

The Rise and (Potential) Fall of U.S. Cartel Enforcement

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Abstract

Government enforcement against collusion, now viewed by the Supreme Court as the “supreme evil” in antitrust, has gone through various phases of enforcement in the U.S. There have been periods in which cartels have been able to collude more or less effectively given various institutional tools at the disposal of the government. By analyzing enforcement and prosecutions data over a long time horizon 1969-2016, this article examines the attributes of cartel enforcement over time and the changing use of tools to assist with detection and punishment. We provide a comprehensive description of critical cartel enforcement events and institutional developments from 1890 to the present. Our examination of the data includes a detailed descriptive analysis which tends to reveal three broad phases of U.S. cartel enforcement and prosecutions. The most recent data indicate a marked decline in the number of prosecutions, but sharp increase in per capita penalties. We also conduct regression-based estimation of the potential quantitative impact of the key institutional innovations to foster detection and prosecutions. Based on the raw data as well as our estimation, we comment on the potential factors that may be driving lower prosecutions in the more recent years. Finally, we briefly compare some key data between U.S. and European Commission cartel prosecutions to examine potential dynamic interlinkages.

Keywords: collusion, price-fixing, cartels, antitrust, enforcement, prosecution, leniency, fines, incarceration, politics, ACPERA, Antitrust Amendments Act.

JEL Codes: K21, L41, L13, L11.

The paper is work-in-progress. We are still working on various empirical issues.

1. Introduction

Cartel enforcement, covering cases against price fixing, market allocation, and bid rigging, makes headlines. In 2017 alone, the Department of Justice Antitrust Division fined Citicorp \$925 million, Barclays \$650 million and JP Morgan \$550 million criminally for their participation in price fixing cartels. The loss to consumers that cartels create through collusion is unambiguous, so much so that the United States Supreme Court has called cartels the “the supreme evil of antitrust.”¹ However, active enforcement against collusion was not always so, and also seems to be undergoing important shifts in recent years. This essay traces the evolution of the design of the institutional setting of U.S. cartel enforcement by examining its three major attributes: fines, criminal penalties, and leniency over time.

Since at least the 1970s, cartel enforcement started undergoing substantive transformation. Though Becker did not explicitly mention antitrust in his foundational formulation of optimal deterrence (Becker 1968), a number of scholars have applied Becker’s framework to antitrust for over a generation (Feinberg 1980; Bosch and Eckard 1991; Thompson and Kaiserman 2001). The optimal deterrence framework, whether implicit or explicit, has pervaded formulation of antitrust scholars and policy-makers in their approach to issues of institutional design regarding cartel detection and prosecution.

This essay analyzes transformations of cartel policy using an optimal deterrence framework. Government cartel prosecution policy shifts occurred at roughly the same time that much of doctrinal antitrust underwent significant transformation (Kovacic and Shapiro 2000). The doctrinal and policy shifts in antitrust were part of an intellectual shift due to Chicago law and economics scholars as well as Harvard legal process scholars. Together, these groups of scholars advocated for a fundamental change to the existing regime of U.S. antitrust law and policy. This included a clear focus on economic effects, and a shift in civil conduct liability from per se illegality to a more lenient rule of reason as a result of potential efficiencies of the particular business practice.

The contribution of this paper is twofold. First, we analyze the various cartel policy regimes over time. In doing so, we quantify the effects of the various policy regimes on the number of cartels prosecuted, as well as the financial penalties per individual and firm and the impact on number of days in jail for cartel crimes. Our research offers an empirical basis that builds off of prior theoretical literature that examines the impact to deterrence based on enforcement tools and cartel formation (Harrington and Chang 2015; Miller 2009). Moreover, a series of articles have modeled incentives or have offered experimental evidence under leniency to improve cartel detection due to the destabilizing effect that leniency may have on cartel duration (Hamaguchi, Kawagoe and Shibata 2009; Harrington 2008). Through our examination of alternative cartel prosecution regimes, we extend the existing empirical work in the area of cartel stability and duration. To the best of our knowledge, we provide the longest time-series data analysis for the various facets of cartel enforcement by the U.S. Department of Justice.

Second, we offer an analysis of political effects of cartel enforcement. We extend prior work that examines political preferences in cartel prosecutions (Ghosal and Sokol 2014). Due to the time-series data that we use covering the Nixon through end of Obama presidencies, we are able to examine both inter-political party as well as intra-political party effects on cartel prosecution. Examining specific Presidential administrations, data show significant variations between Republican and Democratic administrations, as well as within each party. Our empirical

¹ Verizon Commc’ns Inc. v. Law Offices of Curtis V. Trinko, LLP, 540 U.S. 398, 408 (2004).

analysis provides a basis to study how overall policy differences across administrations and political parties also extends to cartels prosecutions.

Cartel enforcement and specifically questions of cartel detection and stability are difficult ones to address for researchers. Since the 1960s, theorists have questioned cartel stability while empiricists have worked to better understand cartel dynamics (Suslow and Levenstein 2011; Dick 1996). A major hurdle that confounds empirical work on cartel detection and duration assumes that it is possible to determine the overall number of cartels (a “denominator” problem). Cartels require an agreement by cartel members to collude. However, because such collusion is illegal, the agreements or contracts to collude are unenforceable by law and concealed. Because of this concealment, it is difficult to determine the total number of cartels that exist at any given point in time. What empirical analysis can create in terms of a measurement proxy for cartel existence and stability is the total number of cartel prosecutions by the government. These criminal prosecutions are based on hard evidence of collusion. In more recent years, evidence of collusion has tended to emerge as a result of a defendant who defects from a cartel via the leniency program to cooperate with the Department of Justice for a reduction in penalties. Historically, however, the genesis of cartel investigations have been based on more diverse sources of information flows.

We organize the paper as follows. In Section 2, we provide a background of the intellectual context for cartel enforcement. Next, in Section 3, we provide descriptive analysis of critical cartel enforcement events and institutional developments from 1890 to the present.² Thereafter, we describe the data and intertemporal patterns in cartel enforcement in Section 4. In Section 5 we develop the empirical specification and present the estimation results. In Section 6 we discuss whether there has been a potential decline in cartel enforcement in the U.S., given our data and findings. Next, in Section 7, we briefly compare some key data between U.S. and European Commission cartel prosecutions. Finally, we offer concluding remarks in Section 8.

2. Background

The Chicago School transformed antitrust. Cartel enforcement played a smaller role for the Chicago School overall, which focused on the reform of merger and civil conduct enforcement (Bork 1978; Telser 1960; McGee 1958).³ The lack of the emphasis on cartels was due both in part to the overall confusion by the courts as to other areas of law as well as to the fact that conceptually cartel enforcement was “low hanging fruit”: the identification of harm by cartel behavior from the standpoint of consumer welfare was simple. The *per se* application of liability to hard core cartels made them less effective and destabilized them. The present structure of cartel enforcement with high fines, significant incarceration, an emphasis on enforcement against large international cartels and the use of leniency is very different from the primary topics that concerned academic writing from Chicago or other scholars until the 1990s.

In the early formulation of antitrust, three thinkers dominated cartel related thought, all from the Chicago tradition: Stigler, Bork and Posner. Stigler noted that collusion was possible but believed that cartels would break down easily. He offered a theory of equilibrium in a

² We limit our analysis to federal cartel prosecution. *But see* Robert M. Feinberg & Kara M. Reynolds, *The Determinants of State Level Antitrust Activity*, 37 REV. INDUS. ORG. 179 (2010) (examining state level enforcement).

³ *See* BORK, *supra* note 10.

dynamic non-cooperative game.⁴ While Stigler contributed to thinking about coordinated effects in mergers, the application to cartel enforcement was limited due to the fact that the implication of his work is that exogenous conditions for each industry would determine firm interaction but that explicit collusion was difficult.

Of the other Chicago theorists, Bork offered a holistic approach to antitrust reform in the *Antitrust Paradox*. Bork's discussion of explicit collusion in the book was surprisingly short. Indeed, Bork wrote less than a paragraph on the topic of explicit collusion in his chapter on horizontal restraints.⁵ The horizontal restraints chapter instead focused on situations on ancillary restraints where collusive behavior had offsetting efficiencies that were greater than the anti-competitive restraints.⁶ In the policy chapter of the *Antitrust Paradox*, Bork's cartel discussion also was brief. He suggested that the Department of Justice open more field offices across the country to prosecute local cartels.⁷ Bork's rather short treatment of cartels reflected that as a matter of law and policy cartels were both conceptually and doctrinally easy situations to rectify.

Bork's short treatment of cartels meant that left unaddressed a number of significant features about the institutional structure of cartel enforcement (leniency, increased fines and increased incarceration) that were in place by the time of the publication in 1978 of the *Antitrust Paradox*. Moreover, he ignored international cartel issues, which by the late 1970s were beginning to become more significant.

The third major Chicago thinker theorizing about collusion was Richard Posner. His early writing focused on tacit collusion as well as government enforcement.⁸ In his antitrust casebook (both original 1976 edition and 2001 revised edition),⁹ Posner argued against jail time for cartel crimes. Instead, he supported higher fines as a penalty for cartel activity. Encouragement for higher fines suggests a view of suboptimal cartel enforcement. Particularly noteworthy is that with the revised edition of his casebook, Posner continued to believe that antitrust enforcement was suboptimal even with a change of higher fines and significant increased cartel detection among local bud rigging cartels in the 1980s and international cartels in the 1990s.

Comparing Posner and Bork, on the three points that Posner specifically raised: (a) broadening legal liability for plus factors regarding tacit collusion,¹⁰ (b) increased criminal fines (Posner favored increased fines even after the 1974 Antitrust Procedures and Penalties Act),¹¹

⁴ George J. Stigler, *A Theory of Oligopoly*, 72 J. POL. ECON. 1 (1964).

⁵ See BORK, *supra* note 10, at 287.

⁶ Bork had concerns about misapplication of per se rules to cases. See, e.g., *United States v. Topco Assocs., Inc.*, 405 U.S. 596 (1972); *United States v. Sealy, Inc.*, 388 U.S. 350 (1967).

⁷ See BORK, note 10 *supra* at 407.

⁸ Richard A. Posner, *Oligopoly and the Antitrust Laws: A Suggested Approach*, 21 STAN. L. REV. 1562 (1969); Richard A. Posner, *A Statistical Study of Antitrust Enforcement*, 13 J.L. & ECON. 365 (1970); Richard A. Posner, *A Program for the Antitrust Division*, 38 U. CHI. L. REV. 500 (1971).

⁹ RICHARD A. POSNER, *ANTITRUST LAW* (2d ed. 2001); RICHARD A. POSNER, *ANTITRUST LAW: AN ECONOMIC PERSPECTIVE* (1976).

¹⁰ More recently Posner has changed his view on tacit collusion and plus factors. See Richard A. Posner, *Book Review (reviewing Louis Kaplow, Competition Policy and Price Fixing (2013))*, 79 ANTITRUST L.J. 761 (2014).

¹¹ Regarding incarceration, in late 1976, Don Baker, the then Assistant Attorney General for Antitrust presented a speech advocating a significant increase in the use and severity of criminal antitrust. Don Baker, *To Make the Penalty Fit the Crime: How to Sentence Antitrust Felons*, Remarks as Prepared for the Tenth New England Antitrust Conference (November 20, 1976). Consequently, the Antitrust Division promulgated guidelines that pushed for greater severity of criminal enforcement. See U.S. Dep't of Justice Guidelines for Sentencing: Recommendations in Felony Cases Under the Sherman Act, *reprinted in* 2 J. CLABAULT & M. BLOCK, *SHERMAN ACT INDICTMENTS: 1955-1980*, at 549 (1981).

and (c) the use of incarceration (Posner opposed it), Bork was silent on the last two. We interpret the silence of Bork on these issues to necessitate that Bork believed cartel enforcement was suboptimal but for reasons different than Posner. If cartel enforcement approached optimality, advocacy of additional DOJ Antitrust field offices would have been unnecessary. Thus, Bork's belief in suboptimal cartel enforcement focused on the likelihood of detection rather than on increased penalties (incarceration and/or fines).¹²

The current institutional structure of cartel enforcement with high fines, significant incarceration for individuals, a prosecution emphasis on large international cartels rather than small local cartels and the reliance on leniency for cartel detection is very different from what concerned Stigler, Bork or Posner.

