels in the 1980s (EC 2003).

⁴⁰ The EC fined the choline chloride cartel in 2004, but the full decision has not yet been published. The EC chose not to fine the vitamin B3, B12, and feed premix cartels as of early 2005.

⁴¹ The EC declined to prosecute Roche and BASF for fixing the prices of premixes because the companies asserted that there were no effects on prices of their discussions on these products. By a *per se* conspiracy standard the slim evidence presented in EC (2003) seems to confirm a violation. According to Joshua and Jordan (2004), the EU's competition law has already in practice been using such a standard for many years,

⁴² In Europe the weighted mean average was 91%, and in the United States 90%.

above 90%. Similarly, the degree of buyer concentration was low.⁴³ Second, the products were almost perfectly homogeneous, and even at the monopoly price there were no substitutes.⁴⁴ Each of the vitamins was available in at least two forms: animal-feed grade and grades suitable for foods or pharmaceutical formulations. Some were available in 100%-pure forms and in different dilution rates (as low as 2% pure). The “human” grades sold at higher prices than the feed grades; feed grades could not legally be substituted for human use. Third, entry barriers were typically high: the methods of production were capital intensive, required years to build plants, and were frequently protected by patents of technical secrecy. In the four or five cases in which Chinese chemical firms could master the technology of production, the cartels fell apart after three to five years of successful collusion. Fourth: nearly all of the cartels were formed immediately after a period of falling prices and profits.

The vitamins cartels were quite effective. In terms of duration, the mean was 6.2 years. In terms of the direct overcharges on buyers (roughly equivalent to monopoly profits), the total amount worldwide was between \$8.8 and \$11.5 billion: about \$2 billion in North America and \$2.7 billion in the EU. For all 16 cartels, the overcharges amounted to between 21% and 28% of affected world commerce; in both North America the range was 25% to 29% of sales, while in Europe the range was 21 to 32%. Clarke and Evenett (2002, 2003) have calculated the vitamins overcharges to be higher in less developed countries and higher still in those countries with no effective antitrust enforcement. The overcharges are only one part of the effect on consumer welfare, the other being the dead-weight social loss. Less is known about the dead-weight loss because to derive this loss

⁴³ Quantitative data on this point are not available, but in the single cartel in which the participants complained of buyer behavior (vitamin C), the conspirators developed a method of bid rigging and customer allocation that seem to solve the problem. Another problem faced by the cartels was geographic arbitrage by vitamin wholesalers and dealers taking advantage of swings in currency exchange rates. This challenge was solved with quarterly price adjustments in prices to equalize them across currency zones.

⁴⁴ Each vitamin serves unique metabolic functions in animals, and each is produced with unique methods and raw ingredients.

one needs to know the elasticity of demand (Peterson and Connor 1996). However in most manufacturing industries the dead-weight loss is between one-fifth and one-tenth as large as the overcharge. Most research on cartels focuses on overcharges rather than the social loss because most legal systems of cartel enforcement are based on the deterrence principle and optimal deterrence is related to the overcharge.

Monetary sanctions imposed on the vitamins cartel were the largest in history. U.S. government fines totaled \$915 million, Canada's \$100 million, the EU's \$847 million, and other governments only \$17 million. However, almost half of the total sanctions originated from private suits brought in U.S. courts.⁴⁵ While it is difficult to get precise amounts of private settlements (most are confidential), enough information has leaked out to estimate a \$2.2 to \$2.7 billion range. Thus, the total monetary penalties so far are between \$4.7 and \$5.2 billion.

The best way of assessing the size of monetary sanctions on cartels is as a percentage of the overcharge (Table 12). The U.S. Department of Justice has a fearsome reputation for the size of its fines, but these data tell a different story. In only two cases (B2 and B3), did U.S. fines possibly exceed the profits made by the cartel, and on average the fines were only about 50%⁴⁶ Private suits were far more effective in extracting cartel profits, returning 100% to direct buyers in almost every case (restitution) and imposing significant punitive penalties (amount above 100%) as well. Where the government did not obtain criminal guilty pleas, private parties had a legal disadvantage that resulted in smaller settlements (for example, see vitamin B6). On average the U.S. legal system made the vitamin defendants pay about double their illegal gains. In Canada, private suits are not so common, but the Canadian Competition Bureau was harsher in assessing penalties than was the DOJ.

