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PRICE-FIXING OVERCHARGES:

LEGAL AND ECONOMIC EVIDENCE

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Abstract

This paper surveys hundreds of published social-science studies of private, hard-core cartels that contain 699 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%: 19% for domestic cartels, 32% for international cartels, and 31% for all successful cartels. Thus, international cartels have historically been about 68% 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 42%. "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 25% and a mean of 47%.

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 price 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-deterring. 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.

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MOTIVATION

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, and efficiency, but by far the greatest attention has been lavished on market price effects.[1] The increase in transaction prices by a sellers' cartel is commonly called an overcharge by economists or damages by legal writers. It is the increase in the transfer of income or wealth from buyers to the members of the cartel that occurs as a result of a collusive agreement.[2] The overcharge rate is calculated by comparing actual cartel-enhanced prices to some competitive benchmark (Connor 2004). When a cartel achieves high levels of effectiveness (i.e., longevity, stability, and high overcharges), it generates large customer welfare losses.[3] 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 buyers and sellers to misallocate their spending.

The size of cartels overcharges is an issue at the empirical heart of a number of legal and economic controversies. In the rest of this section, I outline three such issues. First, I demonstrate the importance of knowing the size and distribution of cartel overcharges to justify the underpinnings of the U.S. Sentencing Guidelines for federal criminal violations. Second, I note that similar rules govern the fine-setting criteria employed by other jurisdictions' anticartel sanctions. Third, I present evidence of differences of opinion among experts on the critical legal-economic issue of cartel deterrence.

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

Issue 1: The U.S. Sentencing Guidelines

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 sentencing for the federal judiciary (USSG Advisory Group 2003). The Commission was established because of Congressional concerns that sentencing was too variable across Circuits and individual judges and that average sentences were too low for certain crimes. The first set of guidelines was promulgated in 1987, and after three years of study and public comment was made law in 1989. The first guidelines were directed primarily at sentencing applicable to individual defendants

[1] Longevity, also called duration, measures the lifespan of a cartel or, if it has more than one, the length of time of one episode. Some researchers use the term stability synonymously with duration, but more commonly it refers to the absence of price wars or other reversions to competitive conduct during a cartel's time span. Stability is perhaps equivalent to low variation in a cartel's "discipline," where discipline may be measured by how close a cartel's selling prices are to its desired target price or the theoretical monopoly price. In the context of commodity agreements or marketing orders, stability will show up as lower variation in prices compared to the absence of such an agreement. Efficiency can refer to static allocative efficiency (low net social welfare loss) or, rarely, to technical efficiency or dynamic efficiency (rates of technological change). Allocative inefficiency is smaller than but closely correlated with the overcharge.

[2] The overcharge from a buyers' cartel is similarly defined by a price decrease.

[3] Customers are direct buyers and they are usually 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 welfare losses.

with one sole exception, guidelines for organizations guilty of horizontal price fixing and bid rigging (Cohen and Scheffman 1989:332). Although the Sherman Act of 1890 is a criminal statute that encompasses other types of multilateral restrictive business practices as well as unilateral monopolistic conduct, by long tradition only horizontal price fixing and market-sharing agreements have triggered criminal indictments by the Department of Justice (DOJ).[4]

During 1987-89, the Commission turned its attention to developing "organizational guidelines," which were effective in 1991.[5] Organizations are corporations, partnerships, proprietorships, trusts, or other financial entities. The reason given for the delay in issuing the second set of guidelines was "time constraints and the nonexistence of statistical information" (USSG 1989: 1.12). That is, the USSC apparently believed that, unlike all other corporate crimes, it had prior to 1987 sufficient statistical data on price fixing to set penalties at levels that would deter price fixing.

The issue of how high and for how long cartels raise prices was crucial when the U.S. Sentencing Commission (USSC) established its current fine levels for cartels in 1987. These fine levels are in effect today. 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."[6]

Origin and Importance of the 10% Presumption

The Commission explained how it used this estimate to establish cartel fines. After noting that fines should be based on consideration of both the gain to the offender and the losses caused by the offender, the USSC noted that it would double the 10% estimate to account for harms "inflicted upon consumers who are unable or for other reasons do not buy the product at the higher price."[7] The Commission added: "The purpose for specifying a percent of the volume of commerce is to avoid the time and expense that would be required for the court to determine actual gain or loss."[8]

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[4] Criminal filings are made in cases of *per se,* covert, intentional conspiracies by participants are aware of the probable anticompetitive consequences (Hovenkamp 1999:585-586). While there are a few exceptions, potentially illegal anticompetitive conduct such as information-sharing, signaling, refusals to deal, resale minimum-price maintenance, tied sales, exclusive dealing, patent or trademark pooling, mergers, monopolization, and attempts to monopolize are treated as civil matters. More than 90% of all naked cartel cases are brought as criminal actions, but a small number of such cases are, at the discretion of the DOJ, filed as civil matters.

[5] The guidelines for criminal price fixing were at that time moved to the new organizational guidelines.

[6] See U.S. Sentencing Commission Guidelines For the United States Courts, 18 U.S.C. Section 2R1.1, Bid-Rigging, Price Fixing or Market-Allocation Agreements Among Competitors, Application Note 3. The USSC's use of the word "average" is revealing. It implies that a goal was to design sanctions that would apply to typical infringements, rather than exceptionally effective or ineffective cartels. This criterion may be defended on the basis of simplicity and economy of application because it avoids the necessity of estimating overcharges in specific cases, but it may be fairly described as a "one-size-fits-all" approach. Sanctions are adjusted for each cartel participant by evaluating its culpability, but the size of a cartel's damages is not a culpability factor.

[7] The full quotation reads: "The loss from price-fixing exceeds the gain because, *inter alia*, injury is inflicted upon consumers who are unable or for other reasons do not buy the product at the higher price. Because the loss from price-fixing exceeds the gain, subsection (d) (1) provides that 20 percent of the volume of affected commerce is to be used in lieu of the pecuniary loss under Section 8C2.4 (a) (3)." (*ibid.*)..

[8] See U.S. Sentencing Commission Guidelines For the United States Courts, 18 U.S. C.18 U.S.C. Section 2R1.1, Bid-Rigging, Price Fixing or Market-Allocation Agreements Among Competitors, Application Note 3.

It is unclear why the Guidelines doubled the assumed 10% loss,[9] although the explanation in the Guidelines' commentary implies that this could be due to such factors as the allocative inefficiency harms of market power, the disruptive effects on victims caused by antitrust violations[10] and/or the umbrella effects of market power.[11] Regardless, the Guidelines' approach is consistent with the standard optimal deterrence standard promulgated by William Landes (1983). Landes convincingly showed that to achieve optimal deterrence the damages from an antitrust violation should be equal to the violation's "net harm to others", multiplied by the probability of detection[12] and proof.[13]

The USSC Guidelines therefore start with a *base fine* double the 10% presumed overcharge[14] and use it in conjunction with the assigned base Offence level (of 10) for antitrust offenses. They adjust this offense level by a number of factors, such as whether bid rigging[15] and other aggravating factors were involved, and by mitigating factors as well.[16] This adjustment results a pair of "*culpability multipliers*" that are between 0.75 and 4.0 and are in a 1:2 ratio. 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.[17] As the Sixth Circuit noted, the Sentencing Commission "opted for greater administrative convenience" instead of undertaking a specific inquiry into the actual loss in each case."[18]

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[9] Perhaps the doubling can be explained by the Criminal Fine Improvements Act of 1986, which provides an alternative fine: "If any person derives pecuniary gain from the offense, or if the offense results in pecuniary loss to a person other than the defendant, the defendant may be fined not more than the greater of twice the gross gain or twice the gross loss." Pub. L. No. 100-185, 100 Stat. 1280 (codified at 18 U.S.C. § 3571 (1987)) at § 3571(d). Perhaps the 20% figure in § 2R1.1 is a "proxy" for this "twice the gain or loss" provision in the Criminal Fine Improvements Act of 1986.

[10] This should include he corporate time and disruption caused by private suite to recover damages from cartels.

[11] "Umbrella effects" is the name given to higher prices charged by non-cartel members that were permitted or caused by the cartel's supracompetitive prices. The doubling of the 10% presumed overcharge does not, however, given the context, account in any way for the small chances of finding and convicting cartels or the lack of prejudgment interest.

[12] In 1986 the Assistant Attorney General for Antitrust, Douglas Ginsburg, estimated that the enforcers catch less than 10% of all cartels. See USSG (1986: 15). If he is correct, optimal damages for cartels should be tenfold! The percentage of cartels that are caught and proven probably is much higher today. See Spratling (2001). There is, however, no evidence that it exceeds 1/3, so there is no reason to believe that the treble damage remedy should be lowered. See also the discussion in Landes (1983: 115 fn. 1).

[13] Landes (1983: 666-68).

[14] The Guidelines originally provided that "[t]he fine range for an organization is from 20 to 50 percent of the volume of commerce, but not less than $100,000." 18 U.S.C. Appx. § 2R1.1 (1987).

[15] If bid rigging is involved this increases the Base Offense Level by 1, See 18 U.S.C. Appx. Section 2R1.1 (b). This indicates the USSC's belief that Bid-rigging is worse than other forms of illegal collusion.

[16] See Section 2R1.1 and Application Note 1.

[17] These fines usually are adjusted downwards for cooperation or as a part of the Division's leniency program. The USSC's Commentary also notes that "In cases in which the actual monopoly overcharge appears to be either substantially more or substantially less then 10%" they might not employ the 20% assumption. See Application Note 3. But in practice the DOJ almost always uses the figure of 20% of affected commerce as their starting point in their criminal fine calculations.

[18] See *United States v. Hayter Oil Co*., 51 F.3d 1265, 1277 (1995). The court noted:" The offense levels are not based directly on the damage caused or profit made by the defendant because damages are difficult and time consuming to establish. The volume of commerce is an acceptable and more readily measurable substitute...I find nothing other than the following commentary language that indicates that the Sentencing Commission adopted the theory of optimal penalties: "It is estimated that the average additional profit attributable to price-fixing is 10 percent of the selling price."(*ibid*.).

The USSC appears to have adopted the 10% presumption because its use was advocated by the (then) head of the Antitrust Division, Douglas Ginsburg. In a statement to the Commission, Assistant Attorney General Ginsburg stated that "the optimal fine for any given act of price-fixing is equal to the damage caused by the violation divided by the probability of conviction . . . such a fine would result in the socially optimal level of price-fixing, which in this case is zero"(USSG 1986:14). He stated his judgment that "price fixing typically results in price increases that has harmed the consumers in a range of 10 percent of the price..." and that these violations had no more than 10% chance of detection (*ibid.* p.15).

This in turn raises the question of how Ginsburg arrived at his 10% estimate. A prominent analysis of the issue by Cohen & Scheffman (1989) published shortly after the antitrust sentencing Guidelines were promulgated, states that the economic evaluation of a very small number of price-fixing conspiracies was particularly important in shaping the 1986-87 conclusion of Ginsburg and the Commission that the overcharges from price-fixing conspiracies were 10% on the average. The three cases were: *United States v. Container Corp. of America*[19] and the subsequent civil litigation; the Federal Trade Commission case involving the *Bakers of Washington State*; and a short survey by DOJ economists of empirical studies of bid rigging in the road-building industry in the 1980s (*ibid.* pp. 344-345). Thus, the lynchpin of modern criminal cartel fines -- the USSC's simplifying assumption that cartels raise prices by 10% -- is supported by a surprisingly small amount of evidence.

Critiques of the 10% Guidelines Presumption

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 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)." Moreover, the specific data that the Commission uses was attacked as unreliable: "later research has cast considerable doubt on ... these estimates, concluding that the markups, if they existed, were quite small (p. 345)."

Cohen and Scheffman also argue that the Antitrust Guideline, 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. During recent years this criticism has been repeated with perhaps even more intensity. These attacks could be due to rising levels of criminal antitrust fines in recent years.

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, if lagged response in the size of settlements. Not surprisingly, attorneys who have defended companies that have been convicted of collusion in a number of highly publicized international antitrust conspiracies have claimed that the Guidelines have resulted in penalties so

[19] 393 U.S. 333 (1969).

large that they have resulted in overdeterrence. 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. After viewing an intensification of this trend for another two years, Adler and Laing (1999) were even more alarmed.

> "What is….troubling is that the company fines...have risen astronomically – to levels far higher than the fines for other serious economic crimes and in amounts that can be unrelated to the economic harm caused by the violations (p.1)."

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, which is 20% of the volume of affected commerce (p. 3). This approach, he notes, presumes a pecuniary loss of 10% of sales due to price fixing; unlike all other white-collar federal crimes, the actual degree of direct harm caused does not have to be proven by prosecutors[20]. Denger notes a failure of the economic-legal literature, namely, that "…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 on the actual harm caused by price fixing is not confined solely to those sympathetic to the increased exposure of corporate defendants. Graubert (2003) notes that the controversy over whether antitrust payments are excessive (which on p. 7 he equates with payouts greater than reasonable damage estimates) is largely attributable to the "…difficulty of gathering useful data." A well known critic of the effectiveness of antitrust enforcement, Klawiter (2001) expresses skepticism as to whether the severe monetary penalties imposed on cartelists in the late 1990s will in fact deter illegal price fixing.

Issue 2: Global Cartel Fines

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). Therefore, non-U.S. monetary sanctions must be considered. U.S. antitrust enforcement has been a model for many other countries that have more recently adopted such laws. In Japan and Germany, U.S. occupation authorities imposed competition laws after World War II (Wells 2000). Germany's revised competition law implemented in 1958 became one of the principal influences on the adoption of such statutes by the original six members of the European Economic Community (Goyder 1999:18-33). After four years of political discussions within the EEC's Commission, Regulation 17 was passed and came into force in march 1962; its Article 15 lays out the powers of the Competition Directorate General (DG-COMP) to fine companies for competition-law infringements (*ibid.* p. 45). That rule sets a maximum corporate fine of 10% of the company's

[20] Denger appeals primarily to an increase in settlement rates in treble-damage direct-purchaser suits to establish the unfairness of the high fines imposed on corporate price fixers, an increase that, he believes, cannot be explained by increases in overcharge rates. He cites about 8 domestic U.S. law cases that settled for 2 to 4 % of sales in the 1970s and one international case in 2001 that settled for 18 to 20% (pp. 3-4). It is argued below that settlements are inappropriate evidence in this context.

total sales in the year prior to the Commission's decision and specifies that the specific fine will depend on the duration and seriousness of the offense.

Methods of calculating cartel fines are explained in a 1998 Notice and in each price-fixing decision of the EC (Connor 2005:14-15). Yet, authorities on the EU's competition laws are silent on the origins of the 10% rule. Harding and Joshua (2003) state that EU fines are supposed to incorporate both compensatory and punitive components, the latter to serve deterrence (p. 240). EU fines are calculated in six steps. First, the EC considers the "gravity" of the offense. Although a matter of discretion, cartels are usually placed in the "very serious" category, which is the highest of three levels of antitrust infringements. Cartels with large damages that are geographically widespread add to the gravity. The fine calculations base for the most serious infringements start at €20 million. Second, to account for disparities in the power of fines to deter, relatively large companies are fined more than smaller participants: in several global cartels, companies in the upper half of the cartel's size distribution had their fines doubled. Third, fine amounts are increased by 10 percentage points per year for each year the cartel is effective. Fourth, these three factors result in a base fine (called a "basic amount") for each company that is adjusted for culpability; upward for cartel leaders and downwards for various mitigating factors. Fifth, under the EU's Leniency Notice, violators are given 10% to 50% discounts for their degrees of cooperation. In a few cases, amnesty has been granted. Finally, after applying the last four steps, the Commission ensures that fine amount does not exceed 10% of global sales in the year prior to the date of the decision. Rarely does the EC need to worry about reaching the 10% cap (Connor 2003).

Although the fine-setting process is somewhat transparent, why the base fine is €20 million and the basis of the other adjustments is not known. 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 to EU fines. For more effective cartels, an EU fine cannot even be compensatory. 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. However, most companies that engage in cartel behavior are large diversified firms; for them, EU fines can come closer to optimal deterrence levels.[21]

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).[22] 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). Cooperating firms get discounts, and recently recidivists have paid fines as high as 45% of affected sales. The Canadian 20% rule seems to mimic the base fine of the USSGs. If Canada intends to punish cartels, then the presumed overcharge may also be 10%; if only compensation is the aim, then a 20% overcharge is assumed.

[21] 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.

[22] Under Section 45 of Canada's Competition Act, fines are limited to C$10 million, but foreign price-fixing conspiracies can be prosecuted under Section 46, which has no fine limit (Low 2004:17).

Issue 3: 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 overcharges; investigation procedures can reduce the probability of cartel formation or the duration of cartels.

Those critical of aggressive antitrust policy have often embraced the comforting notion that cartels are fragile coalitions. When the OPEC cartel began to have an impact on petroleum prices in the early 1970s, several leading economists predicted its imminent demise. Morris Adelman (1972) wrote that

> "Every cartel has in time been destroyed by one and then some members chiseling and cheating…"(p.71).

In 1974, in a now infamous news-magazine article, Milton Freedman predicted OPEC's imminent collapse. However, research by Eckbo (1976) and Suslow (2001) finds that the mean duration of discovered cartels is around five or six years. The (unknown) duration of undiscovered cartels is likely to be longer. OPEC may be less powerful than in the 1970s, but its production decisions continued to roil the petroleum market through at least 2004.

In a provocative essay that quickly drew rebuttals[23], Crandall and Winston (2003) argue that extant empirical evidence demonstrates that 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).

The great majority of their criticisms are directed at monopoly and merger enforcement, but remedies in collusion cases also attract their disfavor. 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[24]. While Crandall and Winston later admit that there are some "examples" of successful collusion, no studies are

[23] See Baker (2003), Werden (2003), and Kwoka (2003). According to Kwoka (2003: note 2), Crandall and Winston's earlier drafts "… endorsed consideration of outright appeal of the antitrust laws".

[24] I judge that space constraints do not appear to be responsible for such a skimpy treatment of this topic, for they list 59 references. The choice of two of the articles is unfortunate, because both are methodologically deeply flawed. Newman (1988) is discussed later in this paper; Sproul (1993) is criticized by Werden (2003). Both articles appear in journals managed by University of Chicago economists. Two other studies focus on an odd alleged episode of price fixing, the so-called Overlap group of 23 elite U.S. universities that met regularly to allocate needs-based graduate scholarships; this practice was permitted to continue under a consent decree that limited the degree of detail shared.

cited that support the positive effect on prices[25]. As for deterrence, Crandall and Winston rather grudgingly admit that the large DOJ fines meted out to cartels in recent years possibly deterred the most harmful cartels[26]. This grudging admission is immediately tempered by a citation to an entirely theoretical analysis of the dangers of overdeterrence.

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). Kwoka is hardly the first specialist to lament the absence of quantitative estimates of the price effects of overtly collusive arrangements.

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.

LITERATURE SURVEY

This survey has been prepared by checking more than 500 social-science publications and reading more than 100 official decisions of antitrust authorities.[27] The major portion of the overcharge estimates included in the present analysis is taken from books, book chapters, conference proceedings, or papers published in economic, historical, and legal journals whose readers and contributors are mainly academics.[28] The great majority of these publications are peer reviewed. In addition, a minority of the estimates are taken 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.

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, relatively few archival articles treat the economics of cartels, but scores of books were published on the economic and political

[25] They say that the lysine, citric acid, and vitamins cases are "Ill known," but provide no citation for this assertion. There appears to be only one publication that covers the price effects of all three of these three cases with a degree of depth, viz., Connor (2001).

[26] Their reasoning is obscure. Perhaps they are referring to international cartels, cartels with absolutely large overcharges, or conspiracies with high percentage overcharges. In any case, why they expect the probability of discovery or relative size of expected sanctions to be greater in such cases is not clear.

[27] The References section below lists about 350 sources with useful information about the private cartels in this paper's sample. Only about 200 contained usable quantitative overcharge estimates (shown in the last column of Appendix Table 2). The remaining studies in the References were consulted to confirm that for some alleged cartel tacit collusion prevailed or government power protected the cartel. See also table 11 below. Prof. Robert Lande searched for final published decisions of U.S. courts. I searched the EU web sites for all full decisions of the European Commission that found violations of Article 81 (formerly 85) of the Treaty of Rome.

[28] Prior to the 1970s, the majority of quantitative overcharges estimates are found in books and monographs; beginning in the 1970s, most of the estimates from the social science literature are found in journal papers.

aspects of "pools," "trusts," "combines," "syndicates," and all the other terms that were used at the time to encompass what are generally monopolistic arrangements. The distinction between these terms was not well understood until the early 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).[29] But by 1916 Ripley could differentiate the terms in a manner that has endured. Pools or corners were contractual joint-profit-increasing agreements by independent sellers over prices or quantities; today these are called cartels (Ripley 1916: xiv).[30] Ripley cites the U.S. cordage cartel, formed in 1860, as the first documented pool. Other 19th century cartels include cotton bags, distilling, iron pipes, steel, salt (Jenks 1888), wire nails (Edgerton 1997), and a patent pool for porcelain bathtubs.[31]

Trusts proper were legal instruments used in the United States from 1882 to 1902 for combining companies under a single board of directors; this legal form was supplanted as a means of industrial merger with the holding company beginning in the late 1890s (Ripley 1916). Thus, trusts, combines, and holding companies refer more to mergers and acquisitions than to cartels. Yet the word "trust" was used loosely and popularly to cover both cartels and mergers intended to increase market power.

Books

Bullock (1901), a professional economist and author of an early American economics textbook, wrote the first 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.[32] Interest in the subject continued in the early 20th century, with most of the cartel literature from 1900 to 1940 appearing in books. Among the earlier monographs 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).[33] Some of these works were written by historians and others by some of the earliest practitioners of the emerging field of industrial economics. With the exception of Jenks' books, most of these studies contain little or no quantitative data. Bullock opines that the quantitative measurement of the effects of cartels and trusts is not possible.

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[29] In a footnote on p. 184, Bullock quotes with approval Jenks observation that trusts and cartels also aim "to check competition," that is to monopolize industries or prevent entry.

[30] "Cartel," from the German synonym *Kartell,,* came into general use in British 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 I have seen referring to German cartels is to "combinations" that "regulate" industries (Bullock 1901:207). Ripley (1916: xiv) cites German *kartells.* On the continent of Europe, "syndicate" or *comptoirs* was often used to describe a cartel, with a joint sales agency often implied.

[31] 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).

[32] The books include a couple of government reports of investigations and proceedings of major conferences. Moreover, there was no sharp distinction between academic journals and serious pieces in intellectual magazines like *The Atlantic* at the time. Bullock includes one book written in French, but none of the large German literature.

[33] Levy (1968), a careful scholar, cites about 30 books on cartels and closely related subjects published before 1927, the great majority in German.

Liefmann (1897) published one of the first economic monographs that contained the word *Kartell* in its title.[34] 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 he was leagues ahead of his contemporaries in the analysis of the cartel phenomenon. Liefmann (1932) devised one of the most cited and pithy definitions of cartels: "free [voluntary] associations of producers for the monopolistic control of the market (p. ix)." By this definition he meant to include only arrangements by independent companies linked by formal of informal contractual agreements; compulsory commodity schemes enforced by government decrees or parliamentary statutes are not true cartels by his definition, though international agreements negotiated between compulsory national cartels would qualify if the negotiated agreement did not require statutory enforcement.[35] He 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 other cartels that were organized before 1929, but with one exception he includes no useful price series that could be used to compute price effects.[36]

Liefmann's positions continued to influence German economists for decades to come. Beckerath (1930) 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). Indeed, the book contains no price data. 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.

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[34] 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.

[35] That is, if two or more national cartels are joined by a government-to-government treaty, the result is not a cartel proper. It is the voluntary nature of the agreement that is the defining characteristic of true cartels, according to Liefmann. This distinction is a useful one for the present survey, because I wish to focus "private" cartels that are indictable under U.S. antitrust law. Private cartels may contain state-owned companies or legal export cartels as members, but if the arrangement is sanctioned by national laws, protected by national sovereignty, or the result of international treaties, I deem them "public." Compulsory cartels, a type popular in Europe in the 1930s, are a special type of public cartel.

[36] 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)."

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. A later edition of his book, Jenks (1921), received a glowing review by a well known cartel economist (Dana 1922). 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.). 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 seems to have been 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).[37] Ripley, himself the author of an important study of the railroads, aimed at applying the case-study method pioneered by Harvard Law School into advanced economics courses.

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. 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 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. In addition to detailed ownership and price data

[37] A similar book was edited by Curtis (1931).

from industry trade sources, Jones had available testimony and exhibits from one of the early U.S. antitrust trials.

Jones' interest in competition and antitrust laws was extended in his 1921 book. Jones, a Stanford University economist at the time, 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. Both Jenks and Jones share an interest in organizations that have market power, but like most American and British social scientists writing in the first half of the 20th century, they are vague or inconsistent in distinguishing cartels from other powerful economic groupings. Pools, trusts, combines, monopolies, trade associations, conventions, comptoirs, ententes, syndicates, intergovernmental commodity agreements, and cartels were terms often used interchangeably by those writing in English or French (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. In fact, true trusts as legal vehicles for combining the assets of rival firms for market control lasted from only 1879 to the mid 1890s.

Seagar and Gulick (1929), academics at Columbia University and the University of California, authored a long book that focused primarily on trusts and the first three decades of enforcement of the Sherman Act. They illustrate the ill effects of price fixing by recounting the research of others on several examples of U.S. and European cartels. They trace the earliest of the U.S. pools to the cordage industry, which began making agreements on prices at least as early as 1861; manufacturers formed a formal association in 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[38]. As good as it is, this book contains only one fleeting reference to price effects.

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), for example, delineates in a modern manner those characteristics that are essential to a cartel and those features that may vary from cartel to cartel. Basically he 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 to control markets or reduce competition[39]. The essential feature 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. The business organizations may be private corporations, state enterprises, or national cartels. If the organizations are registered in at least two countries, then it is an international cartel. The legal organization of cartels ranges from informal committees that meet on no fixed schedule to formal secretariats or administrative units that may hold significant assets. However, Notz specifically excludes trusts, combines, joint ventures, holding companies and the like, because the economically distinctive

[38] Salt was sold in barrels of 280 pounds at prices of $0.50 to $1.00 per barrel in the 1870s. The National Salt Co., formed to control the salt fields of New York State, purchased the Michigan and Ohio fields in 190, giving it a 73% share of the evaporated salt market east of the Rocky Mountains (Seagar and Gulick 1929: 87).

[39] Notz dwells on private cartels because compulsory cartels were mostly a phenomenon of the 1930s. However, he does briefly mention a phase of the German potash cartel that was nationalized during the Weimar Republic.

characteristic of cartels is that its members retain legal independence in production and marketing decisions while at the same time subjugating their decisions for the "common good," that is, an increase in the pool of profits generated by their cooperative actions. 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, MacDonald 1927, Wiedenfeld 1927, Economic and Financial Section 1927)[40]. 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. In this decade cartels were often embraced because they were perceived as antidotes to the word wide depression and, in some industries, deflation. From about 1933 to 1937 the U.S. antitrust laws were effectively appealed by federal government industrial planning experiments. Indeed, the Brookings Institution sponsored a series of books during this time to assist policy makers in implementing the National Recovery Act.

One of them was a survey of cartels as instruments for national economic recovery and stabilization (Pribram 1935). However, U.S. Supreme Court decisions quickly restored the antitrust laws by 1938 (Wells 2002). In Europe and Japan, cartels became instruments of government policies to reduce excess capacities, raise prices for certain raw commodities, or extend the power of authoritarian regimes over labor and industrial production. When President Roosevelt and his advisors became apprised of the intimate connections between national socialism and compulsory cartels in Germany in the late 1930s, they rejected the cartel as an instrument of economic recovery.

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 several economists working at Harvard University and Radcliff College. Each cartel study was authored by a different member of the project team. Monographs on cartels published by European economists at this time tended to continue to focus on the internal organization of cartels, but contain little else by way of empirical content.

Academic Papers

[40] The United States was not a member of the League of Nations and sent only observers to the 1927 conference.

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, though none of these works suggested that their approaches had forensic value.[41] Among the most useful papers for overcharges are Jenks (1888), Andrews (1889), Edgerton (1897), Hudson (1900), Walker (1906), Stevens (1912), Tosdal (1916), Ripley (1916), and Allen (1923).

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; moreover, despite the well publicized nature of the episode, the paper contains no reference to the seven-year-old Sherman Act.[42] 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 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 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.

The absence of cartel studies in professional journals in the 1920s and 1930s is striking.

Post-World War II Cartel Studies

During and immediately after World War II, 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, a Czech businessman and refugee from the German invasion of his home country, had an insider's knowledge of cartels. He had served as secretary of the Central European group in the international iron and steel cartel (Barjot 1994:65). Louis Marlio (1947), a French economist

[41] These years bracket what is generally called the Progressive Era in American history. Some historians limit the period to the beginning of the first T. Roosevelt administration in 1901 to the late Wilson administration ca. 1919.

[42] 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 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.

who wrote a detailed account of the international aluminum cartel, had a similar background. He had been president of one of Europe's largest aluminum manufacturers and had been appointed to represent the views of the International Association of Chambers of Commerce on the Cartels Commission of the League of Nations (*ibid.* p. 66). Both of these authors found much to admire in the effects of international cartels, whereas 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 views and changes in these views reflected in the social-science literature on cartels.

More useful for the purposes of this survey are books and reports that have focused on the effectiveness of international cartels, examining such elements of effectiveness as duration, profitability, or price effects. 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 that had access to information handed over to investigators of Congressional committees and to the results of grand-jury antitrust investigations (Stocking and Watkins 1946, 1948).[43] These books set a new standard for rigor and detail in the economics literature on cartels, and they have provided a dozen or more overcharge estimates for this survey. In my estimation, Stocking and Watkins (1946, 1948) represents a new era in the economic literature on cartels, because they were the first to apply rigorous modern concepts of the emerging field of industrial economics; moreover, because of access to the information spawned by numerous Congressional investigations and the first antitrust prosecutions of international cartels in the 1940s, they were among the first to focus on the market effects of international cartels. 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). The German cartel law, although based on a rule-of reason approach, proved to be quite effective in purging most of German industry of cartels. The UK had a common-law tradition against monopolies, but this law did not discourage price fixing by trade associations. Through the early 1950s, a majority of the UK's manufacturing output was affected by cartels (Symeonidis 2001, Swann 1974). The reconsideration of the benefits of cartels began around 1950 with a series of empirical studies by the Monopolies Commission, which investigated the structure and

[43] Stocking and Watkins had access to the results of a number of major investigations. The Temporary National Economic (or "Kilgore") Committee published its hearings a few years before their books were published (U.S. Congress 1938-1940). Other Congressional committees investigated the munitions industry and patent pools. The authors also had information on U.S. prosecutions of more than 40 international cartels.

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 proof on cartels to prove the economic benefits of their price fixing and related conduct. Germany and the UK were the prime movers behind the adoption of tough anticartel provisions in the Treaty of Rome, which solidified the antitrust tradition in the EU and its Member States.

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.[44] The great electrical equipment conspiracy resulted in the publication of more books in a few years than any other single historical event since the beginning of cartel literature. The unsurpassed 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. 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 1974, Sultan 1975, and Bane 1973). Sultan's books are by far the most quantitative; he was a business-school student at the time of the prosecutions writing case studies of the industry and subsequently consulted for industry. Sultan is perhaps the only writer to accept the defendants' arguments about the ineffectiveness of the conspiracies. In addition to the books, three economic studies were devoted to the cartels (Kuhlman 1967, Finkelstein and Levenbach 1983, and Lean *et al.* 1985). These studies have become staples of textbooks in industrial organization (e.g., Carlton and Perloff 1990). 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 size of the 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.

There was a brief revival of interest in international cartels after 1973 when the Organization of Petroleum Exporting Countries (OPEC) first used its power to raise crude petroleum prices.[45] Many books and articles were written about the cartel, and two economic studies tried to predict OPEC's staying power by surveying the international cartel literature of the time. First, a chapter of a book by Eckbo (1976) has been widely cited. It originated as an MIT Ph.D. dissertation, and came out soon after the OPEC cartel was roiling world petroleum prices for the first time. Eckbo's work 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 ineffective in this respect. In fact, Eckbo depends heavily on the data in Stocking and Watkins (1946) to make these determinations. He defines an effective price effect as a price that is "*three times unit costs of production and distribution" (p. 26).* It is not clear whether Eckbo refers to total costs or

[44] When the guilty pleas were receive in the Philadelphia U.S. District Court in early 1961, nearly every daily newspaper in the United States placed the events on their front page.

[45] I do not include OPEC's price effects in this survey because it was created and enforced by what amounts to a multilateral treaty organization.

variable costs, so to be conservative I assume he means average variable costs. I have coded Eckbo's 17 effective private cartels as having achieved a 50% overcharge.[46]

The second OPEC-inspired study attempted to use econometric models to predict more precisely the economic performance of international cartels, including many commodity-stabilization schemes that were fostered and enforced by sovereign governments.[47] Even the private cartels were chosen because they were extra-legal. 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 derives a simple empirical model that explains variation in the Lerner Index of market power with three factors: intracartel concentration, the share of cartel market control, and a subjective index of the degree of the cartels' cohesion and monitoring methods. The model was fitted to data on 54 cartel episodes, most of which operated during the interwar period. Each of the three factors is found to be positively significantly related to their Lerner indexes, though the model's fit is modest, probably because of measurement error in the indexes. Griffin finds that the mean Lerner Index for the 54 cartel episodes is 0.31, which is equivalent to a 44.9% overcharge.[48] Eliminating the 16 episodes that were government-sponsored, the mean overcharge for the 38 private cartels is 45.6% and the median is 43.9%.[49]

Relatively few books were written about cartels from the early 1960s until the revelations about the international lysine, citric acid, and vitamins cartels began in the late 1990s. Four books, only one of which attained large sales, 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 Julian (2003) provide a legal overview of mainly EU cartel enforcement. Only Connor (2001) contains empirical overcharge data.

Quantitative Estimates of Cartel Overcharges

[46] This is a conservative assumption. I reason as follows. In the manufacturing industries studied by Eckbo, fixed costs are unlikely to exceed half of average variable costs. Substituting LRMC = FC + AVC = 1.5 AVC into the Lerner index formula yields a value of at least 0.50. Because price is greater than or equal to LRMC, the overcharge is greater than or equal to the Lerner Index of 50%. In fact, Griffin (1989) interprets Eckbo's "effective" cartels as achieving a 100% increase in price (p. 182).

[47] Besides the price effects discussed here, Griffin analyzes the sources of cartel duration.

[48] Four of Griffin's point estimates are slightly below zero; I convert these to zero. 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 a mark-up: MO = (P-C)/C. MO is also zero in perfectly competitive markets, but can approach positive infinity when C is very small. 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).

[49] Somewhat surprisingly, government-sponsored cartels in this period had mean overcharges virtually the same as the private schemes.

Given the importance of the topic for legal-economic discourse, there have been surprisingly few surveys of the empirical findings of cartel overcharges.[50] 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.[51] Indeed, the only work I have been able to locate that purports to survey cartels is a very early paper by Bullock (1901). However, I have found six works that include surveys of a significant number of studies of mark-ups due to overt collusion.[52] The overcharges cited are in a sense byproducts of scholarly research; none claims to be a comprehensive survey. The six studies collect samples of five to 22 estimates. Only one appears in a peer-reviewed journal.

Cohen and Scheffman (1989) recognize that the average size of price-fixing overcharges generated by overt collusion is a critical issue in evaluating the USSGs and assert that there is a sparse economic literature on the topic.[53] Their survey cites only five publications providing such estimates for price-fixing cases not involving bid rigging, one of which is questionable[54]. Cohen and Scheffman defend their decision to limit their survey to a few studies on the grounds that the 1987-89 deliberations of the Commission on the Antitrust Guideline focused on two particularly important cases, *Bakers of Washington State* and *Corrugated Containers*. They cite one short survey of empirical studies of bid rigging in the road-building industry in the 1980s (Werden and Simon 1987). Although supported by only one fairly narrow review, Cohen and Scheffman seem prepared to accept that bid-rigging conspiracies in general generate average mark-ups of around 10% (p. 345). This, in turn, accounts for their support for significantly higher fines for bid-rigging conspiracies than for more straightforward price- or quantity-setting conspiracies.

A working paper by Werden (2003), though not intended primarily to be a survey of the issue, cites 14 studies of cartel overcharges.[55] All of his sampled studies were published since

[50] 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.

[51] Hay and Kelley (1974) authored a classic review of 65 U.S. price fixing conspiracies, which Fraas and Greer (1977) extended to 606 cases from 1910 to 1972. Both studies contain a wealth of information about the number of conspirators, duration, industry, and specific collusive methods employed. However, neither survey covered the topic of price effects, presumably because of the paucity of such data.

[52] Froeb (1995) constructed a popular internet site for antitrust economics, and four pages contained a partially annotated bibliography of empirical studies of the price effects of conspiracies. The internet page is http://www.antitrust.org/economics/conspiracy effects.html ; it was downloaded on Feb. 24, 1999 but no longer appears on the site with its former content [see http://www.antitrust.org/cgi-bin/showcase.pl?casetype=Collusion]. "Antitrust.org" is now maintained by the graduate business school of Vanderbilt University [http://www.antitrust.org/index.html]. He lists 14 published studies published between 1976 and 1994. Of the 14, nine contain remarks about the studies' findings, and all but one is interpreted as showing a significant relationship between collusive behavior and prices. Froeb does not attempt to provide numerical impacts.

[53] There are several hundred published economic studies that try to measure the degree of market power observed in specific industries, in small of large samples of industries, or attained by a single firm or brand. In most cases these studies are unable to or do not attempt to distinguish whether the measured height of market power is derived from the exercise of unilateral, tacit-collusive, or overt-collusive market power.

[54] One of them (Block *et al*. 1981) is irrelevant because it quotes the ratio of out-of-court settlements to *annual* sales for several U.S. bread price-fixing cases. As Cohen and Scheffman recognize in a footnote, both the numerator and denominator of this ratio are inappropriate indicators of an overcharge; nevertheless in the text of there article, they persist in quoting with approbation the "suggestion" that price-fixing mark-ups of under 1% of sales are accurate for this industry.

[55] Irden's paper is a critique of Crandall and Winston (2003). Another critique is by Kwoka (2003). Both comments are unusual in that they were written prior to the publication of Crandall and Winston's paper in December 2003. Baker (2003) is also largely a response to Crandall and Winston.

1991, because he wished to limit the cartels under study to 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. One of these is judged to be methodologically flawed (Sproul 1993); another methodologically sound study, while it finds significantly lower collusive prices in rigged bids than in noncollusive bidding, cannot be converted to a numerical price change from the results as published (Pesendorfer 2000). Three of the studies looked at a total of seven distinct instances of price fixing, thus yielding 14 usable observations, some of which are ranges. The mean overcharge was 18.6% to 27.1%.

The most comprehensive quantitative study of cartel price effects appears in a chapter by Griffin (1989)[56]. He derives a simple a simple empirical model that predicts the Lerner Index of market power using three factors. The model was fitted to data on 54 cartel episodes, most of which operated during the interwar period and all of which operated in a legal environment. All but four of the cartel episodes were effective at raising price. If the but-for price is the purely competitive price, then the Lerner Index is the same as the overcharge, except that it is measured by dividing by the monopoly price instead of the competitive price[57]. 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[58]. If, on the other hand, the but-for price is supracompetitive, then the Lerner index might overstate the overcharge. Griffin (1989: Table 1) concludes that the mean cartel margin was 0.31, which is equivalent to a 45% price increase; the median increase was 39%. Excluding 14 government-sponsored cases made little difference; the respective averages were 46% and 44%.

