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Cartels and Collusion - Empirical Evidence

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1. Introduction

The incentive to coordinate behavior in order to increase profits is a powerful one. Despite the now widespread legal prohibitions on explicit coordination, firms continue to form cartels to restrict output or set prices. Cartels occur in a wide range of industries and they engage in a wide range of behaviors in their efforts to increase profits. They may set prices, rig bids, allocate markets or customers, make side payments to one another, and even develop elaborate structures for implementing and hiding their activities. In this chapter, we discuss the wide variety of techniques that cartels use to increase prices and profits. While we emphasize that cartels are pervasive across a wide variety of industries and are more stable than one might expect, they also require fairly elaborate techniques to achieve these goals. This suggests that tacit collusion, without communication, may be harder than one might otherwise presume.

Empirical research has informed our understanding of the determinants of the formation, prevalence, and duration of cartels. Studies of national and international markets across the twentieth century find cartels in a wide variety of products and services, and these cartels typically last between five and eight years. The most important determinant of cartel breakup is effective antitrust policy. While it has often been presumed that cartels' demise results from cheating by member firms tempted by short term profits, empirical analysis suggests that cheating rarely destroys cartels. The potential profits from collusion provide sufficient incentives for cartels to develop creative ways to limit the temptations that inevitably arise.

While scholars and policy makers have often been concerned that business cycle downturns are associated with cartel formation, the evidence we review here does not suggest strong cyclical effects. There is evidence that cartels are formed during periods of falling prices, but these are more likely to be the result of market integration or an increase in competitive intensity than macroeconomic fluctuations. Similarly, cartel breakup does not evidence strong cyclical effects. In the sections that follow we address cartel formation and breakup, how cartels raise prices, and the effects their actions have. We conclude with a discussion of the effectiveness of antitrust and leniency policy.

2. Cartel Prevalence

Perhaps the most surprising thing about cartels is how pervasive they are. Over a century after the United States first adopted laws making price-fixing a felony, and two decades after the U.S., the European Commission, and competition authorities around the world reached consensus that hard core cartels would not be tolerated, cartels continue to form. They form in local markets with relatively small firms, and they form in highly concentrated global markets dominated by multiproduct multinationals.

Connor (2007) assembles evidence on the operation of cartels in 279 markets between 1888 and 2005. These include at least 57 that were operating legally and over one hundred that had international membership.¹ The Great Britain Board of Trade (1976) studied 125 cartels active in Britain prior to World War II. Many of these were international cartels, covering a wide range of industries. As is the case today, these were predominantly reasonably sophisticated intermediate goods, including electrical and other manufacturing machinery, chemicals, coal and steel, textiles, paper, glass, and non-ferrous metals (91-92). George Symeonidis found that in the UK in the 1950s, 36 percent of industries self-reported having collusive agreements; another 26 percent self-reported some form of coordination.² A comparable study of Finnish cartels found that about a third of all industries self-reported having a cartel.³ Folster and Peltzman (2010) examine similar data for registered cartels in Sweden and found: “Around 1990, there were over one thousand cartel agreements registered, affecting about 15 percent of total sales of goods and services” (255). Audretsch (1989) reports that there were “more than 300 legal cartels in West Germany as of January 1987” (580).

¹ Connor (2007) lists all the cartels in his sample along with industry, country, and some details regarding the cartel’s operation and prosecution (74, Table 2; 136-153, Table A1).

² For his classification of individual industries, see Symeonidis (2002), Table 3.1 and 69-71. For his mechanism for classifying industries as collusive, competitive or ambiguous see 61-65.

³ Hyytinen, Steen, and Toivanen (2011) use a sample of legal cartels in Finland from 1951-1990 to estimate the prevalence of cartels during this period of government sanctioned price-fixing. The sample covers 234 manufacturing industries: in 109 of these industries there was at least one cartel of national scope during the sample period. For the remainder of the sample, no cartel was registered, but it is unknown whether a cartel existed. They present a Hidden Markov Model that “consists of a hidden process and an observation process that reveals information on the hidden state of the industry for some periods, but not for others” (ibid., 2).