⁴⁵ A few small private settlements have been made in Canada. Such cases are still being tried in Australia and the UK. Moreover, there is a very important decision to be made in 2005 in *Empagran v. Roche* by the District of Columbia Appeals Court; if plaintiffs win, billions more in settlements could be forthcoming.

⁴⁶ Moreover, the DOJ chose to skip seven cartels altogether; speed seems to be important in cartel cases.

Table 12. Vitamins: Monetary Sanctions Relative to Overcharges

Product Market	U.S. Govt	Private	U.S. total	Can- ada	EU	Oth- er	World
Beta carotene	62	142-167	204-329	71	48	0	83-101
Canthaxanthin	0	200-250	200-250	0	49-57	0	27-30
Biotin (H)	0	235-261	235-261	40	0	0	62-78
Choline chloride (B4)	8-11	110-146	118-157	14	239-277	0	50-61
Folic acid (B9)	0	137-275	137-275	0	0	0	28-35
Vitamin A	44	109	153	66	30	0.3	17-23
Vitamin B1	0	125	125	0	0	0	17-23
Vitamin B2	127	273	400	90	81-129	0	100-150
Vitamin B3	84-173	124-256	208-429	16	0	0	21-30
Vitamin B5	77	131-155	208-232	127	80-90	0.3	38-54
Vitamin B6	0	59-94	59-94	0	0	0	7-5
Vitamin B12	0	163-190	163-190	920	0	0	8-11
Vitamin C	63-88	144-176	207-264	76	30-60	1.3	57-94
Vitamin D3	0	0	0	0	126-152	0	42-54
Vitamin E	42-46	110-130	152-176	74-94	21-55	0.8	46-70
Feed Premixes	64-55	86-114	150-369	79-102	0	0	32-48
Total	43-55	103-154	171-208	70-78	26-40	0.3	41-60

The European Commission's fines were weaker than those in North America, amounting to only 26 to 40% of the EU's overcharges, for several reasons. Although the EU's fines were almost as large as those by the United States, the EU's sales and overcharges were much larger. Moreover, the slow pace of the EC procedures allowed four cartels to escape fines because of the five-year time limit. Failing to prosecute the huge feed premix cartel was, in my view, a mistake. The absence of private suits in Europe is a glaring difference compared to North America. Finally, the EU's guidelines for assessing cartel fines since 1998 err in paying no direct attention to affected sales or overcharges. However, there is one piece of upbeat news in Table 12, namely the recent EU fines on the choline chloride cartel. By my estimate, Nellie Kroes's first cartel fine rises to new heights – about 250% of the cartel's EU overcharges.

Finally, note the extremely low fines imposed on the cartels outside of North America and Europe. Recall that more than half of the cartel's affected sales were in Asia and Latin America, yet virtually no monetary sanctions were imposed on these continents. This is a sad commentary on the state of antitrust institutions in Asia, but more importantly it shows why global cartels continue to be discovered. Even the ones that are caught keep most of their profits from price fixing!

Can today's antitrust penalties deter global cartel formation? In a word, no.⁴⁷ The most harshly sanctioned international cartel in world history gave up at most 60% of its monopoly profits in the form of penalties. When one factors in the indubitable fact that the probability of being detected by an antitrust authority is less than 33%, the argument for sub-optimal deterrence is un rebuttable.

⁴⁷ This conclusion might not apply to U.S. cartels in operation since the 1993 leniency program was initiated.

10. CONCLUSIONS

This survey identified hundreds of social-science studies of cartels that contained 674 observations of “average” overcharges. The primary finding is that the median cartel overcharge for all types of cartels over all time periods is 25%: 18% for domestic cartels, 32% for international cartels, and 28% for all successful cartels. Thus, international cartels have been about 75% more effective in raising prices than domestic cartels. Cartel overcharges are skewed to the high side, pushing the mean overcharge for all types of cartels over all time periods to 49%. “Peak” cartel overcharges are typically double those of the episodes’ average overcharges.

The results of the survey of final verdicts in decided U.S. horizontal collusion cases, only three of which were international cartels, show an average median overcharge of 21% and an average mean overcharge of 30%. Thus, the 24 U.S. decisions produce average overcharges that are quite comparable to the results of the much larger set of economic estimates. Outside the United States, 62 decisions of competition commissions cited median average overcharges of 29% and a mean of 49%.