Posner's (1975, 2001) treatise on antitrust law is an avowedly economic treatment of the subject. An important issue for Posner is the importance of antitrust law to ameliorate the social costs of monopoly in the economy. 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). In the 2nd edition, seven of his estimates are based on his reading of Stocking and Watkins (1946, 1948), one is an old Supreme Court case, and four are modern quantitative studies of the price effects of market power in major U.S. industries that he assumes are collusive: petroleum, automobiles, cigarettes, and soft drink bottling.

Valerie Suslow and Margaret Levenstein are authors and co-authors of a number of important analyses of international cartels. Levenstein's (1997) oft-cited quantitative-historical study of the bromine cartel yields four estimates of mark-ups for its three episodes. Suslow's (2001) paper on the duration of the interwar international cartels also analyses annual prices for 17 products that were cartelized. Levenstein, Suslow and Oswald (2003) profiles three postwar cartels and has usable price data for two of them. Finally, Levenstein and Suslow (2002) focus

[56] Eckbo (1974) comes close. Eckbo studies 51 episodes in 18 markets, but does not really calculate overcharges so much as place them somehow in high/low categories; Griffin terms Eckbo's approach "subjective."

[57] If P is the collusive price and C is the competitive price, then the Lerner Index is (P-C)/P, whereas an overcharge is (P-C)/C. That is, the Lerner Index is a *margin* and the overcharge is a *mark-up*.

[58] Suppose the competitive benchmark price is $1.00 and the cartel mark-up (or overcharge) is 5%. Then the Lerner Index L is (1.05 - 1.00)/1.05 = 0.0476 = 4.76%. However, if an overcharge is 25%, L = (1.25 - 1.00)/ 1.25 = 0.20 = 20%. One can derive algebraically a one-to-one linear functional relationship between the overcharge and L; it equals L/(1-L). In this paper, I convert estimates of the Lerner Index of monopoly to the overcharge.

on the determinants of success for both the interwar and more modern cartels. The paper aims at assessing three dimensions of cartel performance, stability, duration and "profitability," the last equivalent to overcharges. Although the authors are modest about their accomplishment, this paper contains the fullest accounting of overcharges of any source.[59] They collect price-effect information on five cartels (their Table 8) and 16 price increases for 12 international single-episode cartels prosecuted since 1990 (Table 15). Thus, this paper provides a total of 21 estimates of price effects for international cartel episodes. They conclude that the median cartel price increase was 25% (*ibid.* p.20).

Table 1. Summary of Six Economic Surveys of Cartel Overcharges

Reference	Number of Cartels	Average Overcharge	
		Mean	Median
		Percent	
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

The OECD (2003) report on private "hard-core" cartels contains a summary of a 2001-2002 survey of its government-members on the economic harm caused by cartels recently prosecuted by the European Commission and other national antitrust authorities.[60] Presumably, the examples chosen to be included are among the best documented examples of the degree of harm available to the authorities. The 38 responses to the survey are summarized in Annex A of OECD (2003). While not all of them can be converted to overcharge percentages, the usable responses represent an unusually authoritative compilation of data on mark-ups by contemporary

[59] "I have very little evidence on the excess profits … [from] cartelization. For fifteen cartels … I have anecdotal evidence of price increases…" (p. 20).

[60] A few non-members that participated in an OECD-sponsored "Global Forum on Competition" also submitted responses to the survey. "Hard-core" is a European term that refers to conspiracies that fix prices and/or quantities. Other cartels (soft core?) cooperate on information, technology, marketing, and the like. The distinction seems roughly to correspond to criminal versus civil violations under U.S. law.

cartels that have been prosecuted by courts or commissions.[61] The six surveys just discussed are summarized in Table 1.

The last major source of data is a working paper that attempts to compile data on the price effects of 167 private international cartels that were discovered by antitrust authorities only since 1990 (Connor 2003).[62] The cases covered in that paper include fully prosecuted cartels and a few still being investigated of prosecuted as of mid 2004. A minority of these international cartels yield overcharge estimates. All the overcharges in Connor (2003) are incorporated into this paper.

I have examined scores 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; most such papers contain no references to price changes but are valuable because they are based on primary documents that give details about internal organization. The majority of the short cartel studies were written by economists; the focus in these studies is on testing hypotheses or an improved estimation method for overcharges, so much so that they sometimes do not contain enough information to derive point estimates of the overcharge rate. Nearly all economic articles are written by North American academics using cartel episodes that affected commerce in the United States or Canada[63]. The absence of empirical studies by European or Asian academics 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[64]. 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 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).

[61] In a few cases the harm was reported as a monetary value and the size of affected commerce was missing, but I was able to find a reasonable estimate of the affected commerce from an alternative source. For example, the U.S. DOJ provided a monetary estimate of the U.S. harm caused by the international lysine cartel of 1992-1995, and I found the value of affected commerce in a sentencing opinion written by a federal judge in a criminal jury trial that convicted three of the cartel's managers. I was able to derive 16 overcharge percentages, of which 12 were long-run and 4 were peak.

[62] The working paper incorporates a series of studies on the same subject that commenced in the mid 1990s (Connor 1997, 1998, 2001a, 2001b, 2004). The author has continued to add cases as they appear.

[63] 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), but even these spent significant shares of their careers in U.S. universities.

[64] 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.

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 cartel is one that by contemporary U.S. standards could be criminally indicted under the Sherman Act.[65] Export cartels that fix prices are also included because such cartels are not explicitly legal in most jurisdictions (Levinstein and Suslow 2004).[66]

Some cartels operated prior to the 1890 Sherman Act made participation by U.S. companies illegal, but many cartels headquartered in Europe predate the beginnings of antitrust law there (the late 1950s in the UK, Germany, and the European Economic Community). If these cartels were not formed by means of a legally enforced government monopoly, they are generally considered private schemes.[67] 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.

Because of this paper's antitrust orientation, commodity agreements known to have been initiated, actively sponsored, or overtly protected by national sovereignty are not included.[68] In these cases the active involvement of governments are signaled by the signing of a treaty, government ownership of commodity 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). In general I aim to follow procedures that yield conservative results.

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 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

[65] Criminal indictments for 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 could be criminally actionable.

[66] Out of 56 antitrust regimes surveyed, 30% explicitly exempted export cartels and 59% are silent on them. There appears to be some movement in the United States and elsewhere to make export cartels illegal once again.

[67] 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.

[68] In some cases particularly in the early 1930s, the earlier phases of an international cartel were controlled by national producers' organizations that negotiated voluntary quota reductions; when cheating threatened the effectiveness of the cartel, colonial or metropolitan governments stepped in to pass mandatory supply-control legislation. The early phase of the cartel I deem private, but not the latter.

allocations, or production-capacity agreements. Cartels that focused exclusively on advertising, patent pooling, setting technical standards, R & D and the like are excluded.

The sources fall into two major categories: published estimates contained in studies by economists, historians, or other serious students of the subject and decisions of judges, juries, or commissions in formal criminal or civil proceedings.

Social Science Studies

The first major source 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[69]. 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. I examined a number of monograph-length studies that took a cross-sectional approach.[70] There are also several books that study one cartel: for example, Eliott (1937) on nonferrous metals; Marlio (1947) on aluminum; Blair (1976) on oil; Taylor (1979) and Gray (1982) on uranium; and the most heavily studied cartel of all, heavy electrical equipment (Herling 1962, Smith 1963, Bane 1973, Sultan 1975, and Epstein and Newfarmer 1980). Some economists and historians have spent substantial portions of their careers specialized in cartel analysis (Levenstein, Suslow, Barbezat, Griffin, Schroeter, and Connor, among others), 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. In economics, 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 2004). 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 collusive prices could be figured two ways, either by averaging prices over the entire collusive period (preferably weighted by the quantities sold in each sub period, but often just a simple average of the available collusive price observations) or by choosing a single, peak price. Averaging revealed how effective a cartel was in controlling prices throughout a conspiracy that normally varied in its degree of cohesiveness, whereas the peak price would reflect how close a cartel had come to achieving the theoretical

[69] I have confined journalists' accounts of cartels 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. Books by journalists typically do not focus on the quantitative economic aspects of the case at hand, so in practice there are relatively few overcharges drawn from these sources in the present study. I do not include overcharge estimates embedded in newspaper or magazine articles, though some specialists may judge such assertions to be sufficiently reliable to include in their published studies.

[70] Liefmann (1897) wrote one of the first; Jenks (1900) and Jones (1921) were early writers. The interwar cartels received a great deal of attention from Pietrowsky (1933), Plummer (1934), Hexner (1946), Edwards (1946), Eckbo (1976), Suslow (2002), and the classic studies by Stocking and Watkins (1946, 1948); the post-World War II studies were more quantitative than their predecessors. More modern studies include Heath (1963), Levy (1968), Maurer and Mirow (1982), Spar (1994), Lanzillotti (1996), Levenstein and Suslow (2002), and Connor (2001).

maximum, the monopoly price. The base price was typically assumed to be the long-run competitive equilibrium benchmark price (now rather succinctly, if inelegantly, 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. Some economists of the time realized the importance of averaging before or after prices for periods long enough to eliminate the influence of transitory disturbances in markets, but others were satisfied to identify one month's or one day's price as the but-for price.

A second way of calculating a benchmark price is the yardstick method. In this type of analysis, an economist would collect prices for analogous 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. 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. 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.

Since the 1970s, the rigor and precision displayed in deriving estimates of cartel overcharges have made several advances. Driven by developments in oligopoly theory, statistical methods, 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.[71] An essay by Werden (2004) traces the influence of modern oligopoly theory on forensic economic analysis of collusion. Werden considers modern oligopoly theory to be essentially equivalent to game theory, the most useful of which are models based on Cournot and Bertrand games.[72] Game theory has influenced contemporary concepts of collusion, the design of competition policies, and empirical modeling of oligopolies. Modern oligopoly theory has reinforced the importance of small numbers of buyers and sellers as explanations of collusive behavior; it has provided a rational basis for laws that prohibit agreements ("conscious common schemes") between rival sellers and has given more precision to what constitutes tacit

[71] These data are often proprietary facts revealed during the discovery phase of litigation or submitted to an antitrust authority under compulsory legal processes. In addition to transaction prices of the defendants, production and marketing costs of details of business contracts may be handed over on a confidential basis.

[72] He notes that Cournot quantity-setting games appear to be different from Bertrand price-setting games. Cournot models are typically thought to apply to homogeneous-product industries; Bertrand models are the basis of models that apply to markets with heterogeneous or differentiated goods and to auctions. However, theorists have proven that under certain reasonable conditions (a two-stage decision process in which firms first choose to invest and later choose output or price levels, the firms have capacity constraints, and consumers with the greatest willingness to pay buy up the low-priced firm's output first), the two models predict exactly the same equilibrium quantities and prices. Infinitely repeated games are not useful in forensic settings, if only because they generally fail to generate unique equilibria.

agreements and conscious parallelism[73]; and it has overturned some previously influential concepts of collusion.[74] The game-theoretic idea of the prisoners' dilemma has been the basis of highly effective leniency and amnesty programs for cartel participants. Finally, game theory has been used to justify the shape of behavioral models that can be tested statistically.

In a sense, econometric modeling is an elaboration of the before-and-after method. 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.[75] 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 accounting for such factors. On the other hand, if a cartel operated during a span in which cost conditions (input prices, expansion of capacity, inventories, and technology) were steady and demand conditions (consumer preferences, disposable income, available substitutes, and the like) did not shift, then fancy econometric models and the more traditional methods will yield the same overcharges. For durable cartels, constancy of all these factors is unlikely.

In short, the economics literature on overcharges has evolved in many ways since the first cartel studies first appeared in the very late 19th century. This evolution might affect the way that readers regard the reliability of the overcharge estimates assembled for the present paper. Therefore, this study tries to be careful to annotate the type of study, the method of analysis (if known), the data available to the author, and whether the estimate is an average one or a peak overcharge (see Appendix Table 1). Differences in overcharges may be related to method. Moreover, alternative estimates are sometimes available for the same cartels; the differences will be analyzed.

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. The reasons for analyzing episodes rather than one cartelized market over time are fairly straightforward. 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, a new cartel is launched.

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[73] Werden asserts that actionable collusion may be either *spoken* (classic overt communication) or *unspoken* (communications effected purely by means of marketplace actions). "Tacit" collusion is an ambiguous term because it may refer either to unspoken agreements (e.g., the sudden, simultaneous adoption of basing-point pricing) or to conduct unrelated to any kind of agreement (e.g., barometric price leadership). Similarly, developments in game theory have supported making illegal consciously parallel behavior *if* it is accompanied by certain "plus factors" (a close correspondence between meetings and bids; a pattern of close advanced price announcements; conduct that is multilaterally rational but unilaterally irrational; and certain facilitating practices such as detailed information sharing, bet-price policies, meeting-the-competition clauses, and basing-point pricing.

[74] Werden argues that Chamberlin's small-numbers case, which predicts a "spontaneous" (tacit) shift to monopoly prices when the number of sellers contracts, is inconsistent with noncooperative oligopoly models that predict prices lower than monopoly.

[75] The most common econometric models insert a zero-one ("dummy") independent variable to represent the price effect during alleged or stipulated conspiracy period. An alternative model fits data exclusively to the pre-cartel (or post-cartel) period, and then employs the fitted equation to forecast (or backcast) the but-for prices during the conspiracy.

U.S. Antitrust Court Verdicts

In theory one should be able to determine how high cartels raise prices by a straightforward examination of a statistically significant sample of the many 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 whether a cartel violated the antitrust laws.[76] It therefore is unnecessary for the court in criminal antitrust cases to calculate the extent of any overcharges or undercharges.[77] In civil cases, however, the damages awarded to a successful plaintiff are equal to three times the overcharges,[78] so in these cases plaintiff 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[79] calculated an overcharge are surprisingly rare. As an example of their scarcity, there apparently has never been even a single final verdict in a damages case involving indirect purchasers, even though this is a very actively litigated area of antitrust law where more than 100 cases have been filed against a single defendant.[80]

The reasons for this high settlement rate are not completely clear.[81] One reason is because the litigation is so risky and expensive that settlement often is the most logical

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[76] See the discussion in Sullivan and Grimes (2000:165-233), which shows that in *per se* cases the plaintiff does not have to prove whether prices rose (or even whether defendants had market power). The issue of whether prices rose can be an element of a rule of reason case, but rule of reason cases do not give rise to criminal fines, so are not the subject of this paper.

[77] Normally the government simply relies upon the 10% overcharge presumption. On this basis the prosecutors and the defendants typically settle upon a criminal fine without calculating the actual overcharges involved.

The first time in which the federal government attempted to prove the size of cartel overcharges was in the sentencing phase of *United States v. Andreas*, in which defendants were convicted of conspiring to fix the price and allocate the sales of lysine. The Department of Justice ("DOJ") recommended that the court apply the alternative sentencing provisions of 18 U.S.C. § 3571(d). The court conditionally denied the defendants' motion to reject the sentencing provisions, and granted the parties' motion for an evidentiary hearing to present economic evidence regarding the gains or losses attributable to the conspiracy.

The DOJ retained the expert opinion of an economist, who based his estimate of the defendants' gains on a hypothetical "but-for" price. When the defendants requested more time to research and respond to the expert's opinion, the court ordered DOJ to assist the defendants to obtain the necessary sales, price, and volume information from other lysine producers. The court later opined that DOJ's production of economic data was insufficient, and therefore granted the defendants' motion to bar imposition of the alternative fine provision.

[78] 15 U.S.C. Section 15 (Supp 1992). The Statute also provides that successful plaintiff will recover reasonable attorney's fees and expenses.

[79] Although there have been cases where its staff entered into agreements with defendants over the size of the illegal overcharges, I know of no cases where the Federal Trade Commission calculated the actual size of a cartel overcharge.

[80] See Lande (2004). For example, a reliable source reported that in recent years at least 137 antitrust cases alleging overcharges were filed against Microsoft alone, involving both Sherman Act Section 1 and Sherman Act Section 2 allegations (Groner 2004). As of July 2004 almost all had been dismissed or settled, and there have been no final verdicts.

[81] Most civil cases of all types settle or are dismissed. I have no information as to whether cartel cases are more likely to settle or be dismissed than are other types of antitrust or non-antitrust cases. However, the fact that so few final cartel verdicts can be found suggests that it may be lower. Unfortunately, these settlements virtually always provide little useful public information. Bentson in Salop and White (1988: 318) notes that the most ambitious

alternative for both parties.[82] Rather than incurring substantial litigation expenses,[83] risking personal and corporate time, expenses, and disruption for clients,[84] and face an uncertain probability of an uncertain magnitude of gains (or a total loss[85]), counsel for all parties often recommend and negotiate a compromise.

It might instead be useful to ask why some cartel cases do not settle. One possibility is that the non-settling cases are most likely to be those where the parties have different beliefs as to the likelihood of victory. Settlement is very difficult if plaintiffs are optimistic that they will prevail and the award will be large, while defendants believe the opposite. For this reason non-settling cases might be those in which liability and damages are least susceptible to prediction, and in which the expected likelihood or magnitude of liability cannot be predicted with even a small amount of confidence.[86]

Since most cartel cases settle, it might be desirable to survey settlements as one way of determining the size of the cartel overcharges.[87] However, settlement amounts are too frequently an extremely unreliable guide as to the size of the underlying cases' overcharges. Settlements are by no means likely to be compromises for half of the overcharges.[88] A risk-averse plaintiff with a

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empirical study of private antitrust cases yielded too little publicly available information on settlement amounts to justify analysis.

[82] This type of complex litigation that goes to final judgment has sometimes colloquially been termed a "mutual suicide pact" because of the ardor involved for all concerned.

[83] Salop and White (1988) calculated that attorneys' fees average 30-50% of the overcharge amount. Elzinga and Wood (1988) calculate attorneys fees as being 58%-102% of the overcharge.

[84] The cost of this disruption to the affected firms can be tremendous. See the discussion in Lande (2004: 142-144) in which James T. Halverson was reported to have recommended "that a defendant take exhaustive discovery, particularly if it has an advantage over the plaintiff in terms of resources. Halverson also suggested that any defendant show the plaintiff that it is not costless to sue. Thus a defendant should counterclaim. Halverson bluntly suggested that private plaintiffs look at their pocketbooks rather than the so-called "public interest," so defendants should make plaintiffs worry about their pocketbooks. He also suggested that if more than one private suit is filed, the defendant should get the weak suit to trial first....[after] the plaintiff's board of directors has seen months of attorneys' fees and corporate disruption, the plaintiff's board will work in the defendant's favor and nudge its lawyers toward a compromise.... In sum, he stated, settle strong cases and try the Iak cases, always while delaying the Government."

[85] Both parties have a special incentive to settle cases that, if plaintiff prevails, would bankrupt defendant.

[86] Other factors could include lawyer or client stubbornness, irrationality or denial of the likely impending reality of the court's verdict. Another possibility is the unethical resistance by counsel to accept a settlement that would be good for their clients but would generate fewer legal fees than litigation. This could be especially likely to occur in class action cases since class members cannot effectively supervise their attorneys. It also is possible that as a case develops, plaintiffs are more likely to settle to the extent they come to believe that its potential rewards are likely to be less than the expected payoff. However, since the costs of litigation are automatically recovered by prevailing plaintiffs (See 15 USC Section 15 (1992)) this factor is less important than in other fields.

[87] One might believe, for example, that a settlement represents the lower bound on the expected recovery if the case would go to trial (the present value of three times the overcharge plus attorneys' fees) since a risk-neutral defendant would be unlikely to settle for the entire expected verdict.

One might also believe the supposed rule of thumb that good antitrust cases usually settle for single damages, perhaps on the dubious theory that the trebling (which produces a higher number) and the lack of prejudgment interest (which produces a lower number) would roughly usually cancel one another. I have no evidence as to whether this is the way that plaintiff and defendants, or their attorneys, typically behave. I have, however, heard trustworthy plaintiff and defendant attorneys tell us, anecdotally, they have settled cartel cases for single damages.

[88] If plaintiff and defendant each had, and knew that they had, a 50% chance of winning, then the settlement might Ill be for 50% of the present value of the automatically trebled overcharges. But this would not be true if plaintiff's chance of prevailing was not 50%, if one party was a better bargainer, or if parties were unduly optimistic or

strong case might settle for very little if it needs the money quickly and consequently is in a weak bargaining position.[89] Conversely, a risk-averse defendant with a strong case might settle for what might seem like a overly generous amount to avoid even a small probability that an irrational judge or jury will award an amount large enough to cripple the company.[90] Legal writings are replete with such a wide variety of claims from both plaintiffs and defendants[91] as to settlement motivations that it appears that an analysis based upon average settlements would not be very meaningful.[92]

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.[93] Three sources were explored: computer assisted searches of data bases,[94] reading through a large number of articles and treatises on cartels and on antitrust

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pessimistic about their chances of prevailing. Suppose, for example, that difficult class action certification problems reduced plaintiffs' chances of winning to 25%. And, even if defendants really did raise prices by 30%, this often can be very difficult for plaintiff to prove. If plaintiff only has a 25% chance of obtaining class certification and subsequently proving the damages, a settlement should be at far below the level of 50% of the discounted present value of three times the overcharges. Moreover, publicly available settlements typically contain very little usable data. Often they do not even include the size of the affected commerce, making the calculation of the overcharge percentage highly speculative.

[89] Plaintiffs' counsel typically asserts that defense counsel are able to find barely ethical ways to delay meritorious claims for years. Since antitrust awards do not contain pre-judgment interest (15 USC Section 15), and plaintiffs often need the money in the short term, these delays harm plaintiffs' bargaining position significantly. Plaintiffs' counsel also asserts that defendants often are able to unreasonably prevent the necessary class certifications, and otherwise to make litigation so burdensome that plaintiffs have to settle for only a small fraction of the actual overcharges.

[90] There are many variations on this theme. Attorneys for defendants in cases that have settled for millions of dollars appear to believe, Ill after the cases were over and after there was any threat of further liability, that their clients never affected prices. Defendant attorneys often assert that their clients (who were found by a court to have agreed to fix prices) were prevented by market forces from affecting prices significantly. However, rather than take the risk of having a judge or jury not believe them, they settle for a large sum.

Another factor that can make defendants want to settle even if they did not raise prices is the antitrust law's joint-and-several-liability doctrine, which makes every member of a cartel liable for the overcharges of the entire cartel. See Denger, (2003: 10). This can lead to extremely large potential damages, and even a small risk of a huge payout can, from the defendant's perspective, overshadow a weak liability case. A defendant might be forced to settle for a significant amount even if it did not cause prices to be elevated.

[91] Interestingly, defendants sometimes assert that unscrupulous plaintiff attorneys often only have an interest in the size of their legal fees, rather then the amount they recover for their clients. If true, this gives rise to the possibility that plaintiff attorneys, especially in consumer class action cases, might settle for unduly low amounts solely to secure generous legal fees for themselves. The Courts are supposed to prevent this from happening, but judges sometimes are too busy to do so optimally.

[92] It may be possible, though difficult to derive insights from an analysis of settlements. One could imagine, for example, a study of settlements based upon candid interviews with participants. Anonymous questionnaires about past cases are another possible research method.

[93] I excluded cases that were overturned on appeal.

[94] Computerized searches were not, with only a few exceptions, particularly helpful. Most searches turned up hundreds of useless citations, including searches for "price fixing" or "bid rigging" and "verdict", "amount of overcharge", "overcharge" and "percent", "auction" and "conspiracy" w/in "antitrust", "collusion" and "dollars" or "cents". I never was able to design a successful focused computerized case search.

damages, and messages to groups of knowledgeable antitrust professionals.[95] Every qualifying final collusion verdict is included.[96]

One example will illustrate the difficulties of engaging in this type of research. United States v. Anderson[97] involved a conviction for bid rigging USAID contracts. The Circuit Court Opinion said that the winning bid on the wastewater treatment facility was $107,017,000, the engineers estimated the cost would be $60,000,000, and the defendant's profit was $50,639,000. Thus, the illegal overcharge might have been 47%. The problem with using this figure is that the winning bidder certainly might have made some profit in a competitive market.[98] So 47% represents something like the maximum possible illegal overcharge. However, the Opinion also said that the winning bidder agreed to pay two co-conspirators $5.35 million and $2.2 million for bidding so high that they would not be awarded the contract.[99] This totals 7.1% of the contract price, and means that the overcharge must have been at least this much. Since the true overcharge probably was between 7.1% and 47%, I used 7.1% when computing the overall average.

The vast majority of the cases either settled or were dismissed.[100] This left a disappointingly small sample size to analyze. However, I know of no reason to believe that the sample is biased in any particular direction. Moreover, the sample of 24 observations is roughly as large as the sample size of those in the prior surveys reported in Table 1. Nevertheless, this sample is disappointingly small compared to the number of social science observations. Due to its small size these results should be interpreted with caution. They should be considered only as additional data worthy of analysis and discussion, not as definitive material.

Decisions of Other Antitrust Authorities

Table 1 summarizes 16 percentage overcharge estimates[101] of hard-core cartels that were reported to the OECD (2003) by nine antitrust authorities: U.S. Department of Justice (DOJ), the European Commission (EC), the Korean Fair Trade Commission (KFTC), the Australian Competition and Consumer Commission (ACCC), the Canadian Competition Bureau (CCB), the German Bundeskartellampt (BKA), the Danish Competition Authority, the Norwegian

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[95] For example, inquiries were made on the antitrust listserves of the ABA Antitrust Section, the National Association of Attorneys' General, and of the American Antitrust Institute.

[96] However, many of the verdicts that I did find were only expressed in dollar amounts which I was unable to translate into percentages, so I reluctantly had to omit these cases See, e.g., Bigelow v. RKO Radio Pictures, Inc., 150 F.2d 877, 884, 327 US 251, Chattanooga Foundry & Pipe Works v. Atlanta, 203 U.S. 390 (1906), Transnor (Bermuda) Ltd. v. B.P. North America Petroleum, 736 F. Supp. 511 (S.D.N.Y. 1990), Phillips v. Crown Cent. Petroleum Corp., 602 F.2d 616 (1979).

[97] 326 F.3d 1319 (11th Cir. 2003).

[98] Economists often define "cost" to include a normal rate of return or a normal profit, but I are unsure whether the Court was using the term this way. Moreover, in a competitive market risky construction projects sometimes make a considerable profit, but sometimes result in a loss.

[99] Id. Defendant also agreed to give them other considerations, such as a $25 million subcontract, which probably had a substantial profit built into it, and the designation to win another contract. Id.

[100] I am indebted to dozens of colleagues who responded to appeals for information useful for this study. Nevertheless, I surely found only a minor share of final verdicts, and would be grateful if readers of this article could inform us of final verdicts that I inadvertently omitted.

[101] Four were judged to be peak estimates. Some other estimates were total damages that could not be converted to a rate.

Competition Authority, and the Spanish Competition Authority. 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 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 publish 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.[102] 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.[103] I read about 80 EC decisions that imposed fines on cartels (Burnside 2003: Annex 1). Additionally, commission decisions can be appealed to a court that renders a decision with a recitation of the facts of the case. In this paper, the UK and EC decisions afforded enough data to make several estimates.

GENERAL DESCRIPTION OF THE SOCIAL SCIENCE DATA [104]

The data analyzed in this paper are drawn from two major sources, published social-science studies broadly defined and the decisions of courts and commissions entrusted with the enforcement of antitrust or consumer-protection laws. With very few exceptions, I have attempted to report on every scholarly or serious social science study that contained quantitative information on the price effects of hard-core private cartels.[105] While no time limit was placed on the literature search, the majority of the sources consulted were written after 1945.[106]

In general, I aimed at collecting the largest possible body of information on the subject, and tried to avoid applying some sort of quality screening. In the vast majority of cases, the writers themselves provided the overcharge calculations. In a small minority of cases, I made inferences from price data contained in the works; the bases for my inferences are briefly outlined in Appendix Table 2.[107] Few overcharge claims appearing in newspapers, magazines, and newsletters are included because such assertions are usually from anonymous sources who

[102] Italy, the Netherlands, and Korea are exceptions to this rule; these overcharges are collected in Connor (2003). Moreover, these antitrust authorities and some others have reported a few of their decisions and overcharge estimates to the OECD (2003).

[103] The UK Monopolies Commission also operated in this fashion.

[104] The subsequent tables in this report are constructed from a spreadsheet that incorporates data collected as of April 4, 2004. Appendix Tables 1 and 2 contain a few observations added after that date.

[105] See Appendix Table 5 for a list of excluded studies and the reason for their exclusion.

[106] Unless available in translation, I have mostly confined this survey to English language sources. Many antitrust authorities now translate their press releases and annual reports into English; moreover, members and some nonmembers submit summaries of their annual reports in English to the OECD. The preponderance of sources published after 1945 is explained by the growth of the field of industrial-organization economics. Although theoretical concepts of competition and monopoly go back at least to Adam Smith, the field is generally regarded as having developed a separate identity only in the 1930s. The first textbook of industrial organization was published in 1958 (Bain 1958).

[107] 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 conclusions that a cartel episode was "effective" are not tabulated in the quantitative summaries.

may not be disinterested parties in an ongoing law suit or in some public policy debate, roles that may color their assertions.[108] 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. I 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. I agree that substantial variation in the quality of the price data, the methods used, degrees of judicial scrutiny, and the professional orientation of the sources will result in substantial variation in reliability as perceived by any individual. 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 journals more than other publication outlets that 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.

The data are available in 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.[109] 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.[110] 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.[111] 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.

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[108] Some scholars may have relied on what they judged to be credible journalistic reports of overcharges.

[109] For example, the "nitrogen" cartel is in fact dry salts of nitrogen used as fertilizer, not the gaseous form. The hugely successful "vitamins" cartel is best regarded as a series of overlapping ventures, each of which focused on one of 15 or 16 products.

[110] Episodes are in principle different from phases of cartels that give rise cartels instability. Episodes mark changes in cartel *organization,* whereas stability is measured by changes in the degree of cartel *discipline or cohesiveness.*

[111] In the rare instances where a cartel kept the market price absolutely constant for the whole episode, the two overcharge concepts will be the same number.

Markets

Publications from economists, historians, and related sources yielded useful overcharge or undercharge information on cartels that operated in 262 markets (Table 2). If one group of sellers decided to fix prices 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 262 markets, 35% 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 65% of the cartelized markets[112]. 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.

Table 2. Number of Cartel Markets, by Type

Type	Number	Percent
International membership	91	34.7
National or regional	171	65.3
Bid-rigging schemes	81	30.9
Classic cartels	181	69.1
Cartel found guilty or liable	177	67.6
Currently under investigation (presumed "illegal")	6	2.3
Known to have been operating legally	65	24.8
No record of sanctions (presumed "legal")	27	10.3
Total	262	100.0
Source: Appendix Table 1 (version of 4/4/2005)		

Almost one-third of the sample consists of markets affected by bid-rigging cartels.[113] 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

[112] A few markets were cartelized by both types; typically, a domestic cartel was expanded to respond to foreign competition. The potash cartel is one example; originally German, it became international shortly after World War I because after potash mines in Lorraine became part of France a joint Franco-German scheme was established.
[113] In Europe, bid rigging is generally referred to as collusion involving "tenders."

identical conspiracies. The remaining 69% of the cartelized markets may be called "classic" cartels, those that set market selling prices and/or market quotas for each or its members[114].

Two-thirds of the cartelize markets were found to be in violation of antitrust laws by at least one legal body.[115] The determination of guilt or liability may take the form of guilty pleas (or *nolo contendere* in U.S. courts up until the 1960s), of a decision at trial by judge or jury, of a commission decision to impose fines or other sanctions, of the payments 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, mostly because they operated prior to the enactment of antitrust laws in the jurisdictions in which they functioned. Other legal cartels were organized and registered under antitrust exemptions, such as export cartels or ocean shipping conferences.

In some cartelized markets there are multiple overcharge estimates. There are more estimates than cartelized markets for two reasons. First, about half of the markets experienced multiple phases or "episodes" for which the price effects differed.[116] The sources have distinguished a total of at least 623 episodes (Table 3). This term, which might better be called an observational time period, requires some explanation. Second, for many episodes multiple studies are available. The same episode may have studies of price effects by multiple authors or in several geographic areas.

Episodes

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 earlier cartels the interregnum is a period of contract renegotiation The European-based interwar aluminum cartel (number 18 in Appendix table 1), 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 price-fixing convictions in the fluid milk markets of the Southeastern United States within a few years (Lanzillotti 1996). One may count each conviction as an episode.[117] If one prefers to count the Lanzillotti summary and two other group studies as a three episodes, then the total becomes 420. 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.

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[114] Only a couple of cartels were oligopsonies.

[115] Counted in this category are criminal convictions; adverse decisions of the UK Monopolies Commission, which made recommendations to the government similar to consent decrees; adverse decisions of the European Commission, Parliamentary investigations, and similar civil authorities; and those cartels that paid court-approved damages. Also a few unfinished probes by antitrust authorities are placed in this category.

[116] These episodes are identified in Appendix Table 1 by capital letters following the code numbers that I have arbitrarily assigned for each cartel. Single-episode cartels have numeric coding only. The cartels with multiple episodes have the time spans of the episodes identified by the studies' authors.

[117] However, I was able to extract only eight of these episodes' price effects, plus one overall estimate, from this source. One other study of UK national cartels provided a summary mark-up estimate for 40 cartels. Otherwise, all the other episodes are counted in the manner described.

Table 3. Number of Cartel Episodes, by Type

Type	Number	Percent
International Membership	151	36.0
National	269	64.0
Bid rigging schemes	115	27.4
Classic cartels	305	72.6
Cartel found guilty or liable [a]	283	67.4
No record of sanctions	88	21.9
Under investigation 2003-04	49	11.7
Total	420 [b]	100.0

Source: Appendix Table 1 (version of 10/14/04).
[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.

In general the distribution of episodes across types of cartels (Table 3) is quite similar to the distribution of cartelized markets (cf., Table 2).

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 699 of these estimates.[118] 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. In other cases, an author gives an overcharge for a *representative sub period* of an episode. In the case of international cartels, estimates may be available for multiple regions or currency units during an episode.

Some of the overcharge estimates are said to be *minimum* estimates, and these are shown in the "Average" column of Appendix Table 2 with "+" signs. To be conservative, all such minimum estimates are counted as averages. Some averages are given as ranges, and I have

[118] There are 795 estimates of either 699 average overcharges, 234 peak overcharges, or both. Of the 795, 88% report average mark-ups, 29% report peak mark-ups, and 17% have both types of estimates. Adding both types of estimates brings the total to 933.

preserved these ranges in the appendix tables, but have used the midpoints of the ranges for other tables.

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

Type	Number	Percent
International membership	362	53.0
National or regional	337	47.0
Bid-rigging schemes	141	20.0
Classic cartels	558	80.0
Cartels found guilty or liable [a]	447	63.6
No record of sanctions ("legal")	252	36.4
Total	699	100.0

Source: Appendix Table 1 (spreadsheet dated 4/4/2005).
[a] Included are six cartels still being investigated by authorities.

Second, 234, one-fourth of the 933 overcharge figures that were assembled, are *peak* price effects. In some cases the peak price was reached for only one day during a cartel period of several years; more typically, the peak is 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 was usually straightforward, but in a minority of cases it 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 maximum. I report the peak estimates separately from the average estimates.

SOCIAL SCIENCE STUDIES: RESULTS

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[119] and undercharges drawn from nearly 200 publications.[120] The overcharges refer to at least 674 episodes of cartels that were organized in 237 separate markets. Of these 237 markets, 37% were characterized by international agreements (of which 5% were

[119] As explained in more detail below, 699 of the overcharges are "average" or long-run mark-ups, while the remaining 187 estimates are "peak" or short-run price effects. I analyze the former more often than the latter.
[120] 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.

from intra-EU cartels), while the remaining 63% were national in membership. About one-fifth of the markets were affected by bid-rigging schemes. Finally, roughly 64% of the cartels were found guilty or liable for penalties by a court or commission.

The six periods distinguished in this and subsequent tables were selected to represent increasingly more effective antitrust regimes in the United States and abroad.[121] 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.[122] 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). By and large, economists and other social scientists stood on the sidelines of antitrust-law developments before the 1920s.[123] 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, many 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 in price- or quota-setting. The years 1945-1946 are another logical break point. Again during 1939-1945, nearly all of the interwar international cartels were disbanded. 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. The pace of social-science publications on cartels quickened.

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 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.[124] 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

[121] They are also convenient to chart changes in the historical views toward cartels or in methods of analysis.
[122] There were written laws against price-fixing in ancient times (Assyria, for example), in 15th century England, and in revolutionary France. None is known to have been effective against private hard-core cartels.
[123] The first time the Supreme Court took notice of economists was in the 1925 *Maple Flooring* decision (Kovacic and Shapiro 2000:47).
[124] Even in recent decades, however, there is a notable absence of empirical publications by European economists working out of European research institutions. Obviously, there are many European analysts, most lawyers by training, located in EU and national antitrust authorities' bureaucracies and performing cartel studies, but few of them publish outside of their governments' official organs.

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 at the end of this period.

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

Cartel Episode End Date	Membership		Legal Status		Bid Rigging		Total
	National	Inter-national[a]	Found Guilty[b]	"Legal"	Primary Conduct	Classic Cartel	
	Number						
1770-1890	56	6	25	27	4	58	62
1891-1919	67	38	38	67	10	95	105
1920-1945	9	130	43	96	1	138	139
1946-1973	72	21 (6 EU)	67	26	39	54	93
1974-1990	66	21 (9 EU)	76	11	47	40	87
1991-2004	67	146 (18 EU)	198	15	40	173	213
Total	237	262 (33 EU)	447	252	141	558	699

Source: Appendix Tables 1 and 2 (spreadsheet dated 4/25/2005)

[a] The companies in the cartel were headquartered in two or more countries. EU indicates cartels that operated in two or more Member States after 1958.

[b] One or more members of the cartels pleaded guilty, were fined or otherwise sanctioned by an antirust 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.

Beginning around 1961, the DOJ began seeking guilty pleas from most price-fixing defendants, rather than allowing them to plea *nolo contendere,* which eased the burden of proof for plaintiffs in civil treble-damage suits. Private federal antitrust suits peaked in 1962 as a result of the huge electrical-equipment conspiracy (White 1998: Table 1.1). The number of private cases per year was five times higher in the mid 1960s than the number in the 1940s, and in the 1970s the number tripled from the level in the mid 1960s (*ibid.).* 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.

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 all the present criminal sanctions available to the U.S. government were in place. In 1990, penalties for corporations rose from $1 million to $10 million[125]. 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 whistle-blowers 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. After 1990 the influence of the Chicago School of Economics waned.

Several features of the data set are apparent in Table 5. The number of observations per year averages 3.0, but has generally grown over time. The primary factor that explains the trend is the growth in the number international cartels with usable data.[126] Up until 1890 when price-fixing was legal everywhere in the world, only one estimate is available about every six months on average. After 1890 the number of overcharge estimates found exceeded 3.4 per year in each of the five eras, with a peak of 16.4 per year in 1991-2004.

The first cartel for which price effects can be found is the Coal Gild of northeastern England (also known as the "Newcastle Vend"), which made its first collusive agreement in 1699. This cartel was the longest-lasting cartel found: 145 years. However, it was also quite unstable, with at least a dozen episodes separated by price wars. This cartel depended on coastal shipping for its cost advantage to the London market; it was destroyed in 1845 when railroads lowered the cost of shipping coal from the Midlands.

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 of these 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

[125] Raised to $100 million in April 2004; maximum prison sentences rose from 3 to 10 years.
[126] Although there is a dip in 1946-1990, the correlation between the number of grouped observations per year and a linear time trend is r = +0.80.

were given more publicity because they appeared to be novel forms of business organization.[127] 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. Private suits, where such data is essential to determining damages, were relatively few in the United States until the early 1960s but grew rapidly through the late 1970s (White 1988:Table 1.1).