Posner's (1970) landmark study of antitrust enforcement in the United States catalogued 989 cases involving a horizontal conspiracy between 1890 and 1969. Posner, like others who have since studied U.S. price-fixing, used the Commerce Clearing House Trade Regulation Reporter (CCH) to create a picture of the breadth of cartel activity in the United States. The CCH reports all antitrust convictions by the U.S. Department of Justice (DOJ). Using CCH data from 1955-1997, Gallo (2000) reports 688 horizontal per se violations. Bryant and Eckard (1991) use CCH data to estimate the probability of cartel detection; they report 184 price-fixing indictments between 1961 and 1988.⁴ Calculating a rough average of the number of domestic cartel cases per year, we find a range of 12 to 16 per cases per year (using Posner and Gallo's broader definition) and about 6.5 per year (from Bryant and Eckard). From 1992 – 2010 there were approximately 700 DOJ cartel convictions, or over 36 cartel convictions per year.⁵ It is important to note that in most cases a cartel results in more than one conviction, so this average of raw data from contemporary U.S. cases is not comparable to those of earlier studies. It does indicate that cartels are still active in the United States market, despite increased enforcement.

On average, cartels in the Bryant and Eckard sample lasted a little over five and a half years.⁶ Using comparable CCH data, the average duration of collusion of U.S. price fixing cases over the last twenty years is a little longer, about 8 years.⁷ While the mid-twentieth century cases include some convictions of large, well-known firms, as in the famous GE-Westinghouse electrical equipment conspiracy of the 1950s, many of the convicted firms were relatively small and in geographically well-defined markets, such as road paving and school milk.⁸ While these

⁴ "We treat nolo contendere ("no contest") pleas as equivalent to guilty pleas and convictions in constituting evidence of a conspiracy." Bryant and Eckard (1991), 532.

⁵ Authors' calculations from individual cases listed on U.S. Department of Justice website. Antitrust Case Filings, United States Department of Justice, accessed Nov. 10, 2012, <http://www.justice.gov/atr/cases>.

⁶ Calculated from data provide by Bryant and Eckard (1991).

⁷ This average is not over all cartels, but over all cases as reported in CCH. There is often more than one case per cartel, so this average weights cartels that had more court cases more heavily than cartels with fewer cases. This mostly means that cartels with more members are weighted more heavily, but other things can also affect the number of court cases such as legal actions against individual employees.

⁸ Lanzillotti (1996), Lee (1999), Porter and Zona (1999), and Scott (2000) all study cartels in public provision of school milk. Feinstein, Block, and Nold (1985), Porter and Zona (1993), and Gupta (2001) study price fixing in

markets are still prone to collusion, cartels consisting of multinational firms in global markets now capture headlines.

While international cartels are now a focus of antitrust prosecutions, they are not a new phenomenon. Liefmann (1927), for example, documented forty international cartel agreements from the late nineteenth century (129). Regarding the early twentieth century, Joel Davidow (1983) states: “In the pre-World War II era, cartels were as popular at the international level as they were at the national. Various studies estimated that during the 1930s, 30 to 40 percent of all world trade in manufactured goods was cartelized” (351). International cartels were probably less pervasive in the late twentieth century. Levenstein and Suslow (2004) estimate that \$190 billion of global trade was affected by international cartels in 1997, representing less than four percent of all global trade (815).

Many countries provide or have provided a mechanism for industries to register cooperative export agreements. These agreements sometimes, but not always, explicitly provide for cooperative price setting. They often include coordination and sharing of marketing and transportation costs.⁹ While these registries have largely disappeared along with their explicit exemptions from antitrust laws, hundreds of industries participated in such agreements during the twentieth century.¹⁰ For example, the U.S. Webb-Pomerene Act of 1918 gives an antitrust exemption to firms that create voluntary associations for cooperation in export activities. Andrew Dick’s (1996) study found 125 Webb-Pomerene Associations were created between 1920 and 1965. In 1975, Australia reported sixty-nine registered export associations. Japan had 180 in 1973 and Germany had 227 in 1972.¹¹ The United States had only thirty odd export associations registered under the Webb-Pomerene Act by the 1970s. The Export Trading

highway construction. For more on the electrical equipment conspiracy, see Bane (1973) and Baker and Faulkner (1993).

⁹ Dick (1996b) analyzes the difference between Webb-Pomerene Associations that focused on price and those that focused on joint marketing activities.

¹⁰ Levenstein and Suslow (2005) discusses changes in the laws underlying these registrations and explicit exemptions in fifty-five countries (801-17).

¹¹ Levenstein and Suslow (2005), 793. Jacquemin et al. (1981) examine 545 Japanese export cartels in forty sectors between 1960 and 1970 in order to improve our understanding of the determinants of cartel duration. See also Levenstein and Suslow (2006a), 50n.

