

THE PREDICTABILITY OF DOJ CARTEL FINES*

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Abstract

For criminal violations of the Sherman Act, although guided by federal sentencing guidelines, U.S. Department of Justice has great latitude in recommending corporate cartel fines to the federal courts, and its recommendations are nearly always determinative. In this paper, we analyze the determinants of variation in size of criminal fines imposed by the Antitrust Division of the DOJ on 124 corporate participants of hard-core global cartels. Our behavioral model provides the first direct test of the optimal deterrence theory of antitrust crimes.

Regressions are fitted to a sample of the corporations that participated in international cartels and that were fined between 1996 and March 2010. The predictive power of the optimal-deterrence model is quite good. We find that U.S. corporate cartel fines are strongly directly related to economic injuries from collusion. However, U.S. fines do not conform to the theory's predictions about the probability of detection and conviction of clandestine cartels. We also find that fines complement other antitrust penalties: the number of months that a corporate defendant's managers are sentenced to prison and private damages paid.

Key words: antitrust, Sherman Act, DOJ, Antitrust Division, cartel, collusion, price-fixing, optimal deterrence, fines, penalties.

EXECUTIVE SUMMARY

“PREDICTABILITY OF DOJ CARTEL FINES” by John M. Connor & Douglas J. Miller

- Since the late 1970s, U.S. Sentencing Guidelines and DOJ policy have embraced Beckerian optimal deterrence principles as a rationale for setting cartel fines, but there are no empirical studies of whether the DOJ adheres to these principles.
- Some claim that sentencing is idiosyncratic, i.e., unpredictable.
- We analyze variation in fines on 124 of the 128 corporations convicted during 1996-2010 for criminal price fixing in global cartels. The explanatory factors are U.S. antitrust injuries, proxies for the probability of detection, other penalties, and control variables for time, industry, and nationality. Results follow.
- For data at the level of the firm, our final econometric model predicts extraordinarily well. Thirteen variables explain 76% of the variation in fines.
- Expected U.S. fines are strongly positively related to U.S. harm, as the theory predicts, but the elasticity of fines with respect to harm is less than the optimal value (one).
- Proxies for the probability of cartel detection and conviction do not explain variation in fines, and non-U.S.-fine penalties are strong complements to U.S. fines. Neither of these results supports optimal deterrence principles.
- Correcting for the harms created by the cartelists, fines imposed during the Bush administration were far below those imposed during the Clinton administration.
- Cartelists in the chemical industry were treated relatively leniently. European cartelists were treated more severely than U.S. and Asian firms.

I. INTRODUCTION

1. Some writers on law enforcement believe that penalties for infringements of those laws should not be predictable. The reasoning goes that if penalties for a given crime can be known with certainty before the decision to commit the crime is taken, then the criminal will commit crimes up to the maximum penalty that the criminal can endure. Thus, transparency in sentencing practices is bad public policy because it may encourage criminals to engage in more socially injurious crimes than if they were uncertain about the penalties for each crime. Under this philosophy, leaving wide discretion for prosecutors and judges is a good thing.
2. Price-fixing was made a federal felony crime in 1974. Subsequently, questions were raised about proportionality of sentencing across felony crimes. For example, why was organized crime by underground syndicates (e.g., the Mafia) subject to more severe sentences than the “white-collar” crime of price fixing, especially as the latter often created larger monetary injuries to the public? Both were conspiracies carried out in secret. Thus, a consensus began to evolve that both corporate and individual sentences for price-fixing were too low and too arbitrary. An additional impetus to reform was the ideas of the Chicago School of antitrust, which had been gaining ascendancy among senior government enforcement officials and the judiciary during the 1970s. Among the most powerful Chicago ideas were Becker’s economic theory of crime and the idea that penalties ought to be based on optimal deterrence. Then, prior to the passage of the U.S. Sentencing Guidelines (USSGs), there was a debate in the late 1980s over the wisdom of having more precise penalties for violations of federal crimes.¹ Proponents of the USSGs argued that without guidelines there were grave breaches in proportionality of sentencing. They assembled data showing large geographic and individual variation in plea bargains among prosecutors and penalties imposed by judges for identical crimes. Other proponents were concerned that “blue collar” crimes (auto theft, burglary, and the like) were treated more harshly than equally serious and injurious “white collar” crimes (corporate fraud, tax evasion, and the like).