During 1891-1919, there are 3.8 price observations per year; the rate rises to about 5.6 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.[128] Many of the interwar international cartels were organized as federations of national cartels and were aimed primarily at controlling export sales.[129] 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.[130] 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 covers 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 after 1945. Few international cartels were discovered or prosecuted until the early 1990s -- less than one international cartel episode every two years.

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[127] I know that when the UK, Germany, and the EEC began requiring registration of cartels in the 1950s, hundreds came forth in each jurisdiction.

[128] That is, they had freedom to set prices. In Weimar Germany for a few years after 1923, cartels were regulated. In a few European countries, cartels were required to register with the government.

[129] I do not include national cartels that were fostered by governments (some governments even compelled all the companies in an industry to join) in this data set; likewise, I exclude many international commodity-stabilization schemes that were regulated by government ministries under parliamentary laws or came about because of a multilateral treaty. The second tea cartel in the 1930s, which was authorized by several parliaments of the British Empire and regulated by the Colonial Office, is one example. However, I do include a few international cartels with one or more members consisting in part of government-appointed committee members, government-owned corporations, or government-sanctioned national cartels, if they were formed by a voluntary agreement among the members. An example is the sugar cartel in the late 1930s. Many of the European export cartels also created national monopolies for their members.

[130] U.S. companies apparently believed that patent pooling with foreign firms was legal; others joined cartels indirectly through controlled overseas subsidiaries. These and other subterfuges were judged illegal by U.S. courts.

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. 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 markets with internationally traded goods. The number of overcharge observations exceeds 16 per year, which is triple 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 35% of the observations refer to cartels known to have been prosecuted. Until the mid 1940s, U.S. anticartel sanctions were weak by today's standards. From around the turn of the 19th century American businesspersons became increasingly 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).[131] 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 studied after they 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.[132]

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

[131] Export cartels that in theory did not affect the jurisdiction's commerce were permitted in the United States from 1918 and in most other nations throughout the 20th century.

[132] In the last decade, announcements of probes, guilty pleas, and fines on cartelists are more and more to be found in convenient internet sites and through internet search engines than formerly.

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.

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

Cartel Episode End Date	Membership		Legal Status		Bid Rigging	
	National	International[a]	Found Guilty[b]	Legal or Unknown	Primary Conduct	Other
	Number					
Before 1891	8	2	4	6	0	10
1891 - 1919	4	2	1	5	0	6
1920 - 1945	0	15	1	14	0	15
1946 - 1973	7	1	5	3	3	5
1974 - 1990	1	2	3	0	0	3
1991 - 2003	1	0	0	1	0	1
Total	21	22	15	28	3	40

Source: Appendix Tables 1 and 2 (spreadsheet dated 10-23-04).

[a] Cartels with corporate members from two or more countries. Those with all members from the EU shown separately.

[b] At least one member of the cartel pleaded guilty, was found guilty at trial, paid civil antitrust fines, or made a monetary settlement with plaintiffs in a private suit.

Table 5A displays the number of observations of overcharge observations for what will be termed "unsuccessful" cartels – those with zero average overcharges. These zero-effect estimates will be eliminated from some of the analyses below. About 6% of the average-overcharge data collected indicate that a cartel episode was unsuccessful in controlling prices, but the proportion of all average estimates that are zero declines over time. Studies of allegedly unsuccessful cartels were published almost entirely prior to 1945. Fewer than 1% of the most

recent cartels are judged to be unsuccessful. It appears that the skepticism of earlier analysts about the power of cartels has nearly disappeared in the last 50 years or so.

Trends in Average Overcharges over Time

Table 6 displays the medians of all average overcharges reported, distinguished by the same time periods and types shown in Table 5. Table 6A repeats Table 6 but eliminates the episodes with zero price effects; nearly all of the zero observations come from classic cartels that ended before 1973 and from studies written before that time. 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 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%; for successful cartels it is 30.5%. Perhaps surprisingly, cartels that ended before the Sherman Act was promulgated were not as a group highly successful in raising prices. The below-average overcharges observed in the first era may be explained by the preponderance of "national" cartels, most of them domestic in geographic scope. International cartels did not become common until after 1900. In this paper's data set, only three international cartels ended before 1900.[133]

Beginning in 1891 there is a strong downward trend in overcharges by international, sanctioned, and non-bid-rigging cartels, but there is a weaker downtrend for the other types.[134] The downward time trends are similar but slightly stronger among the successful cartels (Table 6A). 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.[135] 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 in all but the most recent period.[136]

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[133] In Appendix table 2 see the first episodes of the zinc cartel (number 68), copper (22), and gem diamonds (71).

[134] The correlation of median overcharges of all cartels to a linear time trend of the grouped data in table 6 is r = -0.47; for international cartels, the correlation is r = -0.72; similarly, among cartels found guilty, the coefficient is r = -0.81; and for the "classic" cartels r = -0.61. These trends are confirmed in a more formal analysis (Connor and Bolotova 2005).

[135] 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.

[136] This last observation should be ignored because there is only one legal cartel formed after 1990.

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	
	Median percent [a]						
1780-1890	21.0	40.5	16.0	24.4	16.0	22.4	22.1
1891-1919	19.0	49.5	24.5	35.0	24.5	35.0	30.4
1920-1945	27.0	36.9	44.0	31.6	44.0	31.6	35.0
1946-1973	14.7	28.2	13.0	19.5	13.3	23.3	15.3
1974-1990	19.8	40.8	23.0	26.7	23.0	37.0	25.0
1991-2004	22.5	25.0	17.1	25.0	23.9	21.5	25.0
ALL YEARS	19.3	31.6	18.9	27.0	23.8	29.5	25.0

Source: Appendix Table 2 (spreadsheet dated 4/27/2005).
[a] Mean of the medians of the lower bound and the upper bound of ranges, where appropriate. Includes zero estimates. See Table 5 for the numbers of observations in each cell.

Table 6A. Median Average Overcharges of Successful Cartels, by Year and Type

Cartel Episode End Date	Membership		Legal Status		Bid Rigging		All	
	National	Interna-tional	Found Guilty	"Legal"	Primary Conduct	Other	Types	
	Median percent [a]							
1780 - 1890	24.5	50.8	16.2	28.4	22.0		28.7	26.5
1891 - 1919	20.5	50.0	38.1	31.6	24.6		38.0	34.0
1920 - 1945	27.0	40.7	34.0	40.0	44.5		37.5	39.5
1946 - 1973	15.5	38.9	14.4	23.0	15.0		26.3	18.8
1974 - 1990	20.8	41.5	23.0	28.5	25.0		37.0	25.0
1991 - 2003	22.5	25.0	17.1	25.0	24.0		21.5	25.0
All dates	21.0	34.0	19.0	29.1	24.0		31.0	30.5

Source: Appendix Table 2 (spreadsheet dated 11-02-04). Excludes zero overcharges.
[a] Mean of the medians of the lower bound and the upper bound of ranges, where appropriate.
[b] Cell contains only one observation. See Tables 5 and 5A for numbers of observations.
-- = Not available

It is difficult to know what to make of the downward trends for some types of cartels. Globalization and shifts in international trade regimes do not seem to be likely explanations. Trade and investment were relatively unfettered prior to 1920 and after 1990. Trade restrictions were high in the 1930s. The pattern of median overcharges does not correspond to shifts in trade regimes.

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. 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. Perhaps expected profit rates in cartelized industries have declined as an effect of globalization, and those companies that join cartels are satisfied with smaller percentage increases from collusion. 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; that incompetence could extend to the skills needed to negotiate relatively high selling prices. 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.

Average Overcharges across Types

A second pattern that emerges in Tables 6 and 6A is 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 about twice as effective as domestic ones (Table 6A). This is not so surprising in the pre-World War II era because most 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. After 1990 the superior effectiveness of international cartels narrowed considerably.

A third 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. On average bid-rigging schemes displayed 20% lower overcharges, but this pattern is found in only four of the six periods. Bid rigging cartels often were organized to exploit tenders for government public-works projects. Relatively few international cartels engage in bid rigging, whereas bid rigging occurs mostly in national or local conspiracies, so the bid rigging/classic

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.

It is noteworthy that by far the lowest overcharges to be found in Tables 6 or 6A are those for national, guilty, and bid-rigging cartels that ended during 1945-1973. Most of these conspiracies were discovered and prosecuted by the U.S. Department of Justice. It is reasonable to assume that many of these cases are the cartels that were analyzed by the DOJ's staff prior to the DOJ's making its guidelines' recommendations to the U.S. Sentencing Commission. An analysis of the 20 U.S. litigated bid-rigging cases that ended between 1956 and 1985 finds that the median overcharge was 13.3% and the mean 17.3%.[137] These averages are low by historical standards. Thus, the "10% overcharge assumption" embedded in the Guidelines was not so much wrong as short sighted.

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

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 63% of the cartel episodes have overcharges above 20%.[138] The mean overcharge of the 37% of the episodes in the two lowest size ranges (0.1 to 19.9) is 11.1%. *These are the cartels imagined to be typical by the creators of the U.S. Sentencing Guidelines.* The 63% of the cartel episodes with overcharges of 20% or higher have a mean overcharge of 64.0%, 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.

[137] There were 24 observations (see Appendix table 2). Looking at the same sort of cases ending in 1956-1965 results in a 17.9% median and 21.2% mean. There were very few classic cartels prosecuted in the same period (only 3); the median overcharge was 15% and the mean 19%.

[138] Note that from a legal perspective, each episode is an actionable offense.

Table 7. Mean Average Overcharges by Size Category

Percentage Range [a]	Number of Observations	Distribution of Observations		
		Mean	Total	Non-Zero
	Number		*Percent*	
Zero or less [b]	44	0	6	0
0.1-9.9	101[c]	6.6	15	16
10.0-19.9	135	14.4	19	21
20.0-39.9	203 [d]	28.9	29	31
40.0-59.9	101[e]	47.9	16	17
60.0-79.9	47	68.5	7	7
80.0-99.9	12	89.5	2	2
100.0-199.9	26	128.9	4	4
200 or greater	19	422.2	3	3
Total	699	42.1[f]	100	100

Source: Appendix Table 2 (spreadsheet dated 4/4/2005).
[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] 71 are 25.0% or lower and 132 are 25% or higher.
[e] Fifteen estimates of 50% are from Eckbo (1976).
[f] Excluding zeros, the mean is 45.0%.

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.[139] 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 may be somewhat more effective 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.[140] 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. Compared with the data available for the average overcharges in Table 5, these data are over-weighted by observations taken from the interwar period. Approximately one-fourth of the 234 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. Almost 30% of the observations on peak prices are for the period since 1991.

Like the average overcharges discussed above, there are some notable trends in peak effectiveness over time. In all but one of the six periods international cartels achieved much higher peak overcharges than the cartels with members from only one nation; similarly, unsanctioned cartels displayed much higher peak price mark-ups than cartels that were legally punished; finally, price-fixing cartels demonstrated somewhat higher price effects than bid-rigging schemes up to 1945, but the two types were about the same after 1945 (Table 8). Looking at the six columns of Table 8, the only significant temporal patterns are declines in peak overcharges by international cartels and the "legal" cartels.[141]

[139] There is no need to examine effective cartels separately, because nearly all of the peak price effects are non-zero.
[140] Peak price changes may Ill be affected by short-run shifts in demand. Exogenous, unanticipated shifts in demand may exaggerate the peak price changes. However, in some cases these shifts are endogenous. Especially when a Ill financed cartel felt free to announce a new agreement that buyers perceived as likely to be effective, "panic buying" often ensued, which leveraged the purely collusive effect on prices.
[141] The simple correlation coefficients over time for the grouped international-cartel overcharges are -0.57 (1891-2004) and -0.76 (all six periods); for the unsanctioned cartels they are -0.66 (1891-2004) and -0.48 (all periods).

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
	Ratio of Medians [a]					
1770 - 1890	1.25	2.58	1.16	1.67	1.46	1.77
1891 - 1919	1.38	1.55	1.36	2.21	--	1.52
1920 - 1945	1.96	1.83	1.94	1.96	1.47	1.88
1946 - 1973	1.93	1.82	2.49	1.37	3.98	1.78
1974 - 1990	1.75	1.46	1.33	1.26	1.56	1.26
1991 - 2004	1.42	2.34	2.19	2.74	1.41	2.32
ALL YEARS	1.82	1.87	2.22	1.92	1.95	2.00

Source: Appendix Table 2 (spreadsheet dated 4/29/2005)
-- = Not available
[a] The ratio of the median peak overcharges to the median full-period overcharge for those cases when both are known and positive.

ALL YEARS	31	64	39	61	32	49

Source: Appendix Table 2 (spreadsheet dated 4/4/2005). There are 234 observations.
[a] Fewer than four observations.
[b] Fewer than six observations.

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
	Median percent					
1770 - 1890	38	105	19	55	38 [b]	51
1891 - 1919	19	85	33	72	--	37
1920 - 1945	45	73	34 [a]	69	53	72
1946 - 1973	55	36	49	43	46	46
1974 - 1990	35	64	35	39	35	39
1991 - 2004	28	58	24	56	52	47

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. Given the manner in which these ratios were computed, a high number indicates that overcharges were quite variable during the episode being observed. A ratio close to one reveals a cartel that was successful in holding its collusive price *flat* or steady for the affected period. That is, low ratios may be interpreted as cartels that achieved few operational problems. There are no significant trends in these ratios over time, nor are there differences among cartel types in stability in fixing prices.

These data are relevant for assessing whether cartels intended to maximize price increases or to control *variation* in their collusive prices. Apologists for cartels, particularly those writing about them during the Great Depression, tended to assert that cartels did not aim to raise prices so much as stabilize prices.[142] The cartels that should fit this pattern are legal, international cartels that ended between 1920 and World War II. However these cartels achieved no greater price stability than those before and after. This result is inconsistent with the positions of Marlio (1947), Pyndyck (1979), and some other scholars about cartel objectives.

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 all or the great majority of the cartel's managers, not necessarily the cartel's field of operations because export cartels are categorized in their country of origin. If a cartel was composed of member companies with headquarters in only one country or one continent, while others have established 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 under the appropriate row. 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 across multiple Western European countries have the highest overcharges, but curiously those organized within national boundaries in Western Europe were as a group the least successful. North American conspiracies were also quite low. Median overcharges for Asian and global conspiracies were well above average.

Overcharges and Market Size

A commentary in the USSGs asserts that there is an inverse relationship between the size of affected sales and the height of the overcharges achieved by cartels. No conceptual or empirical

[142] As prices were generally falling, "stabilization" may in fact have been equivalent to preventing weak demand from causing prices to decline. See, for example Plummer (1934).

justification is provided for this assertion. Studies of cartels available to the Commission analyze neither factor (e.g., Hay and Kelly 1974, Asch and Seneca 1975, Fraas and Greer 1977, Posner 1970). Eckbo's (1976) and Griffin's (1989) studies have information on price effects but do not link them to cartel size. Finally, it is unclear how this alleged relationship ought to affect the design of appropriate sanctions for cartel violations.

Table 10. Average Overcharges by Cartel Headquarters Location

Principal Location of Cartel Managers	Number of Estimates	Average Overcharge	
		Median percent	*Mean percent*
Multiple nations of W. Europe	124	42.8	54.4
Global	165	29.0	53.0
Asia	48	28.9	53.8
USA and Canada	221	22.3	29.8
Australia, Africa, So. America, E. Eur.	23 [a]	21.5	23.9
Single nations in W. Europe	118	16.8	35.6

Source: Appendix table 2 (spreadsheet dated 4/4/2005). Includes zero overcharges.
a) Only 13 episodes available.

Nevertheless, I decided to try to examine whether this curious hypothesis might be valid. The only appropriate data of which I am aware are those contained in Connor (2003: Tables A.1 - A.12). This working paper has developed affected sales and overcharge data for a minority of modern international cartels; approximately 92 pairs of such data are available; sales are in current U.S. dollars and generally fall into the decade of the 1990s. Correlation statistics were calculated for a number of sub samples.[143] The first sample of 50 cartels examined the largest geographic market for each cartel; the coefficient was not significantly different from zero ($r = -0.105$). To see whether extreme observations might unduly affect the result, I repeated the experiment but dropped first all cartels with $5 billion in sales or more and second all cartels with overcharges of 65% or higher; in both cases r became closer to zero (-0.065 and +0.019, respectively)., which indicates that extreme observations do not account for the low correlations found. Finally, I examined geographic sub groups of the cartels: global, U.S., EU and other single national markets. The correlations for these four samples varied from -0.17 to +0.24, none statistically significant.

[143] The simple correlation coefficient r takes a value of unity when pairs of numbers are perfectly aligned positively or negatively and a value of zero when unrelated.

There is no empirical support for the market size-overcharge connection. The policy implication is that there is no justification for going proportionately easy when sanctioning the largest cartels.

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.

The task in the remainder of this section is to learn whether the various overcharge estimates are sensitive to the methods, data sources, time period, or disciplines of the authors. To do so, three approaches are taken.

Sources of the Estimates

Confidence in the estimates may be judged in part by the 267 sources from which the estimates were derived. A single source often provides multiple estimates (e.g., Stocking and Watkins 1946). The single most common type of source is 96 adverse antitrust decisions by U.S. courts (33 decisions), the European Commission (17), by the antitrust authorities of seven nations (28), and three reports of the OECD (18) (Table 11). In many instances the decision contains an explicit rendition of the overcharge, but in others the decision shows the price effects that were generated by the cartel.

The second most frequent source of estimates is papers in peer-reviewed journals, 83 articles in all. Nearly all of these journals are in the discipline of economics, law and economics, or economic history. Social scientists typically accord a high degree of credibility to peer-review outlets. The third most frequent source is 58 books or chapters in books. Some have a degree of peer review, but this practice varies by publisher and author; a few began as university essays or dissertations. The great majority of the books were authored by academics, but a couple of books were written by parties to a suit (e.g., Bane 1973, Sultan 1974), and a few were

written by investigative journalists (Gray 1982). A high but unknown share of the more recent articles and books were written by economists who served as experts in litigation.

Minor sources include six government reports (three by the League of Nations), 20 economic working papers, one speech, and three magazine articles.[144] Many of these sources are subject to internal reviews by department supervisors or senior editors, but the reviews are not usually blind ones. Some of the working papers are subject to rigorous review, but most are the authors' responsibilities.

Table 11 shows the types of ultimate sources for each of the estimates. By "ultimate source" is meant the original study from which the estimate was quoted or derived; for example, if a book chapter cites or interprets a legal decision, the latter is the ultimate source. The units of observation are the estimates, not the sources.

Table 11. Numbers of Social-Science Sources and Overcharge Estimates

Source Type	Number of Sources	Estimates	
		Number	Percent
Peer-reviewed academic journals:	**83**	**170**	**22.8**
1. Economics, economic history		149	20.2
2. Other social science		14	1.9
3. Law		7	1.0
Books and monographs:	**47**	**241**	**32.4**
1. Academic authors and editors		213	28.6
2. Journalists		2	0.3
3. Interested parties or unknown		26	3.5
Chapters in edited books:	**11**	**54**	**7.3**
Government reports	**6**	**23**	**3.1**
Court or commission decisions [a]	**96**	**146**	**19.6**
Economists' working papers	**20**	**106**	**14.2**
Newspapers, magazines, speeches	**4**	**4**	**0.1**
Total	**267**	**744**	**100.0**

Source: Appendix Table 2 (spreadsheet dated 4/27/2005). Includes either average or peak estimates; those with both are not double counted.

a) There are 33 U.S. court, 17 European Commission, 8 UK, 8 Taiwan FTC, 4 Japan FTC, 4Korean FTC, 2 China Monopolies Commission, 1 Swedish, and I French decision. Interpreted by social scientists and legal scholars.

[144] Only magazine articles favorably cited by experts are included.

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 63% of the total. In addition, 14% of the estimates were taken from economist' working papers and conference presentations, most of which were distributed in the last few years, examined modern international cartels, and appear to be intermediate versions of book chapters and journal manuscripts.[145] The majority of the government reports 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. Decisions of courts of law and competition-law commissions are subject to the review of higher courts. In sum, 775 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 higher institutional reviews.

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[146]. 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; moreover, there is a trend away from evaluating cartels from the point of view of the theory of pure monopoly to a more sophisticated and nuanced view informed by game theory and other conceptual advances in industrial economics. Because in previous sections above differences in average overcharges were found over time, I also disaggregate the data by the cartels' termination dates.

The results of this temporal analysis are displayed in Tables 12 and 12A; the discussion will focus on the successful cartels. The publications are classified according to four periods that correspond roughly to milestones in social-science analysis of cartels. The era prior to 1946 is marked by studies that betray a relatively undeveloped understanding of oligopoly theory, some confusion about essential nature of private cartels, and the absence of statistical methods of analysis. Various authors would confuse cartels with "combinations" (mergers and acquisitions), unified firms with monopoly power, and large diversified or multinational corporations – categories now viewed as distinct economic phenomena. In the earlier years when antitrust enforcement was weak or nonexistent, many writers failed to see the necessity of distinguishing voluntary agreements to restrict trade from wholly compulsory arrangements. In 1946, with the appearance of the landmark studies of Stocking and Watkins (1946, 1948) cartel

[145] Several of them have notes to that effect.

[146] Alternatively, one might infer that analysts may have increasingly employed techniques that have won court approval as forensically reliable (see Connor 2004a).

Table 12. Average Overcharge Estimates by Publication Dates

Cartel Episode End Date	Publication Date of Study				
	Before 1945	1945-1970	1971-1989	1990-2004	Number
		Percent			
Before 1891					
Median	22.0 [35]	25.1 [4]	19.5 [9]	30.0 [14]	62
Mean	25.6	39.4	24.7	29.6	
1891-1945					
Median	26.0 [103]	42.7 [79]	43.9 [34]	29.0 [31]	247
Mean	49.1	76.1	44.4	38.9	
1946-1990					
Median	–	24.0 [17]	20.0 [90]	18.7 [72]	179
Mean	–	36.4	29.2	37.4	
1991-2003					
Median	–	–	–	25.0 [211]	211
Mean	–	–	–	37.9	
Number	138	100	133	328	699

Source: Appendix Table 2 (spreadsheet dated 4/4/2005).
Note: Superscripts indicate sample size in cell.

studies moved to a higher level of analytical rigor. These studies and those that followed had the advantage of at least a decade of rapid developments in oligopoly theories that loosened economists from their sole dependence on the twin concepts of pure competition and pure

Table 12A. Average Overcharge Estimates by Publication Dates, Successful Cartels

Cartel Episode End Date	Publication Date of Study			
	Before 1945	1945 - 1970	1971 - 1989	1990 - 2003
	Median percent			
	Mean percent			
1770-1890	25 [31]	25 [4]	21 [8]	50 [9]
	29	39	31	46
1891-1945	30 [91]	44 [74]	44 [34]	29 [31]
	55	81	44	39
1946-1990	–	24 [17]	23 [80]	19 [71]
	–	36	33	38
1991-2003	–	–	–	25 [210]
	–	–	–	38

Source: Appendix Table 2 (spreadsheet dated 11-02-04).
Note: Superscripts indicate sample size in cell. "Successful" means non-zero overcharge.

monopoly, thereby sharpening the understanding of collusive behavior in general and the distinctions between overt and tacit collusion.[147] By the 1970s and 1980s, further advances in oligopoly theory were being made (though had not yet been integrated into the consciousness of most empirically oriented economists), the "Chicago School" of economics was having an impact on the field, and quantitative statistical methods first came into widespread use by economists and economic historians.[148] By about 1990 or so, knowledge of game theory pervaded the modeling efforts and empirical research of professional economists; moreover, a reassessment of the Chicago-School challenge had asserted itself.

Table 12A demonstrates some interesting trends, but provides no evidence for concluding that overcharges vary systematically over time. Looking initially at cartels that ended in the pre-antitrust era, one sees that contemporary and early writers about these cartels arrived at moderate estimates of cartel price effects – a median estimate of 25%. Studies prior to 1990 continued to calculate a similar or lower median price effect.[149] However, 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 50%.[150]

A pattern of virtually constant median estimates is evident for the cartels that were active after the Sherman Act became law but ended before 1990. The second category is dominated by the international albeit Eurocentric "interwar" cartels, many of which were revivals of similar legal export cartels operating before World War I. Both contemporary chroniclers of these interwar cartels and studies published since 1990 were equally conservative in their evaluation of price effects. For those cartels ending between 1945 and 1990 (many of them bid-rigging agreements), there appears to be no tendency for estimates of median price increases associated with cartel behavior to change as publication dates become more contemporary.

The analysis presented in Tables 12 and 12A is suggestive but has many shortcomings, principally because many other things could be changing over time besides the analytical approaches of various writers. Averaging could mislead because the samples of cartels (even those ending in the same broad periods) change as the publication periods change. To remedy these defects I present a second analysis of the sensitivity of overcharge estimates to analytical approach.

Publication-Type Comparisons

[147] Two books on oligopoly published in 1933 are often cited as the beginning of industrial-organization economics as a distinct field.

[148] Although an article published by Joe Bain in 1951 is usually credited as the first statistical study in industrial economics, such methods were uncommon in cartel studies until the very late 1960s.

[149] The samples of cartels in each time period overlap, but are not identical. I will correct for changes in the sample immediately below.

[150] Note that the mean does not fluctuate over time for the earliest group of cartels, but I regard the mean as less indicative of central tendency than the median.

Table 13 examines whether median overcharges vary by type of publication and prosecution status. Using peer-review journals as the basis of comparison, estimates of overcharges tend to be higher in other types of publications for guilty cartels that ended prior to 1946; for unsanctioned cartels the opposite is true. However, for more contemporary cartels, studies in journals tended to produce similar estimates to other publication types.

Table 13. Median Average Overcharges by Publication and Cartel Type

Publication Type	Cartel Year and Cartel Prosecution Status					
	1888-1945		1946-1973		1974-2004	
	Guilty	Legal	Guilty	Legal	Guilty	Legal
	Percent					
Peer-reviewed journal	10	30	17	7*	23	22
Book	29	32	13	23	23	15
Book chapter	56	20	--	74*	18	43
Government report	21*	13	16*	0*	30*	50*
Official decision	51	--	13	--	25	--
Other	39*	--	14*	0*	24	28*

Source: Appendix Table 2 (spreadsheet dated 4/4/2005).
- - = Not available
* = May be unreliable because fewer than 7 observations.

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 one cartel episode at a time. Recall that a cartel episode refers to a single market, time period, and form of cartel organization. This check on reliability requires us to examine only those episodes that have two or more estimates derived

from at least two of seven different methods.[151] Only 91 episodes (about one-third of the total) are available, because the majority of the cartel episodes have only one study using a uniform method of overcharge estimation.

There are 291 pairs of observations available for this analysis of reliability. I have identified six general methods of estimation. In the full sample of 674 average overcharges, the most widely used (45% of the total) 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 benchmark prices refer to periods before the cartel began its operation, after the cartel ceased its activity, or a period during the affected period when there was a brief breakdown (a disciplinary price war perhaps) in full collusion. The base periods require judgment on the part of the analyst, because the but-for period ought to be as free from demand or supply conditions not observed during the collusive period as possible. 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 2004). Sixth, approximately 10% of this study's estimates are quotes from or interpretations of decisions made by antitrust authorities. Finally, about 10% of the estimates are given by writers who did not explain their methods; these unspecified estimates are mostly from archival sources studied by economic historians, from legal-economic studies by antitrust specialists, or from books written by journalists that summarize estimates provided by anonymous sources close to a lawsuit involving a cartel. In general, these unspecified estimates are produced by non-economists writing without the benefit of anonymous peer review, whereas the other five methods are studies written by professional economists.[152] One may speculate that most of the unspecified estimates are before-and-after comparisons.

In Table 14 each entry in a cell is constructed by taking the median estimate of the method listed in the first column and dividing that number by the corresponding median estimate that used the method in the heading of the table. All possible ratios are calculated with the median ratio shown. A median ratio of one indicates that there is no difference between methods on average. Several of the median ratios are drawn from such small sub samples that I refrain from drawing any conclusions.

A general comment about the ratios is that nearly all of them lie between 0.5 and 1.5 and most are close to unity. This demonstrates that by and large different authors and different methods applied to identical cartel episodes do not result in markedly different estimates. The

[151] In a small number of cases, a particular study may offer more than one approach to the study of a cartel episode, but in the vast majority of cases the estimate being compared are taken from studies by different authors typically writing at widely separated times.

[152] There are several notable exceptions to this dichotomy. Eckbo, a Ph.D. economist, did not in explain his method; several estimates of overcharges by economic historians use state-of-the-art analytical methods; and some of the aluminum cartel's "economic" estimates were drawn from a businessman's memoir (Marlio)

Table 14. Median Rates of Estimates for Same Episodes by Different Methods

Numerator Method	Denominator Method						
	Unspec-ified	Before and After			Cost Based	Yard-stick	Econo-metric
		Price Before	Price During	Price After			
	Ratio of medians [a]						
Unspecified	1.00	1.15 [32]	- - [1]	0.88 [9]	1.34 [3]	1.31 [20]	0.45 [20]
Price before cartel	0.87 [32]	1.00	0.92 [5]	1.38 [52]	1.38 [11]	1.20 [24]	0.44 [46]
Price during cartel	- - [1]	1.09 [5]	1.00	0.45 [2]	2.22 [3]	5.33 [12]	- - [0]
Price after cartel	1.14 [9]	0.73 [52]	2.23 [2]	1.00	- - [1]	0.59 [2]	0.32 [11]
Cost or profit	0.74 [3]	1.38 [11]	2.22 [3]	- - [1]	1.00	- -	0.60 [7]
Yardstick	1.36 [20]	0.77 [21]	6.70 [10]	- -	- -	1.00	0.57 [4]
Econometric model	0.54 [21]	0.51 [45]	- -	0.32 [11]	1.66 [7]	1.76 [4]	1.00

Source: Appendix Table 6 (spreadsheet dated 10-28-04). - - = Fewer than three pairs available

[a] Ratio of median overcharges using method in left column divided by the median based on method above. Superscripts indicate numbers of pairs.

Table 14A. Median Ratios of Estimates for Same Episodes but Different Methods (Simplified)

Numerator Method	Denominator Method				
	Unspecified	Before and After [a]	Cost Based	Yardstick	Econometric Model
			Ratio of medians [b]		
Unspecified method	1.00	0.93 [38]	0.74 [2]	0.72 [20]	1.86 [21]
Before and after	1.08 [38]	1.00	0.78 [15]	0.68 [33]	2.01 [66]
Cost based	1.34 [2]	1.29 [15]	1.00	2.10 [1]	0.60 [7]
Yardstick	1.39 [20]	1.48 [33]	0.48 [1]	1.00	0.57 [4]
Econometric model	0.54 [21]	0.50 [66]	1.66 [7]	1.76 [4]	1.00

Source: Appendix Table 2 (spreadsheet dated 10-28-04).

- - = No pairs available

[a] Ratio of median overcharges using method in left column to medians based on method above. Superscripts indicate numbers of pairs.

correspondence among the three before-and after methods is quite close.[153] Therefore, in Table14A all of the before-and-after methods are treated as one method.[154] In this table, all the ratios are between 0.5 and 2.0. Nevertheless there are three differences worth commenting on.

First, the eclectic estimates that termed "unspecified" are on average quite close to the before-and-after price method. There are 38 pairs of observations, and the median unspecified estimate is only 8% lower than the median before-and-after estimate for the same cartel episodes. Moreover, when the top row of unspecified estimates are compared to the three other estimation methods (cost, yardstick, and econometric), the pattern is quite similar to the pattern in the second row of table 14A. This confirms a guess made earlier that most of the unspecified estimates probably employ the before-or-after method.

Second, another 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. In principal, econometric models are simply more formal and precise ways of applying the before-and-after method. 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. An example of such a situation is when a cartel's formation is preceded by a predatory price war that forces the pre-cartel price to unsustainably low, sub competitive levels (Connor 2004). The before-and-after method does not lend itself easily to adjustments for such subtle influences as seasonal demand and currency exchange rates.

Third, compared with the before-and-after, the cost-based and yardstick techniques yield relatively high overcharge estimates.[155] 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.

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[153] But not perfect. The overcharge estimates developed by comparing the cartel-affected price with a *pre-cartel* price are lower than those constructed from a *post-cartel* price. The ratio of 46 paired comparisons is 0.70. This result is unexpected, because it implies that post-cartel prices are lower than pre-cartel prices. Post-cartel real prices are sometimes observed to be higher than the pre-cartel price; speculation as to why has centered on institutional features of markets (e.g., long-term supply contracts) that cause price declines to lag or on the possibility that the learning involved in cartel cooperation translates into more effective tacit cooperation after a cartel is dissolved (Connor 2001). Other scholars have noted the incentive that former cartelists have to keep their prices high during the post-conspiracy period when they are negotiating a settlement for private damages (Harrington 2004). On the other hand, post-cartel prices have sometimes been lower than pre-cartel prices because the cartel was preceded by a sharp price decline and because exposed cartel members may try to repair customer relations with favorable prices. It appears that the latter forces outweigh the former.

[154] This approach increases the number of paired observations slightly.

[155] These two methods seem to be conservative relative to statistical modeling, but the number of pair-wise observations is quite limited.

Sensitivity to Peer Review

As one further test of reliability, I examine whether the average overcharge estimates are sensitive to type of review given to a particular study. One might expect peer review to rein in exaggerated or unsubstantiated overcharge estimates. In the "peer-review" category I include academic journals, dissertations, explicit court and commission decisions, and reports issued by the OECD. This is a restrictive concept of peer review, because doubtless some of the books and chapters from conference proceedings were also peer reviewed. Furthermore, to allow for improvements in analytical rigor over time, I distinguish three time periods separated by the years 1946 and 1974. Finally, I divide the observations into those cartels that are known to have been legally sanctioned and those not sanctioned.

The results are shown in Table 15. Peer review does not systematically produce lower estimates of overcharges. To simplify the comparisons, let us look at the median overcharges of the two largest sources: journal papers and books. In four of the five instances, peer-reviewed-journal estimates are larger or about the same as estimates from books. For example, in the case of convicted cartels ending 1946-1973, peer-reviewed studies display slightly higher average overcharges (34% versus 33%).

Perhaps the strongest finding is the contrast between convicted and other cartels. In the vast majority of comparisons, the unsanctioned and presumptively legal cartels generated higher price mark-ups. This finding has significant implications for anticartel policy, because it suggests that *ceteris paribus* less effective cartels are the most likely to be caught and sanctioned. It also suggests that there is a large social payoff from increasing the probability of cartel detection.

Table 15. Average Percentage Cartel Overcharges, by Legal Status and Type of Study

Date of Publication	Convicted Cartels [a]							Legal and Unsanctioned Cartels							
	Peer Reviewed			Other				Peer Reviewed			Other				
	J	G	D	B	C	W	O	J	G	D	B	C	W	O	
	m*edian*														
	mean														
Before 1946	--	21^{3}	37^{8}	23^{43}	--	--	--	29^{21}	10^{12}	--	30^{49}	30^{1}	--	--	
	--	19	33	64	--	--	--	32	21	--	40	30	--	--	
1946-1973	34^{3}	--	12^{20}	33^{25}	--	--	7^{1}	44^{8}	--	245^{6}	33^{54}	5^{1}	--	--	
	27	--	68	64	--	--	7	40	--	225	43	5	--	--	
1974-2004	19^{96}	21^{6}	25^{99}	33^{31}	52^{11}	24^{96}	63^{2}	30^{42}	50^{1}	--	23^{15}	23^{38}	25^{3}	28^{1}	
	27	150	37	32	62	34	63	51	50	--	25	42	18	28	

Source: Appendix Table 2 (spreadsheet dated 4/4/2005).

[a] At least one closely related episode was subject to an adverse decision of a court or antitrust authority.
Note: J=Peer reviewed academic journals, G=government publications, and D=court and commission decisions (including those reported to the OECD). B=books, C=chapters, W=working papers by academics, and O=other (journalistic, speeches, etc.). Superscripts are number of observations.

U.S. COURT VERDICTS

Results

The results of the survey of final verdicts in collusion cases are that the 25 collusion episodes had a median average overcharge of 21.6% and a mean average overcharge of 30.0% (Appendix Table 4).[156] The 9 cases that reported peak overcharges produce a median peak overcharge of 71.4% and a mean peak overcharge of 130%. All but 5 found that the cartel had raised prices by more than the USSC's 10% benchmark. Due to the small number of final verdicts it would not be meaningful to analyze these verdicts in even smaller groups, e.g., there were only find 8 final verdicts involving bid rigging episodes, so it does not seem worthwhile for this article separately to report the median or mean figures for bid rigging cartels.

Reliability

How useful are the decisions of judges and juries in answering the question of how high cartels raise prices? Their verdicts are of course based on the opinions of the competing expert witnesses, who come to radically different conclusions about the size of the damages involved.[157] Both sides make their presentations and the finders of fact decide which expert is more believable on particular issues (with plaintiff having the burden of proof).[158]

This may or may not be the best way to determine which expert witness's conclusions are more accurate since many skills besides facts and economic reasoning can play a role in the judge or jury determination. While the common law system of jury and judge verdicts is far from perfect, it is the system the nation has chosen to use in a wide variety of life and death decisions affecting society.[159] Since the United States long has continued to use this system,[160] our nation has made an implicit decision that judges and juries are the best way to arrive at the truth the largest percentage of the time. I know of no way to prove whether judges or juries achieve results better than those of the economists who publish studies in journals and books.

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[156] For a discussion of the merits of examining only final verdicts, see Connor and Lande (2004).
[157] It is extremely unlikely that there has ever been even a single antitrust case where experts for opposing sides agreed upon the amount of damages. Similarly, although there is no evidence for the allegation, the economic studies reported elsewhere in this article are open to the charge that some of the authors' and their methodology are biased. Occasionally, judges appoint special masters to advise them on the damages.
[158] Moreover, the likelihood and size of damages also will depend upon the absolute and relative abilities of the defending and prosecuting counsel. It is an open question whether defendants or plaintiff are likely to have the best legal representation on average.
[159] While it may be true that some juries and trial or appellate judges juries are not objective, the burden of proof should be on those who would assert that the overall system, including its appeals, has a systematic bias, or that an alternative approach to answering the question of how high cartels raise prices would be superior.
[160] In other nations with admirable judicial systems, judges or judicial panels are the vehicles of decision making in antitrust cases, which are typically are civil matters.

Neither sample is perfect: each has it strong and weak points. But since the question of how high cartels raise prices is an important one that deserves as reliable an answer as can be ascertained, this method deserves consideration. And, since our two major approaches reinforce one another, the credibility of both is strengthened.

Further, since such a large percentage of cases settle, one reasonably might ask whether the few that do not settle are in some manner different from those that do. Since the motivations for settling and not settling are so varied, one can only speculate as to the biases involved.

Are there likely to be any significant systematic differences between cases that settle and those that do not? Is there reason to believe that classes of cases for which settlement will be less likely - such as in cases where the parties have different expectations as to what the outcome is likely to be - when the overcharge percentage is especially high? As examples I will present two contrasting possibilities. First, it certainly is possible that for cases when the cartel overcharged by a large percentage the defendants might reason that plaintiff is likely to be able to prove at least some overcharges to the fact finder's satisfaction. Defendant might be more likely to settle these cases.[161] Alternatively, it could be true that a small overcharge percentage -- less than 5% -- might be too small for plaintiff successfully to distinguish from purely random movements in prices. If plaintiffs believed that defendant had increased price by 4%, but knew that it would be extremely difficult to prove this, they would be less likely to sue.[162] As these examples illustrate, one can speculate as to why a survey of verdicts could be biased in either direction. While one should certainly acknowledge this method's potential flaws, I know of no reason to believe that it is either systematically biased or unreliable, or why this unreliability would shift the results in a particular direction.