Company Act of 1982 expanded the scope of the permissible activities and limited potential liability, generating new interest in export exemptions. In 2002, there were 150 ETCs registered in the United States.¹²

Cartels are not only widespread across time and geography, they occur across a wide variety of products and sectors. Levenstein and Suslow (2011) assemble a sample of 81 international cartels prosecuted by the U.S. Department of Justice or the European Commission between 1990 and 2010. Most of these were in intermediate manufactured goods and services and span a variety of industries:

Forty percent are in chemicals, especially food additives. Another quarter are in a variety of other manufacturing industries, with multiple cartel convictions in steel, carbon and graphite products, plastics, and paper industries. Cartels were also found in specialized services, such as fine arts auctions and specialized tanker shipping. The only major sector that does not appear in the sample is final consumer goods (Levenstein and Suslow, 462-3).

There are some industries that seem particularly prone to collusive activity, across space and time. Levenstein and Suslow (2006a, Table 3) discuss a number of historical examples of industries in which there are repeated episodes of collusion. Industries as varied as shipping and sugar, which are characterized by relatively high fixed costs, rarely seem to maintain stable competition. There are also firms who seem drawn to cooperative behavior.¹³ This may reflect firm or industry culture. For example, Spar (1994) argued that the culture of cooperation in the early diamond industry facilitated collusion. In the early twentieth century U.S., intense competition was sometime considered unethical because it deprived others of their livelihood (Levenstein 2012, 8). There are also contemporary industries whose culture and business practices appear to facilitate or encourage collusion. For example, in a post-2008 financial crisis

¹² Levenstein and Suslow (2005), table 1; 818-19.

¹³ For example, Degussa was convicted of price-fixing by the European Commission for participation in Methionine (1986-1999), Methacrylate (1997-2002), Organic Peroxides (1971-1999), Hydrogen Peroxide and Perborates (1994-2000), and Vitamin B3 (1992-1998). See Levenstein and Suslow (2010), 34n.

municipal bond market case, industry observers claim that bid rigging was considered normal business practice:

But the reason no one was whispering isn't that their actions weren't illegal – it's because the bid rigging was so incredibly common the defendants simply forgot to be ashamed of it. "The tapes illustrate the cavalier attitude which the financial community brought toward this behavior," says Michael Hausfeld, a renowned class-action attorney ... "It became the predominant mode of transacting business." (Taibbi 2012, 82).

Recidivism may also be evidence of learning on the part of managers and firms. Participants in a cartel in one market may transfer their experience to other markets.

3. Cartel Formation

Economists' theoretical models provide limited insight into why an industry which could profitably collude might not do so.¹⁴ The empirical literature on cartel formation is equally sparse.¹⁵ In general cartel formation is not publicly observed, and therefore is harder to measure than breakup. There are relatively few natural experiments that a researcher can use to test hypotheses about conditions under which cartels may be more likely to form. Changes in enforcement offer one such opportunity. There is evidence that changes in antitrust policy affect the incentive to form a cartel. For example, scholars have argued that the temporary suspension of antitrust enforcement during the period of the National Recovery Act in the United States (1933 – 1935) encouraged cartel formation.¹⁶

Conversely, increases in enforcement may discourage cartel formation. The most prominent example of the latter is the restructuring of leniency programs in the mid-1990s in the United States and the subsequent adoption of similar programs in numerous other countries around the world. The impact of leniency is nuanced and depends on policy design. Chen and

¹⁴ See, for example, Filson et al. (2001), Schmitt and Weder (1998), Bos and Harrington (2010), Eaton and Eswaran (1998), Hviid (1992), Kuipers and Olaizola (2008), Prokop (1999), and Thoron (1998).

¹⁵ See, for example, Filson et al. (2001) on formation of federally sanctioned agricultural cooperatives ("marketing orders"), Schmitt and Weder (1998) on cartel formation and sunk costs, Alexander (1994) and Krepps (1997) on the National Industrial Recovery Act, and Dick (1996), testing a model of cartel formation on a Webb-Pomerene cartel dataset.

¹⁶ See Alexander (1994) and Krepps (1997).