The authors’ professions, types of publications, year of publication, degree of peer review, and analytical estimation methods from which these estimates are derived vary greatly. However, extensive examinations of median average overcharges across categories give no reason to regard any sub set of the sample as inherently unreliable. However, peer-reviewed publications do produce slightly lower overcharge estimates than other types of outlets.

The results of the survey have significant policy implications. First, this paper’s introduction noted that there is a view among some antitrust writers that there is little evidence that cartels raise prices significantly for a period long enough to justify extant anticartel laws and, especially, extant

cartel penalties. Consequently, they argue for the repeal or scaling back of the fines or damages that result from collusion. This survey's results, which are based upon an extraordinarily large amount of data spanning a broad swath of history of all types of private cartels, sharply contradict these views. In fact, the data suggest the opposite. Median overcharges are two or three times as high as the level presumed by the U.S. Sentencing Commission, and they are much higher than the statutory limits on cartel fines in the EU, Japan, and many other countries.. Second, bid rigging was no more injurious than other forms of collusion. If anything, the data suggests that bid rigging is slightly less injurious. These results suggest that antitrust sanctions' guidelines should not treat bid rigging more harshly than other forms of collusion. Third, international cartels are typically more destructive of markets than domestic conspiracies. Assuming that antitrust sanctions cannot feasibly be tailored to the damages on a case-by-case basis, Connor and Lande (2004) propose raising the mean overcharge presumption for fines to 15% for domestic cartels and 25% for international cartels. Optimal deterrence policies would then imply monetary fines and penalties that are large multiples of these percentages.

Average fines imposed since 1995 by Canada and the EU on identical cartels have been lower than U.S. government fines (Connor 2005). When the effects of private suits are factored in, it is clear that the U.S. court system is already shouldering the bulk of the world's burden of punishing international cartels. This survey suggests that overcharges generated by cartels discovered outside the United States are higher than North America-centered cartels. Moreover, contemporary international cartels have a majority of their members drawn from Europe and Asia, and these cartels as a group are more harmful than geographically localized conspiracies. Consequently, anticartel laws and fine-setting practices abroad are in even greater need of strengthening.

Global cartels are the most harmful type. Despite the evident increases in cartel detection rates and the size of monetary fines and penalties in the past decade, a good case can be made that current global anticartel regimes are under-detering (Bush *et al.* 2004, Connor 2005). Global cartels are difficult to detect, have less fear from entry of rivals, achieve higher levels of sales and profitability, and systematically receive weaker corporate sanctions than comparable domestic cartels. Base fines of 20% of cartelists' affected commerce, even when adjusted by significant culpability multipliers,⁴⁸ will do little to deter most of these cartels.

For most types of cartels, there are modest downtrends in cartel mark-ups over time. Because the post-1990 era has been the period with by far the highest level of fines imposed, this decrease is consistent with the theory of optimal deterrence. It also suggests that the recent worldwide trend towards the intensification of cartel penalties has been desirable. If procedures for calculating criminal fines correspond more closely to the actual levels of cartel overcharges, monetary sanctions against price fixing will more closely provide optimal deterrence.

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⁴⁸ For a variety of factors, however, very few firms actually pay a fine amounting to 20% or more of the amount of commerce affected. Most violators have their fines reduced for a variety of reasons.

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Appendix Table 1. Alphabetic List of Cartelized Markets