¹ A critical appraisal of this debate can be found in Mark A. Cohen and David T. Scheffman, “The Antitrust Sentencing Guideline: Is the Punishment Worth the Cost?,” *American Criminal Law Review* (1989): 331-342.

3. These concerns were rationales for the new USSGs that were adopted for corporations in 1987.² The introduction of fining guidelines for antitrust violations seems to have been a set-back for the view that prosecutors and judges should be allowed broad discretion in sentencing decisions. Prosecutors and judges were thereafter required to follow the Guidelines, which contained seemingly precise formulas for calculating cartel fines and that were now available for all to see before or after prosecution.³
4. In August 1993, the U.S. DOJ promulgated a striking revision of its long ineffective Corporate Leniency Program. The key revision was that both corporate and individual immunity for federal cartel crimes was granted “automatically” to the first, and only the first, applicant. The conditions for obtaining amnesty were clear to applicants prior to application, and that removed any discretion for approval by DOJ officials. By the late 1990s, amnesty applicants had become the main source of cartel detection. More than 50 other antitrust authorities have adopted similar amnesty programs.⁴ Thus, both the 1987 USSGs and 1993 Leniency Program superficially reduced the discretion of prosecutors in presenting penalty recommendations to federal district judges.
5. In reality, DOJ prosecutors retained a great deal of discretion over cartel-fine recommendations, prosecutorial practices that undermine the predictability of cartel fines. In the United States, nearly all corporate cartel penalties are decided by negotiating guilty pleas. Guilty plea bargaining is nearly a black box for outsiders, i.e., all those other than prosecutors, former prosecutors, and the most experienced defendants’ counsel. Prosecutors have great discretion to request “downward departures” (discounts) from the USSG-required fines, which are offered in return for vaguely defined “cooperation” by defendants. A wide

² By the end of the 1990s, the world’s major antitrust authorities were committed to optimal deterrence as the primary goal for their enforcement activities. The OECD’s Second Report on hard-core cartels evaluated the size of a sample of cartel fines using deterrence as the criterion. See Organization for Economic Development and Co-Operation, *Report on the Nature and Impact of Hard Core Cartels and Sanctions against Cartels under National Competition Laws* (DAFFE/COMP (2002) 7). Paris: Organization of Economic Co-Operation and Development (April 9, 2002).
[<http://www.oecd.org/dataoecd/16/20/2081831.pdf>]

³ In January 2005 the U.S. Supreme Court in *Booker* ruled that the Guidelines were advisory only, but prosecutors and judges have continued to employ them in criminal sentencing.

⁴ See Scott Hammond (2010).

variation in fine discounts persists because of prosecutors' nearly unchallengeable evaluation of the value of "cooperation" offered to prosecutors by non-amnestied cartelists (the so-called second-in, third-in, etc. leniency applicants). Cooperation discounts are routinely granted by supervising judges. Thus, a non-discretionary range of cartel fines has become highly individualized and discretionary.

II. OBJECTIVE AND RATIONALE

6. This paper reports on an analysis of the determinants of variation in cartel fines imposed on 118 corporate participants of global cartels by the Antitrust Division of the Department of Justice from 1996 to March 2010. The models to be tested primarily draw upon testable propositions suggested by optimal deterrence theory. However, we also augment the specification of the models and hypotheses by considering the stated policies and historical sentencing practices of the DOJ and the federal judiciary. These latter factors may be considered constraints on the DOJ's ability to implement purely optimal fines.
7. Greater understanding of the determinants of cartel fines is important for policy assessment and for specialists in law and economics. First, The DOJ's policies and procedures are often held up as an exemplary, highly successful paradigm for the scores of antitrust authorities that have been developed active anticartel programs in the past two decades. Now that it has accumulated a substantial record of enforcement, a retrospective analysis is feasible. Second, of interest to the law-and-economics discipline is the extent to which DOJ sentencing practices conform to the tenets of the optimal deterrence theory of crime, now the dominant basis for antitrust law enforcement. The one empirical study assessing the adherence of corporate sentencing included few antitrust convictions in its data set. Third, DOJ officials often emphasize the idiosyncratic features of sentencing, going so far as to deny the predictability of negotiated fines in advance of plea bargaining. If so, this raises doubts about the transparency and proportionality of cartel fines.