Harrington (2007) demonstrate that while full leniency decreases the incentive to form cartels, since it makes defection more profitable, partial leniency combined with imperfect detection can provide cartels with a tool to punish defectors. It follows that partial leniency can increase the profitability of collusion and the likelihood of cartel formation.¹⁷

The essential question regarding cartel formation is why an industry that was not colluding yesterday would start colluding today. The literature often frames this as a question of the relationship between the business cycle and cartel formation: do firms that were not colluding start doing so during economic downturns? While cartels seem to form during periods of falling prices, the existing evidence suggests that formation occurs in response to increases in the *intensity of competition*. That is, what matters is the nature of competition in a particular market, rather than declines in the aggregate price level.¹⁸

Although data are limited, one can further explore this question of the possible link between cartel formation and business cycles. Levenstein and Suslow (2006a) includes a meta-analysis of case studies of cartels that formed between 1857 and 1950 (67, Table 10). These studies vary in their methodology and data; in order to have some consistency, we focus on twelve U.S. cartels and compare to NBER business cycle reference dates for this subsample.¹⁹ We find that eight (67%) began in years during which there was a recession.²⁰ Alone, one might draw the conclusion from this that cartels are much more likely to form during recessions. However, 63% of the years between 1857 and 1950 experienced recessions. Cartels in this subsample started disproportionately in years with recessions, but not excessively so, given that there

¹⁷ Spagnolo (2000; 2008) makes a similar point that partial amnesty can increase the set of collusive equilibria. Thus, it is possible that leniency policies that reduce liability, but do not entirely eliminate it, facilitate collusion. See Aubert, Rey, and Kovacic (2006) for a proposal to improve leniency programs.

¹⁸ Levenstein and Suslow (2006a), “Many studies report that a cartel was formed during a period of falling prices, but this is not always, or even usually, associated with falling demand (either for the particular product or in the general economy). Instead, falling prices were often the result of entry or the integration of previously distinct markets” (67). See also, Levenstein and Suslow (2011).

¹⁹ It is important to note that cartel formation is often measured with error. We use the start date of the first known agreement between any two cartel members as reported by the competition authority in its enforcement action. In some cases, cartel may have begun earlier, but the authorities do not have evidence of explicit communication.

²⁰ NBER business cycle reference dates, from 1857 to the present, can be found at US Business Cycle Expansions and Contractions, The National Bureau of Economics Research, Sep. 20, 2010, www.nber.org/cycles.html.

were many recession years during this period.²¹ A similar analysis of the 71 cartel episodes in Suslow (2005)'s inter-war sample (1918-1938) finds that 55% of the cartels began during months that were recessions. Over this period, 43% of the months were recession months. As in the sample of twelve case studies, cartels started disproportionately during recessions, but not overwhelmingly so.

Turning to Bryant and Eckard's (1991) sample of U.S. horizontal price-fixing conspiracies which formed between 1932 and 1985, we find that 39 percent formed during years in which there was a recession.²² Thirty-nine percent of these years are designated by the NBER as experiencing a recession. This evidence does not indicate any relationship between cartel formation and business cycle downturns. For about a third of the sample, we also know the month or quarter in which the conspiracy began. For this sub-sample, about 25% of the cartels formed during months in which the U.S. economy was in recession. NBER designates about 21 percent of the months between 1932 and 1985 as recessionary. Again, this, admittedly rough characterization of the data does not suggest that cartels are more likely to form during recessions.²³

Finally, we turn to Levenstein and Suslow's (2011) sample of contemporary international cartels prosecuted by the U.S. DOJ or the European Commission. For this chapter, we have updated the sample to include all convictions through the end of 2011. We find that only 11% of the cartels started during recessionary months. This undoubtedly reflects in part the dampening of the business cycle during the period 1971 to 2004 when these cartels were formed: a mere

²¹ Part of this is driven by the NBER use of month-year dates, while for these cartels we only have the year of each cartel's formation. So any cartel that began during a year when there was a recession is counted as "starting during a recession year" even though it may have started before or after the months of the recession.

²² We are extremely grateful to Bryant and Eckard for their willingness to share their data with us.

²³ The finding is comparable to Andrew Dick's (1996) study of the formation of Webb-Pomerene Associations between 1920 and 1965. He finds no association between the timing of the formation of export association and fluctuations in export demand (215, Table 4). He defines downturns as periods of declining prices in the broad export sector in which the cartel is operating: "I define business cycle timing based on U.S. export price movements. To assure exogeneity with respect to a cartel's actions, business reference cycles are measured using one of four broad export price indexes—foods, crude materials, semifinished manufactures, or finished manufactures, depending on the cartelized product. I begin by evaluating the effect of actual export business cycle timing on cartels' stability. I define a dummy variable CYCLE that equals one if the cartel's sector was in a peak-to-trough period (a downturn) during the cartel's final year and equals zero if the sector was in a trough-to-peak period (an upturn)" (ibid., 270-71).