Name	Code No.	Characteristics				Number of	
		International	Location	Bid Rigging	Found Guilty, Liable for Civil Penalties, or Extralegal ^c	Episodes	Average Observations
Airlines, US passenger	172		US			1+	1
Air Routes, Danish	235	X	EUR		EC fines	2	2
Almonds, US and export	205		US		Legal cartel	1	2
Aluminum, metal (interwar)	18	X	EUR		U.S. consent decree	6	28
Aluminum, metal (1990s)	199	X	INTL			1	1
Aluminum phosphide, US	82		US		U.S. guilty pleas	1	2
Asphalt, Alabama, US	204		US	X	US settlement	1	1
Asphalt, Oklahoma, US	7		US	X	Jury trial decision	1	1
Auction houses, fine art	42	X	US+UK		U.S. pleas, EU fines	1	5
Auctions, houses in DC, US	53		US	X	U.S. trial	1	1
Auctions, used police cars, NY City	52		US	X	Civil settlement	1	2
Automobile manufacture, US	25		US			1	2
Ball & roller bearings, France	115	X	FR		France, fines	1	1
Banks, Euro-Zone fees, DE & NL	216	X	DE		EU fines	9	9
Basic materials, JP	214		JP		JFTC actions	1+	1
Bath tubs, iron, UK	63		UK		Legal cartel	1	1
Bath tubs, enameled, US	239		US		US trial	1	1
Bedsteads, metal, UK	167		UK		Legal cartel	1	1
Beef, US	45		US		US trial		
Bond underwriting, US	153		US	X		1	1
Bread, white pan, US	37		US		U.S. Appeals Court	1	1
Bromine	6	X	US		U.S. guilty pleas	3	4
Cable, rubber & plastic, UK	59		UK		Legal cartel	1	1
Cable, power, Germany	124		DE	X	Germany, fines	1	1
Carbon, arc lighting, US	188		US		Legal cartel	2	2
Carbon black, US exports	152		US		Legal export cartel	1	1
Carbon dioxide, US	202		US		US civil settlement	1	1
Carbon fiber, US	198		US		US investigation	1	1
Cardizem heart medicine, US	203		US		US civil trial	1	1
Carton board, EU	39		EUR		EU fines	1	1
Cartons, corrugated, US	142		UK		US trials	1	6
Carpets, woven, UK	62		UK		Legal cartel	1	1
Cathode ray tubes (see electronic radio & TV tubes)							
Cell phones (see telephone)							
Cement, Norway	212		NO		Legal cartel	1	1

Cement, South Africa	70		ZA	X		1	2
Cement, Germany	106	X	DE	X	Germany, fines	1	1
Chicken, US	144		US		US trial, consent decree	1	1
Cigarettes, U.S.	26		US			1	1
Citric acid	76	X	INTL		U.S. pleas, EU fines	1	6
Choline chloride	81	X	US		US jury trial	1	4
Coal, Ruhr, Germany	155		DE		Legal cartel	1	2
Coal, anthracite, eastern US	160		US		US trial	10	16
Coal, black, Australia	179		AU			6	9
Coal, Newcastle, England	166		UK		Parliamentary inquiry	5	17
Coconut oil, Philippines	206		PL		Legal cartel	1	1
Coke	147	X	EUR		Legal export cartel	1	2
Concrete, Denmark	51		DK	X		1	1
Concrete, Germany	114	X	DE	X	Germany, fines	1	1
Construction & procurement, JP	213		JP	X	JFTC actions	5+	5
Construction, 8000 buildings, Germany	177		DE	X	Germany fines	1	1
Construction, electric wiring, Denmark	122		DK	X	Denmark, fines	1	1
Construction, electrical, France	175		FR	X	France consent decree	1	1
Construction, university, France	176		FR	X	France consent decree	1	1
Construction, roads, Colorado, US	222		US	X	Civil settlement	1	2
Construction, roads, France	177		FR	X	France consent decree	1	1
Construction, roads, Korea	193		KO	X	Korea FTC fines	1	1
Construction, roads, seal coating, US	211		US	X		1	2
Construction, kitchen, Japan	163		JP	X	Japan trial	1	1
Construction, US Navy shipyard, Japan	162		JP	X	JFTC fines	1	1
Construction, Netherlands	108	X	NL	X	Netherlands, fines	1+	1
Construction, Norway	107	X	NO	X	Norway, probe	1+	1
Construction, public, Japan	161		JP	X	A few civil actions	1+	2
Construction projects, Korea	32		KO	X	Korea, fines	1+	1
Construction, USAID in Egypt	101	X	EGY	X	U.S. trial	1	1
Construction, roads, Florida	1		US	X	Trials, settlements	1+	1
Construction, roads, Germany	123		DE	X	Germany, fines	1+	1
Construction, roads, SD & NC, US	34		US	X	Trials, settlements	1+	2
Construction, roads, US	195		US	X	Trials, settlements	1+	1
Construction, sewers, US	33		US	X	Trial	1+	3
Copper metal	22		X US+INTL			9	30
Copper concentrate	88	X	INTL		US, EU Probes	1	1
Copper smelters, UK	225		UK	X		4	4