3. Key developments in U.S. cartel enforcement

The time period of 1960 - 1978 witnessed important structural shifts in the institutions of government cartel enforcement. There were three shifts in terms of government enforcement: fines, incarceration and the introduction of a leniency program. The shifts to higher financial penalties, greater criminal sanctions, and leniency¹³ were changes to increase probability of detection and severity of punishment associated with cartel behavior. Cartel related criminal fines, which had been raised in the 1950s for the very first time since 1890, even when adjusted for inflation seem low by today's standards. Additionally, cartel behavior was treated as a misdemeanor rather than a felony. From a moral standpoint, a crime being shifted to a felony from a misdemeanor also increased moral/reputational stigma for such crime.¹⁴ Leniency created the possibility of a reward for a firm defecting from a cartel.

To motivate the empirical analysis in Section 5, we offer an overview of the significant events in the timeline of cartel policy. Enforcement began with the passage of the Sherman Act.¹⁵ Under the Sherman Act, the maximum fine for collusion was set at \$5,000. After a half century of fines at the same level, Congress raised the maximum fine in 1955 to \$50,000 per count. Incarceration was not used much in antitrust's first half century.¹⁶ However, starting in the late 1950s, DOJ began an enforcement shift to greater incarceration for collusion. In *United States v. McDonough Co.* yielded the incarceration of four executives.¹⁷

Cartel enforcement became more robust in the period 1958-61 due to the electrical equipment price fixing cases. These collusion cases involved 30 corporations and 45 defendants.

¹² Bork's policy prescription of increased cartel enforcement via additional DOJ field offices suggests that Bork may have been less convinced than Stigler of the inherent instability of cartels. See George J. Stigler, *A Theory of Oligopoly*, 72 J. POL. ECON. 44 (1964). That is, if cartels naturally fail, the case for increased cartel enforcement via more staffing of regional field offices would be weak. Subsequent research into cartels suggests that cartels are more successful than Stigler may have anticipated. See Margaret C. Levenstein & Valerie Y. Suslow, *Breaking Up Is Hard to Do: Determinants of Cartel Duration*, 54 J.L. & ECON. 455 (2011).

¹³ It was during this period that DOJ introduced the first iteration of the leniency program. Though the original leniency program was introduced in 1978, DOJ Antitrust had been discussing the leniency program since 1976, according to senior DOJ Antitrust officials at the time with whom we conferred.

¹⁴ See generally R.A. DUFF, LINDSAY FARMER, S.E. MARSHALL, MASSIMO RENZO, & VICTOR TADROS, *CRIMINALIZATION THE POLITICAL MORALITY OF THE CRIMINAL LAW* (2014).

¹⁵ Sherman Act, Pub. L. No. 97-290, 96 Stat. 1246 (1982), codified at 15 U.S.C. § 6a (2000).

¹⁶ Gregory J. Werden, *Individual Accountability Under the Sherman Act: The Early Years*, 31 Antitrust 2, 100 (2017).

¹⁷ *United States v. McDonough Co.*, 1960 Trade Case. (CCH) ¶ 69,695 (S.D. Ohio, Dec. 9, 1959).

The cases received significant public attention due to the size of the overcharges, the high profile companies involved in the collusion, and the relatively small financial penalties and jail time for “respectable” people.¹⁸ To put the fines in perspective, Professor Connor explains regarding the penalties, “Corporate antitrust convictions were the equivalent of corporate parking tickets.”¹⁹

Due to the low penalties – both monetary and incarceration – imposed in the 1950s and 1960s, legislative changes were introduced during the 1970s to increase the severity of punishment. In 1974, Congress enacted the Antitrust Procedures and Penalties Act.²⁰ Among the things covered under the act were cartel related enforcement issues. Collusion was reclassified a felony from merely a misdemeanor. Further, the maximum financial penalty for collusive behavior was increased to \$1 million. It took only a few years for the higher penalties to be implemented in cartel cases. In the *U.S. v. Continental Group, et al.* cases, DOJ secured the first set of felony convictions for collusion at trial with the maximum felony sentence imposed.²¹

Responding to a lack of effective detection, DOJ created its initial leniency program. In 1978, DOJ introduced its leniency program, in which a firm could defect from a cartel and receive a reduced penalty from DOJ if it came forward with information about the cartel. However, because of the design of the leniency program, this iteration of the leniency program was ineffective.²²

Significant changes in cartel enforcement occurred in terms of the number of cases prosecuted under Reagan as well as case prioritization for merger and civil enforcement. Data show that civil Sherman Section 1 and 2 government enforcement significantly diminished.²³ The creation in 1982 of the Horizontal Merger Guidelines, revised in 1984, also altered antitrust enforcement by increasing the number of merger filings. These shifts in DOJ Antitrust resources impacted cartel enforcement.²⁴ As a result, criminal enforcement increased under Reagan in terms of the number of cases and marginally in terms of penalties imposed.²⁵

Further tweaks to the structure of enforcement occurred in 1984, when Congress passed the Criminal Fine Enforcement Act. The Act increased individual fines to \$250,000.²⁶ Further

¹⁸ See generally Gilbert Geis, *The Heavy Electrical Equipment Antitrust Cases of 1961*, in WHITE COLLAR CRIME 117 (Gilbert Geis & Robert F. Meier eds., 1977).

¹⁹ JOHN M. CONNOR, GLOBAL PRICE FIXING: OUR CUSTOMERS ARE OUR ENEMY 43 (Springer, 2001).

²⁰ Antitrust Procedures and Penalties Act, Pub. L. No. 93-528 §5, 88 Stat. 1706, 1709 (1974).

²¹ *U.S. v. Continental Group, et al.*, 603 F.2d 444 (3d Cir. 1980).

²² Only one leniency application was received per year and not a single leniency application was for an international cartel. See Address Before the ICN Workshop on Leniency Programs by Scott Hammond, *Cornerstones of an Effective Leniency Program*, (Nov. 22, 2004): <http://www.justice.gov/atr/public/speeches/206611.pdf>. An important issue also is that DOJ’s resource allocation changed shortly after the introduction of leniency. In 1979, the Hart Scott Rodino Act of 1976 went through its first full year of implementation. The first year of merger filing notifications totaled over 800 filings. Increasingly, merger control became far more resource intensive, potentially distracting from other areas of enforcement.

²³ Ghosal & Sokol, *Evolution*, *supra* note 13.

²⁴ In 1982, Congress passed the FTAIA to clarify the extraterritorial application of the Sherman Act. See Sherman Act, Pub. L. No. 97-290, 96 Stat. 1246 (1982), codified at 15 U.S.C. § 6a (2000).

²⁵ *U.S. v. B&B Construction Co.* (1981) marked the first time maximum prison terms were imposed under the 1974 statute. Much of the cartel enforcement in the 1980s and early 1990s appeared to have focused on procurement and infrastructure collusion. William Kovacic, *Criminal Enforcement Norms in Competition Policy: Insights from US Experience*, in CRIMINALISING CARTELS: CRITICAL STUDIES OF AN INTERNATIONAL REGULATORY MOVEMENT (CARON BEATON-WELLS & ARIEL EZRACHI eds., 2011).

²⁶ Criminal Fine Enforcement Act of 1984, Pub. L. No. 98-596, 98 Stat. 3134, reenacted in Criminal Fine Improvements Act of 1987, Pub. L. No. 100-185, 101 Stat. 1279 (codified as amended at 18 U.S.C. § 3571(d) (2000)).

penalty enhancement came in 1987 as a result of the US Sentencing Guidelines (passed in 1984), which were applied to all cartel offenses.²⁷ Yet further changes to cartel enforcement with the passage of the Antitrust Amendments Act of 1990. The Act increased maximum fines for collusion to \$10 million for corporations and \$350,000 for individuals. The Act also increased prison terms to up to three years.

The 1990s witnessed a transformation of cartel detection mechanisms. The fundamental change to cartel prosecution occurred in 1993 when DOJ revised its leniency program. Under the revised leniency program, DOJ offered a leniency applicant automatic amnesty under two settings: 1) if there was no pre-existing cartel investigation, and 2) if there was full cooperation. Further, amnesty was available to a leniency applicant even when cooperation with DOJ began after an investigation had already been initiated. Finally, in the situation when the corporation qualified for automatic amnesty, DOJ provided for all automatic amnesty based on full cooperation directors, officers, and employees.

Unlike the prior iteration of leniency, this version of leniency with full amnesty was a major success and transformed cartel detection.²⁸ DOJ first provided leniency in 1995 for the lysine cartel. As a result of the information that emerged from the leniency program, cartel members settled with DOJ in 1996 for criminal fines of \$105 million, which was a record amount at that time.²⁹ Additionally, cartel members paid out \$305 million in private damages.³⁰ Of note, the majority of lysine cartel members were international. This change in the make-up of cartel members by US versus international member was significant. Prior to 1995, fewer than 1 percent of all DOJ cartel indictments involved non-US firms. Leniency helped to uncover more international cartels as additional international cartel cases quickly followed lysine.³¹

Following lysine, a change that began under Clinton and continues to the present has been the increased internationalization of cartel prosecution. DOJ has increased the scope and depth of its cooperation with foreign enforcers on international cartels including coordinated enforcement and information exchange. As the current head of DOJ Antitrust Makan Delrahim explains, “Without such close cooperation in criminal enforcement, I firmly believe that our most important prosecutorial tool, our leniency program, would be much less effective in uncovering some of the most harmful cartels.”³²

The George W. Bush presidency also introduced changes to the structure of cartel prosecutions. Congress passes the Antitrust Criminal Penalty Enhancement and Reform Act (ACPERA) in 2004. The Act increased the maximum fine for collusion to \$100 million. It increased prison terms up to 10 years and increased individual fines to \$1 million. The Act also

²⁷ Until the implementation of the Sentencing Guidelines, judges were reluctant to impose significant sentences on white collar offenders. D. Daniel Sokol, *Policing the Firm*, 89 NOTRE DAME L. REV. 785, 795 (2013).

²⁸ Christopher R. Leslie, *Replicating the Success of Antitrust Amnesty*, 90 TEX. L. REV. 171 (2012).

²⁹ 1996 also marked the first use of the alternative fine statute (18 U.S.C. § 3571(d) (2000)).

³⁰ CONNOR, *supra* note 32.

³¹ As ICPAC (2000 at chapter 4) noted, the change in international priorities and the effect of new leniency were significant within a short time span. “From 1987 through 1990, the Antitrust Division did not file a single criminal cartel case against a foreign-based corporation or individual...By 1997, the figures had surged so that 32 percent of corporate defendants and the same number of individual defendants were foreign-based.” Final Report, DOJ Antitrust Division, International Competition Policy Advisory Committee (2000), <http://www.justice.gov/atr/icpac/finalreport.html>.

³² Makan Delrahim, *Good Times, Bad Times, Trust Will Take Us Far: Competition Enforcement and the Relationship Between Washington and Brussels*, Remarks as Prepared for College of Europe in Brussels, (February 21, 2018), <https://www.justice.gov/opa/speech/assistant-attorney-general-makan-delrahim-delivers-remarks-college-europe-brussels>.

offered single damages (unlike the usual treble damages) for the leniency applicant to cooperate with plaintiffs. Further, in 2006, Congress amended the wiretapping statute to include coverage of antitrust violations. Finally, in 2012 DOJ closed its Atlanta, Philadelphia and Cleveland field offices. DOJ Antitrust field offices historically participated in cartel enforcement, often in smaller cases. At the very end of the Bush Administration, DOJ published a guidance of Frequently Asked Questions about the Antitrust Division's Leniency Program and Model Leniency Letters³³ which addressed requirements for leniency, the application process and its operation.