8. The analysis shows for the first time that cartel fines are quite predictable, but that the DOJ tends to impose fines that are only partly consistent with principles of optimal deterrence of crime. In addition, fines are influenced by temporal and jurisdictional factors.

III. MODELS AND METHODS

9. US sentencing guidelines for cartel violations are explicitly based on Beckerian principles of optimal deterrence of crime.⁵ This approach assumes that offenders respond rationally to incentives. They are utility maximizers who optimally allocate their time among competing legal and illegal activities. The decision to engage in crime is related to the *expected* marginal benefits of alternative activities, the perceived probability of apprehension and conviction, and the expected marginal penalties imposed for various crimes. The dual of utility maximization by a decision maker evaluating a crime is minimization of social costs of detection, conviction, and monitoring or incarceration. These costs can be private (antitrust compliance training, legal defense costs, etc.) or public (policing markets, supporting prosecutors and the judicial system, operating penal systems).
10. In the context of cartels, optimal deterrence theory is couched in terms of the expectations of the founders and managers of cartels. Individual expectations about cartel penalties are formed on the basis of information from historical experience -- that of the firm itself, its legal advisors, and of other firms that were defendants in comparable price-fixing litigation. The expected size of expected monetary penalties affects both the probability of detection and the rate of cartel formation. If expected fines are low, the incentive for applying for leniency is low, cartel defections slow, and the likelihood of detection is lowered. Therefore,

⁵ For explanations of optimal deterrence theory, see Garoupa, Nuno, "Theory of Optimal Law Enforcement," *Journal of Economic Surveys* 11 (1997): 267-295; Polinsky, A. Mitchell and Steven Shavell, "The Economic Theory of Public Enforcement of the Law," *Journal of Economic Literature* 38 (March 2000): 45-76; and Posner, Richard A. *Antitrust Law: Second Edition*. Chicago: University of Chicago Press (2001).

increasing penalties will make cartels more fragile and increase detection rates. Assuming that the benefits of overt collusion derive from exogenous market characteristics, up to some point higher penalties efficiently discourage the formation of most cartels.

11. A somewhat simplified version of the theory of optimal sentencing proposes that an optimal fine is (1) equal to the degree of economic harm created by the violator, (2) divided by the probability that the authority will detect and convict the violator, and (3) reduced by an amount equal to expected penalties⁶ imposed by other jurisdictions for the same crime.
12. The sample employed in this paper comprises all but four of the 128 companies in 39 global cartels penalized by the United States Government for price fixing from 1996 to March 2010. The first global cartel fined is *Lysine* and the most recent *Marine Hose*. All companies were convicted through guilty-plea agreements that conferred partial leniency. The sample excludes 30 companies in these cartels that were apparently granted immunity from criminal prosecution by the DOJ.⁷ A summary of the sample is given in Connor and Miller (2010: Table 1).
13. This regression model is used to explain variation in the absolute US fines imposed on the guilty cartelists. To explain that variation, we collected data on proxies for the cartelists' price-fixing injuries on buyers, factors related to the likelihood of detection, the size of other penalties, and other reasonable determinants of U.S. fines. A list of all 24 variables initially tested and the

⁶ For infringements that are punished solely by the EC, this amount would be zero. In the context of international cartels, EC decisions should consider government fines and settlements in private damages actions previously completed in North America. If not yet completed, the theory assumes that the Commission's senior officials are able to make reasonable projections about future penalties in the EU or elsewhere.