Dairy processing, US	54		US		US consent decree	1	1
Diamonds, gem, So. Africa	71	X	ZA		Legal cartel	1	1
Distributors, natural gas, TW	229		TW		TFTC fines	2	2
Dredging, river, Japan	164		JP	X	Japan trial	1	1
Drugs (see pharmaceuticals)							
Dyestuffs	159	X	EUR		Legal cartel	1	2
Electric light bulbs	21	X	EUR			1	15
Electric light bulbs, US	189		US			1	1
Electric light bulbs, UK	184		UK		UK Commission	1	2
Electric meters, UK	61		UK	X	Legal cartel	1	1
Electric motors, UK	60		UK		Legal cartel	1	1
Electric power equip. U.S.	48		US	X	US pleas, settlements	5	18
Electric power equip., Nor.	116	X	NO	X	Norway, fines	1+	1
Electric power equipment	129	X	EUR	X	US conviction	2	3
Electric power equip., UK	183		UK	X	UK Commission	1	4
Electronic radio & TV tubes, UK	192	X	UK		UK Commission	1	5
Explosives, US	98	X	US	X	U.S. guilty pleas	1	1
Fertilizer (see nitrogen, phosphate, potash)	--						
Fire protection installation, Australia	121		AU		Australia, fines	1	1
Ferrosilicon, US	100	X	US		U.S. pleas	1	1
Flour imports, Taiwan	234		TW	X	TW FTC fines	1	1
Ferry services, English Channel	41	X	EUR		EU, fines	1	1
Frozen foods, Australia	120		AU		Australia, fines	1	1
Frozen fish, US	36		US	X	US guilty pleas	1	3
Fuels, military, Korea	112	X	KO	X	Korea, fines	1	1
Games & toys, UK	104	X	UK		UK, fines	1	1
Garbage collection, NY & NJ	233		US	X	NYC convictions	2	2
Gasoline, retail, Italy	109	X	IT		Italy, fines	1	1
Gasoline, retail, France	110	X	FR		France, fines	1	1
Gasoline, retail, Sweden	111	X	SE		Swedish court, fines	1	1
Gasses, compressed, Canada	102	X	CA	X	Canada, fines	1	2
Glass, flat, Benelux	237	X	EUR		EU fines	1	1
Glass, flat, US	113	X	US		US settlement	1	1
Graphite electrodes	84	X	INTL		US, EU, Korea, fines	1	8
Gunpowder, US	158		US		First episode legal	2	2
Gymnasium seats, US	2		US	X	US settlements	1	1
High fructose corn syrup, US	197		US		US settlements	1	1
Hotel association, Spain	125		ES		Spain, fines	1	1

Insecticide, forest, Canada	83	X	CA	X	Canada pleas	1	1
Iron & steel rolls, cast, EU	227	X	EUR	X	EU fines	1	1
Iodine	40	X	EUR		Legal export cartel	1	1
Lead	69	X	INTL		Legal export cartel	4	4
Lemons, California	210		US		Legal cartel	1	2
Linerboard, US	201		US		US civil settlement	1	1
Linoleum exports	137	X	EUR		Legal export cartel	1	1
Linoleum, UK	180		UK		UK Commission	1	2
Lysine	75	X	INTL		US pleas, EU fines	1	11
Manufacturing, UK	55		UK		Legal cartels	40	1
Manufacturing, U.S.	38		US		US pleas, fines	57	1
Magnesium metal	28	X	US		US pleas, fines	2	4
Magnesite	94	X	EUR		US prosecution	1	1
Market makers, NASDAQ, US	31		US		U.S. settlements	1	1
Mercury	72	X	EUR		Legal cartel	3	6
Methionine	78	X	INTL		EU fines, US settlements	1	2
Methyl glucamine	85	X	INTL		EC, Canada fines	1	1
Milk, 3 counties, Kentucky	9		US	X	U.S. state convictions	1	1
Milk, 2 counties, Florida	10		US	X	U.S. state convictions	1	1
Milk, 3 counties, Florida	11		US	X	U.S. state convictions	1	1
Milk, Danville, Kentucky	12		US	X	U.S. state convictions	1	1
Milk, Owensboro, KY	13		US	X	U.S. state convictions	1	1
Milk, core area, Kentucky	14		US	X	U.S. state convictions	1+	1
Milk, Southeastern U.S.	15		US	X	U.S. state convictions	109	1
Milk, Dallas, Texas	19		US	X	U.S. settlement	1	1
Milk, Cincinnati, Ohio	30		US	X	U.S. trial	1	1
Milk, AMPI cooperative	226		US		U.S. trial	1	1
Milk, U.S. marketing orders	207		US		Legal cartel	1	2
Mobile/cell phones (see telephone)							
Mushrooms, canned, Germany	230	X	INTL		EC fines	1	1
Nails, Germany	186		DE		Legal cartel	1	1
Nitrogen (sodium nitrate) fertilizer	16	X	INTL			2	7
Nonferrous metals, UK	181		UK		UK Commission	1	2
Oil (see petroleum)							
Oranges, California navel	209		US		Legal cartel	1	3
Paper, carbonless, EEC	89	X	EUR		EC fines	1	1
Paper pulp, bleached sulphate	228	X	INTL		EC fines	2	4
Paper pulp, mechanical sulfite	138	X	EUR			1	1
Paper, thermal fax, US	99	X	US		U.S. pleas & trial	1	1