Under the Obama administration, changes came with an overall change relating to individual culpability within organizations as a result of the Yates memo³⁴ and an almost immediate embrace by DOJ Antitrust.³⁵ Individual culpability became a priority within organizations as a result. Another change was that under a small highly particularized set of circumstances, DOJ offered compliance credit as a mitigating factor for lower penalties for companies involved in collusion.³⁶ Corporate monitors for particularly egregious cartel violators were also introduced as an additional punishment beyond traditional fines and jail time.³⁷

Finally, under the Trump Administration, the Frequently Asked Questions about the Antitrust Division's Leniency Program and Model Leniency Letters³⁸ was updated to reflect penalty plus anonymous markets, related non-antitrust offenses (e.g., bribery), Type B leniency for employees and protections for former employees.

These changes over time suggest a number of tentative conclusions. U.S. cartel enforcement and prosecutions have undergone fairly dramatic fluctuations over the last four-five decades. Unlike other parts of antitrust that went through significant policy transformation because the law was misguided and was in need of correction because it was not in synch with developments in economic analysis, with cartel prosecution the emphasis on cartel prosecution and substantive law of prosecution of cartels was economically correct but the mechanism of prosecution needed to be reformed.

4. Data description and intertemporal patterns

Following up on the narrative in the previous sections, we now provide a quantitative look at the transformation of U.S. cartel enforcement by examining the intertemporal path of some of the key cartel prosecution and enforcement data over a long time period, 1969-2016. Subsequently, in Section 5, we use these data to empirically estimate some relationships to highlight the effects of various policy and institutional shifts.

³³ U.S. Dep't of Justice., *Frequently Asked Questions About the Antitrust Division's Leniency Program and Model Leniency Letters* (2017), <https://www.justice.gov/atr/page/file/926521/download>.

³⁴ Memorandum from Sally Quillian Yates, Deputy Att'y Gen., U.S. Dep't of Justice, *Individual Accountability for Corporate Wrongdoing* (Sept. 9, 2015), <https://www.justice.gov/dag/file/769036/download>.

³⁵ Bill Baer, Ass't Att'y Gen., Antitrust Div., U.S. Dep't of Justice, *Prosecuting Antitrust Crimes*, Remarks as Prepared for the Georgetown University Law Center Global Antitrust Enforcement Symposium 8 (Sept. 10, 2014), <https://www.justice.gov/atr/file/517741/download>; Brent Snyder, Deputy Ass't Att'y Gen., Antitrust Div., U.S. Dep't of Justice, *Individual Accountability for Antitrust Crimes*, Remarks as Prepared for the Yale School of Management Global Antitrust Enforcement Conference 2 (Feb. 19, 2016), <https://www.justice.gov/opa/file/826721/download>.

³⁶ D. Daniel Sokol, *Troubled Waters Between U.S. and European Antitrust*, 115 MICH. L. REV. 955, 974 (2017).

³⁷ See Sokol, *supra* note 39.

³⁸ U.S. Dep't of Justice., *Frequently Asked Questions About the Antitrust Division's Leniency Program and Model Leniency Letters* (2017), <https://www.justice.gov/atr/page/file/926521/download>.

4.1. Data sources

Our primary source of data is the U.S. Department of Justice's (DOJ) Antitrust Division Workload Statistics for the period 1969-2016. The earliest date for which we have all of the data is 1969, and the most recent year for which data are available is 2016. This provides us with 48 years of time-series data on enforcement and related attributes. Data for the more recent years are available online, and for the earlier years we compiled the data from the Antitrust Division's published paper records.

The specific annual data series we examine include; the total number of antitrust cases; the total number of civil and cartel cases; various penalties related to cartel cases such as the number of individuals incarcerated, and the number of days served in jail; and monetary fines levied on individuals and corporations. There are some nuances about the Antitrust Division's workload statistics on cartel cases that are important to clarify. First, the time series on cartel cases relates to the number of cases filed during the year as opposed to the actual number of cartels prosecuted. Second, the DOJ's official statistics are for the fiscal reporting year as opposed to the calendar year. These two aspects imply that the annual data on cartels need to be interpreted carefully. The additional aspects of DOJ's cartel data are as follows: (a) the DOJ's average won-loss record on cartels is near perfect, ranging from 98% to 100% for most years. This implies that cartel cases filed nearly always lead to prosecution; and (b) the typical time from initiating a cartel case to prosecution appears to be in the 1.5-year range.³⁹

Given the data characteristics and limitations noted above, the data on cartel cases are used to effectively proxy the data on cartels prosecuted. However, the data on the number of firms and individuals prosecuted, and fines, are the actual series. Therefore, for a given year, this may create a mismatch between the number of cartels prosecuted versus the various prosecutions and penalties data. If a cartel case is decided quickly then there no mismatch, but if a particular cartel case is decided over a longer duration, this is likely to be a mismatch.

In contrast to the cartel cases time-series, the data on incarceration, fines on individuals, and fines on corporations are based on actual prosecutions during the year. With this in mind, the summary statistics on the fines per cartel and the fines per firm, along with the data on the number of firms convicted per cartel, need to be interpreted accordingly. Given the nature of the statistics as maintained by the DOJ, there is no easy way to resolve this issue. However, given that our primary objective is to focus on the medium to longer term patterns, and not the shorter-run fluctuations, this particular attribute of the time-series data may not matter much. Overall, while these administrative and definitional aspects will not alter the longer-run relationships we wish to study, it is important to keep these in mind as we discuss the data and the estimates.

While our data enables us to examine the shorter-run, year-to-year, fluctuations in various enforcement variables, our primary focus is on the more systemic changes under alternative policy regimes and Presidential periods. The fundamental effects we are focusing on essentially play out over the medium-to-longer run. Given the characteristics of the DOJ's cartel cases data noted above, the broad time-series patterns and shifts over time on cartel cases initiated, for all practical purposes, will mimic the actual time-series on cartel prosecutions. Given this, we refer to the cartel cases series as the cartel prosecutions series.

Aside from the antitrust enforcement data, we also use some U.S. macroeconomic data, such as U.S. GDP. These data are from the Federal Reserve Bank of St. Louis (FRED database). Finally, we use data on the total number of mergers and acquisitions in the U.S. economy. These

³⁹ Ghosal, Genesis, *supra* note 16.

data are compiled from various sources including the U.S. Federal Trade Commission merger series, Thompson’s Financials, and the Institute for Mergers, Acquisitions and Alliances. All monetary data in our paper are measured in real 2010 dollars. In **Table 1** we present the summary statistics for some of the key enforcement and prosecution indicators.

Table 1. Summary statistics

Variable	Mean	Std. Deviation
Total cartel cases per year	44.52	23.71
Total fines per year (2010\$, ‘000)	264,940.62	405,456.32
Total jail days per year	6,101.32	7,976.23
Fines per cartel (2010\$, ‘000)	7,068.64	10,763.38
Jail days per cartel	164.05	248.05
Number of individuals fined per cartel	1.22	1.52
Number of firms fined per cartel	1.81	2.66

2. Intertemporal patterns of cartel enforcement

Next we display several of our main variables in figures 1-8 and discuss the patterns, keeping in mind that our data cover the period 1969-2016. **Figure 1** shows that prior to 1979-80, the mean number of cartel cases were about 20 per year. The mean number rises sharply during the Reagan years to about 60 cases per year. Thereafter, it falls steadily reaching a low of 25-30 cases per year during the George W. Bush administration. The mean rate of cartels prosecuted during the George W. Bush administration was almost at historical lows, harking back to the late-1960s and early-1970s. This is particularly revealing as our general understanding from the shift during the Reagan years was that enforcement importantly moved away from civil and into cartel enforcement. But the starkly low numbers during the Bush administration show a reversal, and highlight the sharp within-Republican administrations’ variation in cartel enforcement. The high mean rate of cartel prosecutions is effectively offset by the historic low mean during the George W. Bush presidency.

Intriguingly, however, Figure 1 shows a sharp increase in the mean number of cartels prosecuted during the Obama administration. While the pre-1980 period generally contains uniformly low number of prosecutions, the post-1980 period reveals a mixed picture with highs reaching almost 100 cases and lows of about 25. These patterns are important to highlight as the key leniency change occurred in 1993, with subsequent changes in penalties, which lead to a more effective detection and enforcement mechanism. If it were the case that there was a reduction in the (unmeasured) population of cartels due to the improved leniency mechanism, it would be somewhat unlikely that there would be a sharp increase subsequently during the Obama administration. Perhaps a conclusion one may reach is that the Bush administrations’ stance was hands-off markets, irrespective of the nature of the violations, civil or cartel, which is a different stance from Reagan administration which altered the ratio with less civil and more cartel prosecutions.

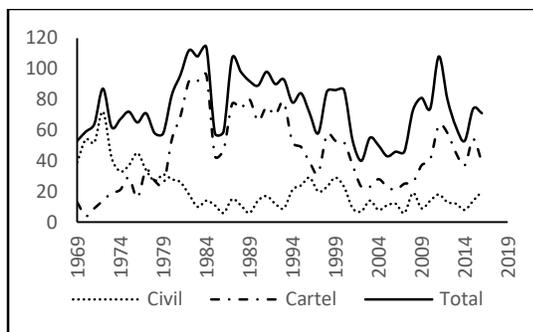


Figure 1. U.S. Antitrust Cases: Total, Civil, and Cartel

Figure 1 also allows us to put the cartel prosecutions in perspective relative to the Antitrust Division’s civil enforcement, as well as the total. Aside from the Clinton administration, U.S. civil enforcement shows a dramatic decline. This is consistent with the Chicago School’s emphasis on efficiencies in, for example, both horizontal and vertical mergers as well as conduct.

While in this paper we do not conduct extensive econometric tests of structural breaks (“*regime shifts*”) in the time-series data due to our desire to reach a wider interdisciplinary audience, we draw on the estimation and inferences in an earlier paper to emphasize some of the results. In a prior paper Ghosal shows that the estimated structural break for cartel cases was 1979 and for civil cases 1972.⁴⁰ The estimation and testing for structural breaks (regime shifts) showed that the sample mean of the cartel cases series was statistically higher post-1979, and the sample mean of the civil cases was statistically lower post-1972. One complication in implementing the structural break tests is that the econometric methods were developed for high-frequency data with long time-series. Such data allow for more sophisticated testing for “multiple” structural breaks in the data, when present. Our data are annual and for a total of 48 years. In terms of the received econometrics literature for testing for structural breaks, this is not a large enough time-series to test for multiple breaks.⁴¹

To present a clearer picture on the greater emphasis on cartel enforcement, in **Figure 2** we present the ratio of cartel cases and civil cases to total antitrust cases. The pre-Reagan years saw the ratio at about 30% on average. This ratio increases to an average of over 70% during the Reagan years. The ratio declines steadily after that, reaching a low of 36% during the George W. Bush administration, before rising again under the Obama administration. While the mean ratio (as well as the actual number of cartels prosecuted) clearly seems to vary between-Presidential administrations, there is also substantial variation within-Presidential administrations.⁴² In comparison, we see that the ratio of civil cases to total cases steadily declines through the 1970s reaching a low of around 10% in the early 1980s. Subsequently, the mean ratio stabilizes in the approximately 20% range.

⁴⁰ Vivek Ghosal, *Regime Shift in Antitrust Laws, Economics and Enforcement*, 7 J. COMPETITION L. & ECON. 773 (2011).

⁴¹ See e.g., George Kapetanios, *Unit Proof testing against the alternative hypothesis of up to m structural breaks*, 26 J. TIME SERIES ANAL. 123 (2005); Zhongjun, Qu & Pierre Perron, *Estimating and Testing Structural Changes in Multivariate Regressions*, 75 ECONOMETRICA 459 (2007).