⁷ Nor does the sample encompass the 206 companies that participated in convicted global cartels with affected sales in the United States that were not punished or given immunity by the DOJ; the vast majority of the 206 was convicted by other antitrust authorities. Reasons for lack of punishment by the DOJ may include: inadequate evidence should the suspect demand a jury trial, low affected sales, large previous or anticipated monetary penalties by other parties, the statute of limitations, and inadequate DOJ resources to investigate or prosecute certain cartels.

expected sign is in Connor and Miller (2010: Table 2); 11 were dropped for statistical reasons.

14. To operationalize these explanatory factors, in place of harm we substituted the violator's U.S. affected sales. Affected sales is in fact the proxy for harm in the U.S. Sentencing Guidelines. For a sub-set of the sample, we find that affected sales is highly positively correlated with direct estimates of the monetary overcharges attained by these cartels.
15. Coming up with quantitative indicators of the probability of cartel detection and conviction is quite challenging.⁸ Because contemporary cartels take steps to cover up their activities, the probability of detection is by all accounts well under 100%. Most experts have opined that the probability of cartel detection is around 10% to 30%, which is a range consistent with the few economic studies on the subject and known probabilities of other property crimes like burglary or auto theft. But these are mere average suspicions, whereas the true measures of the chances of being discovered are cartel-specific. If we did not try to capture cartel-specific differences in the probability of detection, we would implicitly be assuming that all cartels were equally likely to be detected, which seems untenable.
16. Thus, we developed proxies for detection probabilities using economic reasoning and information about the process of detection. For example, the cartel-studies literature suggests that bid-rigging schemes are more difficult for authorities to detect than are classic price-fixing cartels; if so, antitrust authorities ought to place systematically higher fines on bid riggers. A dummy variable (=1 if bid rigging, zero otherwise) was used to discover whether bid rigging conduct was more severely penalized. A second example is concerns the roles of market concentration in aiding or frustrating anti-cartel enforcement. In general, a large number of sellers (cartel participants) makes cartels unstable, and this makes detection easier for authorities; on the contrary, a large number of buyers is more likely to be hoodwinked by a secret cartel than a small number, and when there are few buyers they are more likely to notice and complain about collusion to

⁸ The probability of detection is more precisely a forward-looking, subjective notion of the chances of being caught that the cartelists believed at the time the cartel was formed. As economists are not well equipped to delve into the psychology of the criminal mind, the usual assumption is that they correctly anticipated the actual monopoly profits from collusion, the chances of being caught, and the monetary costs of being convicted.

authorities.⁹ Thus, two logical explanatory variables are the numbers of sellers and buyers in a cartelized market.

17. Other relevant proxy variables relate to the costs and difficulties of *prosecution after detection*. For example, when a cartel has a record of conducting protracted plea negotiations, optimally deterring fines will be higher. To illustrate, consider a possible proxy for cover-up: the length of time the DOJ took to investigate a case (PROBE)¹⁰; a lengthy probe may well signal that the defendants had destroyed most of the evidence needed to convict them or that defendants were stubbornly adversarial in plea negotiations. Given that plea negotiations are intended to be labor-saving substitutes for trials, it is reasonable for prosecutors to impose higher penalties on firms that were particularly uncooperative during negotiations. Additional probability factors will be discussed with the results below.

18. The third dimension of optimal deterrence is the role of alternative cartel penalties. First, we examine monetary penalties imposed from private suits or fines outside U.S. jurisdiction. Optimal deterrence theory suggests that penalties for a given crime are completely fungible. That is, the total amount of monetary penalties is what determines optimality; the origin of multiple penalties is irrelevant. One reason we have sampled only participants in global cartels is to be able to explore tests of the effects of extra-jurisdictional penalties.¹¹ These include fines by governments outside the United States as well as recoveries by private plaintiffs (mostly in North America). At the time plea agreements are

⁹ If the cartel conduct is bid rigging, then the position of buyers and sellers is reversed. In fact, in bid rigging there is always just one “buyer” (the entity offering the tender) and oftentimes one seller (the bidding ring).

¹⁰ PROBE has significant measurement errors caused by the secrecy that surrounds DOJ investigations, whether internal to the Division or through a grand jury. In a minority of cases an investigation is revealed on the same day that the first cartel indictment is announced. More commonly, especially in global cartel cases, the start of an investigation becomes public when corporations reveal that subpoenas are served, when prosecutors exercise search warrants, or cooperating foreign antitrust authorities conduct simultaneous raids with the DOJ.