DECISIONS OF OTHER ANTITRUST AUTHORITIES

Table 16 assembles 171 average overcharge estimates that originated from adverse cartel decisions by antitrust authorities: final judgments of U.S. courts and administrative decisions of commissions around the world. In some cases the method of estimation is not known, in others the price-effect data are lifted from the decisions. The data are arranged by geographic location of the cartels. There are 110 non-U.S. observations, 73% of them from Europe. The largest number of observations comes from decisions made by the European Commission and the UK Monopolies Commission.

The mean overcharge is almost 46%, and the means derived from European and Asian decisions are close to those from U.S. court decisions. However, because of positive skewness, it is more appropriate to examine the medians. The median North American overcharge is the

[161] Some cases with large overcharges settle, while some smaller ones do go to trial.

[162] Further, it might be less likely that plaintiff would even file a civil case unless it believed that damages were likely to be high. However, this article is examining overcharge percentages, not total recoveries, and it focuses on medial percentages. Aren't plaintiffs likely to file cases with large expected total payoffs, regardless what overcharge percentage that constitutes? What difference does it make to plaintiffs or their attorneys if they prove a 1% overcharge on $1 Billion in sales, 10% on $100 million, or 100% on $10 million? In all three examples the amount of the expected overcharge would be identical.

lowest, and those from Asian authorities the highest, but none strays far from the median estimates from all sources for the years 1974-2004 (compare Table 6).

Table 16. Overcharges from Decisions of Antitrust Authorities, by Jurisdiction

Antitrust Authority	Number	Median	Mean
		Percent	*Percent*
North America:	**61**	**20.0**	**43.2**
Mexico	1	18.8	18.8
United States	59	20.0	42.8
Canada	1	90.0	90.0
Europe:	**80**	**23.8**	**48.3**
Denmark	1	25.0	25.0
European Commission	43	31.0	40.8
France	4	31.0	30.5
Germany	3	13.0	13.0
Hungary	1	15.0	15.0
Spain	2	3.0	3.0
Sweden	1	8.3	8.3
UK	25	14.3	74.3
Asia and Australia:	**30**	**28.0**	**45.0**
Australia	2	10.5	10.5
China	2	21.1	21.1
Israel	1	120.0	120.0
Japan	8	28.8	26.1
Korea	8	22.1	45.4
Taiwan	9	65.0	74.5
Total	**171**	**23.1**	**45.9**

Source: Appendix Tables 2 and 4 (spreadsheet dated 4/4/2005).

CONCLUSIONS

Empirical Findings on Cartel Overcharges

The survey identified hundreds of social-science studies of cartels that contained 674 observations of "average" overcharges.[163] The primary finding is that the median[164] 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.[165] Thus, in general 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 long-run averages.[166] These results are generally consistent with the few, more limited, previously published works that survey cartel overcharges. Six economic studies that exhibited high standards of scholarship report samples with simple average median overcharges of 28% and simple average mean overcharges of 31% of affected sales.

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%.[167] Thus, the 24 U.S. decisions produce average overcharges that are quite comparable to the results of the much larger set of economic estimates. All but five of the reported decisions found that the cartel had raised prices by more than the USSC's 10% benchmark.[168] Outside the United States, 62 decisions of competition commissions cited median average overcharges of 29% and a mean of 49%. Except for the UK Monopolies Commission (median of 20%), all other jurisdictions reported higher overcharges.

The authors' professions, types of publications, degree of peer review, and analytical estimation methods from which these estimates are derived vary greatly. However, extensive examinations of source reliability give no reason to regard any sub set of the sample as inherently unreliable.

Issue 1: the USSGs

In the sample of 674 social-science overcharges, 79% were higher than the 10% presumption contained in the U.S. Sentencing Guidelines; 60% were above 20%. 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

[163] Average overcharges are those calculated from an entire cartel episode, not just a peak or isolated result.
[164] All figures presented in this section incorporate all relevant zero estimates and omit peak results.
[165] This study has a majority of episodes and estimates taken from international cartels.
[166] If one assumes that the peak mark-ups are the result of a cartel having achieved something close to monopoly price levels, then the lower average overcharges imply that historical cartels are constrained by substitutes, fear of entry, internal discord, or other factors that frustrate optimization. This is a common finding in studies that measure the degree of monopoly power.
[167] In addition, the 9 cases that reported peak overcharges produce a median peak overcharge of 71.4% and a mean peak overcharge of 130%.

[168] Because of the relatively small number of verdicts (sample of 23), it is improper to place much weight on sub-groups of these data.

and, especially, extant cartel penalties. Consequently, they argue for the repeal or scaling back of the fines or damages that result from collusion. Even some who recognize that a significant number of cartels are harmful believe that the U.S. Sentencing Commission's presumption that cartels raise prices by 10% is too large. 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. Moreover, the great majority of the overcharge estimates – those with overcharges above 20% -- have a mean overcharge of 55.3%, more than five times the Guidelines' presumption.

The Guideline's 10% overcharge presumption was, moreover, based upon the estimate that "the average gain from price-fixing is 10 percent of the selling price."[169] The Guidelines "average" is the equivalent of the mean, not the median.[170] The correct comparisons are therefore not between the Guideline's figure of 10% and the medians of 27% for the economic studies and 22% for the case verdicts. Rather, the truer comparison would be to the mean figures of 36% and 27% respectively. One must be agnostic on the question of whether, from the perspective of optimal deterrence, mean or median figures should be used as the basis of the U.S. Sentencing Commission's presumption. However, the decision to focus on the median figures has been a conservative one.

Surprisingly, 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 the USSC should amend its Guidelines, which currently treat bid rigging more harshly than other forms of collusion. Nor is there any empirical basis for the Guideline's statement that cartels are less dangerous when they are formed in larger markets.

There is another respect in which this paper has been conservative: it focuses solely on the public injury that arises from the transfer of income or wealth from purchasers to the cartel. However, cartels also can lead to allocative inefficiency, umbrella effects, less innovation, managerial slack, and to non-price harms to quality and variety, etc. Yet, these factors have not taken these harms into account. Nor have the figures been adjusted for inflation. While the Guidelines seem to have doubled the 10% presumption to account for its omission of these factors, I believe that doubling is insufficient.

For all of these reasons, if the U.S. Sentencing Commission decides to re-examine whether 10% is the right overcharge presumption,[171] Connor and Lande (2004) propose raising

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[169] 15 U.S.C. 1 Application Note 3.

[170] The inclusion of a few highly successful cartels in a sample implies that the sample's mean is significantly higher than its median. The mean will also be higher than the median because overcharges cannot be less than zero.

[171] This article's introduction observed that it was possible that *Blakely v.Washington* could mean that the 10% presumption will be declared unconstitutional or employed less often. Instead, defendants may litigate the actual overcharges. If this happens, most of the 79% of cartels that overcharged more than 10% should acquiesce to the government's use of the 10% presumption. Only the 21% of cartels that overcharged less than 10% should be likely to contest this. However, these fines have no prejudgment interest, so defendants benefit from the delay that comes from litigation.

However, a key issue is whether cartels usually know in advance of litigation roughly how much they overcharged. Could most cartels predict in advance of litigation, for example, that a Court will find that it overcharged 5%, as opposed to 15%? How risk-averse are they, in light of the probability that lengthy, protracted

the presumption to 15% for domestic cartels and 25% for international cartels.[172] This is a conservative and modest proposal in light of this article's demonstration that cartels typically generate at least two or three times the harms presumed by the current Sentencing Guidelines.

Issue 2: Global Sanctions

The principal antitrust authorities abroad also seem to base their typical or maximum fines on a 10% harm presumption.[173] Many jurisdictions follow the EU's lead in limiting their cartel fines to at most 10% of a guilty company's annual sales.[174] This self-imposed restriction will not, under a wide range of conditions,[175] result in fines that reach or exceed a cartelist's monopoly profits. *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.

The survey results suggest 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.

Issue 3: Cartel Deterrence

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 deterring (Bush *et al.* 2004, Connor 2005).

For most types of cartels, there are modest downtrends in cartel mark-ups over time.[176] Since 1990 the average overcharges of discovered cartels fell to 15-16% for domestic cartels, and to 25% for international cartels.[177] Because the post-1990 era has been the period with by

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litigation could result in a much higher result? I believe that cartels often are risk seekers and often will be able to make this prediction with a fair degree of accuracy.

[172] If the policymakers decide that it would be unwise to make this differentiation, however, a 20% overall presumption would be appropriate. The doubling of the base fine and the 0.75 to 4.0 culpability multipliers are not affected by this proposal.

[173] Is there something particularly alluring about the fingers of two human hands that impels decision makers to fixate on ten or multiples of ten when designing numerate sanctions' standards?

[174] Canada centers its fines around 20% of affected Canadian sales, but has no culpability multipliers other than leniency discounts. Brazil permits 30% of affected sales.

[175] The conditions are that the targeted company is fairly specialized, has most of its sales inside the jurisdiction's borders, and joins a highly durable international conspiracy with a low probability of detection (Connor 2003).

[176] The fact that cartel overcharge estimates do not change systematically over the past century (except as noted above) provides a rough indication that progress in theories and empirical methods has not totally invalidated cartel case studies published in the early years of cartel scholarship. I also ascertained that median overcharges are not sensitive to whether or not a study was subject to formal peer review. However, in an analysis of finely matched cartel episodes, I did find that econometric approaches typically produced lower estimates than did application of the before-and after method.

[177] This period also has the highest proportion of cartels that are international.

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.

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,[178] will do little to deter most of these cartels.

[178] 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 Cartels and Their Characteristics

Appendix Table 1. Alphabetic List of Cartelized Markets

Name	Code No.	Characteristics				Number of	
		Interna-Tional	Loca-tion	Bid Rig-ging	Found Guilty, Liable for Civil Penalties, or Extralegal [c]	Epi-sodes	Average Obser-vations
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.

Appendix Table 2. Summary of Price-Fixing Damages, Social-Science Studies

Cartel Type, Location, and Dates[a]	Method of Analysis	Overcharge or Undercharge		Source
		Aver-age	Peak	
		Percent		
1. Florida state **road-building** contract auctions, 1738 projects, 1981-1986; no mention of convictions	Econometric model; average of 5 bidders, maximum of 19 bidders	8-10	34-45	Gupta (2001)
2. Bid rigging against schools by the Folding **Gymnasium Seating** Council, U.S., April 1954-early 1960; DOJ consent decree in early 1960; study controls for changes in costs				
2A. Same as above	Benchmark price is for Jan.-Mar. 1954	40.9	--	Erickson (1976: 192-193)
2B. Same as above	Benchmark price is for brief breakdown period April-June 1959	36.6	--	Erickson (1976: 192-193)
2C. Same as above	Benchmark price is for Sept. 1960 – March 1961	30.4	--	Erickson (1976: 192-193)
3. Bid rigging, **rock salt** sold to state and local governments, northern U.S.; began in early 1930s and renewed in 1948-49, but court testimony covers only 1954-1960; umbrella pricing by two largest U.S. companies; guilty at trial	But-for price is average of 1961-63 prices; study controls for changes in costs	60	66	Erickson (1976: 197)
4A. Bid rigging and market divisions, **structural steel** sold to construction contractors **for public buildings**, upper Midwest of U.S., March 1950–August 1962; probably convicted	Pre-conspiracy prices (1948-March 1950) compared to conspiracy period except for one brief breakdown in collusion; peak is 1961-62	9.0	27.9	Erickson (1976: 199)
4B. Same as 4A above	Conspiracy prices compared to post-conspiracy prices (Sept. 1962-Dec. 1963); peak prices from 1961-62	0	17.3	Erickson (1976: 199)
5. Bid rigging and market divisions, **structural steel** sold to construction contractors **for bridges**, upper Midwest of U.S., March 1950–Aug. 1962; meetings were "interrupted" from July 1960 to March 1961				
5A. Conspiracy period March 1950 – August 1962, excluding interruption	Benchmark price is for 1948-March 1950	9.0	--	Erickson (1976:199)
5B. Same as 5A.	Benchmark price is for 1948-March 1950	27.9	--	Erickson (1976:199)
5C. Late phase of conspiracy, April 1961 – August 1962	Benchmark price is for Sept. 1962 – Dec. 1963	0.0	--	Erickson (1976:199)
5D. Same as 5C.	Benchmark price is for Sept. 1962 – Dec. 1963	17.3	--	Erickson (1976:199)
5E. Same as 5A	Compares profit on equity 1950-1961 of a typical conspirator with the U.S. national industry average	50	--	Erickson (1976:199)

6. Price fixing of **bromine** sold to pharmaceutical manufacturers to make potassium bromide, U.S., three phases:				
6A. National Bromine Co., pool 1885-1891	Base is 1880-1884 prices	9.7	19	Levenstein (1997)
6B. Shields pool, 1892-1902	Base is March 1891-October 1892 prices	65.2	126	Levenstein (1997)
6C. Shields pool, 1892-1902	Base is 1880-1884 prices	31.6	81	Levenstein (1997)
6D. Dow Chemical pool, 1902-1914	Base is several non-cooperative periods during 1905-1908	74.4	257	Levenstein (1997)
7. Bid rigging by 8 members of the Asphalt refiners Assn. of liquid **asphalt** contracts for the Oklahoma Highway Dept., 1954-1968, found guilty by jury trial	Comparison of constant OK winning bid price with average delivered prices in 6 surrounding states supplied from OK	71	71	Funderburk (1974:69-70)
8A. Cemented **tungsten carbide**, invented by Krupp Steel and General Electric in early 1920s; two firms formed a cartel in 1928 protected by patents later invalidated; GE had a U.S. production monopoly, but Krupp sold to two US importers, which colluded with GE and were monopolistically bought be GE in 1936 and 1937; price lowered in Oct. 1936-1940; GE indicted for price fixing by DOJ in 1941, found guilty at trial in 1947	U.S. price in 1927 when Krupp still exported to U.S. compared to GE's U.S. 1928-Oct. 1936 price	800+	800+	Stocking and Watkins (1948:132-134), Berge (1944:43)
8B. Same as 8A	U.S. price 1928-36 compared to yardstick of (Krupp's) monopoly European price	787-886	--	Stocking and Watkins (1948:132-134), Berge (1944:43
8C. Same as above, except for Oct. 1936 to 1941	U.S. price October 1936 to 1941 compared to yardstick of (Krupp's) monopoly European price	99-302	--	Stocking and Watkins (1948:132-134)
8D. Same as 8C	U.S. price October 1936 to 1941 compared to highly profitable Government wartime price	395-829	395-829	Stocking and Watkins (1948:132-134)
8E*. Same as 8A	U.S. price in 1928-1936 compared to Krupp's U.S. import price to two US exclusive importers and GE co-conspirators	886	886	*U.S. v. General Electric Co. et al (10/8/1948)*
9. Bid rigging **school milk** contracts, Boone, Kenton, and Campbell Counties, Kentucky, 1984-1988	Geographic yardstick, surrounding competitive counties	13	21	Lanzillotti (1996:433)
10. Bid rigging **school milk** contracts, Dade and Broward counties, Florida, 1979-1985	Average 1986-1989 post-conspiracy prices	13	16	Lanzillotti (1996:443)
11. Bid rigging **school milk** contracts, three counties, Florida, 1979-1985	Average 1986-1989 post-conspiracy prices	2.6	7.5	Lanzillotti (1996:433)
12. Bid rigging **school milk** contracts, Danville, Kentucky 1983-1988	Prices bid to state agency in same county	49	59	Lanzillotti (1996:447)
13. Bid rigging **school milk** contracts, Owensboro, Kentucky, 1984-1988	Prices bid to state agency in same county	126	280	Lanzillotti (1996:447)

14. Bid rigging **school milk** contracts, Kentucky "core conspiracy area," 1981-1988	Geographic yardstick, surrounding competitive counties	25	35	Lanzillotti (1996:448)
15. Bid rigging **school milk** contracts, summary of several cases of school-milk bid rigging in South of U.S. 1979-1988, estimates prepared for trial and used for settlements, from among 109 specific cases listed; may include numbers 9-14 above	Various methods used for numbers 9 to 14 above	15-20	- -	Lanzillotti (1996:452)
16A. Price fixing of **nitrogen and nitrate** (nitrate of soda, ammonium sulfate), international private cartel, including some national cartels, formed July 1929 after four years of sharply falling prices; included Chilean miners' national export cartel and UK and German producers of coke-byproduct and synthetic manufactures; collapsed 1931	Method not explained, and number cannot be found in original source	75	--	Posner (1975:818-820 and 2001:304), Stocking and Watkins (1946:163), Wallace and Edminster (1930: 54-56)
16B. Same as 16A	Ammonium sulfate average UK prices in 1932 compared with 1930 average	35	--	Stocking and Watkins (1946:163)
16C. Same as 16A	UK ammonium sulfate prices one month after collapse of cartel relative to last 6 months of cartel	43	--	Stocking and Watkins (1946:163)
16D. International cartel was reformed at end of 1932 and continued to operate until at least 1947; a period of rising demand	U.S. ammonium sulfate prices in 1933-39 relative to 1932 prices	24	38	Stocking and Watkins (1946:165)
16E. Same as 16D	Ave. UK ammonium sulfate prices in 1933-39 relative to 1932	15	21	Stocking and Watkins (1946:163-65)
16F. Same as 16A	Lerner index	42.9	--	Griffin (1989:189-190)
16G. Same as 16D	Lerner index	28.2	--	Griffin (1989:189-190)
17A. Price fixing **sugar**, international private cartel comprised of the 21 governments with 85-90% of world sugar imports; began in 1938, ended Sept. 1939; froze the export shares of all exporting regions	Ave. prices on the London market in Sept. 1937-Sept. 1939, relative to 1935-36 prices	30	--	Posner (1975:818-820), Posner (2001:304), Stocking and Watkins (1946:46)
17B. Same as 17A; international sugar cartel of 1937-1939	Lerner index	6.4	--	Griffin (1989:189-190)
17C. International cane and beet sugar cartel of May 1931- Sept. 1935; a private agreement with possible government enforcement applied to the national sugar cartels of Cuba, Java, Peru, and five European countries to reduce output and set export quotas; Hexner calls this cartel a dismal failure because importing countries boosted their self-sufficiency; Plummer says only Hungary passed legislation to enforce the agreement	Lerner index calculated by Griffin	14.9	--	Griffin (1989:189-190), Hexner (1946:192-193), Plummer (1934:20-23)
18A. Price fixing and territorial quotas of	Price in Europe in 1905	--	100,	Posner

aluminum; the first international private cartel of the world's five manufacturers, formed by contract on Nov. 2, 1901 in effect until late 1906	compared to early 1901		100[a]	(1975:818-820), Posner (2001:304), Stocking and Watkins (1946:228), Eckbo (1976:33)
18B. Second international cartel; same membership as 18A; tighter contract signed in late 1906; members and outsiders added 200% more capacity in 1905-08; late 1907 recession put added stress on the cartel; formally dissolved Sept. 30, 1908	Benchmark is German ingot prices in late 1908 relative to mid 1907; decline in part due to fall in demand	--	50	Stocking and Watkins (1946:233)
18C. Same as 18B	Author's interpretation of case studies of other researchers	50+	--	Eckbo (1976:33)
18D. Same cartel as 18B, but data are from a top manager of the cartel in its later years who is an apologist for the benefits of cartels	Exact transaction prices from 1906 to 1908 in gold French francs; the base of comparison is the price demanded by the cartel's French members in Jan. 1908 which would have guaranteed a good rate of return; cartel dissolved in April 1908 and prices fell far below the base price; peak is all of year 1907	83	167	Marlio (1947: 13)
18E. Same as 18A and 18B combined, but prices in U.S. market; imports flood into the U.S. market in 1910-1912	Alcoa's U.S. prices in 1910-1912 compared to 1902-07 average cartel U.S. prices	65	82	Stocking and Watkins (1946:229,233)
18F. Third international cartel agreement reached June 12, 1912 (5 days after Alcoa accepted a DOJ consent decree to end an antitrust probe!); ended by outbreak of war in August 1914	Average annual U.S. price in 1913 versus 1912	5.0	--	Stocking and Watkins (1946:238-245, note 44)
18G. Same as 18F above	Average European transaction prices Jan. 1913 to Jan. 1915; peak is 1914; compared to same base price as in 18D above	30.4	33.3	Marlio (1947: 18)
18H. Prices fall after end of war prompting fourth, unwritten cartel agreement in 1923; lasted until 1926; Alcoa formed a holding company for its burgeoning European assets which was controlled through its Canadian subsidiary; European members refrained from exporting to US and Alcoa did not export to Europe at less than cartel's prices	Method not explained and numbers not found in S&W; S&W refers to 1922-1924 price changes of 33% in Europe and 44% in the U.S.; Elliott considers 1923-25 boom "mainly" responsible for price increases	--	38,59[b]	Posner (2001:304), Stocking and Watkins (1946:251), Elliott *et al.* (1937:256)
18I. Same as 18H above	Author's interpretation of case studies of other researchers	50+	--	Eckbo (1976:33)
18J. Fifth international private cartel, 1926-1930; unlike some others, this author interprets new cartel agreement in 1926 as start of a new episode; other authors consider 1924-1938 as one episode	Author's interpretation of case studies of other researchers	50+	--	Eckbo (1976:33)
18K. Price fixing of aluminum in Europe by 8 companies that owned a common joint venture, the Alliance Aluminum Co., July	London list or "official" price compared to the price members could buy out of	45	75.1	Marlio (1947: 37-40)

1931 – early 1939; joint venture purchased and sold aluminum stocks to members; cost-saving technological change rapid in 1930s	Alliance Aluminum stocks; peak is Nov. 1931			
18L. Same as 18K.	Transaction prices from Nov. 1931 to Dec. 1936 in gold French francs compared to Mar. 1938–Jan. 1939 (1.1 FF) , a period the author, an expert insider, calls cooperative but not very effective; peak is Nov. 1931	83.6	101.2	Marlio (1947: 39-40)
18M. Same as 18K above	Author's interpretation of case studies of other researchers	50+	--	Eckbo (1976:33)
18N. Study that measures the U.S. market power of Alcoa during the period when it was a monopolist in the U.S. market (1923-1940) partly because of agreements with European producers that limited imports	Econometric model with excellent data that measures short-run and long-run mark-up over Alcoa's U.S. marginal costs, including accounting profits	59-65	--	Posner (2001:304), Suslow (1986: 399-400)
18O. Same as 18J above	Compares average London metal price 1926-29 with price in late 1930 after US-Canadian entry	24.4	--	Oualid (1938:20-21)
18P. Same as 18K above	Average London price 1932-36 with July 1931 or late 1930	5.3-17.7	--	Oualid (1938:20-21)
18Q. Same as 18K above	Same as 18P, except base of comparison is price in "cartel-free" markets Belgium, Netherlands, and Central Europe	17.7-25	--	Oualid (1938:20-21)
18R. Same as 18A	Lerner index predicted from econometric model	203.0	--	Griffin (1989:189-190)
18S. Same as 18F	Lerner index predicted from econometric model	66.7	--	Griffin (1989:189-190)
18T. Same as 18J	Lerner index predicted from econometric model	44.9	--	Griffin (1989:189-190)
18U. Same as 18K	Lerner index predicted from econometric model	51.5	--	Griffin (1989:189-190)
18V. Same as 18A, but authors believe that 1904-07 prices were strongly affected by a boom in demand	European price change from 1900 to 1902	25	--	Elliott *et al.* (1937:226)
18W. Same as 18H above	Changes in prices in the US from 1922 to 1924	44	--	Stocking and Watkins (1946:251)
18X. Same as 18F	European prices in 1912-14 relative to competitive 1908-11 period	0-70	--	Elliott *et al.* (1937:228)
18Y. Same as 18H, except that transactions prices are taken from an exhibit from a private antitrust suit against Alcoa	Peak U.S. price in Dec. 1925 relative to 1920-21 when Alcoa faced large European import competition; adjusted for $.03 rise in U.S. tariff in Sept. 1922	--	32	Elliott *et al.* (1937:255)
18Z. Same as 18H; author believes that over-capacity, increased scrap supplies, and depression caused prices to decline 20%;	Cartel was able to bring off an "orderly reduction in prices" with no change in profits	0	--	Elliott *et al.* (1937:260)

costs declined by 20% 1926-1930/31				
I8AA. Same as 18H above	Changes in prices in Europe from 1922 to 1924	33	--	Stocking and Watkins (1946:251)
18BB. Same as combination of 18H and 18J.	Average U.S. net realization prices in 1924-1938 compared to 1921-22;peak is 1937; includes Great Depression .	13	38	Stocking and Watkins (1946:229,252-269)
19. Bid rigging of Dallas-Fort Worth **school milk** contracts in 1980-1992 by 9 dairy processors, which paid a large settlement to end a civil suit.	Examines winning bids in DFW to those in San Antonio, Texas for several types of milk	5.0-6.0	--	Lee (1999)
20A. Price fixing of **crude rubber** international private cartel, London-based Rubber Growers' Assn., agreed in recession year 1920 to cut output by 25% in 1921; Dutch producers supported cut; in November 1921 UK and colonial legislatures made it a government program	World price change from just before cartel (1920- early 1921) to late 1921	--	100	Posner (1975:818-820), Posner (2001:304), Stocking and Watkins (1946:64-65)
20B. UK government rubber-quota program encouraged expansion of Dutch East Indies production; by 1926-27 it was no longer effective; officially abandoned Oct. 1928; new scheme implemented June 1934-April 1944; the Intl. Rubber Regulation Cmte. in London with government and industry members set output and export limits, which were negotiated by Britain, Holland, France (and their colonies) and Siam; Suslow judges the IRRC to be a private cartel	Real world prices in 1934-39 compared to base years 1930-33; peak year is 1937	119	149	Suslow (2001: 57), Hexner (1946: 280-293)
20C. IRRC based its price objective on covering full costs of production plus a rate of return on assets of about 7.5%; extensive studies of plantation costs in all areas were commissioned	Nominal prices 1936-1939 compared to upper limit of full costs of production	15-134	141	Hexner (1946: 287)
20D. Same as 20B	Lerner index	194.1	--	Griffin (1989:189-190)
21A. Price fixing and quotas for **electric incandescent light bulbs**, international private cartel formed as Phoebus SA, incorporated in Switzerland, by contract on Dec. 23, 1924 by British, German, Dutch, Hungarian, Japanese, French, and U.S. companies; ended Sept. 1939; reestablished 1945-55, but weak after GE withdrew in 1945	Method not explained; cannot find such price change in the original source (S&W)	37	--	Posner (1975:818-820), Posner (2001:304), Mirow and Maurer (1982), Stocking and Watkins (1946:340-45)
21B. Same as 21A above	Prices of 25, 40, 60 Watt bulbs in Holland in 1938 relative to U.S. (yardstick) prices; average assumes 25 W accounts for 50% of market and other sizes 25% each	222	367	Stocking and Watkins (1946:344)
21C. Same as 21A above	Same as above except Germany vs. USA	140	220	Stocking and Watkins

				(1946:343)
21D. Same as 21A above	Same as above except Sweden vs. USA	77	110	Stocking and Watkins (1946:343)
21E. Same as 21A above	Compare (retail?) prices of 60W bulbs in Germany in 1929-30 with same bulbs before cartel began (1924-25); no adjustment for cost reductions	-11	--	Benni *et al.* (1930:75)
21F. Same as 21A above	Cartel price reduction in Sweden as new local lamp factory was being built in the early 1930s	27	--	Stocking and Watkins (1946:343 and footnote 106)
21G. Same as 21A	From Phoebus' records, average net 1937-38 manufacturers' prices in 8 W. European member countries, relative to Japan, the only nonmember in the world	322	--	UK Monopolies Commission (1951: 196)
21H. Same as 21A	Same as above for British Empire prices	281	--	UK Monopolies Commission (1951: 196)
21I. Same as 21A	Same as above for Brazil	148	--	UK Monopolies Commission (1951: 196)
21J. Same as 21A	Same as above for China	111	--	UK Monopolies Commission (1951: 196)
21K. Same as 21A	Same as above for non-Phoebus Europe	276	--	UK Monopolies Commission (1951: 196)
21L. Same as 21A	Same as above for rest of the world	214	--	UK Monopolies Commission (1951: 196)
22A. European **copper** market was cornered by the "Secrétan" syndicate of four UK and French firms by signing long term supply contracts with major mines; Sept. 1887-Mar. 1889; Mar. 1889 crash came after unexpected increases in mine output and recycled Asian supplies arrived	London Metal Exchange prices in late 1888 compared with costs (mine contract prices held by syndicate); maximum price is compared to LME price at end of March 1889	31	129	Elliott *et al.* (1937: 395)
22B. The "Amalgamated Pool" raised $155 million to finance purchase large stocks of U.S. copper in April 1889; price crashed at end of 1901 when pool owned 200,000 tons	Price in mid 1901 compared with end of 1901	35	--	Elliott *et al.* (1937: 397-98)
22C. Amalgamated Copper Co. organized a US supply-control cartel in 1906; effective 1907-1912.	Average prices late 1907-1912 compared to 1906; peak effect was from early 1906 to "Panic of 1907"	35	127	Elliott *et al.* (1937: 398)
22D. Copper Export Assn. was formed Dec. 1918 covering 95% of US production; it agreed (illegally) to reduce output by 42% during 1919; by 1923 large post-war govt. stocks were liquidated and it disbanded; 1923-26 was one of the few normal period in the copper market after 1913	Author's estimate of price elevation above competitive levels in 1919	29	--	Elliott *et al.* (1937: 418-419)

22E. Price fixing of **copper**, Copper Exporters Inc., the only Webb-Pomerene Association to have foreign (non-U.S.) members [sic], effective October 1926 – May 1930, world prices; officially dissolved 1932 [preceded by 1888-1890 and 1918-1922 cartels]	Method not explained; cannot find Posner's number in original source	31	--	Posner (1975:818-820), Posner (2001:304), Stocking and Watkins (1948:125-131)
22F. Same as 22E above; world prices March 1929	Compared with average of 3 years before cartel contract signed	--	63.1	Stocking and Watkins (1948:127)
22G. Same as 22E; world copper prices in year following Great Crash, May 1929-May 1930; cartel lost control of prices after May 1930 when large African mines opened; formally dissolved in 1932	Same as above	38	--	Stocking and Watkins (1948:127)
22H. Same as 22E; an early economic study of international cartels, most of them European based, that depends on information from previously published economic studies and press accounts; writing at the beginning of the Great Depression, the author is more impressed by the failures of cartels to raise prices than their successes; of scores of private cartels studied, only two have data on their price effects; international copper cartel maintained near monopoly over supply, but experienced rapidly falling demand and rise in stocks	World export prices in Dec. 1932 compared to May 1929-April 1930	--	-72	Plummer (1934:149-152)
22I. Same as 22B, but judged effective only from early 1899 to Dec. 1901; ended by lack of European cooperation and domestic cheating	New York wholesale prices 1899-1901 compared with 1898	31-64	--	Herfindahl (1959:81)
22J. Same as 22B	New York wholesale prices 1899-1901 compared with 1902-03	55-64	--	Herfindahl (1959:81-82)
22K. Same as 22C; Herfindahl is skeptical that any of the collusive arrangements alleged in 1904-05, 1906-07, 1908, 1909, or 1912-13 were effective	New York wholesale prices 1904-13 compared with 1906	0	--	Herfindahl (1959:92-99)
22L. Same as 22D; the CEA was successful in restricting supply in 1921-22 and possibly in 1918-20 also, but price effects were weak and brief	New York wholesale prices 1921-22 compared with 1923-26	0+	--	Herfindahl (1959:92-99)
22M. Same as 22E above.	Compared world prices March 1929 with average of 3 years before cartel contract signed	--	63.1	Stocking and Watkins (1948:127)
22N. Same as 22E, except shorter effective period	New York wholesale prices April 1929-April 1930 compared with competitive 1926-28	28	--	Herfindahl (1959:208)
22O. Same as 22N	New York wholesale prices April 1929-April 1930 compared with 1931	88	--	Herfindahl (1959:208)
22P. Same as 22D; a 1918-1922 (or 1924) U.S. Webb-Pomerene Assn. that liquidated large wartime stocks, but may not have	Lerner index	0	--	Griffin (1989:189-190), Hexner

affected export prices				(1946:224)
22Q. Second international copper cartel formed with exporters of all countries except Canada as members; active May 1935 – Sept. 1939; agreement on output reductions; New York export prices	Base price late 1934-early 1935 compared to 1938-1939 average price; peak price March 1937 affected by "war fever"	11-33	84	Stocking and Watkins (1948:129)
22R. Same as 22Q; London exchange prices, which S&W assert are better reflection of output and export quotas	Comparison of May 1937 price with May 1935 price	--	150+	Stocking and Watkins (1948:129)
22S. Same as 22Q; average annual prices of spot purchases of standard copper on the London exchange, in pounds sterling ; author believes that rise chiefly due to increased demand	Base is 1932-34 prices compared to 1936-39; peak is 1937	40	73	Hexner (1946: 228)
22T. Same as 22E; League of Nations copper price series; authors state that cartel aimed at a price of $0.18/lb. and tried to reduce prices during early 1929 demand spike; it lost control of price after late April 1930	Price before contract signed compared to May 1929-mid April 1930 when cartel achieved its target price; peak was a few days in April 1929	29	71	Benni *et al.* (1930:21)
22U. Same as 22E above; second study of same cartel by League of Nations researcher, but 8 years later	Considers the cartel a failure because it could not control prices when demand dropped in early 1930 and African mines opened compare 1929 price with lowest in 1930s (1932)	--	-72	Oualid (1938:35)
22V. Same as 22Q above	Author believes that March 1935-Sept. 1936 primarily the result of quotas; but peak rise in Jan. 1937 heavily influenced by surge in demand	36.6	90.3	Oualid (1938:37)
22W. Same as 22E	Lerner index for 1926-1930	0	--	Griffin (1989:189-190)
22X. Same as 22Q	Lerner index for 1935-1939	0	--	Griffin (1989:189-190)
22Y. Same as 22Q above; author is careful to identify periods when demand was weak or strong enough to affect prices; 1936-38 were years with steady or mixed growth in demand	New York electrolytic quality copper, f.o.b. prompt delivery; change from 1931-34 to 1936-38 average; 1937 is peak year	37	67	Walters (1944:146)
22Z. Same as 22Q	Same as 22R above, except base year is 1934, the one with the most comparable demand conditions to 1936-38	50.3	83.2	Walters (1944:146)
22AA. A Paris-based cartel operating in "the late 1890s" (ca. 1896-99) had almost a monopoly, but little effect on prices	Method not explained	0	--	Jenks (1907:49)
22BB. The next-to-last known phase of the copper agreement (began ca. 1964) ended in 1966; members of the cartel agreed to sell "outside normal marketing channels" to certain preferred customers (who were forbidden to resell) at a lower price fixed for 2 years at a time; all other buyers purchased copper on the London Metal Exchange, which was manipulated by the	No estimates are available for non-U.S. sales; in the mid 1960s U.S. producers kept domestic prices higher than the export (LME) price	0+	--	Kronstein (1973)

cartel through occasional large purchases by the cartel on the LME; author hints at a U.S.-African agreement on exclusive territories				
22CC. Same as 22E	Average 1929 prices compared to competitive 1923-26 prices or to Mar. 1932 price; peak was Mar. 1929	30	75	Elliott *et al.* (1937: 441)
22DD. Same as 22B	London cash prices during Jan. 1888-Feb. 1889, compared to either early 1887 or late 1889.	75-118	--	Andrews (1889:509-514)
22EE. Last international copper cartel; lasted from 1968 to as late as 1988	Econometric model that predicts a Lerner Index	25.0	--	Griffin (1989:189-190)
22FF. Same as 22A	Econometric model that predicts a Lerner Index	51.5	--	Griffin (1989:189-190)
22GG. Same as 22D	Econometric model that predicts a Lerner Index	0	--	Griffin (1989:189-190)
22HH. Same as 22E	Econometric model that predicts a Lerner Index	0	--	Griffin (1989:189-190)
22II. Same as 22Q	Econometric model that predicts a Lerner Index	0	--	Griffin (1989:189-190)
22JJ*. Same as 22A	London Metal Exchange prices from "late 1887" (before) to a few months later	--	100+	Prain (1975: 103)
22KK*. Same as 22E, except that authors believe cartel not effective until after 9/1927	Price increase from 9/1927 to 3/1929	--	65	Wallace and Edminster (1930:261)
23A. Bid rigging of **cast-iron pipes**, used for rail beds, culverts, drainage, or sewage; all U.S. states west and south of Pennsylvania and Virginia, circa 1895-1896; found guilty at trial; Judge Taft concluded that an f.o.b. plant price of $13/t for 16" or smaller pipe and $15/t for 30-36" pipe was sufficient for a reasonable profit	Method not explained; apparently Posner's interpretation of this famous Supreme Court case	39	--	Posner (1975:818-820), Posner (2001:304), *U.S. v. Addyston Pipe*
23B*. Omaha, NE municipal tender for 512 pieces of 20" pipe in 12/1895	Trial documents reveal that a "premium" or "bonus" of $23.40/ton (a profit yardstick) was the overcharge split among the cartel, whereas the delivered cartel price was $15.40	52.0	--	*U.S. v. Addyston Pipe*
23C*. St. Louis, MO tender	Bonus of $6.50/t on a winning bid price of $24/t	37.1	--	*U.S. v. Addyston Pipe*
23D*. Same as 23C	Bonus of $6.50/t when the delivered but-for price was $17 to $18/t	36-38	--	*U.S. v. Addyston Pipe*
23E*. Atlanta, GA contract of 12/1895, size of pipe and winning bid not mentioned	Bonus was $7.10/t; reasonable profit yardstick is the but-for price of $13to $15/t	47-55	--	*U.S. v. Addyston Pipe*
23F*. Average bonus of $3.63 made by cartel from 6/1/1895 to 12/31/1895	Bonus relative to reasonable profit yardstick	20-21	--	*U.S. v. Addyston Pipe*
23G*. Sales of So. Pittsburg Co. in WV, MI, and OH; a non-member of the cartel was located in Columbus, OH	Bonus varied from $1/t to $1.50/t; yardstick is reasonable profit price	5.6-8.8	--	*U.S. v. Addyston Pipe*
23H*. Chattanooga Co. generated a $3/t bonus on all sales in West-central	Yardstick is reasonable profit price	16.7-17.7	--	*U.S. v. Addyston Pipe*