⁴² While we do not display these data in a figure, ratio of total cartel cases to total civil cases is less than 1.0 in the pre-1980 period, a mean ratio of about 6 during the 1980-1993 period, and thereafter fluctuates around a mean of about 2.4.

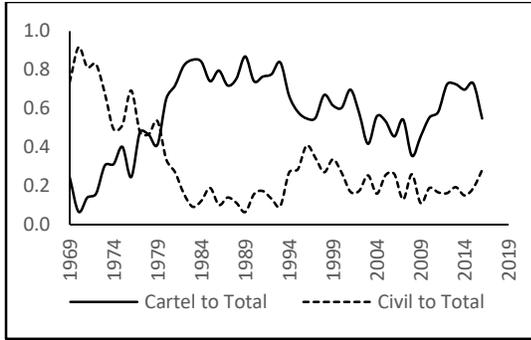


Figure 2. Ratio of Cartel and Civil to Total Antitrust Cases

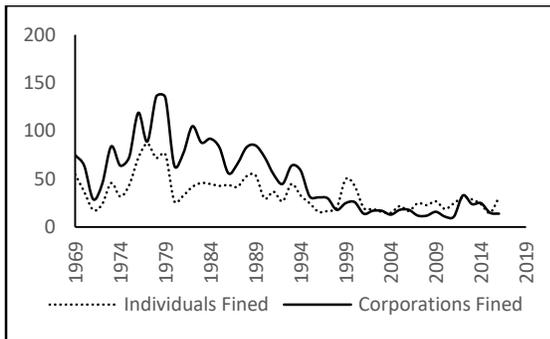


Figure 3. Total Number of Corporations and Individuals Fined

After having examined the overall number of cartel cases, we now focus on penalties related to cartel prosecutions. First, we examine incarceration time. Incarceration time is only one aspect of penalty, and is unique to U.S. antitrust. The European Commission, among other important jurisdictions, do not have jail terms for cartel offenders. **Figure 3** shows that the number of individuals and corporations fined have steadily declined over time. At face value, this presents a puzzling picture as it may be interpreted as relatively weaker enforcement. However, the real story is revealed in the subsequent figures.

Figure 4 shows that the average number of days of incarceration has risen dramatically. The early part of the sample shows an average of about 100 days of incarceration, but this number rises to almost 700 days of incarceration on average in the later part of the sample. These data show a completely different pattern compared to the data on total cartels prosecuted. The incarceration related penalties are clearly a product of the policy changes we documented earlier. Irrespective of whether actual number of cartels prosecuted were high or low, the penalty regime moved to a new, higher plane.

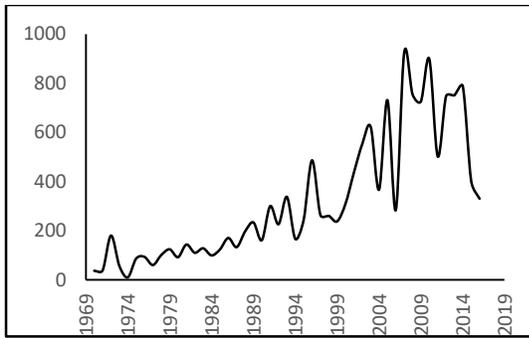


Figure 4. Average Number of Days Incarceration

Further detail is added in **Figure 5**, which displays the total number of individuals sentenced to incarceration. These data show a lot more fluctuation and less of a secular trend (as is the case in figure 4). There is no definitive shift in the number of individuals sentenced to incarceration. The total number of individuals incarcerated increases dramatically during the Reagan administration, then fall to relatively low levels, before showing an uptick in the latter part of the sample. Overall, and examining the average number of days of incarceration in Figure 4, the clear message is that the severity of penalties has increased dramatically over time.

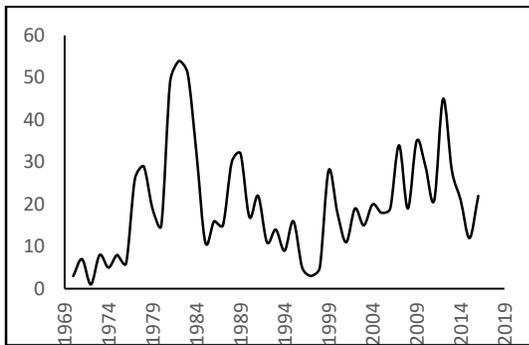


Figure 5. Total Number of Individuals Sentenced to Incarceration

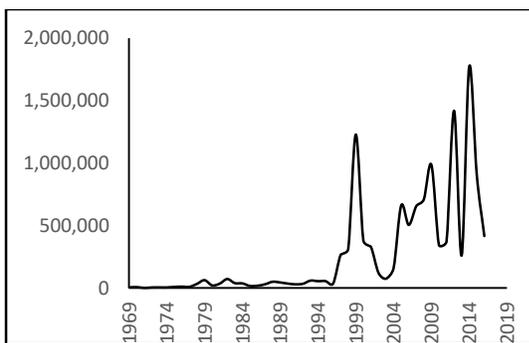


Figure 6. Total Individual and Corporate Fines (Real 2010\$, '000)

Next we focus on the second aspect of penalties, monetary fines. We examine total fines, as well as fines on individuals and corporations. **Figure 6** reveals that there has been an order of magnitude increase in total fines levied on individuals and corporations after the mid-1990s. In

Figure 7 and **Figure 8** we disaggregate the data and display fines per individual and fines per corporation. The fines per individual show a lot of variation over time, but lack of a clear secular trend. There are some large spikes in the period mid-1990s to mid-2000s, but aside from these peaks, there emerges no clear secular trend. The data on corporate fines in **Figure 8**, however, show that before mid-1900s the fines were extremely low, but have large increases after that. The mid-1990s also correspond to the period when the leniency program was restructured. The figures suggest that introduction of the revised leniency program created increased effectiveness for cartel enforcement (detection) and penalties.

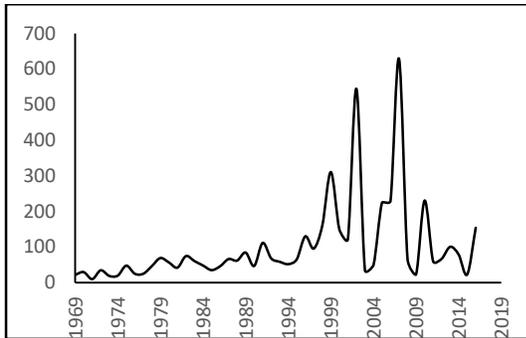


Figure 7. Fine per individual (Real 2010\$, '000)

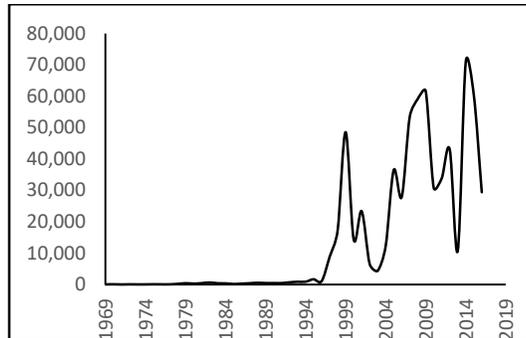


Figure 8. Fine per corporation (Real 2010\$, '000)

Overall, the story that emerges for U.S. cartel enforcement from figures 1-8 is that the main changes in enforcement appear to be fewer in the number of cartels prosecuted, and individuals and corporations prosecuted, but more in the increasing severity of penalties in terms of incarceration time and fines.

Finally, we examine two data series related to total funding for the Antitrust Division, and the ratio of cartel fines to the Antitrust Division’s funding. The total funding (budget) data (real 2010\$) in **Figure 9** shows a marked decrease during the Reagan administration, then a secular increase over several years, and relatively flat since the 2003-04 period. **Figure 10** shows that the “ratio” of total cartel fines to the Antitrust Division’s budget averages around 0.4 before the 1995-1996 period. After that, however, the mean value of the ratio is close to 5, with highs reaching values as large as 10-12. This large increase since the mid-1990s is, of course, due to the large increase in individual and corporate fines we discussed in figures 7-8.

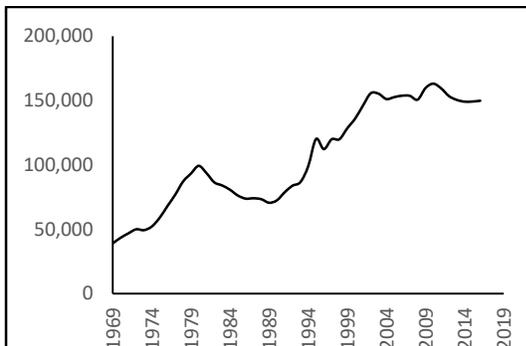


Figure 9. Antitrust Division funding (Real 2010\$, '000)

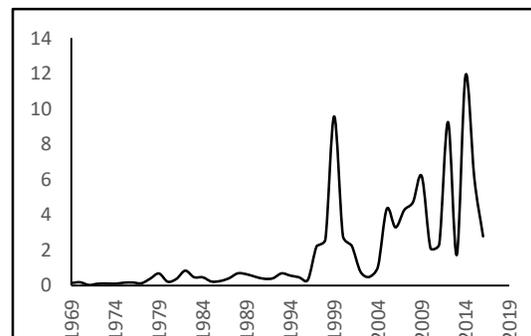


Figure 10. Cartel fines to Antitrust Division funding

5. Empirical framework and estimation results

Having examined the broad patterns in the data, we now turn to estimating the effects of various forces driving cartel prosecutions and penalties. In section 5.1 we spell out the empirical specification. Given our desire to reach an interdisciplinary audience, we restrict our framework and scope of analysis only to the essentials. After discussing the empirical specification, we present our estimation results in section 5.2.

5.1 Empirical framework

In this section we develop the empirical specification to examine whether the institutional changes related to leniency and the new penalty programs, among other factors we consider below, had measurable effects on the full array of cartel enforcement and prosecution variables. Over our full sample period 1969-2016, the number of cartel cases prosecuted by DOJ has perhaps been the most visible enforcement variable. As we noted in section 4, the fines, for example, show noteworthy jumps only in the latter part of our sample period. Given this, we structure our specification by focusing on the cases prosecuted, and then discuss estimation for monetary fines and incarceration days.

There are multiple forces that are likely to influence the U.S. Department of Justice's (DOJ) cartel enforcement path. In our empirical specification we include a wide range of variables are likely to affect DOJ's decisions and enforcement. The total population of cartels is, of course, unobservable, and can only be modeled as a function of variables we can measure. In our empirical specification, we include the following:

(1) Institutional factors (*Inst*). Several administrative and legal milestones have affected cartel enforcement. It is widely recognized by antitrust scholars and DOJ that the old leniency program started in 1978 was ineffective.⁴³ The leniency program became effective when DOJ restructured it and the new program went into effect in 1993, with the first leniency settlements in 1996 (Lysine case).⁴⁴ Given this, we focus on the 1993 date. We focus on two other institutional innovations: The Antitrust Amendments Act (1990) which increased fines and jail terms; and ACPERA (2004) which further increased fines and jail terms. With introduction of *Inst* features like leniency, high fines and incarcerations regime, we expect higher likelihood of detection and deterrence and less collusion.

(2) Political factors (*Pres*). Examining the potential Presidential effect is interesting because of the institutional structure of the Antitrust Division. The Assistant Attorney General, who heads the Antitrust Division, is appointed by the U.S. President, potentially setting the stage for shifts in enforcement with changes in the President and their specific priorities.⁴⁵ If a Presidential

⁴³ Joe Chen & Joseph E. Harrington, Jr., *The Impact of the Corporate Leniency Program on Cartel Formation and the Cartel Price Path*, in POLITICAL ECONOMY OF ANTITRUST (VIVEK GHOSAL & JOHAN STENNEK eds., 2006); Hammond, *supra* note 35.