¹¹ Global cartels are also interesting because of their large sizes and high overcharge rates compared to other international or domestic conspiracies. Focusing on global cartels is convenient because details about them are better reported and this somewhat reduces the effort required for data collection.

made, many private damages actions in North America are either completed or well along. Thus, a limitation of our study is that our variable OTHPEN compiles only penalties publicly announced by the end of the study period, i.e., March 2010. Although imperfect because some “non-DOJ” penalties lie beyond early 2010, we believe that this variable will approximately capture the intended variation.¹² Second, we examine the role of individual penalties on cartel executives. Because fines on cartel managers are feeble, we focused on the number of sanctioned executives belonging to the firm and the length of their imprisonment. DOJ policy statements suggest that penal sanctions are *substitutes* for fines, as does optimal deterrence theory.¹³

19. Our data set combines cross-sectional and temporal features, hence the model also examines the changes in cartel fines over time. The period 1995-2010 spans two presidential administrations, and there is some evidence that investigative resources shrank and anti-cartel enforcement slackened somewhat in 2001-2008 compared to the 1996-2000 reference period (Connor 2009). If in fact there was a reduced anti-cartel commitment in 2001-2008, the sign of the coefficient of time will be negative. The simplest approach is to test TIME, the number of years after 1990 in which the cartel was prosecuted. Alternatively, we replaced TIME with BUSH1 and BUSH2, which are dummy variables that equal one during 2001-2005 and 2005-2008, respectively. This gives us two measures of the size of fines relative the years 1996-2000 (roughly the second Clinton administration). Finally, cartel duration is hypothesized to be positively related to the size of cartel sanctions. Plea bargains sometimes include a concession to a defendant on the dates of its collusion, which causes affected sales to be understated.
20. Finally, the model includes two factors that have nothing to do with optimal deterrence or time. They capture differences in geographic or industry variation. The legal principle of proportionality requires that fines for equally culpable violations should be equal; we check one possible source of non-proportionality by looking at the geographic origin of the firms. Next, we test the influence of industry on fines. Each cartel is classified into one of three broad industry groups, each of which might be more or less prone to collusion.

¹² Because of opt-out suits and settlements, OTHPEN is underestimated, but if OTHPEN is equally underreported across cartels, our statistical results are still valid.

¹³ “The Division has long emphasized that the most effective way to deter and punish cartel activity is to hold culpable individuals accountable by seeking jail sentences” (Hammond 2008).

IV. DATA SOURCES AND SAMPLE

21. The sample of convicted global cartelists is drawn from an original data set, Private International Cartels (PIC). PIC attempts to identify and collect information on the members, market characteristics, penalties, and other legal-economic dimensions of all international cartels discovered by any antitrust authority¹⁴ since January 1990. The members are the companies and their executives that were identified by prosecutors as participants in illegal hard-core price-fixing schemes. Every cartel has members resident or headquartered in two or more nations; *global* cartels are international cartels that operated in two or more continents. For a large proportion of the cartels we identified the revenues of the cartels during the collusive period (“affected sales”). Finally, for a large minority of the cartels, PIC contains market price effects (the buyers’ overcharge) of these cartels.¹⁵
22. The sample employed in this paper comprises 124 companies in 39 global cartels penalized by the United States Government for price fixing from 1996 to March 2010. Our sample is a type called “repeated cross-sectional,” the type that Levitt and Miles (2006: 151) identify as responsible for progress in economic studies of crime. The first global cartel fined is *Lysine* and the most recent *Marine Hose*. All companies were convicted through guilty-plea agreements that conferred partial leniency. The sample excludes 30 companies in these cartels that were apparently granted immunity from criminal prosecution by the DOJ.¹⁶

¹⁴ This term includes criminal law agencies like the DOJ, civil-administrative commissions like the EC, and national courts.

¹⁵ For details of data collection methods, see Connor and Helmers (2006).