Tennessee				
23I*. In Jan. 1896 cartel made an average bonus of $7 to $8/t	Yardstick is reasonable profit price	39-47	--	*U.S. v. Addyston Pipe*
24. Sophisticated oligopoly model that measures market power in the U.S. **crude petroleum and natural gas** markets 1947-1971; Appelbaum's model does not distinguish tacit from overt collusion; some members non-U.S.	Econometric model prediction of average mark-up on full marginal costs	6.5	--	Posner (2001:304), Appelbaum (1979:283)
25A. Mark-ups in the U.S. **automobile** industry; study is a general one of mark-up and productivity change; it does not distinguish overt from tacit behavior; oddly, 6 of 17 industry groups have higher average mark-ups than "automobiles" (e.g., chemicals is 61%); financial profits for the industry averaged only 3.2%; source is a 1990 NBER working paper, but results same in 1993 refereed journal paper	Morrison uses a large scale, sparsely specified, pooled 1953-1986 time-series econometric model of 18 major industry groups in manufacturing, one of which is transportation equipment	14?	--	Posner (2001:304), Morrison (1990: 25,43)
25B. Same as 25A above	Tables 2, 2A show mark-ups average 30.6%; Table 2A shows the largest mark-up of 38.5% in 1978	31	39	Morrison (1990: 25,43), Morrison (1993: Tables II and V)
26. Price elevation due to oligopoly market power from all sources (unilateral, tacit collusive, and overt collusive) in the U.S. **cigarette manufacturing** industry.	Large-scale, richly specified oligopoly econometric model fitted to 1955-90 data; focused on excise tax incidence; average wholesale price (with taxes) divided by the sum of variable production cost, advertising expenditures, and excise taxes	37	--	Posner (2001:304), Barnett *et al.* (1995: tables 1 and 3)
27. Price elevation due to all sources of market power (unilateral, tacit, or overt) of the U.S. **soft drinks bottling** industry (does not include the syrup makers like Coca-Cola)	A cross-sectional econometric model applied to 1972-1987 data on 40 food processing industries; Lerner index of market power is 3rd highest and virtually tied with the 4th and 5th highest	60	- -	Posner (2001:304), Bhuyan and Lopez (1997:1039-40)
28A. International patent-pooling cartel in **magnesium** metal market combined with exclusive supply contract by Dow Chemical with fabricator AMC (a General Electric affiliate), July 1927-1942, which raised prices to all U.S. buyers	Prices charged to all U.S. buyers 6/33-11/38 compared to yardstick of AMC's prices or export prices	27-37	--	Stocking and Watkins (1946:295)
28B. Dates of cartel above are changed to Oct. 1932 (the date Alcoa signs a contract with I.G. Farben) to April 1942 (Alcoa, Dow and 3 others indicted by DOJ); U.S. cartel member pleaded *nolo* and paid fines; beginning in 1942, wartime price controls were imposed at levels to guarantee high profits	Real net prices charged by Dow Chemical to foreign customers during 1933 -1941 compared to 1942-1943; "after" prices more reasonable because of rapid cost reductions before and during earlier years of cartel; peak year 1933	9.4+	47	Suslow (2001: 56), Stocking and Watkins (1946: 274-303)
28C. Same as 28A for years 1927-1929	Lerner index	61.3	--	Griffin (1989:189-190)

28D. Same as 28B for years 1934-1937	Lerner index	33.3	--	Griffin (1989:189-190)
29. Auctions for U.S. **Forest Service timber**, 1975-1981, Pacific Northwest, 108 auctions in an area with high timber density; most other forest areas are less competitive	Econometric model of collusion with supply effects; mean compared to model of competitive market price	5.7	--	Baldwin *et al*. (1997)
30. **School district milk-supply**-contract bid rigging in Cincinnati, Ohio by three dairies, 1980-1990, for 2% chocolate milk in pints; from a trial with finding of guilt	Average price of winning bids relative to competitive control group of dairies, from fitted econometric model; maximum is highest year	6.5	11.3	Porter and Zona (1999:263), Porter and Zona (2004:229)
31. Brokerage firms that in early 1990s were **market makers on the NASDAQ exchange** and that beginning May 27 or 28, 1994 no longer avoided odd-eighth quotes on the stocks of four large companies after exposure of the practice in newspapers. More than 20 of these market-maker paid record civil damages	Comparison of bid/offer spreads on four stocks before and after 5/27/94	50	--	Christie *et al*. (1994)
32. Winning bids in 134 construction contracts for Government of Korea **public works construction projects** worth more than $10 million each, Jan. 1995-June 1998	Econometric model using forecasting approach	15.5	--	Lee and Hahn (2002:83)
33A. Bid rigging by three contractors on city contracts for **sewer construction** in a Southeastern U.S. city, late 1970s to Jan. 1980, from plaintiff's expert opinion prepared for a trial held in 1985-1988	Direct court testimonial evidence on City Project No. 67	18+	--	Howard and Kaserman (1989:389)
33B. Same as 33A	Three statistical models applied to six other projects (ratio, dummy variable, and forecasting methods)	27-41	--	Howard and Kaserman (1989:389)
33C. Same as 33A	Statistical model applied to Project No. 67	25-47	--	Howard and Kaserman (1989:389)
34A. Bid rigging in 2,014 No. Carolina and So. Dakota state **highway construction** projects, 1975-1982, with identity of some collusive firms certain and others suspected	Econometric model for NC price data	18	--	Werden (2003:2); Brannman and Klein (1992
34B. Same as 34A	Econometric model, auction prices in SD	6.5	--	Werden (2003:2); Brannman and Klein (1992
35. From well-known price-fixing trial*, U.S. v. Socony-Vacuum,* of 24 integrated **Midwest petroleum refiners** (of which 12 were convicted); agreement to restrict refinery output, March 1935-April 1936; prices are Midwestern spot 3rd grade gasoline, 60-62 octane, f.o.b. Oklahoma	But-for prices are averages of 1934, 1933-34, or 1932-34; max. price was 5.4 ¢ per gal. in 12/35	23-31	36-46	Johnsen (1991:179)
36. Five firms pleaded guilty to bid rigging U.S. Dept. of Defense procurement contracts for **frozen fish**, 1981-Sept. 1989, consisting of three distinct episodes	Econometric model that uses post-conspiracy prices to:			Froeb et al. (1993:419-423
36A. Same as 36, for 11/86-7/88 (103 bids)	Backcast period A	30	--	
36B. Same as 36, for 6/84-11/86 (74 bids)	Backcast period B	23	--	

36C. Same as 36, for 9/88-9/89 (44 bids)	Forecast period C	23	--	
37. Bakers of Washington State colluded on price of **white pan bread** from about 1954 to 1964; confirmed by a decision of the U.S. 9th Circuit Court	Yardstick is conservative, the average U.S. retail price; maximum price difference is late 1958	15+	20.5	Mueller and Parker (1992:79)
38. An event study of the impact on stock prices of price-fixing indictments, mostly **U.S. manufacturing sector,** announced during 1962-1980 on 127 publicly traded U.S. firms in 57 conspiracies (out of 200 total); at least 85% pleaded guilty and were fined	Econometric study; estimated additional revenues from the conspiracies are compared to the companies' total sales;	8.7	--	Bosch and Eckard (1991: 315)
39. EU **carton board** cartel, 1/86-12/91	EC decision to impose fines, 7/13/94, contains estimate	20-26	--	Connor(2003: Table A.5), Levenstein and Suslow (2002: 49), EC (7/13/94)
40. An international cartel in **iodine** was formed in 1878 by Chilean, English, and French companies; in the 1930s these companies and others from Germany, Italy, and Norway were linked by a common selling organization in London; Japanese producers joined in June 1937; ended in Sept. 1939	Eckbo's estimate is in a table, but he provides no discussion of his reasoning	50+	--	Eckbo (1967:37), Hexner (1946: 254-255)
41. **Ferry Operators**, English Channel Freight, 10/92-12/92; EC fines	EC orders nullification of collusive rate increase	10	10	Levenstein and Suslow (2002:Table 15), Connor(2003: Table A.5)
42A. International **fine-art auction house** services 1992-2000, convicted by U.S.DOJ, EU, and large private plaintiffs' settlement	Plaintiffs' assertion	0-20	--	Levenstein and Suslow (2002:Table 15)
42B. Same as 42Aabove	Information about changes in U.S. commission rates paid by all clients	91-200	--	Connor(2003: Table A.4)
42C*. Same as 42A above	Based on unchallenged testimony at US trial about Sotheby's increased profits of $50-75 million, its market share (50%), and revenues	31-50	--	Ashenfelter abd Graddy (2002:section 6)
42D*. Same as 42A above	Government's calculation of overcharge and affected commission revenues accepted by judge for sentencing of Sotheby's owner	27-29	--	AP (4/23/2002), *NY Law J.* (4/23/2002)
42E*. Same as 43A above	Calculations of class-action lead counsel of total damages ($300 million) and total commissions	94-100	--	Stewart (2001)
43. **Shipping conference**, France to Central & West Africa 1975-1992; fined by EC 4/1/92	From decision of the European Commission printed in the *Official Journal*	34-39	--	Levenstein and Suslow (2002:Table 15), Connor(2003: Table A.4), *EC Official Journal*

				L134 (5/18/92:3)
44. A 1952 U.S. court decision concluded that 3 beet-sugar refiners had conspired to undercharge **sugar-beet** farmers in the 1939-1941 crop years by $0.25 /ton	Prices paid to growers by processors in 1939-1941, excluding Sugar Act payments; lowest (peak) price is from 1939	4.6	7.6	Adams and Bock (1980; 143-144)
45. U.S. jury trial concluded that grocery retailers in California had conspired from 1953 to 1970 to under pay their suppliers of **beef**	1953-1970 wholesale prices of beef compared the three years after the conspiracy terminated	47	65	Adams and Bock (1980; 145-146)
46. Suppliers of **vanadium ore** conspired to lower prices to certain corporate customers in the U.S. in the 1950s; a rare monopsony case; jury trial decision in 1962	But-for price was that paid for the same grade of ore at the same time by the U.S. Government	39?	--	Adams and Bock (1980; 146)
47A. First international **platinum** cartel was formed in 1903; one UK and one French marketer of Russian metal; ended 1914	Average stabilized price 1905-14 compared to 1903	125	--	Elliott *et al.* (1937:152)
47B. Second intl. wholesalers' cartel formed 1920; included original 2 members plus one U.S. firm and "German interests"; ended in early 1931 after opening of new mines in Russia, Columbia, So. Africa, and Canada after 1927	Cartel's peak effectiveness was 1920-1927; peak price of $120/oz. reached in 1925; comparison is with price early 1931	--	336	Elliott *et al.* (1937:153)
47C. The second international platinum (a byproduct of gold, copper, or nickel mining**)** miners cartel was formed in 1918 by companies mining and smelting in Russia, UK, Canada, So. Africa, Columbia, Germany, and France; Russia withdrew in 1927; did not control substitute palladium prices; may be related to 47B	Real prices 1919-1927, compared to non-cartel period 1929-1931; peak is 1924	74	122	Suslow (2001: 56), Hexner (1946: 235-237)
47D. The third international platinum miners' cartel began Oct. 1931 with establishment of Consolidated Platinums Ltd. in London which managed export quotas and set refined metal prices; probably collapsed 1933	Real prices in 1932-1933 compared to 1930-31; 1932 is peak year	4.6	11	Suslow (2001: 56), Hexner (1946: 235-237)
47E. Same as 47D above	Real prices in 1932-33 compared to 1935-38 or to 1935 alone because 1936-38 had better demand conditions than 1935	3.8-28.0	10-36	Suslow (2001: 56), Hexner (1946: 235-237)
47F. Same as 47C	Lerner index	75.4	--	Griffin (1989:189-190)
47G. Same as 47D	Lerner index	11.1	--	Griffin (1989:189-190)
48. **Electric power generating and transmission equipment**, bid rigging against U.S. electric utilities began in 1930s but data available only for 1950-1959, overcharges of about $175 million per year in 1950s, 29 corporations pleaded guilty in 1960 and paid fines of almost $2 million, almost 2000 private treble-damages suits filed with settlements of over $400 million				Carlton and Perloff (1990:213-216)
48A. Average price increases on all	Result of five-year study by	9-10	--	Carlton and

products	joint committee of Congress			Perloff (1990:216), U.S. Congress (1965)
48B. Same as 48A; widely cited study by FTC staff members, eight of the most important product classes out of 20 that were cartelized during 1950 or earlier and 1959; analysis covers sub period 1950-1954	Econometric model applied to data from special survey of 70 firms in industry, 553 annual observations 1950-1970	6.7	--	Carlton and Perloff (1990:216), Lean et al. (1985:836)
48C. Same as 48A, except a temporary lapse in cartel discipline called the "White Sale" of 1955	Same as 48B	2.8	--	Carlton and Perloff (1990:216), Lean et al. (1985:836)
48D. Same as 48A, except final collusive episode of 1956-1959	Same as 48B	3.7	--	Carlton and Perloff (1990:216), Lean et al. (1985:836)
48E. **Turbine electric generator** quarterly transaction prices 1948-1963 from industry trade association; Sultan concludes that conspiracy was "ineffectual" (p ix) and had no "measurable impact on price… when measured with the dummy variable technique" (p.111); yet hidden in an appendix is a Version II model cited by Carton and Perloff that includes both direct and indirect effects; finds positive 1960-72 price differences, which seem to be due to tacit behavior	Very complex econometric simulation model with and without conspiracy effects for 1955-59; average price differences are much larger in 1958-1960 than after 1960; maximum effect is 1960	8-9	49	Carlton and Perloff (1990:216), Sultan (1975:346-348)
48F. **Large electric power transformers** 1947-late 1959	Simple comparison of defendants' transaction prices with the 10 quarters of prices after the cartel was prosecuted; peak prices 1956	30-38	90	Kuhlman (1967: 553)
48G. Same as 48A; a journalistic monograph of the U.S. electrical equipment conspiracy based on interviews, court proceedings, and Congressional hearings	Comparison of "book" (list collusive) prices in early 1950s with late 1994-early 1955 price war "discounted" prices, all products	--	40-45	Smith (1963: 110)
48H. Same as 48G above, **large circuit breakers**	Price in winter of 1957-1958 price war among members of the electrical circuit breakers cartel, compared to previous book prices	60	60	Smith (1963: 112)
48I. Same as 48G above, **switchgear**	Same as above for 1958 prices	--	40-45	Smith (1963: 114)
48J. Same as 48E; decision from a bench trial in *Ohio Valley Electric v. General Electric*	Judge compared actual prices paid with post-conspiracy prices and adjusted the price difference downward to account for a number of changes in demand and supply conditions	21	--	Finkelstein and Levenbach (1983)
48K. Same as 48A; estimates made by two academic economists in late 1962 working for the Anti-Trust Investigation Group, a consortium of 164 plaintiffs' counsel for the 1,912 treble-damage suits; analysis used	But-for prices were before, during, during, and after (1948, 1950, 1955, and 1961) with the last year giving the largest overcharges;	10-11	--	Bane (1973:217-219)

both list prices and buyers' prices paid from 1948 to end of 1961 and corrected price increases for labor and material costs; steam turbine generators 1948-1960	"conservative" Blue Book figures used all four years			
48L. Same as 48H, except for large circuit breakers 1956-1959	Same as 48K above	28	--	Bane (1973:217-219)
48M. Same as 48K above, except large power transformers 1956-1959	Same as 48K above	37	--	Bane (1973:217-219)
48N. Same as 48K above, except watt-hour **meters** 1956-1959	Same as 48K above	13	--	Bane (1973:217-219)
48O. Same as 48A; result of a jury trial in 1964 in *Philadelphia Electric v. General Electric et al.* for a mix of products purchased by the plaintiff	Jury decision on actual damages	8.7	--	Bane (1973:314)
48P. Same as 48A; result of a bench trial in 1964 in *Ohio Valley Electric v. General Electric et al.*	Bench decision on actual damages	11	--	Bane (1973:314)
48Q. Same as 48A; result of a court's special master's analysis, Prof. Kessel of the Univ. of Chicago, in *Atlantic City Electric v. I-T-E Circuit Breaker* trial; plaintiffs included Gulf State and Kansas City Power and Light; after the Special Master's report was issued, I-T-E quickly settled	Range of estimates is for different mix of purchases by two utilities	21-24	--	Bane (1973:217-219)
48R. Same as 48E	Previous estimate is from the text; this one is from Table A18.4 for 1955-59	13.3	--	Sultan (1975:348)
49A. Classic empirical study of the Joint Executive Committee, a famously unstable U.S. **railroad** cartel that fixed prices and market shares on transport from **Chicago to East Coast** cities for 328 weeks from 1880 to 1886 prior to the passage of the Sherman Act	Average price increase during "cooperative periods" identified by the JEC's detailed internal records	66	--	Porter (1983)
49B. Same as 49A; an econometric analysis of the Joint Executive Committee, one of the most intensely examined cartels in history; the model specifies both demand and supply relationships and, unlike Porter (1983), corrects for serial correlation	To derive the average equilibrium price during collusive periods, one must solve the supply equation for logP in terms of estimated coefficients	50.8	--	Ellison (1994: Table 2 p.42), Ellison (2003)
49C. Same as 49A, except author's econometric model for 1871-1898 uses 56 semiannual observations of real prices of grain shipments; controls for a few railroad costs and demand factors; distinguishes between months when Great lakes shipping via Buffalo was competitive and months when ships could not sail	During 1871-74 JEC period when there were only two companies serving Chicago from the East, winter rates compared to pre-JEC period	24.4	--	Briggs (1989:201)
49D. Same as 49A above	Same as 49C above except summer rates when there was a large fringe competing	9.5	--	Briggs (1989:201)
49E. Same as 49A above	Compares winter rates during JEC when there were 4 or 5 railway companies with pre-JEC rates	5.5	--	Briggs (1989:201)
49F. Same as 49A	Same as above except summer	.5	--	Briggs

	rates			(1989:201)
49G. Same as 49A except model is two equations solved simultaneously, which allows for feedback effects; covers only the JEC cartel period; has a greater array of controls for demand and supply shifters, including market concentration	Alternative model specifications result in some variations in the estimated coefficient for price; larger effects are highly significant	13.7-30.8	--	Briggs (1989:203)
50A. **Quebracho** (tanning agent) cartels organized voluntarily by about 20 Latin American and 1 UK firm in four agreements 1916-17, 1919-22, 1926-31, and 1935-44; cartels were "reinforced by decrees of the Argentinean and Paraguayan governments"; nevertheless, the cartel's U.S. agents were prosecuted by the DOJ in 1942	New York import prices for 1926-30 compared to 1923-25 "before" prices from Hexner (1946)	5	--	Hexner (1946: 281), Suslow (2001: 57), Wallace and Edminster (1930:359-361)
50B. Same as 50A above for years 1919-1922	Real prices in 1920-22 taken from Berge (1944) compared with 1924-1925; peak is 1920	12.4	15	Suslow (2001: 57), Berge (1944: 112-120)
50C. Same as 50A above for years 1926-1931	Real prices in 1926-31 compared with 1924-1925 and with 1932-34; peak is 1930	26	45-60	Suslow (2001: 57), Berge (1944: 112-120)
50D. Same as 50A above for years 1935-1942	Real prices in 1935-39 compared with 1932-34; peak is 1939	23	35	Suslow (2001: 57), Berge (1944: 112-120)
50E. Same as 50A and 50D above	NY import prices for 1935-39 compared to 1932-33	52	--	Hexner (1946: 281)
50F. Same as 50A and 50C above	Eckbo's interpretation of Hexner and information from the 1942 U.S. antitrust indictment	50+	--	Eckbo (1976: 38-39), Hexner (1946: 279-281)
50G. Same as 50A and 50D above for 1934-1946	Same as 50F above	50+	--	Eckbo (1976: 38-39), Hexner (1946: 279-281)
50H. Same as 50D above; information from Congressional testimony in 1942 and from court documents when six trading companies pleaded *nolo* in 1942	Last of six price increases from Nov. 1934 to Jan. 1941, compared to pre-Nov. 1934 price	--	95	Berge (1944:118)
50I. Same as 50A	Real prices in 1926-31 compared with 1932-34; peak is 1930	40	45-60	Suslow (2001: 57), Berge (1944: 112-120)
51. **Ready-mix concrete** bid-rigging cartel in Denmark, January 1994 to January 1996; prices on several grades from 18 sites; collusion was facilitated by detailed price reports issued by the Danish Competition Authority that made previously secret discounts known to sellers; study controls for costs; no mention of prosecution	Average prices compared to quarter before new government price reporting began	19	25	Albaek *et al*. (1997:433,440)
52A. Bid rigging of English oral **auctions** of 340 quality-graded **used 1988 Chevrolet Caprice police cars**, New York City, January 1990-May 1991; alleged bidding ring active in 3 of 13 auctions; civil case settled out of court	Ratio approach statistical analysis of Howard and Kaserman (1989); mean of three auctions	17.1	22.4	Nelson (1993:385)
52B. Same as above	Dummy variable model following Howard and	16.6	21.4	Nelson (1993:390)

	Kaserman (1989); from Equation 1			
53. Bid rigging ring in Washington, DC of 680 **houses sold at public auction** (mortgage foreclosures or NISI proceedings), Jan. 1967-August 1990, followed by English "knockout" auctions among ring members to distribute profits; six members pled guilty, 6-9 found guilty at trial	Econometric model with almost perfect fit to sample of bids by members found guilty at trial; model accounts for complex profit payout system	32.5	146+	Kwoka (1997: Tables 1 and 2)
54. Regional market power of AMPI **dairy cooperative** with 30,000 members, 1972-April 1975 (date of DOJ consent decree) over farm milk prices	Econometric dummy-variable model of the price premium in markets with average market shares, relative to post-decree margin, as a proportion of U.S. average blend price of farm milk	3.0-4.0	--	Madhaven *et al*. (1994: Tables 1 and 4)
55. Intensive case studies of 40 cartels in **UK manufacturing** before and after the 1956 antitrust legislation and Restrictive Practices Court decisions from 1959 and later made 85% of the sample cartels illegal. Despite strong demand increases and moderate inflation in early 1960s, 39 of 40 cartels showed significant price declines.	Change in nominal wholesale UK prices reported by sellers or major buyers from 1956-59 price levels to various periods following first negative Court ruling in 1959	0-30	--	Swann *et al.* (1974: 156-57, 166)
56. Same as 55 above, UK **wire ropes**, non-marine, 1956-59	Price 36 months after negative ruling	15.3	--	Swann *et al.* (1974: 156-57, 166)
57. Same as 55 above, UK **porcelain sanitary bathroom fixtures,** 1956-59	12 months after	20.0	--	Swann *et al.* (1974: 156-57, 166)
58. Same as 55 above, UK **steel pipes, sewage** and drainage, 1956-59	36 months after	25.0	--	Swann *et al.* (1974: 156-57, 166)
59. Same as 55 above, UK **rubber and plastic coated cable**, 1956-59	6 months after	25-30	--	Swann *et al.* (1974: 156-57, 166)
60. Same as 55 above, UK **small electric motors**, 1956-59	36 months after	20-25	--	Swann *et al.* (1974: 156-57, 166)
61. Same as 55 above, UK **electric meters;** probable bid rigging against government electricity-generating companies	72 months after, as reported by one buyer	15.0	--	Swann *et al.* (1974: 156-57, 166)
62. Same as 55 above, UK **carpets**, mechanically woven, 1956-59	Up to 10 years later	0	--	Swann *et al.* (1974: 156-57, 166)
63. Same as 55 above, UK **iron bath tubs**, 1956-59	Average 1965-69 prices	30+	--	Swann *et al.* (1974: 156-57, 166)
64. Same as 55 above, UK **steel drums**, 1956-59	Average 1960-69 prices	--	10	Swann *et al.* (1974: 156-57, 166)
65. Same as 55 above, UK **electricity transformers, largest sizes;** probable bid rigging against government electricity-generating companies, 1956-59	Average 1960-1970 prices	--	25	Swann *et al.* (1974: 156-57, 166)
66. Same as 55 above, UK **electricity**	Average 1960-1970 prices	--	25-41	Swann *et al.*

transformers, system and distribution; probable bid rigging against government electricity-generating companies, 1956-59				(1974: 156-57, 166)
67A. The **Sugar Trust** was formed in Nov. 1887 and was effective in eastern U.S. until the Spreckels factory in Philadelphia opened in early 1892	The increase in gross margins in 1888-89 divided by the average wholesale price; peak is Sept. 1889; UK and German yardsticks show no technological change affecting prices	6-14	15	Jenks (1900:145)
67B. Same as 67A, except that in mid 1892 the Trust bought out Spreckels; until new rival firm appeared in Sept. 1898	The increase in gross margins in 1892 to mid 1898 relative to average price; peak is Sept. 1896	7-9	16	Jenks (1900:145)
67C. From "narrative evidence," weekly memos of meetings of the Sugar Institute, a trade assn. of the 14 U.S. **cane sugar** refiners from Dec. 1927 to 1936 when Supreme Court declared it to be an illegal cartel; Institute achieved higher prices solely through collusion on trading rules, in face if increasing competition from beet sugar and imports	Comparison of prices in relatively competitive period 1926-27 (Lerner Index was 0.031) to cartel period (Lerner ave. 0.085 and monopoly index 0.110) and adjusts for only source of cost changes (raw cane sugar)	6.3	11.9 (calculated to be 95% of monopoly price)	Genesove and Mullin (2001:382), Levenstein and Suslow (2001: 42)
67D. same as 67C above	But-for price is from 1937-1939	1.1	--	Genesove and Mullin (2001:382)
67E. Eastern U.S. Sugar Trust, from a quantitative NEIO model fitted to 1890-1914 price, demand, and cost data; Am. Sugar Refining Co.'s market share fell from 91% in 1892 to 71-86% in 1893-97 to below 62% after 1901.	Elasticity-adjusted Lerner indexes significantly greater than zero for 1893-1897, between two price wars; peak 1893	23.4	29	Genesove and Mullin (1998:368)
67F. Same as 67E	Elasticity-adjusted Lerner indexes significantly greater than zero for 1901-02	15.5	20	Genesove and Mullin (1998:368)
67G. Same as 67E	Elasticity-adjusted Lerner indexes significantly greater than zero for 1908	7	--	Genesove and Mullin (1998:368)
67H. Same as 67E	Elasticity-adjusted Lerner indexes significantly greater than zero for 1913	3	--	Genesove and Mullin (1998:368)
68A. History of several early attempts (1847, 1862, and 1885) at forming national **zinc** cartels in France and Belgium that held stocks of zinc off the market to raise prices; the first was "successful" for 13 years (viz., 1847-60), the others were not.	Historical case study, but no price data discussed; method unclear	0+	--	Devos (1994)
68B. First international **zinc** export cartel began 1910, ended Sept. 1914; included all the largest firms in AT, BL, UK, FR, DE, and NL with 62% of world production; large US market was protected by tariffs	No prices available, but characterized as a "weak" cartel	0+	--	Benni *et al.* (1930), Plummer (1934:102)
68C. Second international **zinc** cartel similar to 68A; began Sept. 1928, revised in Jan. 1929 and dissolved Dec. 1929 because market price stayed above its target price; signed only 3-month contracts	A "weak" cartel also	0+	--	Benni *et al.* (1930), Plummer (1934:102)

68D. Same as 68C; international **zinc** cartel May 1928-late 1929	Lerner index	37.0	--	Griffin (1989:189-190), Hexner (1946:249)
68E. Same as 68C; members included all major European producers; monthly agreements on production cuts of 5% to 10%; no control over new electrolytic-zinc process factories and friction between vertically integrated and nonintegrated members	European prices from Mar. 1929 to lowest level in May 1931	63	--	Elliott *et al.* (1937)
68F. A revival of the 1928-29 European cartel with Australia and Canada added; output adjusted every 3 months if price exceeded or fell below £24/t; mid 1931-1934 (or 1935)	Lerner index	14.9	--	Griffin (1989:189-190), Hexner (1946:249), Plummer (1934:102-103)
68G. Same as 68F; beginning in July 1931 and continuing through 1933, European producers reduced production to 45% below rated capacities; stocks reached normal levels by 1933 causing prices to rise through mid 1934	No precise data provided, but analysis consistent with 68E above	0+	--	Elliott *et al.* (1937:764)
68H. Historical case study based on internal memorandums of 2nd international **zinc** cartel; the Zinc Producers Group of 22 companies in Australia, UK, Germany, France, Spain, and Canada operated from 1945 to 1975 using output restraints, purchases of stocks, list price targets, and manipulation of the zinc contracts on the London Metals Exchange; effective only from 1964 to 1968.	But-for price is 1960-62 or 1961-63 average f.o.b. cash price on the London Metals Exchange compared to July 1964 – Dec. 1968 average; peak is 1965 average	39-46	53	Tsokhas (2000: Table 1)
69A. Same companies, conduct, and time period as 68H above, except for the **Lead** Producers Group; price increases effective only in 1965-1967.	Base period is 1960-64 or 1961-65 LME cash contract prices; collusive period is 1965-1967; peak is 1966	34-53	49-69	Tsokhas (2000: Table 2)
69B. **Lead** cartel, all leading mining and smelting companies of 8 countries, signed an agreement 11/1/38, abandoned 9/39, but considerable doubts about whether agreed reductions in sales were ever implemented	London spot exchange prices Nov. 1938 to August 1939	0	--	Hexner (1946: 230)
69C. International **lead** cartel 1921-1923	Lerner index	20.5	--	Griffin (1989:189-190)
69D. This author states that there were no international agreements prior to April 1931 after London prices had declined by 60% since 1929; in 1930 and 1931 the Lead Producers' Association cut non-US production by 80-85%	Production quotas caused late 1931-1932 prices to rise above the lowest previous price observed in June 1931	10-50	--	Elliott (1937:662)
70A. South African **cement** cartel fixed prices and quotas from at least 1922 to 1994; adopted a multiple basing-point pricing system in 1956; legally exempted after 1986 by the So. African Competition Board, which reversed its position in 1995; Leach's extensive apologia of cartels fails	Prices set by cartel in Natal area compared to bulk prices charged by a new importer of Spanish cement in 1984-85; cartel later cut prices in Natal by 24% and drove importer out of business	5-10	--	Fourie and Smith (1994:130), Leach (1994), Levenstein and Suslow (2001: 42)

to criticize the Natal-import episode				
70B. Same as 70A above	Authors derive average 1972-1990 mark-up by comparing cement price-cost margins with those in buildings-materials mfg. and all manufacturing	17-26	--	Fourie and Smith (1995)
71. Historical/political-science study of the So. African **gem diamond** cartel, the Diamond Syndicate, that got control of all major mines in 1888 and began to reduce sales in that year	Prices in 1889 to 1890 compared to 1888	50	80	Spar (1994), Levenstein and Suslow (2001: 42)
72A. An export cartel organized by the two dominant producers of **mercury** located in Italy and Spain, both with government ownership or control; cartel reserved home markets for each company and operated exports through joint sales agents in Switzerland or London or in the importing countries 1928-1936; interrupted by Spanish Civil War	Eckbo's interpretation of case studies by others; prices may refer to export markets that were subject to antitrust actions	50+	--	Eckbo (1976:33), Hexner (1946: 232-233)
72B. Same as 72A above, except for 1939-1949	Eckbo's interpretation of case studies by others; ; prices may refer to export markets that were subject to antitrust actions	50+	--	Eckbo (1976: 33), Hexner (1946: 232-233)
72C. Same as 72B above from period when sole selling agency was established in London until it was nationalized by the UK government in 1942	Eckbo's assumption on the basis of the UK nationalization	50+	--	Eckbo (1967: 40)
72D. Same as 72A; from an early economic study of international cartels, most of them European based; writing at the beginning of the Great Depression, the author is more impressed by the failures of cartels to raise prices than their successes; of scores of private cartels studied, only two have data on their price effects, one of them the international mercury cartel, which controlled 88% of global supply in 1927 and 58% in Aug. 1932, during a period of rapidly falling demand	Price change from May 1931 to August 1932 in UK, from information in previously published economic studies and press accounts	--	-58	Plummer (1934:149-152)
72E. Same as 72A above, except dates of operation are 1926-30; in 1931 mercury cartel control dropped to 57%; prices are minimum annual League of Nations series in pounds sterling	Average 1926-30 prices compared to competitive 1932-35 period; peak is 1926	99	126	Oualid (1938:22-23)
72F. Same as 72A and 72B combined	Lerner index, econometric model	108.3	--	Griffin (1989:189-190)
72G. International cartel 1954-1970	Lerner index, econometric model	270.4	--	Griffin (1989:189-190)
72H. International cartel 1975-1982	Lerner index, econometric model	42.9	--	Griffin (1989:189-190)
73A. From 1897 to 1919, the German **potash** cartel, the Deutche Kali Syndikat, which contained a mix of private and state-owned mines, had a near monopoly on	In June 1909 the cartel's contract expired and three dissident members signed contracts with U.S. importers	45+	--	Newman (1948: 578), Schroeter (1994), Tosdal (1916)

world exports; Newman states that industry was nationalized and all producers compelled to join the cartel in April 1919; Schroeter judges that the cartel began as early as 1876 and that the Prussian state began controlling the cartel in late 1910; Tosdal believes start date is 1879	at prices well below the 1908-early 1909 U.S. c.i.f. import price			
73B. Same as 73A above	As interpreted by Levenstein, prices in 1910 reached "double average costs"	--	50+	Levenstein (2000), Schroeter (1994), Spar (1994), Levenstein and Suslow (2001: 42)
73C.Same as 73A above	German price of chloride of potash in 1878 compared to the 1896-1906 average	55	--	Levy (1927:295)
73D. Same as 73A above	Estimates price-cost margin in 1910 to be 200%; costs appear to be close to LRMC	100+	--	Schroeter (1994:76)
73E. First international potash cartel formed in August 1924, after deep price cuts during 1919-1923; voluntary agreement between the German and French national (both were government-controlled) cartels to set prices and quotas (70%, 30% respectively) for U.S. exports; in 1929 the only significant U.S. producer was secretly bought by the German cartel; lasted in its original form until 1932; overcapacity was cut and the industries rationalized, causing production costs to decline in 1920s and 1930s; no cost changes in 1920s	U.S. import prices of Manure salts (20% potash) set at start of cartel compared to competitive 1909-10 U.S. import prices	25.8	--	Newman (1948: 583), Schroeter (1994:77) , Wallace and Edminster (1950:105)
73F. Same as 73E above	Same as 73E for muriate of potash (51% potash)	42.7	--	Newman (1948: 583)
73G. Same as 73E above	Same as 73E for sulfate of potash (49% potash)	50.7	--	Newman (1948: 583)
73H. Same as 73E above	Change in U.S. import prices from September 1924 to May 1929 for manure salts	65.2	--	Newman (1948: 583)
73I. Same as 73E above	Change in U.S. import prices from September 1924 to May 1929 for muriate of potash	12.4	--	Newman (1948: 583)
73J. Same as 73E above	Change in U.S. import prices from September 1924 to May 1929 for sulfate of potash	11.4	--	Newman (1948: 583)
73K. Second international cartel; Polish producers were added in 1932 as members and given a 4% export share; Spanish production expanded rapidly under French and British ownership from 1932 to 1934 when it captured 33% of U.S. market	Prices of U.S. imports in 100%-potash-equivalents fell from 1933 to 1934 because of Spanish entry into the world export market	71.6	--	Newman (1948: 584)
73L. Third international cartel; signed a new agreement with Spanish producers in 1935 giving them 15% export share; outbreak of Spanish Civil War in 1936	Same as 73E above for years 1934 to 1937-1941	37.7	--	Newman (1948: 583)

reduced Spain's exports; Russia and Palestine added in 1936; probably ended Sept. 1939				
73M. Authors view 1st, 2nd, 3rd international potash cartels 1926-35 (73E, 73K, and 73L) as one cartel	Compare average 1927-35 German potash prices with price in 1926; peak is 1934	24	33	Oualid (1938:26)
73N. Same as 73M	Compare 1926-35 French prices with 1926; peak is 1927-29	40	46	Oualid (1938:26)
73O. Same as 73M	Lerner index	56.3	--	Griffin (1989:189-190)
73P. Same as 73E; Schroeter ascribes price increase to a renewed agreement in May 1925 that adjusted the French-German export quotas and set of 50-50 common sales agencies in the importing countries.	Berlin potash prices in late 1925 compared to 1924 and early 1925 prices	50+	--	Schroeter (1994:78)
73Q. Same as 73E	Average Berlin prices in 1928-1932 relative to 1924 prices	55-65+	--	Schroeter (1994:80)
73R. Polish potash mines opened in 1927 and were admitted to intl. cartel with a national hegemony and a 4% export share in 1932; Russian cartel entered with a 10% quota in April 1934; but failure to incorporate large Spanish production from 1932 to May 1935 was the cause of a price crash in 1934-35	Berlin prices in 1928-32 relative to 1934-35; peak price in 1931	73	89	Schroeter (1994:80)
73S. Same as 73R; in May 1935 Spanish producers were allotted a national hegemony and a 15% world export share; U.S. producers made a secret agreement in 1935 to follow the intl. cartel's prices, for which they were found guilty in 1940	Berlin prices in 1936-37 after Spain joined cartel compared to 1934-35	26	--	Schroeter (1994:78)
73T*. Same as 73A	Compares prices in 1908 with prices offered during cartel suspension on two-year 1909-1910 contracts to US importers	25-40	40	Wallace and Edminster (1950:97)
73U*. Same as 73E	Compares average 1926-28 muriate of potash US import prices with period of weak cartel power 1924-25; peak is 1928	7.8	13.5	Wallace and Edminster (1950:105)
73V*. Same as 73E	Compares average 1926-28 potash sulphate US import prices with period of weak cartel power 1924-25; peak is 1928	6.1	11.3	Wallace and Edminster (1950:105)
73W*. Same as 73E	Compares average 1926-28 manure salt US import prices with period of weak cartel power 1924-25; peak is 1928	19.2	27.4	Wallace and Edminster (1950:105)
73X*. Same as 73E	Compares average 1926-28 kainite of potash US import prices with period of weak cartel power 1924-25; peak is 1928	22.0	30.3	Wallace and Edminster (1950:105)
74A. International **steel** cartel centered in Western Europe in 1930s; cartel raised	Prices in Germany above world price, apparently from	33	--	Levenstein and Suslow

prices in domestic markets of members, but sold abroad at lower, possibly competitive prices; seems to cover two episodes below (74B and 74C)	Barbezat's studies; Baker applies a general oligopoly model to U.S. data from 1933-39; Gallet's model refers to oligopoly pricing in the US 1950-1988			(2002:12,42), Barbezat (1989, 1990, 1994), Baker (1989), Gallet (1997)
74B. First international steel cartel of Sept. 1926-March 1931	S & W conclude that it "…lacked power over prices"; Benni et al. agree for whole period; peak is Sept. 1928-March 1929	0?	20	Stocking and Watkins (1946:203), Benni *et al.*(1930:14)
74C. Second international steel cartel of June 1933- Sept. 1939	This reorganized cartel was bigger and more successful than the first, but its power over price cannot be disentangled from the recovery of the world economy from the Great Depression	?	?	Stocking and Watkins (1946:182-211)
74D. Same as 74C	Lerner index	38.9	--	Griffin (1989:189-190)
74E. Same as 74C, but League of Nations prices collected f.o.b. Antwerp in pounds sterling, which author states are the same as found all over continental Europe	Average prices July 1933-Oct. 1936 compared to either Jan. or April 1933	9.3-17.5	--	Oualid (1938:40)
74F. Same as 74A	Lerner index	13.6	--	Griffin (1989:189-190)
75. International **lysine** cartel 1992-1995, prosecuted and sanctioned by the U.S., EU, Canada, and Mexico				
75A.	Changes in world prices	--	41	Levenstein and Suslow (2003:49), *The Observer* 10/25/98
75B.	Change in U.S. prices 1993, peak prices from trade journal	--	67	Levenstein and Suslow (2003:50), *Chem. Market Reporter* 7/17/95
75C.	Official estimate of overcharge during 1992-95, combined with court records of U.S. affected sales	17.1	--	OECD (2003:55)
75D.	Selling prices in U.S. relative to LRMC	17.6	56	Connor (2001b, 2004)
75E	Econometric model of the U.S. lysine market	17.6-18.0	56-57	Morse and Hyde (2000)
75F.	Benchmark is pre-cartel Canadian prices	22	--	Connor (2001b,2003: Table A.1)
75G.	Benchmark is pre-cartel EU prices	17	--	Connor (2003: Table A.1), EC decision of 6/27/2000
75H.	Benchmark is pre-cartel world prices	14	--	Connor (2001b, 2003: Table A.1)
75I.	Residual analysis from	8	--	Connor (2001b,