Paints, export, Japan	157		JP		Legal cartel	1	1
Petroleum, US	24	X	US			1	1
Petroleum, TX & Okla.	190		US		Legal cartel	1	1
Petrol., offshore leases, US	154		US	X		1	1
Petroleum refining, Midwest	35		US		U.S. trial	1	1
Petroleum, lamp oil, Ontario	134		CA		Legal cartel	3	3
Pharmaceuticals, UK	105	X	UK	X	UK probe	1	1
Pharmaceuticals, US	141		US		US trial	1	1
Pharmaceuticals, respiratory, Italy	118	X	IT	X	Italy, fines	1	1
Pharmaceuticals, cholesterol, Italy	119	X	IT	X	Italy, fines	1	1
Phosphate rock exports, US	135	X	US		U.S. indictment	2	2
Phosphorus, red	132	X	EUR			1	1
Pipes, cast iron, SE US	23		US		U.S. trial	1	1
Pipes, concrete, US	143		US	X	US trials	1	2
Platinum	47	X	EUR			3	7
Plumbing fixtures, US	156		US		US trial	1	1
Plywood, US	145		US		US trial	1	1
Plywood, Japan	178		JP	X	JFTC fines	1	1
Polyvinyl chloride plastic	232	X	EUR		EC fines	1	1
Porcelain, sanitary, UK	57		UK		Legal cartel	1	1
Potash	73	X	EUR			4	19
Quebracho extract	50	X	ARG		U.S. conviction	3	8
Quinine	131	X	EUR		U.S. pleas, fines	1	2
Railroad, Chicago to East, US	49		US		Legal U.S. cartel	1+	7
Railroad, U.S. South	133		US		Legal U.S. cartel	1	1
Raisins, US	208		US		Legal US cartel	1	1
Rayon	136	X	EUR			1	1
Roundwood buying, Sweden	236		SW	X		2	2
Rubber, crude	20	X	EUR		Legal export cartel	2	4
Salt, Michigan	194		US			2	4
Salt, rock, US	3		US	X	U.S. convictions	1	1
Salt, white, Salt Union, UK	168		UK		Legal cartel	4	9
Salt, white, duopoly, UK	215		UK		Commission decision	1	1
Scholarships, graduate, US	173		US		DOJ consent decree	1	1
Shipping, France-Africa	43	X	EUR		EU fines	1	1
Shipping, 3 conferences	171	X	EUR		Legal cartels	6	2
Shipping, chemical tankers	86	X	EUR		U.S. pleas	1	1
Shipping, express packages, US	127		US		Legal U.S. cartel	1	2
Soil & gravel, Japan	165		JP	X		1	1
Soft drinks, US	27		US			1	1
Sodium chlorate	79	X	EUR			1	1
Sorbates	77	X	INTL		US and EU fines	1	5