¹⁶ Nor does the sample encompass the 206 companies that participated in convicted global cartels with affected sales in the United States that were not punished or given immunity by the DOJ; the vast majority of the 206 was convicted by other antitrust authorities. Reasons for lack of punishment by the DOJ may include: inadequate evidence should the suspect demand a jury trial, low affected sales, large previous or anticipated monetary penalties by other parties, the statute of limitations, and inadequate DOJ resources to investigate or prosecute certain cartels.

V. PRINCIPAL ESTIMATION RESULTS

23. Given levels of disaggregation of the data employed in this study, the overall fit of the final model is quite satisfactory.¹⁷ After several econometric adjustments, the fitted regression model retains 11 independent variables (see Connor and Miller 2010: Table 3). These variables explain 76.5% of the variation in US cartel fines.¹⁸ Ten of independent variables have significant or nearly significant regression coefficients, and all but one of them carry correct signs.¹⁹ The variables that measure predictions drawn from optimal deterrence theory of crime do very well in predicting variation in the size of fines.
24. Our model yields one particularly interesting estimate that bears directly on optimal deterrence: the elasticity of U.S. fines with respect to firm-level U.S. harm. It has a value of 0.59.²⁰ That is, for global cartels during 1990-2008, if the harm for a given cartel is double the harm of another cartel, the expected fine on the more harmful cartel is only 59% higher than the fine on the less harmful cartel. To be consistent with optimal deterrence principles, if harm doubles, penalties also should double (i.e., the elasticity should be 1.0). Thus, our model estimation must be interpreted to mean that U.S. cartel fines are by themselves sub-optimal.²¹

¹⁷ We found that the sum of other penalties fit better than its parts. Bid rigging, the service industry (including construction), and the variable measuring that government agencies were the main buyers were collinear, so we retained bid-rigging in the model. Six other variables were very weak and were dropped.

¹⁸ This degree of goodness of fit is far higher than Cohen (1996) achieved. Various diagnostic tests were favorable. We could find no evidence that the estimated coefficients were biased.

¹⁹ In a predictive model, variables that are below “conventional” levels of statistical significance (such as 10%) are sometimes retained in the final form of the model. For example, DURATION was significant at the 10.7 % level in one of two models, so it was retained. The only other “questionable variable” is BIDRIG, which was retained because it plays a role in the USSGs.

²⁰ This elasticity estimate is statistically highly significant. Moreover, its value is virtually constant during the sample period.

²¹ Whether U.S. fines *combined* with private U.S. antitrust settlements are optimal needs to be investigated.

25. We examined the effects on fines of six factors that we hypothesized are proxies for the probability of cartel detection. These hypotheses are not supported by the estimation results. For example, the presence of a dominant firm within the cartel was not significant in any of our models. Also, bid rigging and government as the major buyer have insignificant effects on USF. Thus, Tullock's Theory of Bureaucracy is not supported, and the policy conclusion is that cartels based upon bid-rigging conduct do not justify higher fines than classic price-fixing cartels.²² Bid rigging is an aggravating factor on paper but not in practice. While the DOJ is expected to impose higher fines against noncooperative or obstructive defendants, we find that a non-zero probe length is significantly negative.²³ We think it unlikely that prosecutors reward defendants' intransigence. Rather, long-lasting probes may signal that prosecutors judged their evidence relatively weak. It is also possible that the probe dummy captures a change in DOJ policy regarding the secrecy of its investigations.²⁴ The final anomaly is that companies in cartels with one more member than other cartels (an increase in the number of firms N) are predicted to incur roughly 12% higher U.S. fines. The DOJ does not reward firms in cartels that should be easier to catch with lower fines. We find it puzzling that the DOJ should treat defendants in well populated cartels more severely. The only sensible detection-related result is that when a cartel sells to many buyers, U.S. fines rise. Thus, the effect of a large pool of whistle-blowers is overwhelmed by the effect of large numbers of buyers on increasing cartel-monitoring costs.

²² The U.S. Sentencing Guidelines impose higher fines for bid-rigging schemes because they were believed to generate systematically higher overcharges. For a discussion of this issue, see Connor and Lande (2005).