⁴⁴ While these factors have transformed cartel enforcement, in the bigger picture these changes can be viewed as endogenous to broader shifts in intellectual thinking about cartel enforcement and the political willingness to prosecute. Robert W. Crandall & Clifford Winston, *Does Antitrust Policy Improve Consumer Welfare? Assessing the Evidence*, 17 J. ECON. PERSP. 3, 4 (2003); William E. Kovacic & Carl Shapiro, *Antitrust Policy: A Century of Economic and Legal Thinking*, 14 J. ECON. PERSP. 43 (2000).

⁴⁵ The number of cartel cases in the post-WWII period was approximately 20 per year through the Carter years. Prosecutions increased by 112% during the Reagan administration, and the upswing continued during the George H.W. Bush administration. Since then, the number of cartel cases has tapered off, followed by a marked reduction of prosecutions under George W. Bush administration. There was an uptick during the Obama administration. See Ghosal & Sokol, *Policy Innovations*, *supra* note 11.

regime is such that it is placing greater emphasis on cartel enforcement, detection and prosecution, we expect collusion to be lower due to the increased likelihood of detection and penalties.

(3) DOJ's investigative workload (*Busy*). First, periods of high M&A activity may swamp the Antitrust Division with merger clearance and investigation work, potentially taking resources away from cartel enforcement. Second, in selected instances, examination of merger-specific information during routine investigations may serve as one of the conduits for information about collusive activity in markets (Ghosal, 2008 and 2011a). We use the total number of antitrust investigations by the Antitrust Division as our proxy for *Busy*.

(4) Macroeconomic conditions (*Cycle*). Examining the effects of business cycles on cartel activity is a common in the literature. The main argument regarding *Cycle* is that we expect the propensity to engage in collusion to be higher when economic conditions are weak due to the relationship to low demand.⁴⁶ Our main control variable is the percentage change in GDP (*GDP*).

(5) DOJ's funding (*Funds*). An increase in DOJ's funding is a useful control as greater investigative resources and signals potentially more vigorous enforcement. Since this is a relatively transparent signal, it has the potential to influence firms' behavior towards fewer anti-competitive activities. The previous empirical literature, however, indicates that the link between funding and cartel cases appears rather tenuous, with no clear estimated effect of funding on actual enforcement patterns.⁴⁷ We use the percentage change in real funding as the control variable.⁴⁸

Combining the above variables, our specification is given by (1):

$$[1] \text{ Cases}_t = \alpha_0 + \sum_{k=1}^n [\delta_k \text{ Cases}_{t-k} + \varphi_k \text{ Busy}_{t-k} + \tau_k \text{ Cycle}_{t-k} + \lambda_k \text{ Funds}_{t-k}] + \zeta \text{ Inst}_t + \phi \text{ Pres}_t + \omega_t.$$

⁴⁶ See e.g., Andrew R. Dick, *When Are Cartels Stable Contracts?* 39 J.L. & ECON. 241 (1996); Vivek Ghosal, *Regime Shift in Antitrust Laws, Economics and Enforcement*, 7 J. COMPETITION L. & ECON. 733 (2011); Vivek Ghosal, *The Genesis of Cartel Investigations: Some Insights from Examining the Dynamic Interrelationships between U.S. Civil and Criminal Antitrust Investigations*, 4 J. COMPETITION L. & ECON. 61 (2008); Margaret C. Levenstein & Valerie Y. Suslow, *What Determines Cartel Success?* 44 J. ECON. LIT. 43, 74-75 (2006).

⁴⁷ The picture related to funding is complicated for various reasons. First, the Antitrust Division can "utilize" existing staff (attorneys, paralegals, economists, etc.) at varying rates over workload cycles. When workload is high (low), the staff work more (less), at a higher (lower) rate of utilization. Second, the Antitrust Division has the ability to access additional funding for cases they are actively prosecuting, and under litigation. Third, the exact nature of enforcement, cases being pursued, and related attributes, can change under low versus high funding periods. For example, under Reagan, funding dropped sharply, but so did civil enforcement priorities. These are some of the reasons why the literature has had a difficult time precisely estimating the effect of funding on enforcement actions. For a discussion of related issues, see, e.g., Ghosal, *Regime Shift*, supra note 16.

⁴⁸ The level of funding is influenced by a combination of factors related to the complexity of cases, number of internal investigations, party of the President, composition of the House and the Senate, among others. In addition, the utilization of economists and attorneys (whose salaries are the most significant component of the Antitrust Division's annual budget) vary considerably over work cycles. This variation in utilization poses a problem of clearly linking antitrust investigations to the level of funding. Further, since the Antitrust Division has to request funds from the legislature and requests for increase in funds may follow increase in investigations, funding may potentially be endogenous. Vivek Ghosal & Joseph Gallo, *The Cyclical Behavior of the Department of Justice's Antitrust Enforcement Activity*, 19 INT'L J. INDUS. ORG. 27 (2001). Ghosal and Gallo also found no evidence in the data that funds are endogenous. See id.

Specification (1) captures the dynamic path of cartel prosecutions. In our estimation in section 5.2, we also use other dependent variables such as those related to monetary fines and jail terms.

5.2. Estimation results

The estimation results are presented in **Table 2**. The main inferences are as follows:

Table 2. U.S. cartel prosecutions and penalties

	1. Total cartel cases	2. Total fines per cartel	3. Total jail days per cartel	4. Number of individuals jailed per cartel	5. Number of individuals fined per cartel	6. Number of firms fined per cartel
Intercept	41.552** (0.037)	-3.825 (0.629)	-377.195 (0.144)	-0.156 (0.609)	1.743* (0.060)	2.536 (0.130)
LDV	0.472*** (0.010)	-0.057 (0.773)	0.133 (0.473)	0.255** (0.050)	-0.002 (0.980)	-0.067 (0.471)
Policy2	13.905* (0.093)	0.712 (0.809)	187.035* (0.078)	0.221 (0.241)	-1.079* (0.088)	-1.467 (0.197)
Policy3	-1.522 (0.837)	7.502** (0.047)	325.323** (0.030)	0.165 (0.388)	-1.626*** (0.009)	-3.041*** (0.009)
Policy4	-8.356 (0.286)	14.934*** (0.006)	255.466 (0.110)	0.377*** (0.003)	0.406* (0.100)	0.590 (0.153)
President	-8.489** (0.037)	0.147 (0.962)	171.912 (0.119)	0.096 (0.314)	-0.132 (0.418)	-0.358 (0.216)
Busy _{t-1}	-0.030 (0.350)	0.013 (0.193)	0.593* (0.071)	0.001 (0.246)	0.000 (0.709)	0.003 (0.281)
GDP _{t-1}	-1.493 (0.173)	0.174 (0.635)	-16.069 (0.157)	-0.010 (0.485)	0.054 (0.244)	0.064 (0.451)
Funds _{t-1}	-0.484 (0.132)	-0.317* (0.091)	3.287 (0.440)	0.008 (0.193)	0.039* (0.065)	0.062* (0.067)
\bar{R}^2	0.668	0.521	0.386	0.297	0.479	0.548
ρ	-0.160	-0.125	-0.237	-0.099	-0.039	-0.243

Notes:

1. All specifications are estimated using annual time-series, 1969-2016. *LDV* is the lagged-dependent variable, and *President* is a dummy variable: Republican=1.

2. The various policy regime periods are as follows:

Policy1: ≤ 1977 . Pre-old leniency period. (This is excluded from the estimated regression as the effect is subsumed into the regression constant.)

Policy2: 1978-1992. Old leniency to new leniency period.

Policy3: 1993-2003. New leniency and Antitrust Amendments Act period.

Policy4: 2004-2013. Post-ACPERA period.

3. *p-values* computed from robust standard errors (two-tailed test) are in parentheses. A *p-value* <0.001 is reported as 0.001. Asterisks *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively. ρ denotes the first-order autocorrelation.

(1) The *Policy* variables (Policy2, Policy3, Policy 4) are generally not significant for the total number of cartels prosecuted.⁴⁹ But they are highly significant for the total fines per cartel and jail days per cartel. In general, they are not particularly meaningful for determining number of individuals jailed per cartel, or number of individuals and firms fined per cartel. Examining

⁴⁹ We keep in mind that since there are four Policy(.) variables, we include three in the estimated regression with Policy1 subsumed in the regression intercept term.

column 2 in table 2 related to total fines per cartel, we see that the Policy3 (1993-2003: new leniency and the Antitrust Amendments Act period) and Policy4 (2004-2013: post-ACPERA period) estimates are highly significant, with the Policy4 estimate being an order of magnitude larger than Policy3. For total jail days per cartel (column 3), we see that the Policy2 and Policy4 estimates are statically significant and quantitatively large. The Policy4 estimate is large, but the significance level is marginal, only at 11% level. As with the fines effects in column 2, the incarceration effects in column 3 show large policy effects. These effects tally with our discussions in sections 1-3 related the key institutional and policy changes, and ratcheting up of monetary fines and incarceration days that can be imposed.

It is somewhat intriguing that the estimated effects of the Policy(.) variables are generally statistically insignificant and quantitatively small for the three variables related to: the number of individuals jailed per cartel (column 4), the number of individuals fined per cartel (column 5), and the number of firms fined per cartel (column 6). A lot of the official and press coverage on busting cartels since the prosecution of the Lysine cartel has focused on how the Department of Justice has gone after large and expansive (in terms of firms and individuals colluding) international cartels. While this does show up in fines levied and jail terms (columns 2 and 3), it does not show up in the last three columns of table 2.

(2) The political party of the *President*, with a simple Republican versus Democrat demarcation is only significant with a negative coefficient for total cartels prosecuted. The negative and significant estimate implies that over our full sample period 1969-2016, somewhat fewer cartels were prosecuted under Republican administrations. This is perhaps not a finding one may expect a priori as one may expect, for example following the Reagan change in emphasis, that Republicans would prosecute more cartels. This negative sign is likely being driven by the very low, almost historically low, prosecutions under the George W. Bush Presidency. The Presidential variable is not significant in any other column. We note that cannot include each Presidential period specifically in the estimated regression as the Presidential terms have significant overlaps with the included Policy1-Policy4 variables.

(3) In general, the variables Busy, GDP and Funds are not significant. These findings are similar to those in some of the earlier literature.⁵⁰ As we had noted earlier, the complexities of allocation and utilization of the Antitrust Division's professionals to alternative areas of enforcement, as well as varying utilization rates for staff over workload cycles, renders no clear predictions on those estimated coefficients. While some papers in the literature find that recessions lead to greater number of cartels prosecuted, there are other papers that find no relationship.

(4) The lagged dependent variable is significant only for total cartel cases (column 1) and number of individuals jailed per cartel (column 4), indicating persistence in these variables. The lagged dependent variable is not significant for any of the other variables.

We experimented with alternative specifications, including considering deeper lag lengths. Our results were similar in spirit. Our main conclusion from the above empirical exercise is that the policy shifts related to fines and incarcerations affected those variables considerably, but do not reveal a meaningful impact on total number of cartels prosecuted, or the number of individuals and corporations fined per cartel.

⁵⁰ Ghosal, *Regime shift*, *supra* note 53; Ghosal & Sokol, *Policy Innovations*, *supra* note 11.

6. (Potential) Decline of Cartel Enforcement and Prosecutions?

As we noted in Figure 1, with some fluctuations, DOJ Antitrust is prosecuting fewer cartels. This has been the case for a number of years, aside from the increase under the Obama administration. Understanding the causal factors may be complicated and require additional research to disentangle a number of potential factors. Below we discuss some factors that may be at play driving the secular trends and intertemporal fluctuations.