	75D,F,G, and H above; Asia and Latin America			2003: Table A.1)
75J.	Magazine article; Canadian peak prices	--	50	Levenstein and Suslow (2002:Table 15)
75K.	Prediction of price change due to collusion from a dynamic simulation model of the lysine industry that focuses on the role of ADM's entry	24.6	--	De Roos (2004:50)
76. International **citric acid** cartel, mid 1991- early 1995; convicted and fined in the U.S. and EU	Transaction prices compared to a range of long run full economic costs			
76A.	Transaction prices compared to a range of long run full economic costs	16-20	18-33	Connor(2001a and 2001b), Connor (2003: Table A.1)
76B.	Benchmark is pre-cartel prices in Canada	19-32	--	Connor (2003: Table A.1)
76C.	Benchmark is pre-cartel prices in EU	45-50	--	Connor (2003: Table A.1), EC decision of 12/5/2001
76D.	Benchmark is pre-cartel world prices	30-34	--	Connor (2003: Table A.1)
76E.	Official U.S. government estimate, method not reported	31	--	OECD (2003:55)
76F.	Statement of EC Commissioner M. Monti 9/13/00 after fines imposed	--	50	Levenstein and Suslow (2003:50), *European Report* 9/13/00
77 International **sorbates** cartel 1979-1997, successfully prosecuted by U.S. DOJ, Canada, EU, and private plaintiffs in U.S.				
77A.	Press report from anonymous source on US price effects	14	--	Levenstein and Suslow (2003:50), *WSJ* 10/1/98
77B.	Benchmark is pre-cartel and post-cartel U.S. prices from trade magazines	35-45	--	Connor (2003: Table A.1), *Chem. Market Reporter* (various dates)
77C.	Same as above for Canada	37-47	--	Connor (2003: Table A.1)
77D.	Same as above, world prices	42	--	Connor (2003: Table A.1)
77E.	Trade journal.; simple increase in U.S. transaction prices	--	14	Levenstein and Suslow (2002:Table 15)
78A. International cartel in **methionine** 1986-1999, successfully prosecuted by EU and large private settlements in U.S.	Benchmark is pre-cartel U.S. prices from trade magazine sources	10-14	--	Connor (2003: Table A.1)
78B. Same as 78A, but for the European Union; span is Feb. 1986 to Feb. 1999	Narrative of meetings gives both target and transaction ("going") prices from mid	33.0	57.3	*EC Official Journal* L255 (10/8/2003):1-32

	1990 to Feb. 1999; overstated benchmark (proxy for pre-cartel price) is mid 1990 price; peak is mid 1992			
79. International **sodium chlorate** cartel formed by exporters from Switzerland, Sweden, Italy, Germany, France, and Czechoslovakia 1931; ended in Sept. 1939	Real prices in 1931-1939 compared to nearly constant prices in 1920-1930, a period of relatively robust demand; peak year 1934	45	67	Suslow (2001: 58), Hexner (1946: 339-340)
80. International cartel in 15 **bulk vitamins** and Carotenoids, various dates between 1988 and 1999; prosecuted by U.S. DOJ, EC, CBC, ACCC, and private plaintiffs in U.S. and Canada.				
80A. **All vitamins** in US, 1989-99 [a]	Press report of U.S. class-action counsel estimate	20	--	Levenstein and Suslow (2002:Table 15)
80B. Same as 80A for Canada, 1989-99	Statement of CBC officials	30	--	Levenstein and Suslow (2002:Table 15)
80C. V**itamin E** in US, 1990-99	Analysis of U.S. list or spot prices before cartel operated	55-65	82-90	Connor (2003: Table A.1), Connor (2001a:322-330)
80D. **vitamin B1** in US, 1991-94	Analysis of U.S. list or import prices pre-cartel	9-11	16	Connor (2003: Table A.1)
80E. **vitamin B2** in US, 1991-95	Analysis of U.S. list or import prices before and after cartel for vitamin B2	12-19	21	Connor (2003: Table A.1)
80F. **vitamin B5 (calpan),** 1991-98	Analysis of U.S. list or spot prices before cartel	25	59	Connor (2003: Table A.1), Connor (2001a:322-330)
80G. **folic acid (B9),** 1991-94	Analysis of U.S. list or import prices before cartel for folic acid (a B vitamin)	23	38	Connor (2003: Table A.1), Connor (2001a:328)
80H. **vitamin C,** 1991-95	Analysis of U.S. list or import prices pre cartel	10-23	31	Connor (2003: Table A.1), Connor (2001a:322-330)
80I. **vitamin B3 (niacin),** 1992-98	Analysis of U.S. import prices before cartel	33	71	Connor (2003: Table A.1), Connor (2001a:329)
80J. **vitamin B12,** 1991-94	Analysis of U.S. list or spot prices pre cartel	13	73	Connor (2003: Table A.1)
80K. **beta carotene,** 1991-98	Analysis of U.S. list or import prices pre cartel	25-35	--	Connor (2003: Table A.1)
80L. **vitamin B12** in Canada, 1991-94	Analysis of Canadian list or import prices pre cartel	14	72	Connor (2003: Table A.1), Connor (2001a: 322-330)
80M. V**itamin A** for world, 1990-99	Analysis of world list prices pre cartel	25-30	--	Connor (2003: Table A.1, 2001: 322-330)
80N. Same as 80D **vitamin B1,** 1991-94	Analysis of world list prices	9-10	--	Connor (2003:

	before cartel			Table A.1, 2001: 322-330)
80O. Same as 80E **vitamin B2,** 1991-95	Analysis of world list prices before cartel	12-19	--	Connor (2003: Table A.1, 2001: 322-330)
80P. Same as 80F **vitamin B5,** 1991-98	Analysis of world list prices before cartel	25	--	Connor (2003: Table A.1, 2001: 322-330)
80Q. **vitamin B6**	Analysis of world list prices before cartel	4-40	--	Connor (2003: Table A.1, 2001: 322-330)
80R. Same as 80G **folic acid (B9)**	Analysis of world list prices before cartel	23	--	Connor (2003: Table A.1, 2001: 322-330)
80S. Same as 80H **vitamin C**	Analysis of world list prices before cartel	11-23	--	Connor (2003: Table A.1, 2001: 322-330)
80T. Same as 80K **beta carotene**	Analysis of world list prices before cartel	25-30	--	Connor (2003: Table A.1, 2001: 322-330)
80U. Same as 80K **other Carotenoids** in US	Analysis of U.S. list prices before cartel	9-13	--	Connor (2003: Table A.1, 2001: 322-330)
80V. Same as 80K **other Carotenoids,** world	Analysis of world list prices before cartel	25-30	--	Connor (2003: Table A.1, 2001: 322-330)
80W. Same as 80I **vitamin B3**	Analysis of world list prices before cartel	33	--	Connor (2003: Table A.1, 2001: 322-330)
80X. Same as 80J **vitamin B12**	Analysis of world list prices before cartel	33	--	Connor (2003: Table A.1, 2001: 322-330)
80Y. Same as 80A . An innovative trade model is fitted to international trade data in **all bulk vitamins** for 90 countries without significant domestic production; covers the years 1985-1999 (misses last 14 months of cartel); converted into 2000 U.S. dollars; importing nations with anticartel laws are distinguished from those that did not; model predicts quantity and price effects of the global vitamins cartel ; total overcharge is $2,626 million	Simple average of 24 overcharges on vitamins imports	19.7	60.5	Clarke and Evenett (2002: Table 7)
80Z. Same as 80A and 80Y above for 24 countries identified by the OECD with anticartel laws during the affected period (a possibly generous designation), excludes U.S. and many EU countries with large exports	Simple average of 24 overcharges on vitamins imports	19.7?	60.5?	Clarke and Evenett (2002: Table 7)
80AA. Same as 80A and 80Y above, but excluding five countries present authors believe did net effectively enforce their laws during most of 1989-1999: So. Africa., China, Romania, Peru, Bulgaria, Zambia.	Simple average of 19 countries	13.2	60.5	Clarke and Evenett (2002: Table 7)
80BB. Same as 80A and 80Y above for 20 largest countries with no anticartel laws	Simple average, as above	30.1	34.8	Clarke and Evenett (2002: Table 7)

80CC. Same as80A and 80Y above for 20 countries plus 5 mentioned in 80X	Simple average, as above	33.0	60.5	Clarke and Evenett (2002: Table 7)
80DD. Same as 80A for South Korea, 1990-99	Comparison of 1997 import price relative to 1990, year before cartel	70.0	--	KFTC (2003: 2)
80EE. Same as 80A and 80DD	Comparison of 1997 import price relative to 2000, year after cartel	38.4	--	KFTC (2003: 2)
80FF. Same as 80H; one of the weakest and least durable of the vitamins cartels because of large Chinese exports	Sophisticated simulation model estimated with accurate industry parameters that predicts "no collusion" price of $27/kg. and collusive price with Chinese fringe of $33	22.2	--	De Roos (2001:20)
80GG. Same as 80H and 80FF	Same as 80FF except that but-for price of $29.96 is from noncooperative oligopoly regime; peak price assumes no fringe	22.3	29.5	De Roos (2001:28)
80HH. Same as 80H and 80FF	Same as 80 GG except that but-for price of $29.00 is punishment-phase price war	26.3	33.8	De Roos (2001:28)
80II **Vitamin B6,** 1991-94	Analysis of U.S. list or import prices before and after cartel	7-28	19	Connor (2001a:326)
80JJ. **Vitamin D3,** 1992-98?	Analysis of U.S. list or import prices before cartel	36	47	Connor (2001a:323)
80KK. Same as 80H	Analysis of U.S. list or import prices after cartel	10	21	Connor (2001a:326)
80LL. Same as 80II	Analysis of U.S. list or import prices after cartel	48	79	Connor (2001a:326)
80MM. Same as 80D	Analysis of U.S. list or import prices after cartel	50	59	Connor (2001a:326)
80NN. Same as 80I	Analysis of U.S. list or import prices after cartel	16	33	Connor (2001a:329)
80OO. Same as 80C	Average annual 1991-98 EU transactions prices in euros vs. before (1990) prices	25.0	39.2	EC (2001:86)
80PP. Same as 80C	Average annual 1991-98 EU transactions prices in euros vs. after (1999) prices	51.9	67.2	EC (2001:86)
80QQ. Same as 80C	Average annual 1991-94 EU transactions prices in euros vs. before (1990) prices	8.7	19.6	EC (2001:86)
80RR. Same as 80D	Average annual 1991-94 EU transactions prices in euros vs. before (1990) prices	6.5	18.5	EC (2001:87)
80SS. Same as 80D	Average annual 1991-98 EU transactions prices in euros vs. after (1996-99) prices	79.7	100	EC (2001:87)
80TT. Same as 80E	Average annual 1991-94 EU transactions prices in euros vs. before (1990) prices	19.4	31.8	EC (2001:87)
80UU. Same as 80D	Average annual 1991-98 EU transactions prices in euros vs. after (1997-99) prices	24.3	37.1	EC (2001:88)
80VV. Same as 80F	Average annual 1991-94 EU	39.6	58.3	EC (2001:88)

	transactions prices in euros vs. before (1990) prices			
80WW. Same as 80II	Average annual 1991-94 EU transactions prices in euros vs. before (1990) prices	45.5	86.0	EC (2001:88)
80XX Same as 80II	Average annual 1991-94 EU transactions prices in euros vs. after (1996-99) prices	91.5	144.7	EC (2001:88)
80YY. Same as 80H	Average annual 1991-95 EU transactions prices in euros vs. before (1989-90) prices	14.8	30.4	EC (2001:89)
80ZZ. Same as 80H	Average annual 1991-95 EU transactions prices in euros vs. after (1997-99) prices	76.0	100	EC (2001:89)
80AAA. . Liquid **vitamin A** in US, 1990-99	Benchmark is pre-cartel spot and list US prices	70-75	200	Connor (2001a:320,331)
80BBB. Dry **vitamin A** in US, 1990-99	Benchmark is pre-cartel spot and list US prices	40-45	70-75	Connor (2001a:320,331)
80CCC. **Vitamin E**, world, 1989-99	Benchmark is pre-cartel price	35	--	Connor (2001a:336)
81. **Choline chloride (a/k/a vitamin B4)** cartel 1989-1998, divided markets between No. American and European manufacturers; convicted by U.S. DOJ, in a US civil jury trial, and in EU				EC (2001:86)
81A.	Benchmark is pre-cartel EU prices	9	--	Connor(2003: Table A.2)
81B.	Benchmark is 1988 price for analysis of U.S. import prices from Canada	39	57	Connor(2003: Table A.3), Connor (2001a:330)
81C.	US jury trial; jury chose plaintiffs' expert's econometric model estimate	33.6	--	Hausfeld (2003:5)
81D.	Benchmark is post-cartel price (1999) compared to U.S. import prices from Canada	66	88	Connor(2003: Table A.3), Connor (2001a:330)
82. **Aluminum phosphide** cartel Jan. 1990 to Nov. 1990, convicted by U.S. DOJ				
82A.	Benchmark is pre-cartel price	47	--	Connor(2003: Table A.3)
82B.	Estimate reported in press, method unknown	48	--	Levenstein and Suslow (2003:49), *Kansas City Star* 7/14/94
83. **BT forest insecticide**, bid-rigging of Canadian government tenders 1991-1992, convicted after CBC probe	Statement of CBC officials	65	--	Connor(2003: Table A.3)
84. International **graphite electrodes** cartel 1992-1998, convicted by U.S., Canadian, EU, and Korean authorities				
84A.	Statements of DOJ officials about U.S. prices; DOJ sentencing memo of 10/19/99	50-60	--	Levenstein and Suslow (2003:49), DOJ (10/19/99,

				11/30/00)
84B.	Statements of CBC officials about Canadian prices; CCB press release 7/20/00; government report to OECD;	90	--	OECD (2003: 53), Levenstein and Suslow (2003:49), CBC (7/18/00)
84C.	EC report to OECD, EU prices	--	50	OECD (2003: 54)
84D.	KFTC report to OECD, Korean import prices	25.1	--	OECD (2003: 54)
84E.	U.S. govt. report to OECD about U.S. prices	--	65	OECD (2003: 55)
84F.	Benchmark is before prices in U.S.	51-65	--	Connor (2003: Table A.4)
84G.	Benchmark is before prices in EU	50	--	Connor (2003: Table A.4)
84H.	Benchmark is before world prices	50-58	--	Connor (2003: Table A.4)
85. International cartel in **methyl glucamine** 1990-1999, convicted by CBC and EC	Benchmark is pre-cartel prices	75	--	Connor (2003: Table A.4)
86. International bid-rigging cartel in **shipping of chemicals in parcel tankers** 1998-2002, convicted in U.S.	Estimates reported in business press	15	--	Connor (2003: Table A.4), *WSJ 2002*
87A. International **sulfur** cartel operated 1934-1939; members included U.S. private producers with 80% of world supply and an Italian state agency	Eckbo's interpretation of Hexner's case study	50+	--	Eckbo (1976:39), Hexner (1946: 272-273)
87B. Same as 87A	Lerner index, econometric model	81.8	--	Griffin (1989:189-190), Hexner (1946:273)
87C. International **sulfur** cartel 1907-1910 (or 1913), an agreement with the Italian monopoly to limit U.S. exports to Europe	Lerner index, econometric model	112.8	--	Griffin (1989:189-190), Hexner (1946:272)
87D. International **sulfur** cartel 1922-1932; an agreement between the U.S. Webb-Pomerene Assn. and the Italian monopoly to limit exports and set quotas for each party	Lerner index, econometric model	31.6	--	Griffin (1989:189-190), Hexner (1946:272)
87E. Cartel of 1947-1958	Lerner index, econometric model	38.9	--	Griffin (1989:189-190)
88. International cartel alleged in **copper concentrate** 2001-2003, probe by U.S. and EU	Press reports, method unknown	25	--	Connor(2003: Table A.4)
89. EU **carbonless paper** cartel 1992-1995, fined by EC	From Eur. Commission decision	10-24	--	Connor(2003: Table A.5), EC (8/8/2002)
90A. EU **zinc phosphate** cartel 1994-1998, fined by EC	Proxy prices are Special High Grade US zinc quarterly prices, 1994Q2 to Dec. 1997; pre-cartel 1992-93 benchmark	8.4	--	Connor(2003: Table A.5), EC 12/11/2001), *Purchasing Magazine*
90B. Same as 90A	Proxy prices are Special High Grade US zinc quarterly prices; post-cartel 1998-99	17.8	--	Connor(2003: Table A.5), EC 12/11/2001),

	benchmark			*Purchasing Magazine*
91A. EU **seamless steel tubes** cartel 1990-1995, fined by EC	Analysis of "oil country tubes" prices; benchmark is pre-cartel (ca. 1986) corrected for general price inflation	15	--	Connor(2003: Table A.5), EC 12/8/1999), Levenstein (2002)
91B. Same as 91A	Analysis of "oil country tubes" prices; benchmark is post-cartel (ca. 1996) corrected for general price inflation	9	--	Connor(2003: Table A.5)
92A. EU **flat stainless steel** cartel 1993-1996, fined by EC	1994-97 prices of flat stainless steel coils, Type 304, cold rolled from trade magazines; EC statement gives peak price change in March 1995, which permits but-for price during cartel to be inferred	60.0	90+	Connor(2003: Table A.5), EC (1/21/1998)
92B. Same as 92A	Same as 92A above, except used 1997Q1 (post-cartel) price as the benchmark	66.9	100+	Connor(2003: Table A.5), EC (1/21/1998)
92C. Same as 92A	Apparently the authors' interpretation of the EC Decision	--	100	Levenstein and Suslow (2002: 50), EC (1/21/1998)
93A. EU cartel in **district insulated heating steel pipes;** Nov. 1990-March 1996; fined by EU	EC decision has about ten references to price changes induced by the cartel, including 3/93 and 12/93-2/94 price wars; these are converted to annual price changes and weighted by annual EU sales to calculate the cartel average; the peak period is 1/95-3/96	17	30	Connor(2003: Table A.5),), *EC Official Journal* (1999/60/EC: 14,47)
93B. Same as 93A	Authors' interpretation of the full EC decision	10-20	--	Levenstein and Suslow (2002: 51), *EC Official Journal* (1999/60/EC: 14,47)
94. A **magnesite** export cartel was established by Austrian and Czech producers in 1923 (probably ended 1939) as a joint marketing venture; U.S. producers later developed "an understanding" with the cartel to divide the No. Am. and European markets, for which they were prosecuted by the DOJ in 1941	Eckbo's interpretation of the antitrust prosecution	50+	--	Eckbo (1967:40)
95. EU **steel beams** cartel 1984-1990, EC fines	Benchmark is EU prices in mid 1990 to late 1992 after the cartel members were raided	20-30	--	Connor(2003: Table A.5), EC (2/16/94), *The Independent (1/14/93)*
96. **British sugar refining** cartel 1986-1990, fined by EC	From EC decision	50	--	Connor (2003: Table A.2), EC (10/14/1998)
97. **Mobile telephone roaming charges** in	Trade journal reports of	450	--	Connor(2003:

UK and Germany; EC probe underway 2003; dates uncertain (2000-2002?)	yardstick fees in other European countries			Table A.5)
98. **Explosives** cartel in U.S. regions 1985-1993; some bid-rigging; U.S. convictions	DOJ indictment for the IL, IN, and KY prosecution, dated 11/5/1997; method unknown	3-4.5	--	Connor (2003: TableA.6), *Business Crimes Bulletin (11/1997)*
99.International cartel in **thermal fax paper** sold in large rolls in U.S. 1990-1992, U.S. convictions	Press stories paraphrasing DOJ and CCB officials	10	--	Connor(2003: Table A.6), Levenstein and Suslow (2002: 51), *L.A. Times (*7/15/94)
100. International **ferrosilicon** cartel 1989-1991, convicted in U.S.	From a decision of the US Court of Appeals 2nd Circuit of 11/1999 on the prices set by the cartel in its early months, compared to prices in 1989	5.2-10.3	--	Connor (2003: Table A.6), *NY Law J. (11/19/1999), Platt's Metals Week (8/12/2002)*
101. International bid-rigging cartel, **USAID wastewater construction** projects in Egypt, 1988-1996, convicted in U.S. courts; court opinion gives details on profits made on one large bid (47%)	U.S. federal Court of Appeals 11th Circuit (2002) decision gives restitution ordered to be paid to USAID and affected sales; also U.S. govt. report to OECD; consistent with profit rate less a generous "normal" industry profit rate.	33-38	--	Connor (2003: Table A.6), OECD (2003:56)
102A. Canadian bid-rigging cartel in the **compressed industrial gasses** industry June 1989 – May 1990; fined by predecessor of the CCB	Statement of the Canada's Ontario Ministry of Health on the effects of the post-cartel price cut on its gas purchases	21	--	Connor (2003: Table A.6), *Globe and Mail* 2/8/1992)
102B. Same as 102A	Prices in Ontario compared to US border cities during conspiracy	40	--	Connor (2003: Table A.6), *Globe and Mail* 2/8/1992)
103. Alleged international **sulfuric acid** cartel in U.S. and Canada 1988-1998; under DOJ investigation 2003-04	From *Chem Market Reporter* and other trade magazines, prices for bulk deliveries of pure or standard virgin grade to US, Gulf or Tampa; but-for US price is from year 2000	32-53	--	Connor (2003: Table A.6)
104. International cartel operating in the UK retail market for **children's games and toys** Jan. 1999-April 2001; under UK investigation	UK Office of Fair Trade estimate	42	--	Connor (2003: Table A.6)
105. International cartel in the markets for **generic pharmaceuticals** (Warfarin and penicillin) sold by bidding for UK national health service contracts 1996-2000; under UK investigation	UK national health service estimate	163	--	Connor (2003: Table A.6),
106. International cartel, **cement**, mostly bid rigging against several German government units 1993-2001; fined by the Bundeskartellamt (BKA)	Press reports of BKA decision include BKA-estimated overcharges by cartel on a price per ton basis; trade sources on Belgian and EU-wide prices yield the rate	11-23	--	Connor (2003: Table A.6),

107. International bid-rigging cartel in large-scale, mostly Norwegian government, **construction projects** 1994-2000; under investigation	Estimate by the Norwegian antitrust authority	37	--	Connor (2003: Table A.6),
108. International bid-rigging of Dutch government **construction projects**, exposed by parliamentary investigations in 2002-2003 ; began decades ago, ended 2002	Dutch government estimates from testimony at Parliamentary hearings	8.8	--	Connor (2003: Table A.6),
109. International cartel in **retail gasoline** in Italy 1994-2000	Italian competition authority statement	3.6	--	Connor (2003: Table A.6),
110. International cartel in **retail gasoline** in France 1999-2002	French competition council statement; conservative estimate based on comparisons of prices in near by countries	25+	--	Connor (2003: Table A.6),
111. International cartel in **retail gasoline** in Sweden Nov. 1999-Feb. 2000, convicted by the competition authority and by Stockholm court on appeal	Estimate of the Swedish competition authority	8.3	--	Connor(2003: Table A.6), Fallenius (2001: 145, 148)
112. International cartel in bids for **military fuel** to the Korean defense procurement agency 1998-2000	Analysis by the Korean FTC	17	--	Connor(2003: Table A.6)
113. International **flat glass** cartel operating in U.S. 1991-1995; DOJ investigation, no indictments; civil settlement approved 2/2000 after jury finding of guilt in private treble-damages trial (but before damages phase)	Conclusion of plaintiffs' expert's (John Beyer) testimony from an econometric model	30-35	--	Connor(2003: Table A.6)
114. International cartel in **ready-mix concrete** in Germany 1995-1998; fined by Germany's BKT	Report of the German government to the OECD	9	--	Connor (2003: Table A.6), OECD (2003:54)
115. International cartel in manufacture of **ball and roller bearings** in France 1993-1997, fined by the French competition council	French Competition Council statement	17.6	--	Connor (2003: Table A.6)
116. International bid rigging in the Norwegian **electrical (hydro-power) equipment** industry 1990-1997, fined by Norway	Norwegian competition authority report	9	--	Connor (2003: Table A.6), OECD (2003:55)
117. International cartel that fixed the fees for Italian **cell (mobile) telephone services** 1998-1999, fined by Italian antitrust authority (AGCM)	Estimate of the Italian antitrust Authority AGCM	11	--	Connor(2003: Table A.6),
118. Bid rigging against Italy's national health service for **pharmaceuticals treating respiratory illnesses** 1995-1997, fined by AGCM	Statement of the AGCM	50	--	Connor(2003: Table A.6),
119. Bid rigging against Italy's national health service for **pharmaceuticals treating high cholesterol** 1995-1997, fined by AGCM	Statement of the AGCM	50	--	Connor(2003: Table A.6),
120. **Frozen foods** cartel in Tasmania, Australia , "late 1990s" (ca. 1996-99), prosecuted and fined by Australian Competition and Consumer Commission	Report of the government of Australia to the OECD	10-12	--	OECD (2003:53)
121. Installation of **fire protection devices** in Australia; ca. 1996-99; fined by Australian CCC	Report of the government of Australia to the OECD	5-15	--	OECD (2003:53)

122. Bid-rigging by 260 **electric wiring contractors and electricians** in Denmark in late 1990s (ca. 1996-99); convicted and fined by Danish courts	Report of the government of Denmark to the OECD	20-30	--	OECD (2003:54), Gommesen (2003)
123. Bid rigging of public tenders for **road markings** in Germany in 1990s (ca. 1990-99); fined by BKA	Report of the government of Germany to the OECD	13+	--	OECD (2003:54)
124. **Power cables** (high tension?) in Germany beginning in 1902; ended late 1990s; probably bid rigging; fined by BKA	Report of the German government to the OECD	--	50	OECD (2003:54)
125. **Hotel association** in Spain; ended late 1990s; fined by Spain's competition authority	Report of the government of Spain to the OECD	3	--	OECD (2003:55)
126. **Sugar** in Spain; ended late 1990s; fined by Spain's competition authority	Report of the government of Spain to the OECD	3	--	OECD (2003:55)
127A. The U.S. Railroad Express Cartel fixed prices for **long-distance shipments of packages by rail or ship** from 1851 to 1913, when its members came under the authority of the Interstate Commerce Commission; in its 62 years; only one price war, in response to a failed attempt at large-scale entry; only two brief episodes of dissention; annual profits in late 19th cent. averaged 40% on invested capital despite very large side payments to shipping firms (which provided no free services)	Rates are taken from several archives of the internal business records of the five cartel members; mark-ups are calculated from the inter-member charges (costs) for transshipments between exclusive territories in 1885-1900	150-233	--	Grossman (1996:227)
127B. Same as above	Change in rates in overlapping cities during the only recorded price war in 1886 -1888	50-72	--	Grossman (1996:229)
128. To stem to steep decline in **tea** prices since 1927, a voluntary agreement in 1930 by four regional producer associations representing hundreds of tea plantations led to an agreement on significant output reductions in 1931-1932; followed by a mandatory British Empire cartel in 1933	Prices in 1931-1932 (the first since before 1927) compared to prices in late 1920s in the London market (handled 56% of world market) for four teas, weighted by the four regions' average quantities sold in 1931 and 1932.	29.0	--	Gupta (2001: 146)
129A. International Electric Association operated from London from 1945 to at least the early 1980s; members rigged bids to private and public utilities, most in low-income countries; controlled 72-86% of world trade in **heavy electrical power equipment** in 1965-67; 1945 DOJ conviction; 1947 FTC consent decree covered only trade with U.S.; U.S. Congress hearings and Brazilian investigation in early 1980s, but no legal actions; the IEA as a formal organization was still in existence in 1999 but effectiveness ended earlier (ca. 1990-95)	Detailed internal records of IEA's bids for large power transformers May 1965-Dec. 1967 show differences in winning prices between rigged and unrigged tenders (latter is the yardstick); lower average is for industrialized countries; upper is for LDCs; peak is for bids with single bidders	11.9-18.7	69	Mirow and Maurer (1982: 276-282), Epstein (1971), Epstein and Newfarmer (1980: 52), Jenny (2003)
129B. Same as 129A above	Winning bid prices when by agreement only one IEA member bid and no outsiders bid vs. bids with outsiders	50	--	U.S. Congress (1980:125)
129C. With the advice of their foreign	National price indexes for all	34	50	Hasegawa

licensors, the four Japanese manufacturers of heavy electrical equipment formed a domestic cartel in May 1931; two more joined by Dec. 1933; rigged bids to achieve agreed quotas; effective in certain more standardized product lines but not high-tech lines until about 1938-39	heavy electrical equipment in 1933-1937 relative to base years 1930-32; peak year was 1937			(1994:252)
130A. International **uranium** cartel of world's major producers in France, Canada, Australia, UK, and South Africa was founded in 1972 and operated effectively from mid 1974 to Dec. 1975; private U.S. suit filed against Gulf Oil (parent of Canadian member) resulted in payout of about $1 billion; criminal DOJ misdemeanor case ended with Gulf pleading *nolo* and paying $40,000 fine, because of Canadian government objections	U.S. prices in Dec. 1974 to Dec. 1975 compared to early 1974; peak is Dec. 1975; world prices followed similar trend	244	471	Mirow and Maurer (1982: 95-118), U.S. Congress (1977)
130B. Same as above; book by Canadian journalist identifies the effective cartel period as mid 1972 to Feb. or Mar. 1974, after which market forces influenced primary control; by July 1974, world prices were 25% higher than the cartel's list price	Price data not very precise; appears that pre-cartel price outside U.S. was about $4.50/lb.; cartel raised prices by $2 to end of 1973 and by another $1.34 in late Jan. 1974	44	74	Gray (1982: 147,151,164)
130C. Same as 130A	Lerner index predicted from econometric model	100.0	--	Griffin (1989:189-190)
130D*. Same as 130A, except that price data from the US civil trial show that the cartel floor prices in 10/1973 and 1/1974 led the rise in spot US prices; author concludes that cartel had only short-run price effects.	Average US Nuesco spot prices in 10/73 to 12/74 compared to spot prices in 6/73 to 9/73 ($6.25)	62.7	140	LeCraw (1977: 78)
130E*. Same as 130A	Same as above except that the base price is total economic costs, including profit and a risk premium (also $6.25)	67.2	140	LeCraw (1977: 78 and 82)
130F* Same as 130A	Author concludes that it was "unlikely" that cartel affected prices	0	0	Joskow (1976)
131A. **Quinine** Convention, intl. cartel with four manufacturers (NL, DE, UK, FR); agreements on reducing export sales, stocks, and member quotas from 1959-1966; 1968 criminal indictments by U.S. DOJ resulted in *nolo* pleas and substantial fines; EC fined 6 firms $470,000 in 1970	World prices in early 1964 to 1966 compared to prices in early 1960s; some of the increase was due to a surge in demand by the US military	--	400	Mirow and Maurer (1982: 130), U.S. Congress (1966-67)
131B. Same as 131A	Price offered to League of Nations for relief programs compared to cartel price	77.5	--	Staley (1937:289-290)
132. **Red phosphorous** cartel 1959-"early 1960s" (ca. 1963); three companies from UK, NL, and DE; price fixing and territorial division everywhere except Asia	Prices before cartel compared to cartel price in early 1960s	43	--	Mirow and Maurer (1982: 134-135)
133. The Southern Railway & Steamship Association was the second successful and stable U.S. cartel 1875-1887; all **long distance freight and passenger transport**	An estimate made by the association in prior to its first month of operation of revenue losses due to discounting from	42	--	Hudson (1890: 71)

among companies operating south of the Potomac and Ohio rivers and east of the Mississippi; historical study based on its internal records	regular rates			
134A. The Western Ontario **petroleum lamp oil** refiners' cartels, 1870-73	Econometric cartel model with monthly wholesale lamp oil prices Jan. 1870 to May 1880, with dummy variable for known collusive periods; difference between predicted competitive and collusive prices	31	55	Grant and Thille (2001: Figure 2)
134B. Same as above for 1874 to mid 1877	Same as above	68	84	Grant and Thille (2001: Figure 2)
134C. Same as above for mid 1877 to May 1880	Same as above	0	--	Grant and Thille (2001: Figure 2)
135A. The 1926-1939 **phosphate rock** cartel began with the cooperation of the French and German national cartels (under government pressure); in 1933 the Phosphate Export Assn. (a U.S. Webb-Pomerene assn.) joined the European cartel, for which it was indicted by the DOJ in 1939; other phosphate cartels from North Africa, Egypt, and Curacao joined in 1933-1934	Eckbo's interpretation of the abuse of dominant position of the French and German cartels in place of "unpublished" export prices; such prices are shown in Hexner (1946:265)	50+	--	Eckbo (1967:39), Hexner (1948: 264-266)
135B. U.S. Webb-Pomerene phosphate export association, active 50 years, 1919-49 and second episode 1961-67	Econometric model with insignificant quantity effects; price effect almost significant	9.2	--	Dick (1992:103)
135C. International cartel of 1933-1937	Lerner index from econometric model	72.4	--	Griffin (1989:189)
136A. **"Artificial silk" (rayon)** cartels formed in Germany, France, and Italy in late 1920s; unusual cartel because a technologically dynamic industry with rapid output and productivity increases	Author asserts that neither national nor international industry groups show any signs of market power	0	--	Benni *et al.* (1930)
137B*. Examines two earlier episodes, 1906-Oct. 1910 and 1911-14; members from DE, FR, IT, CH, BL, UK, and (after 1911) US; assigned export quotas and exclusive home-country monopolies	The Feb. 1913-1914 agreement allowed members to buy additional export quotas for a "commission"; a yardstick	5	--	Coleman (1969:73)
137. An international **linoleum** cartel was formed Dec. 1911 by almost all the factories of Europe; invented in 1860, but production technology standardized in early 1900s; cartel enforced uniform quality standards and grades; cartel objective was constant prices, not higher ones; ended 1939 [UK branch ended operations 1960]	European prices from League of Nations show nearly flat prices 1924-1930, despite large increases in industry labor costs and two biggest material inputs (linseed oil and cork)	0	--	Benni *et al.* (1930:64)
138. **Mechanical sulphite paper pulp** cartel formed in 1930 after European prices fell 66% by leading companies from Austria, Germany and Scandinavia; probably ended 1939	Prices of sulfite pulp fell 22-26% 1930-35; but prices of yardstick (noncartelized sulphate pulp) fell more	2.8-10.0	--	Oualid (1938:26)
139. Bid-rigging on sales to U.S. government purchases of **titanium metal**	Prediction from a time-series econometric model used for	1.1	--	Duggan and Narasimhanm

1970-1976; found guilty at trial in *U.S. v. RMI Co.* (1978)	expert economic testimony			(1981:243)
140. The Wisconsin Alumni Research Foundation held the Steenbock patent to **Vitamin D** and licensed its manufacture; author, the U.S. AAG for antitrust alleges that its agreements with various buyers set prices in 1930s until the weakness of the patent became apparent in 1938-40	Compares agreement with du Pont for use in bread products with prices charged to Gen. Mills (1940) and Gen. Baking (1938)	48-233	--	Berge (1944:104-105)
141. A conspiracy (11/1900-7/1904) among three U.S. industry associations (for manufacturers, wholesalers, and retailers) to raise the retail prices of **pharmaceuticals** to a pharmacist by "blacklisting" him; from a U.S. jury trial decision in *Loder v. Jayne* (1906)	The Court decided the combined price effects of the three restraints on trade using the change in gross profit on sales from before the conspiracy to during	8.0	--	Timberlake (1961:258)
142A. U.S. **corrugated cartons (containers)** cartel 1960-1976; guilty finding confirmed by Supreme Court; private federal class-action suit (*In re Corrugated Container Antitrust Litigation*) against three last defendants, of which 2 settled before the trial's conclusion	Jury decision after hearing class plaintiffs' expert testify to a 8% to 19% overcharge and defense expert testify to a less than 1% figure	5	--	Finkelstein and Levenbach (1983:148)
142B. Same as 142A	Plaintiffs' econometric model prediction; authors judge that it has some major econometric estimation problems	7.8-19.1	--	Finkelstein and Levenbach (1983:148)
142C. Same as 142A	Plaintiffs' model is fitted to same data, but some if not all estimation problems are corrected	4.0-4.3	--	Finkelstein and Levenbach (1983:148)
142D. Second treble damages suit by opt-outs from federal class (see 142B above)	Revised econometric model by plaintiffs' expert, which authors judge to be more problematic than the original	26	--	Finkelstein and Levenbach (1983:149)
142E. Same as 142D above	Testimony by Defendants' expert finds numerous problems with plaintiffs' model	0	--	Finkelstein and Levenbach (1983:149)
142F. Same as 142D above	Jury's decision	0	--	Finkelstein and Levenbach (1983:149)
143A. In *New Mexico v. American Pipe and Construction* bid-rigging on **concrete pipes** from Feb. 1968 to Dec. 1973; one of several similar cases	Plaintiff's expert predicted the but-for price from an econometric model using dummy variable for a brief competitive period; model judged sound by experts	15.5	--	Finkelstein and Levenbach (1983:150), Parker (1977)
143B. Same as 143A	Defendant's expert presented a rival econometric prediction using the "residuals" approach, which is inappropriate	0	--	Finkelstein and Levenbach (1983:149, 164)
144. In *In re* **Chicken** *Antitrust Litigation* (1980) only the plaintiffs presented econometric evidence on an alleged association program to raise prices Jan. 1971-March 1973; the DOJ imposed	Plaintiff's experts predicted a negative overcharge, which is judged to have serious autocorrelation problems	-5	--	Finkelstein and Levenbach (1983:165)

injunctive relief				
145A. In *In re* **Plywood** *Antitrust Litigation,* three manufactures were found guilty of price fixing (using basing-point pricing system) from Feb. 1968-Dec. 1973 by a jury; jury ignored the statistical evidence and figured damages from the "phantom freight" charges and excess weight allowances.	Defendants' econometric model predicted no overcharge because of high demand during conspiracy, but experts judge the model is highly flawed	0	--	Finkelstein and Levenbach (1983:154-158), Rubinfeld and Steiner (1983)
145B*. Southern plywood cartel lasted from 1964 to Dec. 1973; system used Douglas fir plywood prices in Portland, OR plus Denver-to-East RR delivery prices; cartel had 4 members 1964 and 24 by 1974, when CR4 slipped to 55%	The average discount from the official basing price was 5% 1967-1973; post cartel discounts are the but-for prices; best measure is Feb. 1977 when all sellers shifted to F.o.b. plant pricing	19	--	Loescher (1980:16)
146A. International **tin** cartel Sept. 1929-March 1931; initially an entirely voluntary agreement of British, Dutch and Bolivian producers to reduce production by major mines; when cuts became too large, British and Dutch governments stepped in to enforce them and buy stocks; in 1931 an intergovernmental commodity agreement was signed that increased prices soon thereafter	Lerner index predicted from an econometric model	14.9	--	Griffin (1989:189-190), Hexner (1946:240-242)
146B. Same as 146A; Plummer quotes only falling prices	London exchange prices from before cartel to 1930-early 1	-10	--	Plummer (1934:92-94)
146C. Same as 146A	Judged to be "ineffective"	0	--	Elliott *et al.* (1937)
146D. Same as 146A	Price rise from fall 1932 to spring 1933 due to cartel's cut in export volume; after spring 1933 demand increased prices	27-36	--	Staley (1937: 308)
146E. International cartel of 1921-1924	Econometric model predicts Lerner Index	22.0	--	Griffin (1989:189-190)
146F. International cartel of 1956-1981; possibly government sponsored	Econometric model predicts Lerner Index	47.1	--	Griffin (1989:189-190)
147A. International **coke** cartel April 1937-Sept. 1939; export quotas for all major European producers administered by a joint venture in Brussels	Lerner index	85.2	--	Griffin (1989:189-190), Hexner (1946:275-276)
147B. Same as 147A	Compares 1902 domestic German price with price of exports to Austria	53	--	Hirst (1905:115)
148A. The formal U.S. **Whiskey Trust** was formed in May or June 1887 to make distilled alcohol for cheap whiskeys; preceded by numerous short-lived pools that were briefly effective in raising prices during 1882-86; first successful episode ended late 1888; data from hearings of US (Congressional) Industrial Commission.	When pools were operating, gross margin increased about $0.25/bu. of corn; avg. prices net of taxes and discount were $0.85-$1.12 for whiskey made from 1 bu.	22-29	--	Jenks (1900:146-150)
148B. Same as above, 1890-94	First effective period for formal trust is 1890-1894; comparison of gross margin increase with wholesale prices	12-18	--	Jenks (1900:146-150)