²³ The continuous version was insignificant. Cohen (1996: Table 5) has a dummy variable for whether the defendant tried to cover up. Like our dummy version of probe length, it has an (insignificant) negative sign.

²⁴ It is noteworthy that 47 corporate observations (38% of the total) had zero values for the length of the DOJ probe. The cartels include, for example, *Citric Acid*, *MCAA*, and eight *Vitamins* cartels, most of them convicted in the years 1995-1999. This is an impossible number of months. In effect, when the probe is zero, a grand jury operated in complete secrecy, i.e., its existence was only revealed to the press on the day the first defendant pled guilty. The median investigation length is 9.4 months; for positive values, the median is 17.5 months. There is one observation that may be an outlier; the *Industrial Diamonds* case dragged on for more than 10 years because the remaining duopolist (DeBeers of South Africa) was outside the reach of U.S. law; De Beers had a minimal fine imposed.

26. The final element of optimal deterrence concerns the effect of non-DOJ penalties on US fines. Here the results of our model are strong but contradictory to expectations. First, as other monetary penalties on the company (mainly non-US fines and private settlements in North America) rise, unless they become very large, so do US fines. The break point occurs at \$500 million, above which the non-US penalties influence US fines negatively, as expected.²⁵ Second, the length of imprisonment of the cartel's executives was positively related to the company's fine.²⁶ For each additional month of imprisonment, the employer's fine rises by \$183,000. Again, penal sanctions are *complements*, not substitutes for corporate fines.

27. The influence of time alone was not significant. However, the final model includes a dummy variable for the years that roughly cover the first George W. Bush administration (2001-2004). The coefficient is significantly negative at the 10% level; the estimated magnitude of this coefficient suggests that the USF values decreased by roughly 50% during the first Bush administration (relative to the second Clinton administration). The dummy variable for the second Bush administration (2005-2009) had a greater negative effect; it shows that the expected fine was 172% lower during this period relative to the late Clinton years (Figure 1). This result is compatible with the findings of slackened cartel enforcement by the DOJ reported by Connor (2009). However, keep in mind that these striking results are conditional with other changes going on in the late 2000s, such as extremely high affected sales (see Figure 2).

FIGURE 1 AND 2 ABOUT HERE

28. Finally, we find that the marginal effects associated with cartel duration are positive but insignificant at the 10% level. The estimated coefficient suggests that USF increases by about 1.8% given a 10% increase in cartel duration. Cartels with longer duration receive higher USF mainly through the harm caused rather than through any independent adjustment. The chemical industry dummy variable was the only statistically significant industry variable explaining variation in USF. We are a bit surprised that defendants in this collusion-prone industry received a statistically significant reduction of roughly 113% in USF

²⁵ These same effects of "other penalties" were found in our parallel study of EC fines on global cartelists.

²⁶ We earlier measured this effect with a simple count of the number of the company's executives that were sanctioned; it was also positive but not as predictive.

relative to firms in other industries. EUR's coefficient is significantly positive, and its value suggests that European firms were fined roughly 41% more than Asian and North American companies. Rather than representing a discriminatory effect, we suspect that European firms as a group have some undetected culpability factor not accounted for in the model.²⁷

VI. DISCUSSION

29. The variables that measure predictions drawn from optimal deterrence theory of crime are only partially successful in predicting variation in fines on corporations convicted of global price fixing in the United States. The dollar value of fines imposed is strongly positively related to the proxy for the economic injuries imposed on U.S. buyers. However, the impacts of the variables representing the probability of antitrust detection and conviction do not conform at all to the theory's predictions. There is no evidence that the DOJ fines bid-rigging schemes more heavily than conventional price-fixing cartels. Intra-cartel asymmetry and the numerosity of buyers are likewise unrelated to cartel fines. The effects of the number of corporate members of the cartel and prior public information of the existence of a DOJ investigation have signs contrary to theoretical predictions. Another element of optimal deterrence theory that does not hold up well is the idea that other antitrust penalties are good substitutes for U.S. corporate fines in deterring cartel conduct. Rather, we find evidence that the DOJ piles on higher fines when sentencing the cartel managers to heavier prison sentences and when other antitrust monetary penalties rise.
30. Among the control factors tested, three are noteworthy. *Ceteris paribus*, U.S. cartel fines during both Bush administrations were significantly lower than those imposed in the Clinton administration. Guilty firms in the chemicals sector were treated more leniently. And we find that European violators paid heavier fines than companies from other continents.
31. Given the mixed levels of disaggregation of the data employed in this study (i.e., some variables are firm-specific, some cartel-specific), the overall fit of the model