Leniency is a success, there is more internal compliance and there are fewer cartels

From the enforcement standpoint, perhaps leniency is working and there may be fewer cartels being formed.⁵¹ Data analytics also may be leading to greater internal detection and monitoring. The theoretical literature on leniency is that such a program increases the costs of collusion. Thus, the more successful leniency has been the more it has worked to reduce the total number of cartels by preventing formation as well as destabilizing existing cartels.⁵²

Fewer cartels formed (and hence prosecuted) may be due to an increasingly strong overall enforcement structure not merely in the United States but in other major jurisdictions, particularly at the European level due to the work of DG Competition.⁵³ Significant fines for fewer cartels on the part of DG Competition exceed those of the Antitrust Division significantly. Firms have responded with increased compliance training that identify and mitigate situations that lead to collusion.⁵⁴ Similarly, cartel guidelines promulgated by a number of competition authorities also provide guidance on how best to create anti-cartel programs for firms.⁵⁵

It is possible that the increasing number of antitrust regimes that actively enforcement against cartels as well as European enforcement⁵⁶ means fewer global cartels. Compounding the increase in cartel enforcement globally is the impact of how other areas of compliance may be leading to better mechanisms for compliance that may impact cartel detection internally such as anti-bribery and audit related compliance involving accounting fraud.⁵⁷ Thus, the more significant sanctions may be lowering the cartel crime rate.⁵⁸

⁵¹ This could be true as a secular trend, but it does not explain the fairly sharp increase going from the Bush to Obama administrations. This signals more forces are at play than just leniency and deterrence.

⁵² Massimo Motta & Michele Polo, *Leniency Programs and Cartel Prosecution*, 21 INT'L J. INDUS. ORG. 347 (2003); Joseph E. Harrington, Jr., *Optimal Corporate Leniency Programs*, 56 J. INDUS. ECON. 215 (2008); Joseph E. Harrington, Jr. & Myong-Hun Chang, *When Can We Expect a Corporate Leniency Program to Result in Fewer Cartels?* 58 J.L. & ECON. 417 (2015); Leslie M. Marx & Claudio Mezzetti, *Effects of Antitrust Leniency on Concealment Effort by Colluding Firms*, 2 J. ANTITRUST ENFORCEMENT 30 (2014); Cécile Aubert et al. *The Impact of Leniency and Whistle-Blowing Programs on Cartels*, 24 INT'L J. INDUS. ORG. 1241 (2006); Christopher R. Leslie, *Antitrust Amnesty, Game Theory, and Cartel Stability*, 31 J. CORP. L. 453 (2006); Jay Pil Choi & Heiko Gerlach, *Global Cartels, Leniency Programs, and International Antitrust Cooperation*, 30 INT'L J. INDUS. ORG. 528 (2012); Maria Bigoni et al., *Fines, Leniency and Rewards in Antitrust: An Experiment*, 43 RAND J. ECON. 368 (2012).

⁵³ Luca Aguzzoni et al., *The effect of EU antitrust investigations and fines on a firm's valuation*, 61 J. INDUS. ECON. 290 (2013).

⁵⁴ Anne Riley & D. Daniel Sokol, *Rethinking Compliance*, 3 J. ANTITRUST ENFORCEMENT 31 (2015).

⁵⁵ Id.

⁵⁶ Pierre Cremieux & Edward A. Snyder, *Enforcement of Anticollusion Laws against Domestic and Foreign Firms*, 59 J.L. & ECON. 775, 776 (2016).

⁵⁷ See Riley & Sokol, *supra* note 64.

⁵⁸ Oren Bar-Gill & Alon Harel, *Crime Rates and Expected Sanctions: The Economics of Deterrence Revisited*, 30 J. LEGAL STUD. 485 (2001) ("A HIGHER expected sanction lowers the crime rate. This intuitive cornerstone of deterrence theory has garnered extensive theoretical and empirical research."). But see Lucian Arye Bebchuk &

Cartels have gotten smarter and avoided detection.

Under this scenario, cartels are still formed, but more complex, endogenizing the stricter antitrust screens and scrutiny. It may be that firms have learned to game leniency and are able to use leniency to punish competitors and/or harden existing cartels.⁵⁹ In such circumstances, firms are more likely to come to agreement to collude but need not do so in terms of express collusion but mere tacit agreement.

Tacit agreement through price signaling may have become easier over time given changes in case law, particularly since *Twombly*.⁶⁰ *Twombly* has made it more difficult for plaintiffs to overcome pre-trial motions.⁶¹ The increased difficulty of private plaintiffs to bring successful cases against tacit agreement in conjunction with aggressive prosecution of direct evidence through lenience pushes rational firms to change their collusion strategy to a murkier legal area of tacit agreement in which “plus” factors that distinguish agreement from mere interdependence are not always clear.⁶² There are both strict⁶³ and more lenient⁶⁴ readings of *Twombly* across circuits with regard to how much additional evidence is necessary.

We suggest that the new work on partial ownership is encouraging information leakage in ways that may (or may not) be illegal but facilitate collusion. A series of new papers suggest that partial ownership is correlated to greater collusion as a result of ownership by various mutual funds and other passive investors.⁶⁵ In this literature, the claims are mixed. Some claims suggest that there is more than just mere tacit collusion but some signaling of behavior that might lead to greater coordination and higher prices.⁶⁶

If firms also have become more sophisticated in their explicit collusion as a result of partial ownership, then this may explain why total government prosecutions have fallen below more recent levels of enforcement.

Increase (legal) tacit collusion

Posner explained that the ability of firms to lawfully tacitly collude “appears to be common, each tacit colluder reckoning that in all likelihood the others will see the advantages of

Louis Kaplow, *Optimal Sanctions When Individuals Are Imperfectly Informed about the Probability of Apprehension*, 21 J. LEGAL STUD. 365, 365-366 (1992) (suggesting that individual aspects of the criminal actor).

⁵⁹ D. Daniel Sokol, *Cartels, Corporate Compliance, and What Practitioners Really Think About Enforcement*, 78 ANTITRUST L.J. 201 (2012).

⁶⁰ *Bell Atlantic Corp. v. Twombly*, 550 U.S. 544, 559 (2007) (“[I]t is only by taking care to require allegations that reach the level suggesting conspiracy that we can hope to avoid the potentially enormous expense of discovery in cases with no reasonably founded hope that the [discovery] process will reveal relevant evidence to support a § 1 claim.”) (citations and internal quotation marks omitted). See generally William H. Page, *Pleading, Discovering, and Proving A Sherman Act Agreement: Harmonizing Twombly And Matsushita*, [] ANTITRUST L.J. [] (forthcoming).

⁶¹ Page, *Pleading*, *supra* note 68.

⁶² *In re Ins. Brokerage Antitrust Litig.*, 618 F.3d 300, 323 (3d Cir. 2010) (Plaintiffs “must allege facts that, if true, would establish at least one ‘plus factor,’ since plus factors are, by definition, facts that ‘tend[] to ensure that courts punish concerted action—an actual agreement—instead of the unilateral, independent conduct of competitors.’”).

⁶³ *Burtch v. Milberg Factors, Inc.*, 662 F.3d 212, 229 (3d Cir. 2011); *In re Musical Instruments & Equip. Antitrust Litig.*, 798 F.3d 1186, 1193–94 (9th Cir. 2015); *name.space, Inc. v. Internet Corp. for Assigned Names and Numbers*, 795 F.3d 1124, 1129–31 (9th Cir. 2015).

⁶⁴ *Evergreen Partnering Grp., Inc. v. Pactiv Corp.*, 720 F.3d 33, 50 (1st Cir. 2013); *Starr v. Sony MMG Entmt.*, 592 F.3d 314, 325 (2d Cir. 2010); *SD3, LLC v. Black & Decker U.S., Inc.*, 801 F.2d 412, 418 (4th Cir. 2015).

⁶⁵ Elhauge, *Horizontal Shareholding*, 129 HARV. L. REV. 1267, 1267-78 (2016),

⁶⁶ Gaurab Aryal et al., *Public Communication and Collusion in the Airline Industry* (working paper, Feb. 12, 2018).

hanging together rather than hanging separately.”⁶⁷ Shifts in market structure have decreased the risk of certain forms of collusion. Gradually, as empirical work on antitrust markets bears out, at least in a number of markets there has been increased concentration in recent decades.⁶⁸ As markets become more concentrated, it may be easier for firms to pursue strategies of mere tacit collusion.⁶⁹ Data analytics potentially may make it easier to hide cartels because of massive information dumps and ability to signal more effectively through tacit collusion or explicitly through algorithms.⁷⁰

Another strand of the partial ownership literature lacks a causal story of how this price signaling is occurring but argues that even mere tacit collusion is anticompetitive.⁷¹ If this literature is correct, firms have become more sophisticated in their ability to legally signal behavior in the case of tacit collusion.

Shift from greater emphasis on domestic cartels to international cartels

The Reagan enforcement boom in cartels was largely related to state and federal government bid-rigging cases. Many of these cases involved smaller cartels,⁷² based on the size of the fine. Starting under Clinton, the emphasis has been on prosecution of larger international cartels.⁷³ This trend continues to the present. However, less total enforcement in terms of number of cases at present may be partly due to lack of emphasis on domestic cartels (so fewer are caught in this category). The shutdown of the DOJ field offices in Atlanta, Philadelphia and Cleveland may contribute to this asymmetry in terms of cartel size.

Private plaintiffs and states have not picked up the local bid rigging and so this goes undetected

The majority of antitrust litigation is private rather than public. In our paper we analyze the impact of public enforcement. This may not reflect the total dynamic of antitrust litigation.⁷⁴ The relationship between public and private enforcement is complex, including in the area of collusion. It could be the case in which private enforcement is a substitute for private

⁶⁷ *In re Text Messaging Antitrust Litig.*, 782 F.3d 867, 877 (7th Cir. 2015).

⁶⁸ Sam Peltzman, *Industrial Concentration Under the Rule of Reason*, 57 J. L. & Econ. S101 (2014) (finding increased concentration in American manufacturing).

⁶⁹ LOUIS KAPLOW, *COMPETITION POLICY AND PRICE FIXING* 133-45 (2013).

⁷⁰ Salil K. Mehra, *US v. Topkins: can price fixing be based on algorithms?* 7 J.EURO. COMPETITION L. & PRACTICE 470 (2016).

⁷¹ Jonathan B. Baker, *Overlapping Financial Investor Ownership, Market Power, and Antitrust Enforcement: My Qualified Agreement with Professor Elhauge*, 129 HARV. L. REV. FORUM 212, 226 (2016); José Azar et al., *Anti-Competitive Effects of Common Ownership*, [] J. Fin. [] (forthcoming); José Azar et al., *Ultimate Ownership and Bank Competition* (July 24, 2016), <http://ssrn.com/abstract=2710252>. But see Daniel P. O’Brien & Keith Waehrer, *The Competitive Effects of Common Ownership: We Know Less than We Think*, 81 ANTITRUST L.J. 729 (2017).

⁷² See e.g., Robert H. Porter & J. Douglas Zona, *Detection of bid rigging in procurement auctions*, 101 J. Pol. Econ. 518 (1993).

⁷³ Brent Snyder, Deputy Assistant Attorney General Brent Snyder Delivers Remarks at the Sixth Annual Chicago Forum on International Antitrust Chicago, IL, June 8, 2015, available at <https://www.justice.gov/opa/speech/deputy-assistant-attorney-general-brent-snyder-delivers-remarks-sixth-annual-chicago> (“The Corporate Leniency Program revolutionized cartel enforcement, led to the successful prosecution of many long-running and egregious international cartels.”).