148C. Same as above for 1896-99	Effective period is 1896-99; uses gross margin approach	0-9	--	Jenks (1900:146-150)
148D. Same as above for 1906-09	Gross margins in 1906-09 compared to competitive 1903-06 period, taking into account upgrading of product quality	7-12	--	Jenks and Clark (1929:100-105)
148E*. Studies 16 years of at least 4 episodes: the summer quarters of 1882 to 1898 (except for 1895); thus same as 148A to 148C plus 1882-86; peak cartel supply control of US market was 40% to 48% in 1887-1892; slipped to 29% by 1895.	The authors fit four different demand functions to a complex econometric system of equations; the model predicts four elasticity-adjusted Lerner indexes; average overcharges are 83% to 94% below the monopoly overcharge; two peak periods, 4 quarters in late 1888 and 1824-93, are 58% to 84% below monopoly overcharge	8.2-9.9	18.3	Clay and Troesken (2003: 162-163)
148F*. Same as 148E, but adds 22 new quarters of data from April 1888 to March 1895, a total of 38 quarters	Same as above, but for more observations	9.4-11.5	18.3	Clay and Troesken (2003: 162-163)
149A. The U.S. **Wire Nail Pool** lasted for 19 months in May 1895-Nov.1896; very complex organization; made side agreement with similar cartels in Canada and Europe; also co-opted U.S. cut-nail makers; collapsed when new factories came on stream; ineffective after 1901	Comparison of prices in month before cartel with average prices in 18-month period; peak is last 6 months	97	117	Jenks (1900:62), Jenks and Clark (1929)
149B. Same as 149A	Method not explained	113	--	Jones (1921:10)
150. U.S. **steel rails** pool; Jones gives dates of 1887-93 and 1894-98 [Seager and Gulick describe a second episode from 1897 to 1904]; the association of 15 members controlled 90%+ of the U.S. market; set total tonnage and quantity shares to achieve an elevated price	Jones refers to a U.S. DOJ court brief that states that after 1897 prices fell 41%	41	--	Jones (1921:9-10), Seager and Gulick (1929:90-91)
151. U.S. cartel in **steel tubes** from June 1899 to 1900	Prices in 1899 compared with before cartel	227	--	Jones (1921:264)
152. U.S. Webb-Pomerene export association for **carbon black**, active for 48+ years 1923-51 and 1958-70+	Econometric model with dummy variable for the cartel's active years; quantities exported fell 19.8%	7	--	Dick (1992a:103)
153. Effects of concentration (numbers of firms) on the spreads of U.S. **tax-exempt bond underwriting auctions;** a study of 9420 bond issues during 1959-1967; suggests bid-rigging behavior	Comparison of estimated regression coefficients of winning bids in issues with 9 or more bidders with price spread when only two bidders were in the auction	--	2.35	Brannman (1989:73)
154. Same as 153 above for 2221 **auctions for government offshore oil leases** from the U.S. Department of the Interior 1954-1975; suggests bid-rigging behavior	Same as 153 above except competitive number of bidders in 10 or more	--	2.5	Brannman (1989:73)
155A. The **Rhenish-Westphalian (Rhur) Coal** cartel was formed in late 1893, a mix of private and state-owned mines; effective in raising prices until state price controls were imposed in March 1919; the Deutsche	The author states that Essen Coal Exchange prices were representative of the pre-cartel period 1891-93; average 1894-1913 prices and peak 1907-09	16.5	34.6	Liefmann (1932:52)

Mark experienced little or no inflation through at least 1909	prices compared			
155B. Same as 155A	Compares 1902 domestic German price with price of exports to Belgium and Netherlands	5.8	--	Hirst (1905:115)
156. The second phase of a U.S. **plumbing fixtures** conspiracy involved 15 companies from Sept. 1962 (for cast-iron bath tubs) or Oct. 1962 (porcelain toilets) to 1968; most companies pleaded guilty and were fined, but three companies and three executive were found guilty at trial in late 1969.	Authors were guided by direct testimonial evidence accepted by the jury in the trial; price changes apparently were the first increases implemented in late 1962	6-7	--	Demaree (1969:99), Davidow (1972:374)
157. A regression model fitted to 1950-1985 data on 12 legal Japanese export cartels; only the one for **paints** has results consistent with price mark-ups	Coefficient on export price	56.9	--	Dick (1992b:287)
158A. The U.S. **gunpowder trust** was formed in 1872 as a price-setting trade association; became a formal cartel of 7 producers in 1886-1902; later grew to 12 members; assigned quotas in 7 regions, had a penalty system and a trigger mechanism; after 1895 the agreement was kept secret and code names were used to prevent discovery; morphed into the du Pont monopoly by 1907; found guilty of price fixing and monopolization in 1912	In 1882-1884, members of the cartel that were over quota were required to compensate the others by selling powder at 16-25% below the fixed price	16-25	--	Curtis (1931:28), Stevens (1912a: 452)
158B. During 1896-1902, three new gunpowder firms briefly entered the Midwestern market; the strongest of the entrants was Indiana Powder; the trust built a new plant nearby and cut prices in its sales region	Difference between price in Indiana Powder sales region (the yardstick) and prices charges by trust in surrounding regions	29	--	Stevens (1912a:459)
159A. The international **dyestuffs** cartel had dominated the Japanese market before WWI, but a domestic industry had developed during the War to serve the rapidly developing textile industry; tariffs were imposed to protect Japanese dyestuffs in 1924 until the national industry negotiated a division of dye types between exclusively domestic lines and I.G. Farben import lines, effective Aug. 1928; tariffs were eliminated	Comparison of prices of imported dyes (net of tariffs) in early 1928 with immediate price increase after bilateral agreement by Farben in Oct. 1928	5	--	Kudo (1994:216)
159B*. Legal Swiss dyestuffs cartel was formed by three companies in 9/1918 to combat expected decline in export demand as major importing countries increase tariffs; starting in late 1918, quantity exported fell by 73% in 1924-25 compared to 1913; prices highest in 1918-1920, but this was an abnormal period; ended 1929	Real average Swiss export prices of dyestuffs in 1921-1925 are compared to prices in 1910-13; peak is 1922	18.3	48.0	Schmitt and Weder (1998: Table 2)
159C*. A German national cartel was formed under I. G. Farben in 1925; joined with the French cartel to allocate world exports in 1927; Swiss joined in 1929,	During 1932-1939, members could sell export quotas to each other for cash equal to 15-25% of the price; this is a	15-25	--	Haber (1971: 275-76), Schroeter (1990:139)

UK's ICI in 1932, and Japan's NSK in 1935; by 1938, 80-90% of world exports under its control; ended 1939	yardstick			
160. Beginning as early as 1829, large railroads began buying **anthracite coal** mines in 5 counties of NE Pennsylvania refused to carry coal of independent mines (except under onerous tolling contracts); in early 1830s excess mine capacity developed; in 1870s dual ownership accelerated even though PA constitution outlawed it from 1874; in 1873, top 5 RRs carried 90% of coal to Tidewater points; by 1900, the railroads controlled 62% of production and in 1904-1923 it was 70%; court testimony later revealed that Reading RR was the collusive price leader				
160A. NYC prices fell 54% 1864-72; various pool agreements began Jan. 1873 with 5 members; first cartel ended August 1876	Curtis interprets "Pooling agreement" of 1873 that set supply limits; immediate effect on Eastern Tidewater price of coal compared with before price	38	--	Curtis (1931:343), Jones (1914)
160B. Same as 160 for August 1876 to December 1877	Same method as above for what Curtis calls the "1876 pool agreement"; Jones writes that pool unable to agree from Aug. 1876 to Dec. 1877	0	--	Curtis (1931:343), Jones (1914)
160C. Same as 160 for 1886;[note that Curtis omits mention of three successful pools that began 1/1878, 1879, and 12/1884].	Same method as above for 1886 pool agreement, which Curtis interprets as ineffective	0	--	Curtis (1931:343), Jones (1914)
160D. Same as 160 for 1907; Curtis omits mention of the pools that Jones judges to be effective that began in 1/1892, 2/1896, and late 1902	Same method as above for 1907 pool agreement	0	--	Curtis (1931:343), Jones (1914)
160E. Same as 160 for 1921-26; Curtis notes that during 1923-27, average profit rates for railroad-owned anthracite mines were 14 times the rates of the seven railroads carrying the largest volume of coal	Easter Tidewater price in 1921-1926 corrected for inflation compared to the 1913 price	50	--	Curtis (1931:344)
160F (none)				
160G. Same as 160A, Jones' " first pool" of Jan. 1873 to Aug 1876; concentration of coal-tonnage hauling was high (HHI=1809)	Compares average 1873-75 prices of all grades f.o.b. NYC per long ton with 1872 price; peak year was 1875	32.2	37.5	Jones (1914: 41-42, 228)
160H. Same as 160A	Compares average 1873-75 prices of all grades f.o.b. NYC with 1877 price; peak year was 1875	108.1	116.4	Jones (1914: 41-42, 228)
160I. Jones' 2nd pool of Jan. 1878 to 12/31/1878; concentration fell slightly (HHI=1789)	Compares average 1878 prices of all grades f.o.b. NYC with 1877 price	29.1	--	Jones (1914: 45, 228)
160J. Same as 160I for 2nd pool of Jan. 1878 to 12/31/1878	Compares average 1878 prices of all grades f.o.b. NYC with 1879 price	34.6	--	Jones (1914: 45,228)
160K. Jones' 3rd pool of 1880-1884;	Compares average 1880-84	56.9	--	Jones

unlike previous pool, no formal association was formed, just a "friendly understanding" after negotiations in 1879	prices of all grades f.o.b. NYC with 1879 price			(1914: 46-47, 228)
160L. Jones' 4th pool of Dec. 1884 to end of 1885; despite high concentration (HHI = 2363), ineffective because Penn. RR dissatisfied with its quota share; Reading RR went bankrupt in 1884	Prices fell throughout cartel episode	0	--	Jones (1914: 47-48, 228)
160M. Same as 160C, Jones' 5th pool organized by J. P. Morgan in March 1886; agreement in effect from April 1886-Dec 1891, but set total output too high; HHI=2288	Compares average 1888-1890 prices of all grades f.o.b. NYC with 1891 average price	7.9	--	Jones (1914: 49, 228)
160N. Jones' 6th pool of Jan. 1892 to late 1894; dissolved sometime in 1895; Reading RR failed again in 1892, so this year is ignored for price analysis	Compares wholesale price of long ton of "stove coal" f.o.b. NYC in 1893-94 with 1895; peak year 1893	24.4	33.8	Jones (1914: 156-157)
160O. Jones' 7th pool; after numerous secret meetings among 11 railroads that controlled 100% of coal hauling (HHI=1105), in effect 2/1/1896 to late 1897; in early 1897 mines operated only 5-10% of the time; nearly perfect adherence to quotas until recession of 1898 leads to cheating; 1898-99 termed normal, competitive years	Compares wholesale price of long ton of "stove coal" f.o.b. NYC in 1896-97 with 1895; peak year 1897	24.6	28.1	Jones (1914: 55-58,156)
160P. Same as 160O	Compares wholesale price of long ton of "stove coal" f.o.b. NYC in 1896-97 with 1898-99	4.0	--	Jones (1914: 58, 156)
160Q. Same as 160D, Jones' 8th pool of late 1902 to 1911; RRs solved low concentration problem by RR mergers, cross-ownership, interlocking directorships, and elimination of rival mines (by 1907 RRs controlled 78% of all coal output; labor strikes in late 1900 and mid 1902 boost costs; during 1903-11 monthly prices nearly constant; collusion "nearly perfect"(p.180) despite 1908 antitrust trial.	Compares wholesale price of long ton of "stove coal" f.o.b. NYC in 1903-11 with 1898-99 prices adjusted upward for changes in total costs of mining	12.3	12.4	Jones (1914: 59-97, 156-157)
161A. Japanese **public-works construction** bid rigging, several cases discovered roughly 1970-1990; parameters are verified by guilty judgments in legal suits	Using data on the average number of bidders (10) and comparable Canadian data on the spread in bidders' costs, a mathematical model of competitive bidding can simulate the difference between the competitive and collusive price; an elaborate yardstick method	19-50	--	McMillan (2002:141-147), McMillan (1991:208)
161B. Same as 161A	Summary of estimates of scholarly Japanese studies and government commission findings	30-50	--	Woodall (1996: 48)
162. The Star Friendship Association with about 100 corporate members rigged bids on **U.S. naval shipyard construction**	Statements by U.S. government officials of the "low-end estimate" of the U.S.	32-35	--	McMillan (1991:209), *Time Magazine*

projects in Japan in the 1980s; the Japan FTC investigated and fined the firms in 1989; after a threat of a U.S. suit, the association paid $32.6 million in compensation	Navy's losses due to bid rigging, which were 8% higher than the firms' payout			(1/15/90), *New York Times* (11/24/89), *Los Angeles Times* (11/26/89)
163. Bid rigging on a **kitchen construction project** in Matsuyama City, Japan in 1982; bidders were convicted in court; average pre-tax operating income of civil engineering firms in Japan 1966-89 was 5.6% of total assets	Japanese court decision that total profits by the winning firm were an excessive 31% of revenues; I subtract 4-12% of sales as a normal profit	23-37	--	McMillan (1991:210-212), *Kensetsugyo Dokukin Mondai Kenkyukai* (1984)
164. Bid rigging on a **river-dredging project** in Tsukuba City, Japan in 1979 ; tried in court	Prosecution estimate of the excess profits made by the winning bidder	37	--	McMillan (1991:210)
165. Bid rigging among companies that delivered **soil and gravel** to build Kansai, Japan Airport in late 1980s	Comparison of winning bid with the government's (generous) ceiling price	9.7	--	McMillan (1991:210)
166A. The northeastern **English Coal Gild** (a/k/a the Newcastle Vend) was formed by mine owners in 1771 to supply the London market by ship; it first began to collapse between late 1780 and early 1781	Rochester Harbor prices in shillings per chaldron in 1780 are compared to 1785	17	--	Levy (1927:116)
166B. Cartel reformed in 1786-87 with more elaborate agreements on monthly quotas for each mine and fines for overproduction; according to Levy, not effective in raising prices until about 1824; Sweezy dates effective period from about 1810; ended in 1844-45 when rail shipments of coal to London became significant; supplies in Wales and Scotland constrained pricing 1800-1845; experienced five brief intermittent "fighting trades" (price wars); price data from a Parliamentary inquiry that found consumer complaints about prices "not unfounded"	Comparison of before (early 1832) price for best grade of coal with lowest month's price (June 1833) during the Nov. 1832-Aug. 1833 price war	--	56	Levy (1927:120), Sweezy (1938)
166C. Same as above except for 1836	Price at the mouth of the Tyne River in 1836 compared to "pre-cartel" year 1823	22-27	--	Levy (1927:138-139)
166D. Same as above for 1844-1845	Same as 166C above, except price change from 1844	22	22	Levy (1927:161)
166E. Same as above for 1810-11	London price of best grade coal per chaldron before "open market" (competitive period) began in 1812	4-11	--	Sweezy (1938: 155)
166F. Same as above for 1823- July 1824	Same as above before open market of 8/1824-7/1825	12	--	Sweezy (1938: 155)
166G. Same as above for Aug. 1825- March 1826	Same as 166E above before open market of 4/1826-12/1826	16	--	Sweezy (1938: 155)
166H. Same as above for 1827- Feb. 1829	Same as 166E above before open market of 3/1829-8/1829	12	--	Sweezy (1938: 155)
166I. Same as 166B for Sept. 1829 - 1831	Same as 166E above before open market of 1/1832-3/1834	28	--	Sweezy (1938: 155)
166J. Same as above for 1813-14	London price best grade for 1-2 years after open market of	11	--	Sweezy (1938: 155)

	1812			
166K. Same as 166G	Same as above for open market of 8/1824-7/1825	7	--	Sweezy (1938: 155)
166L. Same as 166H	Same as 166E above for open market of 4/1826-12/1826	5	--	Sweezy (1938: 155)
166M. Same as 166I	Same as 166E above for open market of 3/1829-8/1829	9	--	Sweezy (1938: 155)
166N. Same as 166C, but for April 1834-1835	Same as 166E above for open market of 1/1832-3/1834	33	--	Sweezy (1938: 155)
166O. Same as 166D	Price change after the final collapse of the Vend in May 1845 when many small inefficient mines had closed, compared to late 1844 price	75	--	Sweezy (1938: 127, 155)
167. The **Birmingham Bedstead Makers' Alliance** successfully raised prices on metal bed frames from 1891 to 1900; ended because of imports from European continent	Simple comparison of 1891-1900 prices with pre-1891 prices	100	--	Levy (1927:200)
168. The **British Salt Union** was formed in Oct. 1888 by 64 firms that controlled 90% of UK supply, much of it exported; coal accounts for 90% of the cost of production; the Salt Union was acquired by ICI in 1937; mergers from 1945 to 1975 produced a virtual UK duopoly				
168A. Episode of October 1888-1891	Average export prices in 1878-1887 (the yardstick) compared to 1888-1891, corrected for the increase in coal prices	-1	--	Levy (1927:243), UK Monopolies Commission (1990)
168B. Same as 168A; evidence of geographic price discrimination	Average prices in the county where salt was produced in 1888-91 compared to 1878-87, corrected for increase in price of coal; prices briefly peaked in 1888	19	320	Levy (1927:243, 295)
168C. New salt producers entered in early 1890s and by 1892 began to affect prices, though they never dipped below 1878-87 levels; from 1888 to 1905, the cartel formed side agreements with non-Union mines, but by 1907 the Salt Union controlled only 46% of UK production; ended 1906; although domestic power waned, export position was favorable.	Change in export prices from 1904 to 1907	13	--	Levy (1927:243)
168D. The drop in domestic prices from 1904 to 1906 caused a new cartel, the North-Western Salt Co., to be formed in late 1906; achieved nearly 100% market control through at least 1927; profits in 1907 rose 46% over 1906 levels and were 355% higher in 1925	Change in export prices 1906-1907	9.1	--	Levy (1927:244)
168E. Same as 168A	Immediate change in price of common salt f.o.b. works from 10/1888 to 2/1889	--	100-133	Calvert (1913: xxiii)
168F. Same as 168A	Same as 168D above for "fine"	--	100	Calvert (1913:

	grade salt			xxiii)
168G. Same as 168A	Change in works price of finest "brisk" grade from 11/1888 to 9/1890	100	--	Calvert (1913: 15)
168H. Same as 168A	Same as above for 9/1890 to 3/1891	75	--	Calvert (1913: 15)
168I. Same as 168A	Same as above for 3/1891 to 8/1891	50	--	Calvert (1913: 15)
168J. Same as 168A	Comparison of "brisk" grade export price with UK price in 3/1889 to March 1891	52	--	Calvert (1913: 18-20)
168K. Same as 168A	Comparison of Prussian Rock Salt sold to chemical manufacturers versus all others, 12/1888 to 12/1889	38	--	Calvert (1913: 18-20)
169A. A European **steel rails** cartel included the leading manufacturers of the UK, Germany, and Belgium; first formed in 1883, it was unstable until French producers joined in 1907; ended 1914	UK rail prices in 1907 compared to the 1904-06 average	35-75	--	Levy (1927:268)
169B. Same as 169A; with a US-UK price difference of 12% in 1901, large US exports to UK had occurred, but there were none in 1907	UK prices compared to US export prices	21-25	--	Levy (1927:268)
169C. Same as 169A	Compares 1900 domestic German price with price of exports to Portugal	26	--	Hirst (1905: 115)
170. In 1902, German manufacturers of **thorium nitrate** were able to monopolize the only world source in Brazil of monacite, the key raw material; ended sometime after 1904	The price of saltpeter in Germany in 1904 compared to early 1902	56	--	Levy (1927:295)
171A. A study of three **British ocean shipping conferences** 1870-1913; focus is on 47 episodes of entry and 14 predatory price wars of 2 days to 1 year long precipitated by them; all wars saw price changes of at least 30%; no line lost money	Price during war compared to rate before war, average of 4 episodes 1891-1902	60	75	Scott-Morton (1997:693)
171B. Same as 171A above	Price during war compared to after war when entrant was admitted to cartel, two episodes	49	75	Scott-Morton (1997:693)
172. Study of the determinants of all price wars among U.S. **passenger airlines** 1978Q2 to 1995Q4; discussion assumes that conduct observed is tacit collusion by price leadership, but later convicted of illegal signaling, a facilitating collusive device.	Econometric study, but no averages given	15-25+	--	Morrison and Winston (1996)
173. Buyers' cartel by 23 elite U.S. universities that met to fix the (purchase) price of **needs-based graduate scholarships** from 1958 to 1991; 22 found guilty by U.S. court, but DOJ settled with one university that appealed by means of a consent decree	Both econometric studies find that income was redistributed from high- to low-income applicants, but no average price effects	0	--	Carlton *et al.* (1995), Hoxby (2000)
174. Bid rigging by more than 2000 **building construction** companies in	Federal Cartel Office analysis of overcharges on the 8000	9	--	OECD (1976:24)

northern Germany in 1959-1973; 559 were prosecuted by the Federal Cartel Office (BKA), which provided a written report to the OECD on the 8000 projects	projects			
175. A report of the French Technical Commission on Cartels and Dominant Positions to the OECD on bid rigging on public tenders in **electrical wiring construction** ca. 1975	Estimated by the reduction in the winning bid on the same project after the cartel was disciplined	20	--	OECD (1976:26)
176. Same as 175 above, except for **construction of a Mirail University building** ca. 1970 - 1975	Same as 175 above	40	--	OECD (1976:26)
177. Same as 175 above, except for **road building project in France** in 1968	Same as 175 above	22	--	OECD (1976:26)
178. Based on a Japan FTC prosecution of Yuasa Timber Co. and 64 other **plywood manufacturers** that made identical bids for a public tender ca. learly 1970s	JFTC report that found that the identical bids were exactly 10% higher than the previous winning bid for the same product	10+	--	OECD (1976:37)
179. The Northern Collieries Association fixed the price of **black coal** in the Newcastle, Australia region in six episodes from 1855 to 1893; the NCA accounted for 85% of colonial supply in the 1860s, but slipped to 60% by 1900				Flemming (2000:50)
179A. First episode began with 2 mines in 1855, but high prices quickly (by ca. 1856) induced large-scale entry	Price increases ineffective in the long run	0	--	Flemming (2000:50)
179B. Same as above, but for years 1861-62	Price increases only in the short run	0	--	Flemming (2000:50)
179C. Same as above, but for year 1865-66	Price increases only in the short run	0	--	Flemming (2000:50)
179D. Same as above, but for mid 1866-1868	Comparison of real prices of "Northern" coal in 1867-68 with early 1866 price	30		Flemming (2000:50)
179E. Same as 179D	Comparison of real prices of "Northern" coal in 1867-68 with 1870-72 average price	30	--	Flemming (2000:50)
179F. Same as above, but for 1874-1880	Comparison of real prices of "Northern" coal in 1874-80 with 1872 price	55	--	Flemming (2000:50)
179G. Same as 179F	Comparison of real prices of "Northern" coal in 1874-80 with 1881 price	80	--	Flemming (2000:50)
179H. Same as above, but for 1882-1893	Comparison of real prices of "Northern" coal in 1882-93 with 1881 price	46	--	Flemming (2000:50)
179I. Same as 179H	Comparison of real prices of "Northern" coal in 1882-93 with average 1895-1900 price	34	--	Flemming (2000:50)
180A. The **UK Linoleum** Manufacturers Association formed in 1905, formalized in 1934, was judged to have engaged in a long list of horizontal and vertical restrictive practices through 1955 that were anticompetitive; agreements with other European assns. guaranteed a UK	The two UK nonmembers sell linoleum of the same quality and grade at prices 10% below LMA members	10	--	UK Monopolies Commission (1956b:26,66)

monopoly for the LMA; the LMA controlled 80% of the market in 1955; setting common prices; though "not against the public interest," pricing was deemed "perilous" by the Commission.				
180B. Same as 180A	The Commission seems to suggest that the "loyalty rebate" awarded to all LMA-"approved wholesalers" is a (rent-seeking) yardstick of the cartel overcharge	12.5	--	UK Monopolies Commission (1956b:28)
180C. Same as 180A for period early 1887 to 1904	Pool kept prices at a constant $28/t from 1887 to 1904, except for one brief , "ruinous" price war in (late?)1887	--	87	Seager and Gulick (1929:90-91)
181A. The British **Non-Ferrous Metals** Federation was created in 1945 by the merger of 12 metals associations, one founded in 1875; had 69 members in 1945 covering semi-manufactured copper, brass, zinc and nickel alloys; set common prices in UK and since 1946 in exports under the Lausanne Agreement, which protects UK market from European exports; many other restrictive practices that Commission says "operate against the public interest" and "keep prices up" ; ended 1955	In July 1946, export prices to British Commonwealth countries were raised by £7 to 10 at a time when (yardstick products) copper wire, strips, and tubes sold elsewhere for £242-415/tonne	2-4	--	UK Monopolies Commission (1955: 58,102-03, 208-11)
181B. Same as 181A	Same as 181A above, but £10-21 increase to non-Commonwealth countries	4-8	--	UK Monopolies Commission (1955: 58,102-03, 208-11)
182A. The UK Cable Makers Association, formed 1899, and Covered Conductors Assn. had 22 members in 1950 with 65-69% of UK market for **insulated wires and cables**; prices fixed on exports from 1928 when Intl. Cable Development Corp. formed for power distribution cables; ended 1952	UK parliamentary Standing Committee on Trust reported that in 1921 non-CMA firms sold at 10% lower prices than CMA members	10	--	UK Monopolies Commission (1952a: 17)
182B. Same as above, except for 1948	Loyalty rebates in 1948 are rent-seeking portion of overcharge	10.0	--	UK Monopolies Commission (1952a:75)
182C. Same as above, except for 1949-50	Commission seems to suggest that profit/sales of 10% is reasonable; subtracted 10% from average actual profits on 7 types of cables	14.4+	--	UK Monopolies Commission (1952a: 167)
183A. The British Electrical & Allied Manufacturers Assn sets common prices and terms of sale for 84% of the UK's market for **large electric power equipment**; covers 37 lines of business; cooperates with the Intl. Elec. Assn. on exports; ca. 1930 to 1957	In early 1950s, a yardstick firm, the Central Electric Authority, paid 5-15% lower prices on small transformers of same quality from non-BEAMA firms	5-15	--	UK Monopolies Commission (1957a: 169-77)
183B. Same as 183A	A large industrial firm got 13 bids for 1000 KVA transformers in Jan. 1949; 3	12.3	13.1	UK Monopolies Commission (1957a: 177)

	non-BEAMA bids were lower than 10 BEAMA firms			
183C. Same as 183A	Another large industrial buyer got lower bids from nonmembers on a tender for 17 transformers (10 to 4000 KVA) in 1951-53	8.5	21.5	UK Monopolies Commission (1957a: 178)
183D. Same as 183A	North Scotland Electric Board reports lower bids from nonmembers on small transformers of identical quality	5	--	UK Monopolies Commission (1957a: 178-79)
184A. Since 1905 the Electric Lamp Manufacturers Assn. of Great Britain fixed common prices and standardized product quality; 8 members (two dominant) have 90-95% control of UK **electric bulb** market; ELMA is affiliated with Phoebus (#21 above); price fixing is condemned; ELMA largely prevented superior long-life bulbs from being sold; ended 1951	In 1933-35, UK chain stores sold Japan-made bulbs at lower retail prices than ELMA members	37-66	--	UK Monopolies Commission (1951: 13), Prais (1974)
184B. Same as 184A	In 1939 5 firms not in ELMA sold 60W general-service filament bulbs of same quality to chain stores at 68-71% lower price than ELMA firms; after acquisition in 1950, prices only 31-32% lower	54-57	--	UK Monopolies Commission (1951: 41)
185. German **wire** cartel in operation in early 1900s (ca. 1900-04)	Compares 1900 domestic German price with price of exports	38	--	Hirst (1905:115)
186. German **nail** cartel in early 1900s (ca. 1900-04)	Compares 1900 domestic German price with price of exports	44	--	Hirst (1905:115)
187. German **steel girders** cartel active in early 1900s (ca. 1900-04)	Compares 1900 domestic German price with price of exports to Belgium and Netherlands	20-30	--	Hirst (1905:115)
188A. The U.S. **arc-light carbon** industry began in 1879 and attempted to fix prices 3 times between 1885 and 1887; the first successful episode was by six leading firms in late 1886	Price increase from early 1886 to late 1886	20	--	Passer (1953: 60)
188B. Ten leading firms with 75% of supply agreed to raise prices on April 15, 1887; ended because of large scale entry in July 1887 and inability to control coke (principal ingredient) supplies	Prices in mid 1887 compared to early 1887	100	--	Passer (1953: 61)
189. U.S. **incandescent electric light bulb** industry became unconcentrated because the validity of GE's Edison patent was in doubt until a 1891 court decision affirmed its validity; in August 1896 GE made a price-fixing agreement with 16 other manufacturers; cartel controlled 95% of U.S. market for several years (ca. 1900?)	Change in price of light bulbs of various sizes from 1895-early 1896 to late 1896 and some time afterwards	11-67	--	Passer (1953:162- 163)
190. Major oil fields discovered in Texas	Change in price per bbl. from	0+	--	Wiggins and

and Oklahoma 1926-31 doubled U.S. reserves, causing price of **crude petroleum** to fall 92%; private cartelization attempted ca. 1926- Sept. 1933 resulted in an "imperfect cartel" that was "quite ineffective"; entry at small scales was easy; even imposition of legal quotas from 1929 by TX and OK state commissions was observed by only the top 25 producers with 1% shares or more	1926 to 1932 due mainly to huge shift in supply and some general deflation; no quantitative analysis of whether price decline was slowed by sporadic supply controls.			Libecap (1987)
191A. U.S. Webb-Pomerene **crude sulfur exports** association, active for 46+ years 1929-32 and 1934-1970+	Econometric model predicts 8.3% decline in export volume during cartel years; price effect statistically significant	6.3	--	Dick (1992:103)
191B*. Same as 191A, except refers to effect of an agreement between US and Sicilian producers to divide world market in 11/1923	Compares prices in 1924-1929 with 11/1923	30	--	Wallace and Edminster (1930:262)
192A. British Radio Valve Assn., formed in 1926, had 10 members in 1954-56 that controlled 97% of sales in the UK market for **cathode ray and electronic vacuum tubes;** BVA exclusively supplied all UK manufacturers of radio and TV sets; fixed prices and terms of sale to manufacturers, wholesalers and retailers; condemned as "against the public interest"; ended Sept. 1956	Largest set makers (80% of sales to mfgrs for new sets only) get 70-80% discount off list, smaller (20% of sales) got only 50-60% discounts	4	--	UK Monopolies Commission (1957b: 38-45,108-109)
192B. Same as 192A, but refers to 1953-54 sales of tubes by #1 firm (Phillips with a 59% share) compared to similar sales by 9 smaller members of BVA	Phillips' price-cost margin on sales under BVA agreement was 16% higher than non-BVA sales; yardstick is PCM difference (-21%) of 9 smaller members	--	37	UK Monopolies Commission (1957b: 71)
192C. Same as 192A, except 1936 sales of radio tubes to retail customers through hobby magazines ; at this time US imports were large (20% of UK sales) and subject to a 33% import duty, and a large number of consumers built their own sets	Compares 1936 retail prices of a large variety of BVA-made tubes with U.S.-made tubes	160-175	--	UK Monopolies Commission (1957b: 71-80)
192D. Same as 192A, except refers to 1936 sales by leading UK wholesalers	Price of BVA tubes in 1936 compared to same tubes imported from US	20-27	--	UK Monopolies Commission (1957b:71-80)
192E. Same as 192A, except refers to a change in 1955 BVA list prices of radio tubes effective 9/56 in reaction to the impending (12/56) negative finding the UKMC	Median post-cartel price reduction on the 9 most common models; range was from 11% to 33%, simple average 16.0%	12.5	--	UK Monopolies Commission (1957b: vii, 71-80)
192F. Same as 192E, except 1955- August 1956 list prices of cathode ray tubes	Median price reduction on the 3 most common models; range was from 14.3% to 18%, simple average 15.5%	14.3	--	UK Monopolies Commission (1957b: vii, 71-80)
193. Bid rigging against the **Korean** government by 26 **road construction** firms in 1998-99 building the Western Coast Expressway	The average deviation of three winning bids from the government's pre-qualification review, compared to yardstick of the same ratio for all	10	--	KFTC (2001: 5-6)

	contracts			
194A. The **Michigan Salt** Association operated from April 1868 to at least 1888; supplied northern US west of Pennsylvania; controlled 75% to 95% of MI production; ineffective in raising prices for most of its existence but enjoyed brief success in 1868	MI prices per bbl. in 1868 compared to linear price trend in the competitive periods during 1866-1877	13.8	--	Jenks (1888:92)
194B. Same as above, except second episode May 1881 to March 1882	Compared to average monthly prices June 1880 to April 1881	22.6	--	Jenks (1888:94)
194C. Same as 194B	Compared to average monthly prices April 1882 to Mar. 1883	28.7	--	Jenks (1888:94)
194D. Same as 194A except period immediately after a price war	Prices in mid 1887 compared to early 1887	6.1	--	Jenks (1888:92)
195. A summary of a large number of federally prosecuted instances of bid-rigging in **U.S. road construction,** mostly in the late 1970s and early 1980s	Various methods, used by the Dept. of Justice, not discussed	10	--	Werden and Simon (1987:925)
196. A summary of an analysis of seven 1984-1987 U.S. federal court final decisions in **bid-rigging cases** involving a total of 12 defendants in various industries.	Trial decisions of a judge or jury based on direct testimony and perhaps other methods	20	35	Cohen and Scheffman (1989:347), Cohen (1989b)
197. **High fructose corn syrup** raised prices in the US market from Jan. 1989 to June 1995; 4 of the 5 defendants in a civil suit settled by mid 2004	Rough minimum estimate based on a yardstick: the largest settlement ($400 million by leader ADM)	4.0	--	Connor (2003: Table A.3)
198. **Carbon fiber;** 1993 to May 2002; under US DOJ investigation	Press reports of rise from pre-cartel prices	25	--	Connor (2003: Table A.4)
199. **Aluminum metal**; Feb. 1994 to Feb. 1996; some quasi-official national trade associations were members and openly signed a Memorandum of Understanding; investigated by US DOJ but not indicted, possibly because of international comity reasons	Increase in prices in June 1994 relative to Nov. 1993 pre-cartel prices; caused in part by increased demand	30+	--	Connor (2003: Table A.4), Jenny (2003), Stiglitz (1998:176)
200. **Tobacco leaf**; bid rigging of US auctions 1996-2001; antitrust class action by 400,000 growers and quota holders settled by 4 defendants May 2003; trial for remaining manufacturer scheduled for 2004	Preliminary minimum yardstick estimate made from settlement worth $1,400 million; gross farm sales from USDA data are $15,588 million	9.0+	--	Connor (2003: Table A.6), *Legal Times (6/21/ 2004)*
201. **Linerboard**; 10/1993 to 11/1995 in US market; US civil court case resulted in three settlements by April 2004	Settlement of $202 million is asserted to amount to about 50% of the overcharge; benchmark is pre-cartel price; peak occurred at end of cartel	51	83	Connor (2003: Table A.6), *Legal Intel-ligence (4/22/2004)*
202. **Carbon dioxide;** Jan. 1968 to Nov. 1992 in US market civil case settled 7/1996 just days before trial was to begin	Estimated from Court comments on overcharge during fairness hearing on fees	16.5	--	Connor (2003: Table A.6)
203. **Cardizem CD (diltiazem hydro-chloride) heart medicine;** Sept. 1997 to June 1999 in US market; private damages suit settled 2002; motion to dismiss denied 6/13/2003	The patent holder of Cardizem paid a maker of a generic substitute $90 million as profit compensation to withhold the generic from the market; this is likely to be less than half of the monopoly profits earned by both companies	16-32+	--	Connor (2003: Table A.6)

204. **Asphalt, liquid ;** Alabama bid rigging 1971-78; class-action suit of 133 government units was initiated in 1979 and settled a few years later	Overcharge is shown in Figure 2; based on an econometric model	126	165	Kamerschen and Morgan (2004:690)
205A*. The **Almond** Board of California, a group of elected industry representatives operating under a USDA-enforced Marketing Order, controls 95% of the US market and two-thirds of the world market with inventory; cannot control tree plantings and sells to a concentrated processing sector; from about 1935 to 2004	An econometric model applied to 1962-1997 data predicts a Lerner Index for the US market that is 63% below the monopoly price	37.7	--	Crespi and Chacon-Cascante (2004:10)
205B*. Same as 205A	Same as above for the world export market; the Lerner Index is 66% below the monopoly price	25.6	--	Crespi and Chacon-Cascante (2004:12)
206*. Four-fifths of the world **coconut oil** market is controlled by a Philippines processors' export cartel after 1972 that was composed of 7 companies	An econometric model applied to 1959-1987 data to predict a Lerner Index for the pre-cartel (0.41) and cartel period (.89) 1973-87	739	--	Buschena and Perloff (1991: 1007)
207A*. **Fluid milk** in the US is controlled by USDA-mandated Marketing Orders; mid 1930s to 2004	Econometric model applied to producer (blend) prices in 38 markets (1960) and 46 in 1970; peak is 1970	14.4	17.8	Kwoka (1977:377)
207B*. Same as 207A	Slightly different econometric model applied to 1973 blend-price data; range depends on elasticity of supply of raw milk	3.0-4.4		Ippolito and Masson (1978:54)
207C*. Same as 207B	Effect on consumer prices is net effect of increases in fluid-milk products and decrease in manufactured-milk products	3.6	--	Ippolito and Masson (1978:55)
208* The **California raisin** marketing order controls by USDA mandate a reserve pool through an elected board or industry representatives since 1949; three joint products are made: raisins, fresh grapes, and raisins; price stabilization is achieved.	Authors develop a complex econometric model of the US industry for 1963-1984, with 9 no-control scenarios; grower prices for juice grapes rise slightly but fall by a nearly equal amount on raisins and by a larger amount for fresh; net returns virtually zero	0	--	French and Nuckton (1991: 591)
209A*. The **California-Arizona navel orange** USDA marketing order controls the supply of about 75% of US winter orange supplies; because of a freeze in Florida, the restrictions on selling fresh oranges were unexpectedly suspended in 1985	Predict the negative effect on FOB grower prices during the suspension of the marketing order from best-performing of 4 econometric models with 42 weeks of data from 2/1985 to 5/1987; they later repeat the analysis with more data	7.5	--	Thompson and Lyon (1989:657 and 1991)
209B*. The 1934-1981 **California-Arizona fresh orange** industry was cartelized by a mandatory USDA marketing order; study covers equilibrium prices in 1970s; competition raises prices to growers	An econometric simulation mode predicts prices for oranges with and without the marketing order for Valencia oranges in the 1970s	-20	--	Shepard (1986:118)
209C*. Same as 209B, except navel oranges	Same as above	-15	--	Shepard (1986:118)