Steel, bulk metal, European	74	X	EUR		Legal cartel	2	6
Steel drums, UK	64		UK		Legal UK cartel	1	1
Steel girders, Germany	187		DE		Legal cartel	1	1
Steel and iron, Germany	238		DE		Legal cartel	4	5
Steel pipes, sewage, UK	58		UK		Legal UK cartel	1	1
Steel pipes, insulated, EU	93	X	EUR		EU fines	1	2
Steel rails, US	150		US		First episode legal	1	1
Steel rails, Europe	169	X	EUR		Legal cartel	1	3
Steel, seamless tubes, EU	91	X	EUR		EU fines	1	2
Steel tubes, US	151		US		Legal cartel	1	1
Steel, flat stainless, EU	92	X	EUR		EU fines	1	3
Steel, structural, buildings, US	4		US	X	U.S. convictions	1	2
Steel, structural, bridges, US	5		US	X	U.S. convictions	2	4
Steel, structural, EU	95	X	EUR		EU fines	1	1
Sulfur, international	87	X	INTL			3	4
Sulfur, crude, US exports	191		US		Legal export cartel	2	1
Sulfuric acid, US & Canada	103	X	US+CA		DOJ probe	1	1
Sugar beets, US	44		US		U.S. trial	1	1
Sugar, cane	17	X	INTL		Legal export cartel	2	3
Sugar refining, US	67		US		U.S. trial	2	8
Sugar, Spain	126		ES		Spain, fines	1	1
Sugar refining, UK	96		UK		EU, fines	1	1
Tea	128	X	EUR		Legal cartel	1	1
Tetracycline, US	223		US		Civil settlement	1	1
Thorium nitrate, Germany	170		DE		Legal cartel	1	1
Timber, US auctions	29		US	X		1	1
Tin	146	X	INTL		Legal export cartel	1	4
Titanium metal, US	139		US	X	US trial	1	1
Telephone fees, UK & Germany	97	X	IT		EC probe	1	1
Telephone fees, Italy	117	X	IT		Italy, fines	1	1
Tobacco leaf, US	200		US	X	US settlement	1	1
Transformers, large, UK	65		UK	X	Legal UK cartel	1	1
Transformers, system, UK	66		UK	X	Legal UK cartel	1	1
Tungsten carbide	8	X	INTL		U.S. trial	2	4
Uranium metal	130	X	INTL		U.S. pleas, settlements	1	6
Vanadium ore, US	46		US		U.S. jury trial	1	1
Vitamins and Carotenoids, bulk ^a	80	X	INTL	X	U.S. & EU fines	14 ^a	55
Vitamin D, US	140		US		Patent abuse trial	1	1
Vitamin B4 (see choline)							
Wallpaper manufacturing, BL	231		BL		EC fines	1	1
Wire, Germany	185		DE		Legal cartel	1	1

Wire nails, US	149	X	US		Legal cartel	1	2
Wire rope, non-marine, UK	56		UK		Legal UK cartel	1	1
Whiskey alcohol, US	148		US		First episode legal	5	6
Wire and cable, UK	182		UK		UK Commission	3	3
Zinc metal ^f	68	X	INTL		Legal export cartel	5+	8
Zinc phosphate	90	X	EUR		Fined by EC	1	2
Total 245 markets	--	90	International	79	153 guilty/liable ^d	560 ^b	664 average
					55 known "legal"		216 peak
					37 presumed legal ^e		886 total

Source: Appendix Table 2 and References.

^a One for all vitamins, one for the three Carotenoids, and twelve individual vitamins.

^b This total counts three multiple cartel summaries (see cartel numbers 15, 38, and 55 above) as 206 episodes. Counting these entries as one episode reduces the total to 353. In addition, most bid-rigging cartels could in principle count each contract as an episode, but are treated as one here; for example, in cartel #211 more than 3500 contracts were overtly collusive bids.

^c Fines, trials, consent decrees, settlements, commission decisions, parliamentary inquiries, and known official investigations are all considered adverse sanctions for cartels. Adverse parliamentary and commission decisions resulted in changes in conduct similar to consent decrees.

^d Includes six markets (88, 97, 103, 105, 107, and 198) that in 2004 were being investigated by antitrust authorities; a high proportion will be legally sanctioned.

^e Counts blank entries in column above. Blank entries are cases without information about any criminal sanctions or adverse civil proceedings and are presumptively legal or extralegal.

^f This cartel was fined at the end of its life by the EC (8/6/1984) but operated openly in the belief that it was legal for most of its existence.

NB. Appendix Tables 2 to 5 can be found at:

<http://www.agecon.purdue.edu/directory/details.asp?username=jconnor>