⁷⁴ Robert H. Lande & Joshua P. Davis, *Benefits from Private Antitrust Enforcement: An Analysis of Forty Cases*, 42 U.S.F. L. REV. 879, 905 (2008); Daniel A. Crane, *Optimizing Private Antitrust Enforcement*, 63 VAND. L. REV. 675, 678-98 (2010).

enforcement. That is, DOJ may be resource-constrained⁷⁵ or under-aggressive in its cartel prosecutions, taking safer cases based on leniency rather than investigating the possibility for collusion either based on news reports or based on empirical screens.⁷⁶

State enforcement is not active enough in cartel prosecutions

State antitrust enforcement could play a substitute role for federal enforcement of cartels. However, recent work regarding state antitrust enforcement suggests that collusion is not an enforcement priority. Rather enforcement tends to focus on national related cases that are high profile and seem to be subject to Virginia School public choice rent seeking concerns.⁷⁷ Part of this mismatch regarding cartels may also be due to the fact that states attorney generals differ in their resources and capabilities vis-à-vis DOJ Antitrust. States have fewer such resources.⁷⁸

Because of resource constraints and a concern that bringing cases involving tacit agreement are costly and difficult to prove, cases involving tacit agreement are cases that private plaintiffs bring rather than the government. Not all potential tacit agreement cases are brought because of the economics of litigation. The cost to defend antitrust claims may be significant for the firm defending them. Whereas it is relatively cheap to bring on follow on actions to government cases because of a free riding effect off government investigations or settlements,⁷⁹ bringing a private case is more costly. The appeal of private cases is the possibility of treble damages. In this setting, antitrust enforcement allows for substitutability of private for government claims in the case of collusion.⁸⁰

Technological Innovation

Technological innovation may be at play in impacting the number of cartel prosecutions. The effects of technological change may be in in one both directions. On the one hand, amassing significant data may make it easier to tacitly collude lawfully. Similarly, upstream or downstream firms may be better able, through screening technology,⁸¹ to uncover irregularities that may be collusive and directly renegotiate contractual terms with one of more suppliers in a way that does not disrupt supply chains but that remedies anti-competitive behavior. On the

⁷⁵ John M. Connor, *Global Antitrust Prosecutions of Modern International Cartels*, 4 J. INDUS. COMPETITION & TRADE 239, 266 (2004) (“Without significant increases in cartel detection, in the levels of expected fines or civil settlements, or expansion in the standing of buyers to seek compensation, international price fixing will remain rational business conduct.”).

⁷⁶ Rosa M. Abrantes-Metz & D. Daniel Sokol, *The Lessons from Libor for Detection and Deterrence of Cartel Wrongdoings*, 3 HARV. BUS. L. REV. ONLINE 11 (2012),

⁷⁷ Robert M. Feinberg, *State antitrust enforcement in the US and implications for small business entry and relocation*, 46 APPLIED ECON. 769 (2014); John A. Dove, *Antitrust enforcement by state attorneys general: Institutional, legal and political considerations*, 16 BUS. & POL. 291 (2014); Robert M. Feinberg & Thomas A. Husted, *Do States Free Ride in Antitrust Enforcement?* 51 ECON. INQUIRY 997 (2013).

⁷⁸ Robert Hahn & Anne Layne-Farrar, *Federalism in Antitrust*, 26 HARV. J.L. & PUB. POL'Y 877, 887-90 (2003).

⁷⁹ D. Daniel Sokol, *Strategic Use of Public and Private Litigation in Antitrust as Business Strategy*, 85 S. Cal. L. Rev. 689, 697 (2012).

⁸⁰ David Besanko & Daniel F. Spulber, *Are Treble Damages Neutral? Sequential Equilibrium and Private Antitrust Enforcement*, 80 AM. ECON. REV. 870 (1990); Stephen W. Salant, *Treble Damage Awards in Private Lawsuits for Price Fixing*, 95 J. POL. ECON. 1326 (1987).

⁸¹ D. Imhof, *Econometric tests to detect bid-rigging cartels: Does it work?* Working Papers SES 483, Faculty of Economics and Social Sciences, University of Fribourg (Switzerland), 2017.

other hand, technology may make it easier to collude through price related algorithms.⁸² The evidence for these propositions are rather scarce.

7. Comparison of U.S. and European Commission cartel enforcement

In this section we draw attention to the fact that in the more recent periods international enforcement of cartels has gone up. In particular, the European Commission has been active in prosecuting high profile cartels, with relatively large increase in fines. While an extensive analysis of the international dimension is beyond the scope of this paper, we take a look at potential interrelationships between the U.S. and EC cartel enforcement.

It is likely that developments in European enforcement may have impacted U.S. enforcement, and vice versa. Though empirically it is challenging to isolate these dynamic effects, often with enforcement on the same cases, because of endogeneity concerns, in this section we map out transformations in European cartel prosecutions to draw some parallels to the U.S. experience. While cartel enforcement has grown in other jurisdictions, in terms of fines (EC law does not provide for criminalization of cartel related behavior), the United States and the EC are the two most important jurisdictions for government enforcement. Outside of the United States, private rights of action at present only play a role in the UK, Netherlands and Germany.⁸³ Criminalization plays a role in an increasing number of countries but few cartel members go to jail outside of the United States.⁸⁴

We briefly present a comparison of U.S. and European cartel enforcement. As the U.S. Department of Justice and the European Commission (EC) comprise the two largest cartel enforcement agencies, U.S. cartel prosecution likely does not operate in isolation of developments worldwide. One issue that we did not address in our earlier discussion is that some of the developments in U.S. cartel prosecutions and cartel detection, particularly in the later period of the sample may be related to events in other jurisdictions. In particular, some of the U.S. prosecutions could be related to developments in European cartel prosecutions, and vice versa.

In this section we briefly note some issues, present aggregate enforcement data, and conduct some empirical estimation to shed light on this issue.

European cartel enforcement has gone through changes in prosecution tools, which we briefly summarize. The first legal prohibition against collusion was in the 1957 Treaty of Rome.⁸⁵ Cartel enforcement for decades was rather sparse and penalties relatively meaningless

⁸² Salil K. Mehra, *Antitrust and the Robo-Seller: Competition in the Time of Algorithms*, 100 MINN. L. REV. 1324 (2016); Ariel Ezrachi & Maurice Stucke, *Artificial Intelligence & Collusion: When Computers Inhibit Competition*, 2017 ILL. L. REV. 1776.

⁸³ See e.g., Sebastian Peyer, *PRIVATE ANTITRUST LITIGATION IN GERMANY FROM 2005 TO 2007: EMPIRICAL EVIDENCE*, 8 COMPETITION L. & ECON. 331 (2012); D. DANIEL SOKOL, DANIEL CRANE AND ARIEL EZRACHI, *GLOBAL ANTITRUST COMPLIANCE HANDBOOK* (2014); Barry Rodger, *Why not court? A study of follow-on actions in the UK*, 1 J. Antitrust Enforcement 104 (2013); Marianne Charrier & Gordon Downie, *UK and EU Developments in Collective Action Regimes for Competition Law Breaches*, 35 EURO. COMPETITION L. REV. 369, 369-75 (2014).

⁸⁴ Caron Beaton-Wells, *Criminal Sanctions for Cartel Conduct: The Leniency Conundrum*, 13 J. COMPETITION L. & ECON. 125 (2017).

⁸⁵ See Treaty Establishing the European Economic Community, Mar. 25, 1957, 298 U.N.T.S. 11. The Treaty of Rome has since evolved into the TFEU, which was signed in 2007 and is the current governing treaty of the European Union. See Consolidated Version of the Treaty on the Functioning of the European Union, 2008 O.J. C 115/47

with little deterrence value. Significant fines and prosecution of cartels did not begin until after the First Leniency Notice in 1996.⁸⁶ Shortly thereafter in 1998, the Commission issued its First Guidelines⁸⁷ on the method of setting fines. That was the same year as the first leniency applicant (Tate & Lyle) in the sugar cartel.⁸⁸

European policy initiatives increased during the 2000s, perhaps in part in response to developments in the U.S., and also recognizing the significant welfare losses that were generated by price-fixing agreements between firms. The EC provided its Second Leniency Notice in 2002,⁸⁹ which provided immunity for ongoing investigations. Cartel enforcement became decentralized under Regulation 1/2003,⁹⁰ which allowed then Article 81 application by national courts and agencies. The regulation also increased powers of investigation and set up the European Competition Network (ECN). In 2006, DG Competition introduced its Second Guidelines on the method of setting fines,⁹¹ the Third Leniency Notice,⁹² which attempted to increase transparency (and create a marker system) and the ECN Model Leniency program (to harmonize leniency across the EU).⁹³ In 2008, DG Competition introduced its settlement notice, which provided a 10% discount to participating firms. The first settlement case was in 2010. Finally, in 2012 the EU introduced its Second ECN Model Leniency program.⁹⁴

The empirical literature on European cartel enforcement is relatively small. The evidence to date suggests a similar trend in enforcement to that of the United States. Schinkel⁹⁵ provides a survey of EU cartel enforcement until that time, while Carree, Gunster, and Schinkel⁹⁶ offer a broader survey of European enforcement that includes cartels. Stephan⁹⁷ examines the empirics of leniency in Europe while work by Marshall, Marx, and Mezzetti⁹⁸ analyze the impact of European leniency applications with regard to multimarket colluders. Other work shows that the number of cases and leniency applicants have risen dramatically since 2003, relative to earlier periods.⁹⁹

⁸⁶ Commission Notice on Immunity from Fines and Reduction of Fines in Cartel Cases, rec. 6, 2006 O.J. (C 298) 11.

⁸⁷ Guidelines on the method of setting fines imposed pursuant to Article 23(2)(a) of Regulation No 1/2003. Official Journal C 210, 1.09.2006.

⁸⁸ Massimo Motta & Michele Polo, *Leniency Programs and Cartel Prosecution*, 21 Int'L J. Indus. Oorg. 347, 372 (2003).

⁸⁹ Commission Notice on Immunity from Fines and Reduction of Fines in Cartel Cases, 2002 O.J. (C 45) 3.

⁹⁰ Council Regulation 1/2003, art. 21(1), O.J. L 1/1 (2003).

⁹¹ Guidelines on the method of setting fines imposed pursuant to Article 23(2)(a) of Regulation No 1/2003. Official Journal C 210, 1.09.2006.

⁹² Notice on immunity from fines and reduction of fines in cartel cases (OJ 2006 C298/ 11).

⁹³ EUROPEAN COMPETITION NETWORK, ECN MODEL LENIENCY PROGRAMME, available at http://ec.europa.eu/competition/ecn/model_leniency_en.pdf.

⁹⁴ ECN Model Leniency Programme (revised November 2012) available at http://ec.europa.eu/competition/ecn/mlp_revised_2012_en.pdf.

⁹⁵ Maarten Pieter Schinkel, *Effective Cartel Enforcement in Europe*, 30 WORLD COMPETITION 539, 540-44 (2007).

⁹⁶ Martin Carree et al., *European Antitrust Policy 1957-2004: An Analysis of Commission Decisions*, 36 REV. INDUS. ORG. 97 (2010).

⁹⁷ Andreas Stephan, *An empirical assessment of the European Leniency notice*, 5 J. COMPETITION L. & ECON. 537 (2009).

⁹⁸ Leslie Marx et al., *Antitrust leniency with multi-market colluders*, 7 AM. ECO. J.: MICROECONOMICS 205 (2015).

⁹⁹ Aguzzoni et al., *supra* note 63.

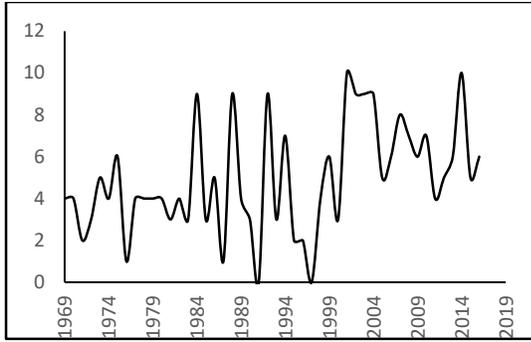


Figure 11. Total EC Cartel Cases

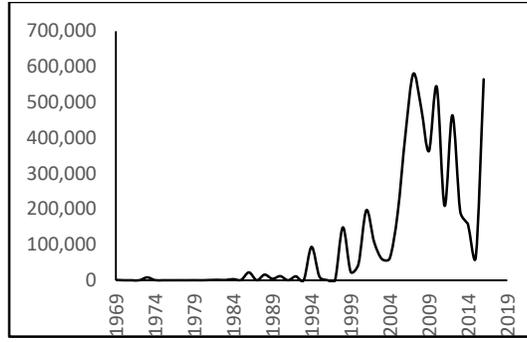


Figure 12. EC Cartel Fines Per Case (Real 2010\$, '000)

To briefly overview the data and make some comparisons between the U.S. and EC, we present a few figures. In **Figure 11** and **Figure 12** we display the total number of EC cartel cases and the fines per cartel, respectively. The time-path of the fines-per-cartel case is relatively similar to that of the U.S., with fines rising dramatically after around the year 2000. However, the number of cartels prosecuted is very low: The average over the full sample period is only 4.5 cartels per year. The highest observation is 10 cartels prosecuted in 2001, and 10 prosecutions in 2014. These numbers are vastly lower than the U.S. sample mean of approximately 42 per year, with a high of 96 prosecuted in 1984. In **Figure 13** we display the ratio of EC to U.S. cartel prosecutions.