210A*. The **California-Arizona lemon** marketing order controls the US supply under a USDA mandate; in 1973 the policy was changed from one that emphasized constant prices to one that kept price constant; grower prices decreased and retail prices increased	An econometric model compares actual 1986-87 retail prices under the constant-price policy with the former consumer-friendly constant-quantity-policy yardstick	1.1	--	Carmen and Pick (1990:354)
210B*. Same as 210A, but examines the effect of the new stabilization policy of returns to middlemen	Same as above, but calculates change in the marketing margin compared to the old policy yardstick	6.8	--	Carmen and Pick (1990:354)
211A*. Two bid-rigging cartels in the **Upper Midwest U.S. road seal-coating construction** industry are detected from 1994-1998 data on almost 18,000 procurement contracts by private and public buyers; authors judge that the upper quintile of contracts (3500) were affected by one or more of two duopolistic cartels.	A sophisticated econometric model incorporating Baysian expert knowledge predicts cartel behavior on bids where the two largest firms are bidders; largest 20% of collusive markups are compared to the upper 20% of markups of competitive bids	8.0	--	Bajari and Yi (2003:Table 12)
211B*. Same as 211A	Same as above, except cartel consists of the #1 and #3 firms	21.0	--	Bajari and Yi (2003:Table 12)
212*. The legal **Norwegian cement cartel** was established in 1923; until 1968 it set market quotas and exported through a common sales agency; without capacity constraints, the cartel over-invested in capacity	Authors find that the cartel exported at prices below marginal cost during 1955-1967	0	--	Roller and Steen (2003)
213A*. Survey report of the Japan FTC on several bid-rigging schemes involving large companies for 21 cases of **public construction projects and materials procurement** in Japan 4/1996-3/2003	Price change if bids were not rigged; method compares actual bid prices to prices "after FTC crackdowns"	18.6	--	Kishi (2004), JFTC (2004:8); Jiji wire service 3/9/04
213B*. Bid rigging of a tender made by Osaka, Japan city government for **germicidal chemicals** used in sewer systems; sometime during 4/1996-3/2003	Price decline on product after a raid by the JFTC	41.5	--	Kishi (2004), JFTC (2004:8); Jiji wire service 3/9/04
213C*. Bid rigging of a tender made by Osaka, Japan city government for one **water purification plant**; sometime during 4/1996-3/2003	Price decline on product after a raid by the JFTC	28.0	--	Kishi (2004), JFTC (2004:8); Jiji wire service 3/9/04
213D*. Bid rigging of a tender made by Osaka, Japan city government for **four water purification plants**; sometime during 4/1996-3/2003	Price decline on product after a raid by the JFTC	28.8	--	Kishi (2004), JFTC (2004:8); Jiji wire service 3/9/04
213E*. Bid rigging of a tender made by Osaka, Japan Prefecture government for a **water purification plant**; sometime during 4/1996-3/2003	Price decline on product after a raid by the JFTC	29.0	--	Kishi (2004), JFTC (2004:8); Jiji wire service 3/9/04
214*. Survey report of the Japan FTC summarizing the average overcharges of 14 price-fixing cartels selling "**basic materials**" (food, plastic, steel, chemicals, drugs, etc.) in Japan April 1992 to March 2003	JFTC staff studies that compare average fixed prices to prices after the cartels were exposed; peak is for largest of 14 cases	12.1	25.0	Kishi (2004), JFTC (2004:7), Jiji wire service 3/9/04
215*. In 1986 the **UK white salt duopoly**	Rees proves overt collusion	23-32	--	UK Monopolies

was found to have colluded in the 1974-1984 period at least, but the duopoly failed to achieve the monopoly level of prices and costs (costs 2 to 5% above); see also #168 above.	using an unusual method: comparing the predictions of noncooperative oligopoly price-leadership models with predictions from an infinitely repeated game model; Rees suggests a profit yardstick of 7 to 16% return on assets			commission (1986); Rees (1993:841)
216A*. In the **Euro-Zone banks** case, the EC fined 5 German banks €100 million for fixing the commission for exchanging their customers' local-currency bank deposits into Euros, from 1/1/1999 to 12/11/2001; originally the cartel consisted of 25 German and Dutch banks, but 20 consented to lower their fixed fees or variable fees in 2000; several eliminated all fees after 10/01 (an infinite overcharge?)	Author explains the basis of the EC's fine was to recover 90% of the banks' illegal profits; fixed commissions were 3.0% and but-for yardstick margin was 0.3%; thus, mark-up was 2.7 percentage points	800	--	Guersent (2004:23)
216B. Same as 216A, except 5 German banks agreed to fix their foreign exchange fees for the Deutsche mark at 3% during the Euro transition period 1/98-12/01	One of the original members of the cartel (Bayerische Landesbank) agreed to eliminate its fixed fee and reduce its variable fee to 2%	50+	--	EC (5/3/01 and 12/11/01), OJ (1/21/03)
216C. Same as 216A above, except an EC consent decree involving Westdeutsche Landesbank of Germany	Percentage charge reduced from 3.5% to 1.5%	133	133	EC (5/14/01)
216D. Same as 216A, except EC consent decree with Bank J. Van Breda of NL	Fixed fee of €2.48 eliminated, but 1.25% fee retained; assumed that a typical exchange amount was €50-200	50-80	--	EC (5/14/01)
216E. Same as 216A, except EC consent decree with ING, Postbank, and ABN AMRO Bank of NL	Minimum fee lowered from fl. 7.5 to 3.5, but 2.75% charge unchanged; assumed typical amount exchanged is €50-200	20-38	--	EC (5/7/01)
216F. Same as 216A, except EC consent decree with Fortis Bank Nederland	Fixed service fee reduced from fl.5 to 2.5	100	100	EC (5/7/01)
216G. Same as 216A, except EC consent decree with ING Bank Group in Belgium	Reduced their minimum fee from BEL 100 to 45, but fee of 2.25% unchanged; assumed typical amount exchanged is €50-200	17-35	--	EC (5/7/01)
216H. Same as 216A, except EC consent decree with Ulster Bank of Ireland	Reduced its fee from 2.25% to 1% and eliminated a minimum fee of €2.5; assumed typical amount exchanged is €50-200	56-80	--	EC (5/3/01)
216I. Same as 216A, except EC consent decree with Bayerische Landesbank of Germany	Abolished its minimum fee of €2 and reduced its service fee from 3% to 2%; assumed typical amount exchanged is €50-200	33-50	--	EC (5/3/01)
217*. Chilean miners of **sodium nitrate,** from the world's sole source of natural *caliche* deposits, formed a series of six voluntary export cartels from June 1884 to January 1914; each lasted an average of 3 years; exports grew 900% from 1880 to 1910; cartel set sales and export quotas for	When first formed, each cartel saw an increase in prices, followed by a slump when it was dissolved because of entry			Stocking and Watkins (1946: 120-127), Wallace and Edminster (1930: 26-56)

each mine and imposed penalties for violations but did not control entry; constant per ton export tax accounted for 30-70% of the export price .				
217A*. First Chilean export cartel of 1884-1886	Chilean f.a.s. export prices 1884-86 compared to 1883; peak is 1886	7.4	21.6	Stocking and Watkins (1946: 121-123)
217B*. First Chilean export cartel of 1884-1886	Chilean f.a.s. export prices 1884-86 compared to 1887-1890; peak is 1886	30.1	47.3	Stocking and Watkins (1946: 121-123)
217C*. Second Chilean export cartel of 1891-1894	Chilean f.a.s. export prices 1891-94 compared to 1887-90; peak is 1894	4.8	7.8	Stocking and Watkins (1946: 121-123)
217D*. Second Chilean export cartel of 1891-1894	Chilean f.a.s. export prices 1891-94 compared to 1895; peak is 1894	7.7	10.8	Stocking and Watkins (1946: 121-123)
217E*. Third Chilean export cartel of 1896-1897	Chilean f.a.s. export prices 1896-97 compared to 1885; peak is 1896	0	3.4	Stocking and Watkins (1946: 121-123)
217F*. Third Chilean export cartel of 1896-1897	Chilean f.a.s. export prices 1896-97 compared to 1885; peak is 1898-1900	9.7	13.6	Stocking and Watkins (1946: 121-123)
217G*. Fourth Chilean export cartel of 1901-06	Chilean f.a.s. export prices 1901-06 compared to 1898-1900; peak is 1906	44.0	71.7	Stocking and Watkins (1946: 121-123)
217H*. Fifth Chilean export cartel of 1907-08	Chilean f.a.s. export prices 1907-08 compared to 1909-1910	18.2	26.2	Stocking and Watkins (1946: 121-123)
217I*. Sixth Chilean export cartel of 1913-July 1914; in July 1919 the Chilean Nitrate Producers' Assn. was formed with active government assistance (by 1925-26 with effective entry control tradable quota rights sold for 24% of the export price)	Chilean f.a.s. export prices in 1913 compared to 1909-1912	8.1	--	Stocking and Watkins (1946: 121-123, 128), Wallace and Edminster (1930: 48)
218*. The "east of Burma" agreement covered **flat rolled steel** products; began ca. 1985; still in operation 2003; steel mills in EU and Eastern Europe agreed to export only west of Burma; Japanese and Korean producers only east of Burma; fixed quotas annually and prices quarterly	Method not explained, but cites a 1993 OECD report by Alan William Wolff	25-30	--	Jenny (2003)
219*. **Roofing felt manufacturers** in Belgium fixed prices and shares from at least 1/1978 to 4/1984; 9 companies controlled 60% of market; fined by EC in 1986	EC Decision mentions several times that the cartel agreed to limit discounts to certain buying groups the yardstick) while charging list to other customers	23-25+	--	EC (8/19/1986)
220*. **Flour procurement** by the Taiwan Flour Mills Association for 32 member companies from May 1997 to May 2000; fined by the Taiwan FTC in May 2000	Press release by Taiwan FTC estimates cost to consumers to be NT$ 2 billion; method unknown	?	?	Taiwan Business News (5/5/2000), KFTC (2002)
221*. **Distributors of natural gas** in southern Taiwan (Pingtung-Kaohsiung and Tainan) fixed prices from 4/2000 to 1/2001 and were required to pay record fines by the Taiwan FTC	An analysis by the Taiwan FTC used the before price as a basis	175-300	--	China Post (1/12/2001), KFTC 2002)
222A*. Bid rigging on **road construction**	Bench trial decision; damages	10.6	--	*State of*

in Greeley, Colorado (the "Second 35th Av. Project") around 1983	from plaintiffs' econometric model accepted			*Colorado v. Goodell Brothers* (1987)
222B*. Same as 222A, for "Third 35 Av. Project"	Same as above	8.7	--	*State of Colorado v. Goodell Brothers* (1987)
223*. **Tetracycline** manufacturers in the US settled a civil damages case brought by 43 states, many cities, and indirect purchasers; a previous criminal trial conviction was overturned by an Appeals Court panel; conspiracy dates uncertain, probably Nov. 1953 to 1960	Defendants offer is based on an overcharge assumed to be 66.7% (method unknown), but "allowing for uncertainties in law and in fact" a compromise offer was made.	41	66.7	*W.Virginia v. Chas. Pfizer (1970)*
224*. In a class action by buyers of **polypropylene carpet,** a Daubert challenge results in a court decision to accept the opinion of one of the plaintiffs' experts	Econometric model predicts an overcharge for 1990-1995 for two types of carpets (rolls and cuts)	8.8	--	*In re Polypro-pylene Carpet Antitrust Litig-ation (2000:32)*
225. **UK copper smelters**, most in Swansea district of So. Wales, began rigging bids for ore 1719-1726 and later rigged bids for export copper; first buyers' cartel of 4 smelters 1719-1726; second more formal agreement ("Associated Smelters") 1737-1779; Newell says second was "quite effective" at lowering ore prices and raising copper prices				Read (1993), Newell (1998), Allen (1923)
225A*. Cornish Metal Co., a sales-agency cartel, formed 1785 to buy all copper ore and set prices; controlled 2/3 by miners and 1/3 by smelters in Cornwall and later made side payments to Anglesea mines; collapsed in Oct. 1787 when stocks reached 2 years' supply, imports increased, and Anglesea defected.	Compares copper prices in 1787-88 with early 1785; peak is 1787	13.3	16	Allen (1923)
225B*. Same as 225A, except period is Dec. 1787 to early 1792; more successful because a new common sales agency covered both Cornwall and Anglesea districts and total production quotas were observed	Large stocks of copper were eliminated 1788-1790 at prices 8% above 1785; peak is 1791	12.0	21	Allen (1923)
225C*. First Copper Trade Association formed 1824; failed Dec. 1829 because no agreement on quotas and leading firms' shares dropped too far.	Author develops a price series on smelters' price-cost margins for 1824-29 and compares margins after collapse of cartel	25-30	--	Newell (1998:183)
225D*. Second Copper Trade Assn. formed 1844 and kept secret until it ended 1867; more elaborate organization and higher degree of control of the industry (CR4 = 70%); copper prices constant during cartel, but ore prices forced down	Author's figures on copper prices and ore prices 1844-1867 compared to 1842-43 prices; profit figures confirm effectiveness of cartel	19	--	Newell (1998:191)
226* Associated Milk Producers was found guilty at trial of price-fixing , mostly in Southern US fluid milk markets from 1972 to 1980	Econometric model applied to 14 markets; dummy measures effect of DOJ consent decree; ave. is for all markets, peak for monopolized markets	4.5	5.3	Madhavan *et al.* (1984:161-69)

227*. Price fixing and market-sharing of **cast iron and cast steel rolls** covered virtually all of W. Europe from Jan. 1968 to June 1980; many changes in pricing and organization during cartel; originally target prices for all Europe, later separate minimum price increases for each currency area; the Intl. Roll Manufacturers' Assn. (IRMA) was the collusive cover from May 1971; from 1971-77, bids from steel companies were handled through a Zurich office (ATAG); 30 companies and national associations fined by EU in 11/83	EC decision recounts many price increases by IRMA that were "quite efficient": from Jan. 1969 10% in 10/69, 40% by 10/70, 46% by 1/73, 55% by 1/74, and 100%+ by 10/74; but general inflation was significant in 1969-74, about 40-50%, so real price increases are calculated	40-60	--	EC (11/15/83: 5-9)
228*A. The EU fined 40 firms from No. Am. and W. Eur. in the European market for **bleached sulphate paper pulp sold in open markets;** two episodes, 1/75-12/76 and 1/79 to 12/84; Decision gives quarterly transaction prices of bright (GE>80) prime bleached softwood pulp from 1/74 to 1982	Episode 1 (1975-76) average prices compared to 1974 (before) prices; peak same years	23	23	EC (3/26/85: para 15, 24, 113)
228B*. Same as 228A	Same as above, except comparison is 1977-78 after prices	25	25	EC (3/26/85: para 15, 24, 113)
228C*. Same as 228A, except episode 2 (1979-81)	Episode 2 average prices compared to 1977-78; peak is 4/80 to 12/81	49.9	64.2	EC (3/26/85: para 15, 24, 113)
228D*. Same as 228C	Same as above, except benchmark is price after collusion	20	31	EC (3/26/85: para 15, 24, 113)
229A*. The Taiwan Fair Trade Commission fined 27 **distributors of liquefied petroleum natural gas (LPG)** in southern Taiwan of price fixing from April 2000 to Jan. 2001	The increase in a kg. of gas in Pingtung-Kaohsiung was from NT$0.50 to $1.00 (before) to $2.00 during	100-300	--	TFTC (1/12/2001), TFTC-OECD (2001:11-13)
229B*. Same as 229A, except in Tainan	Price increase was from NT$0.80 to $1.00 (before) to $2.00	100-150	--	TFTC (1/12/2001)
230*. The EC fined 5 French producers and a Taiwanese export trade Assn. for a Jan. 1973 agreement to raise prices on sales of **canned mushrooms** in Germany in Mar. 1973; in Dec. 1975, the cartel became ineffective because of a surge in Chinese imports.	Prices were raised in Germany Mar. and April 1973 from Jan-Feb. levels	10	--	EC (1/8/1975)
231*. The EC disbanded and fined an association of four manufacturers of **wallpaper** in Belgium that had fixed f.o.b. and retail prices and all terms of sale from 1922 to 1974; perhaps the most detailed set of uniform rules of any trade association ever recorded	The association had complex rules for awarding discounts to wholesalers on the basis of annual purchases from the members; the most revealing yardstick for gauging price effect is the discount offered to all contractors and builders regardless of size	33.3	33.3	EC (7/23/1974: para.13)
232*. The EC fined virtually every major PVC manufacturer of **polyvinyl chloride plastic** for price fixing during 1980Q4 to 1983Q4; although overturned by the	Average transaction prices for three years compared to price several months before the cartel started	56	70	EC (12/21/1988: para. 17-19)

European Court, the price effects were not questioned.				
233A*. A study of bid rigging in the commercial cartage (**garbage collection)** industry in NYC 1978-1985	Uses sales of customers among suppliers as a yardstick to compute the capitalized value of rents from overcharges	50	--	Reuter (1993:193)
233B*. Same as 233A, except for residential customers in NJ and Long Island, NY	Same as above	15	--	Reuter (1993:193)
234*. The Taiwan Flour Mills Assn. was fined by the Taiwan Fair Trade Commission for allocating **flour and wheat imports** among its 32 members from May 1997 to May 2000	Price of imported wheat and flour during cartel compared to before cartel, estimated by the TFTC	5.8	--	TFTC (5/5/2000)
	DATA ADDED AFTER 9/04			
73Y. Same as 73A.	Yardstick is prices of profitable German mines not in cartel, ca. 1900-1910	30	--	Tosdal (1916:830)
149C. Same as 149A.	Author gives monthly prices of 8 d. nails, the modal type; benchmark is prices for 4 months before May 1895; peak is May-Nov. 1896	75	113	Edgerton (1897:260)
149D. Same as 149A.	Same as above, but corrects for increase in major input price, No. 11 steel wire	50	88	Edgerton (1897:260)
149E. Same as 149A.	Benchmark is prices 4 months after cartel dissolved	69	106	Edgerton (1897:260)
149F. Same as 149A.	Same as above, but corrects for increase in major input price, No. 11 steel wire	44	81	Edgerton (1897:260)
166P. Covers all episodes 1770-1845	Econometric model using annual data on wholesale prices	6.9-7.8	--	Hausman (1984:326)
166Q. Covers the years 1699-1770; no other author suggest that this was a cartel period	Econometric model using annual data on retail prices paid by two London buyers	0	--	Hausman (1980)
235A. In 3/1999 SAS Airlines (a DK-SW-NO joint venture) and Maersk Air informed the EC about a new code sharing agreement. After raids in June 2000, the EC determined (the **"Danish Air Routes"** case) that Maersk had agreed to withdrawal from the Copenhagen-Oslo and Copenhagen-Stockholm routes in return for Maersk's monopoly on the Billung-Copenhagen and Copenhagen-Venice routes plus monetary compensation; the agreement was effective from 3/99 to 4/01	The EC decision uncovered secret planning documents that showed that SAS would and did raise the fares on its route to Stockholm by DKK 100 to pay for the Maersk withdrawal; fares are about DKK2000-2500 on this route	4.0-5.0	--	EC (7/18/2001: para. 92-95)
235B. Same as 235A, except for the Copenhagen-Oslo route	Price increase of DKK 100 relative to fares of DKK 2100-2700	3.7-4.8	--	EC (7/18/2001: para. 92-95)
236A. A study of the **Swedish roundwood procurement** market in 1954-1984 found evidence of oligopsonistic pricing behavior by paper buyers in two interrelated sub markets: sawtimber and pulpwood [an EC-	A sophisticated econometric model simultaneously estim-ates the negative price effects on forestry firms for pulpwood in 1979-1984; peak is 1984	25	29.4	Brännlund (1989:702-703)

FI antitrust probe was launched in 2004]				
236B. Same as 236A	Same as above for sawtimber	10	11.8	Brännlund (1989:702-703)
237. The European Union fined 3 companies for price-fixing of **flat glass products in Benelux;** 1978-1981	From internal documents of the cartel quoted in the EC decision (para. 14 and 41)	10-15	--	EC (8/8/84)
238A. The **German iron and steel** cartel of Mar. 1904 – June 1907 fixed prices of crude metal, rails, beams, rods, bars, sheets, axels, wheels, and castings; may be a successor to cartels #185-187 above.	Benchmark is 1895-1897 prices (the last normal demand period) of crude ingots	0	--	Walker (1906:860)
238B. Same as 238A, except billets	Benchmark is 1895-1897 prices (the last normal demand period)	5.3	-	Walker (1906:860)
238C. Same as 238A, except beams	Benchmark is 1895-1897 prices (the last normal demand period)	6.1-9.1	-	Walker (1906:860)
238D. Same as 238A, except rails	Benchmark is 1895-1897 prices (the last normal demand period)	7.7	--	Walker (1906:860)
238E. Same as 238A, except billets	Yardstick is f.o.b. Antwerp prices adjusted for transportation costs and subsidies	30	--	Walker (1906:864)
239. A U.S. Circuit Court convicted 16 companies for price fixing of **enameled iron bath tubs** from 6/1/1910 to 1/1/1911; one of the first cases of anticompetitive patent pooling	The decision quotes letters from the head of the Sanitary Enameled Ware Assn. complaining about cheaters undercutting the fixed price; peak price is from testimony of a nonmember of the cartel	15-17	45	Ripley (1916:614-616)
240. From 1982 to 1999, three companies colluded on **harbor loading services** in Taichung, Taiwan; fined by the TFTC	Based on yardstick prices for unloading scrap iron in two similar harbors	20-120	--	TFTC-OECD (2001:14)
241. Bid rigging on a tender by National Taiwan University Hospital for **surgical suture thread,** by 3 Taiwanese, one U.S., and one German companies in August 1988	Yardstick is prices paid for same products by other Taiwan hospitals in 1997	50-80	--	TFTC-OECD (2001:16)
242. The Taiwan Fair Trade Commission fined 15 **distributors of liquefied petroleum natural gas (LPG)** in Tamshui, Taiwan area of price fixing from May 1999 to May 2000	Before price NT$400 raised to NT$500 per cylinder	25	--	TFTC-OECD (2001:18)
243. The Taiwan FTC fined 5 **cable TV operators** for fixing the price of services from 1/1/2000 to 12/31/2000 in Kaohsiung City and County, Taiwan	TFTC calculated the monopoly profits of the 5 operators for 2000	30.5	30.5	TFTC-OECD (2001:14,19)
244. The Chinese Anti-Monopoly Bureau fined 5 business groups for rigging a bid in late 1999 for the right to operate for 3 years a **brickyard plant** owned by a township in Zhejiang Province, China	The agreement provided for side payments to the 4 losers of RNB200,000; I assume that the winner made at least RNB 50,000 on the RNB180,088 winning bid	38.8+	--	Wang (2001:8-9)
245. The Chinese Anti-Monopoly Bureau fined 1 construction company for rigging a bid with 9 others on Oct. 6, 1998 for the right to **construct a primary school**	The Bureau calculated the illegal gains of the winner to be RNB9000 on the RNB263.574 project	3.4	--	Wang (2001:9-10)

building in Changding County, Fujian Province, China				

[a] If the dates of the cartel's effective period of operation are different from its formal existence, the former dates are given if known.

[b] The first number is from the first edition of Posner, the second from the second (2001) edition.

Note: Connor (2003) includes some observations added August 2003- October 2004; the data appendix tables (A.1-A.12), and lists of sources were being finalized in 2004.

Appendix Table 3. Average Overcharge Observations, by Year and Type

Cartel Episode End Date	Membership		Legal Status		Bid Rigging	
	National	International	Found Guilty	Legal or Unknown	Primary Conduct	Other
	Mean percent [a] *Median percent* [a] *(Standard Deviation)* [a]					
	Mean percent [a] *Median percent* [a] *(Standard Deviation)* [a]					
Before 1891	37-39 20-25 (47)	41-48 42-50 (14)	-- -- --	38-41 31 (43)	-- -- --	38-41 31 (43)
1891 - 1919	40-47 35 (37)	43-44 50 (30)	24 24 (22)	43-46 38-40 (33)	39 39 (0)	42-45 36-40 (33)
1920 - 1945	9-21 6 (14)	42-48 30-31 (76)	45-81 9 (79)	37-45 30-33 (71)	-- -- --	39-47 30-33 (73)
1946 – 1973	18-22 15-20 18	35-36 32-34 19	19-21 13 17	32-35 28-44 21	19-22 12 18	30-33 24-25 21
1974 – 1990	23-25 21-22 (22)	65-68 44-46 (80)	29-31 22-23 (41)	31-40 34-34 (20)	26-29 23-24 (23)	34-36 23-26 (53)
1991 – 2003	17-18 15-16 (17)	32-38[b] 22-25 (52)	30-37 20-23 (47)	19 19 (0)	21-21 17-17 (17)	32-40 22-25 (50)
Total, mean median	25-29 20-22	38-43 30-32	28-35 19-20	38-43 32-36	22-24 17-18	36-42 28-30

Source: Appendix Table 2 (as of 1/6/04)
[a]) If ranges are given, both lower and upper bounds are shown. (lower bound only).
[b]) Includes 12 EU cartels with an average overcharge of ….
-- = Not available

Appendix Table 4. Final Court Decisions with Overcharges Data

Name and Type of Case	Overcharge	
	Average	Peak
1. Addyston Pipe & Steel Co. v. U. S., 175 U.S. 211 (1899) (conspiracy to allocate customers via secret bidding pool)(Court provided a typical result, but not an average figure[180])	34.7-42.6%+	
2. Armco Steel Corp. v. North Dakota, 376 F.2d 206 (U.S. App. 1967) (highway construction bidding conspiracy[181])	18.5%	
3. Armco Steel Corp. v. Adams County, 376F. 2d 212 (1967)(highway construction bidding conspiracy) (same defendants as previous case but different victims)	17.3-20.3%	
4. Colorado ex rel. Woodard v. Goodell Bros., 1987-1 Trade Cas. (CCH) P67,476[182]	9.6%	
5. FTC v. Superior Court Trial Lawyers Association, 493 U.S. 411 (1990) (legal aid attorneys conspired to raise fees[183]	16.7%[184]	75%
6. Freeman v. San Diego Ass'n. of Retailers, 322 F. 3d 1133		150%

[180] "The cost of producing pipe at Chattanooga, together with a reasonable profit, did not exceed $ 15 a ton. It could have been delivered at Atlanta at $ 17 to $ 18 a ton, and yet the lowest price which that foundry was permitted by the rules of the association to bid was $ 24.25. The same thing was true all through 'pay' territory to a greater or less degree, and especially at 'reserved' cities."

This means that the typical price increase was at least $24.25 - 18 = 6.25/18 = 34.7% And, 24.25 - 17 = $7.25/17 = 42.6%

[181] "We have no difficulty whatever in holding that there was adequate basis... proximate injury in the amount of $258,355, on the extent of the artificiality involved in the fixed prices and its ingrediency in the $1,396,500 list-price aggregate ... which had entered into the construction projects let during the conspiracy period, and in the $2,000 quantity of direct purchases made by the State." If $258,355 of the $1,396,500 was an overcharge, then the overcharge would have been 22.7% of the base figure of $1,138,145.

[182] The court found that plaintiff has reliably proved the overcharges on two of the three contracts at issue; competitive prices of $333,253 and $343,051 were increases by $35,381 and $29,732. Colorado ex rel. Woodard v. Goodell Bros., 1987-1 Trade Cas. (CCH) P67,476 Id at 7.

[183] Legal aid attorney conspired to raise fees. Cartel/boycott by Washington DC lawyers (public defenders) that demanded (& received) a price increase from $30 hr court time and $20 hr non court time to $35 hr for both in the span of a week. They would later seek and obtain a price increase to $55 hr court time & $45 hr non court time (without a boycott).

[184] The increase was 16.7% for in court time and 75% for out of court time, but it was not possible to compute the average.

(2003)(conspiracy to standardize subscription charges[185])		
7. Greenhaw v. Lubbock County Beverage Ass'n., 721 F. ed 1019 (5th Cir. 1983)(conspiracy to fix retail price of liquor for 4 ½ years[186])	7.74%	
8. Homewood Theatre v. Loew's, 110 F. Supp. 398 (D. Minn. 1952) (conspiracy involving first run films[187])	6.3%	
9. Kruman v. Christies' Intern. PLC, 284 F. 3d 384, 390 (C.A. 2 2002)[188] (fine art auction cartel)	50 %	150%
10. New York v. Hendrickson Bros. 840 F.2d 1065 (2d. Cir. 1988[189])bid rigging on state construction contracts - three distinct episodes)	49.2% 32.1% 13.6%	

[185] Group of realtor associations combined and standardized their charges. Some raised subscription price from $10 up to $25, others lowered them. Although it was not a simple price fixing conspiracy, Judge Kozinski called it "price fixing". However, since he did not state how much the average charge increased, we did not include it in our median or average estimates.

[186] Jury decided amount of overcharge and appellate court upheld. Id at 1026-27.

[187] $39,432.67 loss on sales of $625,763.78.

[188] "On November 2, 1992, Sotheby's announced it would increase its buyer's premiums from 10% to 15% for the first $ 50,000.00 of the purchase price. On December 22, 1992, Christie's declared an identical increase in its buyer's premiums. The defendants allegedly agreed not to reduce these premiums. The defendants also agreed to set their seller's commissions at identical levels. Prior to March 1995, the defendants would permit clients to negotiate smaller seller's commissions. On or about March 10, 1995, Christie's announced it would implement a fixed schedule of non-negotiable seller's commissions ranging between 2% and 10% depending on the value of the item to be sold. On April 13, 1995, Sotheby's stated it would implement a fixed schedule of non-negotiable seller's commissions substantially identical to the schedule set by Christie's." Id at 390.

For the items covered by the agreement, buyers' commissions rose by 50%, from 10% to 15%. In addition, the new sellers' commissions means that total commissions had increased from 10% up to as much as 25% - a 150% increase.

[189] Jury determined that contract overcharges were $590,000 on what should have been a $1.2 million contract (49.2%: page 1070), $644,000 on what should have been a $2,004,000 contract (32.1%: page 1071-72), and $1,113,000 on what should have been a $8,187,000 contract (13.6%). The Court also noted: "Amfar was advised not to "get too greedy," *i.e.*, it was to limit the excess profit included in its bid to 20-25% and was not to seek excess profits of 40-50%. Later review by Ambrosio of bids submitted by other coconspirators led him to the conclusion that most of them were submitting bids that included excess profits higher than the 20-25 % benchmark." Id at 1070.

Most of the economic analyses we surveyed would have called these different episodes and analyzed them separately, even though legally they were treated together. This clearly is a judgment call upon which reasonable people could differ. If they were treated as one larger conspiracy, the overcharges would total $2,347,000 on a base of $11,391,000, or 20.6% overall. Alternatively the average of the three computed overcharges is 31.6%. In addition, the Court found that a subcontract that should have been bid at $512,000 was given to a fellow conspirator, in return for not bidding, for an additional $338,000, a 66% overcharge. This was not included as a separate overcharge figure, however, since is subsumed in the conspiracy for its prime contract.

11. New York v. Cedar Park Concrete Corp, 85 Civ 1887 (2001) (construction bid rigging during 7 year period[190])	5.87%	
12. North Texas Producers Ass'n v. Young, 308 F. 2d. 235 (5th Cir. 1962) (conspiracy to exclude low cost milk seller[191])	36%	
13. Ohio Valley Electric Corp. v. General Electric Co., 244 F. Supp. 914 (SDNY 1965) (electrical equipment manufacturing price fixing conspiracy[192])	10.9%	
14. Palmer v BRG of Georgia, 498 U.S. 46,47 (1990)(naked division of market for Bar Review courses[193])	167%	
15. Pease v. Jasper Wyman & Son, 2004 ME 29 (2004) (conspiracy to suppress prices paid for wild blueberries[194])	21.6%	32.8%[195]
16. Story Parchment Co. v Patterson Parchment Paper Co., 282 U.S. 555 (1931) (conspiracy to monopolize and destroy plaintiff's business[196])	27.7%	

[190] The conspiracy was organized personally by Paul Castellano, on behalf of "the governing body of New York's five organized crime families". Yet the Court only found that it raised prices by 5.87%.

[191] This involved a horizontal conspiracy to exclude a low-priced milk seller that would have sold milk for 69 cents instead of 96 cents. He was awarded $100,000 in lost profit damages for the period at issues. The important point for our study, however, is the Court's conclusion that that the horizontal competitors caused the price of the milk that plaintiff would have sold to consumers at 69 cents to be sold to them at 96 cents instead. The conspiracy prevented a 36% price drop. Id at 237.

[192] "This overcharge of $5,624,401 is slightly under eleven per cent of the total final order price for all units ($52,027,785) and slightly under ten per cent of the total final billed price, including escalation ($57,116,819). Page 947 This totals 10.92% of the pre-collusive amount.

[193] This case involved an agreement by the only 2 Bar Review preparation companies in Georgia. They entered into a naked division of markets, after which the price of a Bar Review course in Georgia went from $150 to "over $400." Id. at 47. We will conservatively assume that the price only went up to $400, an increase of $167%.

[194] This was a four year average, calculated from Solow exhibit 10, "Underpayment to Growers", whose figures were accepted by the jury. A $56 million judgment was upheld.

[195] For 1997.

[196] Conspiracy to monopolize and destroy plaintiff's business. Jury verdict of $65,000, before trebling. Property that cost $235,000 allegedly reduced in value to $75,000. So damages must have been 65/235 = 27.7%.

17. Strobl v. N. Y. Mercantile Exchange, 582 F. Supp. 770 (1984) (conspiracy to lower the price of potato futures[197])	48.6%	
18. Union Carbide & Carbon Corp. v. Nisley, 300 F.2d 561 (10th Cir. 1961) (1938-48 conspiracy to reduce prices paid for vanadium ore[198])	22.5%	38-47.5%
19. United Nuclear Corp. v. General Atomic Co., 629 P. 2d 231 (N.M/ 1980)(uranium cartel[199])		567%
20. U.S. v. Anderson, 326 F.3d 1319 11th Cir. 2003)(bid rigging on USAID contract[200])	16.4-39.2%	
21. United States v. Andreas, 216 F.3d 645 (2000) (conspiracy to raise Lysine prices[201])		71.4%

[197] Strobl v. New York Mercantile Exchange, 582 F. Supp. 770 (S.D.N.Y. 1984), motion to reduce award denied 590 F. Supp. 875 (S.D.N.Y. 1984), aff'd 768 F.2d 22 (2d Cir. 1985). "The $460,000 figure reached by the jury, therefore, was the equivalent of a finding that the price of the May potato futures contract would have been approximately $18.00, instead of $9.25, had the market been operating solely on the basis of supply and demand...The jury could have concluded from the evidence of low supply that the price of Maine potato futures was artificially low during the conspiracy period." Id. at 779. Price therefore was depressed 48.6%.

[198] "In these circumstances, we cannot say that the jury's finding to the effect that the free market price of 2 percent vanadium ore for the period October 1938 through March 1948 was 40 cents per pound instead of 31 cents was clearly erroneous."

[199] United Nuclear Corp. v. General Atomic Co., 629 P.2d 231, 242 (N.M. 1980) "Fourth, between 1972, when the cartel apparently began, and 1975, when this suit was filed, the price of uranium in the United States increased from approximately $6.00 per pound to approximately $ 40.00 per pound." The Court concluded that the price of Uranium had increased by 566% during the period of the conspiracy but did not say that all of this increase was due to the activity of the cartel. For this reason this cartel's increase has been put in the maximum column, not the average column.

[200] Exhibits 16 and 24 say that the winning bids on the three contracts at issue were $283.984 million On page 77 of the Transcript of Sentencing Before The Honorable Robert B. Propst, May 20, 2002, the judge found that the total overcharges for these three contracts were "greater than 40 and less than 80" million dollars. Using the $40 m loss figure -- this would mean that the three jobs together should have cost $244 million, so 40/244 is 16.4%. For the higher overcharge finding, the contracts should have totaled $204 million, so 80/204 = 39.2%.

[201] "The meeting ended without a sales volume allocation agreement, but two months later, at the recommendation of Whitacre, the cartel raised prices anyway, and prices rose from $ .70 to $ 1.05 per pound. ... [Much later] The producers also agreed on a new price of $ 1.20 for the United States market." Id at 652-53

The Court inferred that at least one sale took place at $1.20, so its maximum increase was (1.20-.70)/.70 = 71.4%. As is typical, this Court was not perfectly clear as to what caused the price to rise. But the plain meaning of the quotation is that the Court found that, as a maximum, the cartel raised the price of Lysine by 71.4%.

In fact this would be a modest conclusion because the Court also wrote: "Together, the three parent companies

22. United States v. Dynalectric Co., 859 F.2d 1559 (11th Cir. 1988) (Bid Rigging on public works project[202])	34%	
23. U. S. v. Foley, 598 F. 2d 1323,1327 (C.A. Md., 1979[203]) (real estate companies agreed to raise their commissions on houses)	16.7%	16.7%
24. In Re Vitamins Antitrust Litigation, Animal Science Products v. Chinook Group, Misc. No. 99-0197 TFA, M.D.L. No. 1285 (choline chloride cartel jury verdict[204])	38%	
25. Wall Products v. National Gypsum, 357 F. Supp. 832 (N.D. Calif. 1973)(Conspiracy over price of gypsum wallboard[205])	27%	
26. Webb v. Utah Tour Brokers Ass.,568 F. 2d 670 (1977)(conspiracy by tour brokers to deny plaintiffs entry boycott, etc.[206])	5%	

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produced all of the world's lysine until the 1990s, presenting an obvious opportunity for collusive behavior. Indeed the Asian cartel periodically agreed to fix prices, which at times reached as high as $3.00 per pound." This would mean that the maximum increase was roughly (3.00-.70)/.70 = 329%

[202] 7. United States v. Dynalectric Co., 859 F.2d 1559 A $1.7 million profit on a $5 million contract is a profit of 34%.

[203] On Sept. 5, 1975, competing real estate executives agreed to raise their commission from 6% to 7%. "Within the following months each of the corporate defendants substantially adopted a seven percent commission rate." Id. at 1327. Since almost all, but not 100% of the sales were at a 7% Commission, 16.7% actually overstates the average actual rise somewhat.

[204] The jury verdict was $49.54 million "before trebling and credit for prior settlements". On page 6 Plaintiff's expert gives total U.S. sales in the industry of $130.85 million. So this one jury verdict was 38% of total industry sales, which means that the markup by defendant had to be significantly more than 38%. Surely 38% is a conservative estimate of the markup involved, despite the fact that the total industry sales came from the plaintiff's expert.

[205] Wall Products Co. v. National Gypsum Co., 357 F. Supp. 832 conspired among themselves and with others, to stabilize and maintain the price level of gypsum wallboard 27%

[206] Webb v. Utah Tour Brokers Ass., 568 F. 2d 670, 676-77(1977). "They had been able to obtain the same transportation service for 70 cents per mile from the other licensed brokers. However, with Greyhound they were obliged to pay a Special Operations Bus Order tariff of three and one-half cents per person per mile. Of the eleven tours operated they had to pay this higher rate for eight tours. Plaintiffs calculated that they suffered a total loss of $10,165 as a result of having to pay the higher tariff for the tours that they took." 3.5/70 equals 5%.

Appendix Table 5. Problematic Sources of Information

Episode Number [a]	Source	Reasons for Concern
74A	Gallet (1997)	Study cannot distinguish overt from tacit collusion
74A	Baker (1989)	Refers to US data, whereas case is a European-based cartel
74B	Barbezat (1989)	Covers a period in which cartel was government-directed
None	Sproul (1993)	BLS data employed are inappropriate (see Werden 2003)
None	Block *et al.* (1981)	Settlements in the bread industry are a poor guide to overcharges, and dividing them by 3 worsens the problem
37	Newmark (1988)	Ten other economists had by 1988 cited this case with approval (see his footnote 10); an Appeals court upheld the conviction; and Mueller and Parker (1992) provide a devastating critique of Newmark.
190	Wiggins and Libecap (1987)	Repeated assertions by authors that cartel was ineffective are not supported by (an entirely feasible) quantitative analysis.
9	Scott (2000)	A critique of Lanzilloti (2000), who appears to defend ably his original conclusions.
None	Sjostrom (1991)	Finds no evidence of national collusion in the *Hardwood* decision of 1921, but most authorities have agreed on this point for some time
207,208,209,210		These USDA Marketing Orders are formed voluntarily by votes of their farmer-members, but once approved all producers must conform to the quality and timing restrictions imposed by the Order's administrators

[a] "None" means that this study is the only one about a potential cartel market; therefore, no cartel observation was created.