²⁷ European firms, for example, tend to be high on lists of cartel recidivists (Connor and Helmers 2006).

is quite good. Nevertheless, because model estimation was potentially affected by harmful collinearity and measurement limitations, we found it difficult to include some other reasonable determinants of U.S. cartel fines. Factors such as an inability to pay,²⁸ defections from the cartel to seek amnesty, and recidivism are omitted from our model. Further experimentation with alternative measures of possibly substitute penalties may be productive. For example, one could examine whether the size or timing of corporate fines of particular authorities (Canada, EU, etc.) might provide more explanatory power than the geographically aggregated penalties that we employed. Also, our measure of individual executives' penalties -- the number of months of prison sentenced -- could conceivably be replaced by more appropriate monetary measures of the opportunity cost of such sentences. Another obvious extension would be to develop a more complex model that takes into account the possibly interrelated decisions of the European Commission and settlements in private antitrust suits.

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²⁸ A traditional reason for discounting cartel fines arises from a defendant's inability to pay. Because most cartels arise in concentrated industries, the exit of even one company can raise industry concentration. Thus, prosecutors are loath to propose and courts are unlikely to accept fines high enough to cause a defendant's bankruptcy. In addition, fines that are too large may impair a defendant's ability to contribute to damages payments in related private suits. However, one empirical study suggests that financial principles rarely find imposed fines high enough to endanger a firm's survival (Craycraft *et al.* 1997).

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Figure 1.

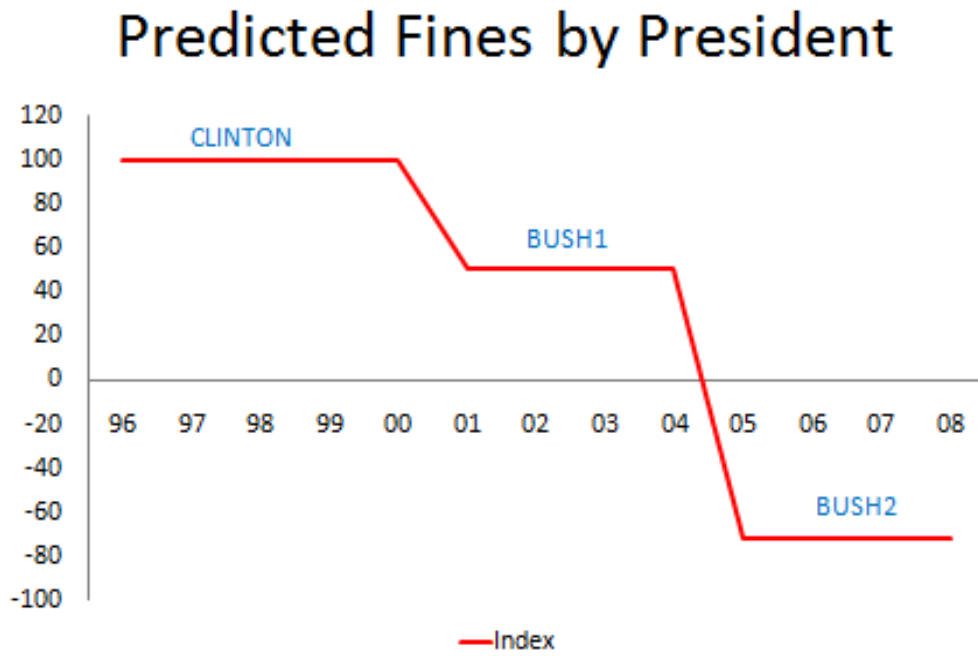


Figure2

US Affected Sales per Convicted Member of Global Cartels