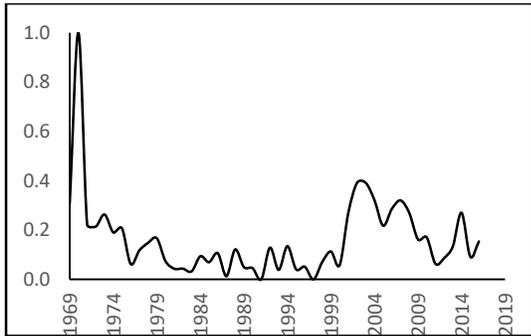


Figure 13. Ratio of EC to US Cartel Cases

The argument that EU Member States have their own cartel prosecutions is unlikely to explain this gaping difference as one can, in a similar vein, argue that the individual U.S. states also prosecute cartels with some States having an active antitrust enforcement agenda.

Finally, in **Figure 14**, we examine ratio of total EC cartel fines per case to the U.S. cartel fines per case. This presents a starkly different picture, with the average EC fine being an order of magnitude greater than in the U.S.

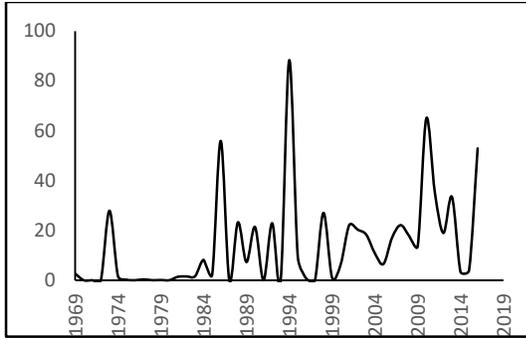


Figure 14. Ratio of Total EC Cartel Fine per Case to US Fine per Case

The overall EC versus U.S. comparisons look a bit puzzling, and the aggregated data that we use do not lend themselves to a clear framework for econometric analysis to examine the dynamic interlinkages. Perhaps the better solution for examining EC-U.S. dynamics is to examine specific cases that each jurisdiction prosecuted, examine their origins, and then analyze whether one jurisdiction may have piggybacked on the other for specific cases or if the prosecution was coordinated from the beginning or benefitted later in time from the other competition authority.

7.1. Examination of Dynamic Interrelationships between U.S.-EC Cartel Enforcement

While our data are aggregate, we estimate some dynamic regression models to examine whether there are interlinkages between U.S. and EC cartel enforcement. For example: Do U.S. (EC) cartel prosecutions increase when EC (U.S.) prosecutions increase? Do U.S. (EC) fines show an increase when EC (U.S.) fines increase? The basic idea is that if there are close relationships (in the aggregate) between the cases prosecuted across the two jurisdictions, then the answers to the above questions is likely to be: yes. However, if the aggregate data mask substantial heterogeneity that may be case-specific, then regressions based on aggregate data may not show clear relationships. With this caveat in mind, below we present three sets of regressions related to: (a) total cartel prosecutions; (b) total cartel fines; and (c) cartel fines per case.

We estimate bivariate autoregressive-distributed lag models, with one autoregressive lag and two distributed lags of the form:

$$[2] \quad X(1)_t = \alpha_0 + \alpha_1 Trend + \alpha_2 X(1)_{t-1} + \alpha_3 X(2)_{t-1} + \alpha_4 X(2)_{t-2} + \varepsilon_t.$$

The specifications we estimate are in logarithmic-levels, implying that the estimated coefficients can be interpreted as elasticities.¹⁰⁰ The specification (2) can be interpreted as follows. For example, in specification (2), $X(1)$ could be U.S. cartel cases, and $X(2)$ EC cartel cases. The specification implies that after controlling for any general time trend in the data ($Trend$), we can examine whether past U.S. cartel cases affect current cases, and whether lagged EC cartels cases affect current U.S. cases. This is a fairly standard bivariate specification to examine

¹⁰⁰ The conceptual and theoretical underpinnings of this framework are spelled out in, for example, David Hendry et al., *Dynamic Specification*, in *HANDBOOK OF ECONOMETRICS* (ZVI GRILICHES & MICHAEL INTRILIGATOR EDS., 1983); John Kennan, *The Estimation of Partial Adjustment Models under Rational Expectations*, 47 *ECONOMETRICA* 1441 (1979).

intertemporal interlinkages between X(1) and X(2). Similarly, X(1) and X(2) could be U.S. total cartel fines, and EC total cartel fines; or U.S. fines per cartel, and EC fines per cartel.

In specification (2), we include a linear time trend as some of the cartel enforcement variables (noted in Figures 1-8) show trends. Omitting the trend variable, when a trend is present, will lead to biased coefficient estimates. Including a trend variable when no trend is present does not diminish the model as the included trend variable will be statistically insignificant. So estimating the specifications by including a trend variable makes it more general.

In reporting the estimates below, we use OLS to estimate the parameters of (2). We note two points before presenting the estimates: (a) Our experiments with including deeper lags of X(1) and X(2) did not reveal any new insights from those reported below; and (b) We also experimented with using the Seemingly Unrelated Regressions estimator to estimate the parameters of (00). Our results were virtually identical to those reported below.

Table 3 presents the cross-relationship between U.S. and EC cartel cases. Our estimates reveal that, based on aggregate data we use, there is no statistically significant interrelationship between U.S. and EC cartel cases. In the dynamic specifications reported below, the only significant coefficient is for $USCases_{t-1}$, indicating a degree of persistence in U.S. cartel prosecutions.

Table 3. U.S. and EC Cartel Cases

	1. $\ln USCases_t$	2. $\ln ECCases_t$
Constant	5.231 (0.455)	-48.27** (0.023)
Trend	-0.002 (0.564)	0.025** (0.021)
$\ln USCases_{t-1}$	0.714*** (0.001)	0.404 (0.297)
$\ln USCases_{t-2}$	-	-0.853 (0.153)
$\ln ECCases_{t-1}$	-0.039** (0.046)	-0.033 (0.611)
$\ln ECCases_{t-2}$	-0.015 (0.237)	-
\bar{R}^2	0.710	-0.034
P	-0.063	-0.020

Notes: (a) all specifications are estimated using data over 1969-2016; (b) \ln denotes natural logarithm; (c) p -values calculated from robust standard errors are in parentheses; (d) the asterisks *, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively; and (e) ρ is the estimate of the first-order autocorrelation.

Next we estimate a similar bivariate specification, but with total U.S. and EC cartel fines. These estimates are presented in **Table 4**. Examining the estimates for $USFines_t$ in column 1, it shows a positive trend over the sample period. As the coefficient on $USFines_{t-1}$ is significant, it shows persistence in U.S. fines data. Finally, the only cross-relational coefficient that is significant is $ECFines_{t-2}$; the coefficient is a small negative. For the estimates presented in column 2 for $ECFines_t$, no coefficient is statistically significant.

Table 4. U.S. and EC Total Fines

	1. $\ln USFines_t$	2. $\ln ECFines_t$
Constant	-176.336*** (0.001)	-326.696 (0.398)
Trend	0.092*** (0.001)	0.154 (0.445)
$\ln USFines_{t-1}$	0.355*** (0.009)	1.890 (0.122)
$\ln USFines_{t-2}$	-	0.659 (0.529)
$\ln ECFines_{t-1}$	-0.012 (0.314)	-0.238* (0.074)
$\ln ECFines_{t-2}$	-0.032* (0.075)	-
\bar{R}^2	0.835	0.407
P	0.005	-0.004

Notes: (a) all specifications are estimated using data over 1969-2016; (b) \ln denotes natural logarithm; (c) p -values calculated from robust standard errors are in parentheses; (d) the asterisks *, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively; and (e) ρ is the estimate of the first-order autocorrelation.

Finally, in **Table 5** we estimate bivariate specifications using data on U.S. and EC fines *per cartel*, as opposed to total fines in the previous table. In contrast to the total fines estimates in the above table, the time trend is significant for both U.S. and EC fines per cartel, and the estimated elasticity is much larger for EC. As in some of the above estimates, the lagged dependent variable, the coefficient on $USPerCartelFines_{t-1}$ is significant, indicating a considerable degree of persistence. Aside from these effects, no other coefficient is significant.

Table 5. U.S. and EC Per Cartel Fines

	1. $\ln USPerCartelFines_t$	2. $\ln ECPerCartelFines_t$
Constant	-154.661*** (0.001)	-807.840*** (0.001)
Trend	0.079*** (0.001)	0.409*** (0.011)
$\ln USPerCartelFines_{t-1}$	0.403*** (0.003)	0.461 (0.637)
$\ln USPerCartelFines_{t-2}$	-	-0.389 (0.668)
$\ln ECPerCartelFines_{t-1}$	-0.011 (0.466)	-0.183 (0.199)
$\ln ECPerCartelFines_{t-2}$	-0.020 (0.332)	-
\bar{R}^2	0.786	0.421
P	-0.017	-0.011

Notes: (a) all specifications are estimated using data over 1969-2016; (b) \ln denotes natural logarithm; (c) p -values calculated from robust standard errors are in parentheses; (d) the asterisks *, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively; and (e) ρ is the estimate of the first-order autocorrelation.

Our overall conclusion from the estimation exercise above is that we do not find any obvious interrelationships between U.S. and EC cartel prosecutions or fines, based on aggregate enforcement data. This is not to say there are no dynamic interrelationships. It is more likely that if we study the same issue on a cartel-by-cartel basis, we may well find that specific cartel

prosecutions in the U.S. (EC) lead to sharing of information and prosecutions in EC (U.S.), with consequent implications for fines and other penalties. If the dynamic case-specific linkages are few relative to the aggregate enforcement data, then aggregate estimation of the sort using specification (2) may not reveal clear interdependence. This line of inquiry, using a combination of case-specific information and aggregate enforcement statistics can be an interesting future extension.

8. Concluding remarks

Cartel prosecution numbers has shifted over time as a result of institutional changes in the DOJ Antitrust toolkit. The three primary changes have been increased fines, increased incarceration, and the introduction of the revised leniency program. These changes in tools have led to potential change to which would-be cartel members respond. A growing internationalization of cartel enforcement also increases the probability of detection and the amount of both government and private damages that firms pay for their illegal behavior. Would-be and current cartel members may be adapting to the current structure of cartel enforcement. Further tweaks to the enforcement system are likely to be introduced for enforcement to keep up with collusion.

Overall, we find that cartel prosecution has shifted over time to a larger set of penalties for violations but with fewer total cartels caught. These results paint an incomplete picture. They do not directly explain whether or not cartel prosecutions have made collusion more or less difficult, how mechanisms for coordination across firms for collusive behavior may be changing in response to prosecutions, nor do they capture how doctrinal changes in tacit agreement or technological innovation may be shifting what may be observed. However, our findings do allow for observations across changes in the economy, presidential administrations, political parties, merger waves, government enforcement in Europe and other factors to fill in important gaps as to at least some attributes of the overall enforcement picture. The overall enforcement profile continues to change and will require ongoing qualitative and quantitative empirical study to better inform policy decisions.