13% of the months within this period were recessionary.²⁴ For this sample in particular, it is important to recognize that start dates are negotiated with the authorities. The only cartels included in the dataset are those that have been selected for us by the legal process; this is not likely to be a random selection of cartels. Because earlier reported start dates increase fines, firms have an incentive to negotiate for a later reported start date. Unless the authorities have conclusive evidence of cartel activity, they are more likely to settle on a later date and a guilty plea, than risk a trial over an earlier start date. Our reported start dates are probably later, on average, than actual cartel formation, but we have no reason to suspect that there is bias with regard to formation during recessions.

NBER business cycle reference dates capture economy-wide recessions, not sector-specific price fluctuations. Cartels do often form in response to falling prices for particular goods, but these are not necessarily linked to falling aggregate price levels associated with downturns in overall economic activity. Firms may be responding to falling prices, but prices were often falling because of events in a specific market. A common “explanation” for cartel formation is that some industry participant became more aggressive, cutting prices or going after others’ customers. In some cases this reflects an internal change in strategy on the part of an incumbent firm, such as a change in leadership. But in many cases, there is a clear underlying exogenous economic reason for this change in behavior such as entry, fluctuating exchange rates, or market integration. For example, European integration and broader globalization increased competitive intensity in many markets. In one illustrative case, hydrogen peroxide producers reported to European Commission investigators that their cartel formed following the expansion of Nordic and former East German producers.²⁵ Similarly, the European Commission reported that: “In early 1986 Rhone-Poulenc and Degussa contacted Nippon Soda

²⁴ Because cartels do not form all at once, and because their formation is almost always furtive, cartel start dates are measured with error. Reported start dates are almost surely later than actual start dates, on average, but it is unlikely that there is any systematic bias toward measuring their formation at a certain point in the business cycle. It is also the case that Suslow (2005) and Levenstein and Suslow (2011) samples both consist of international cartels. NBER business cycle reference dates are for the U.S. economy. These are likely highly correlated with the business cycles of the relevant countries, but certainly not perfectly. In particular, many of the Suslow cartels formed during the 1920s. The U.S. economy was probably stronger than many European economies during this period, so our estimate of the proportion of cartels formed during downturns might be an underestimate.

²⁵ Commission Decision 2006/903/EC (Hydrogen Peroxide and Perborate), 2006 O.J. (L 353) 54.

and Sumitomo because they felt that the Japanese [methionine] producers' were encroaching on 'their' home markets...."²⁶ Ferry operators shipping freight across the English Channel formed a cartel after the United Kingdom withdrew from the European Monetary System. The depreciation of the pound led to falling real revenues for Continental firms, "requiring" a coordinated response on both sides of the Channel.²⁷

There are also some industries where cartels seem to form on a regular basis. Following the meeting of the 2012 International Competition Network, Phil Evans wrote: "The cartel discussions ... all appeared to point to a factor in cartel formation that is rarely talked about – the fact that some industries appear to have cultures of behaviour that appear to more easily step over into cartelisation, than others. This is one of the 'softer issues' that emerged during discussions that need exploring, but that the agencies themselves are unlikely to be in a particularly strong position to do so."²⁸ It would be useful to have research that analyzes characteristics of business or national culture that make cartel formation more likely. This could provide insight into the challenges to cartel formation, building on research on cartel formation and maintenance costs as discussed in Bradburd and Over (1982) and Alexander (1994). Such an analysis might also provide the basis for effective outreach and education tools for competition authorities attempting to encourage a culture of competition and change business norms.

4. How do cartels set prices?

What kinds of agreements do cartels come to in order to raise prices? Sometimes they simply agree not to undercut one another. Other times they agree to specific prices, which the authorities and the conspirators often refer to as target prices. They may only agree to a minimum price, so that it is permissible for firms to charge different prices. Under such an agreement, firms may still negotiate prices with their own customers. Cartel members may agree to specific percentage increases; in other cases, the agreements coordinate prices to limit secular declines in price. The latter occurs both for products that are at the end of the product

²⁶ Commission Decision 2003/674/EC (Methionine), 2003 O.J. (L 255) 1.

²⁷ Commission Decision 97/84/EC (Ferry Operators-Currency Surcharges), 1996 O.J. (L 026) 23.

²⁸ Phil Evans, Reflections on ICN (Rio) 2012, Competition Online Forum, May 7, 2012, <http://groups.yahoo.com/group/CompetitionOnlineForum>.

life cycle (e.g., fax paper, videotapes) and products that have been affected by aggregate fluctuations in demand. Cartel members may agree to coordinate the timing of price announcements. In some cases, the timing of price announcements is intentionally manipulated to disguise collusive activity, with the initial price announcement rotating among cartel members (e.g., electrical carbon) or the timing being intentionally staggered (e.g., MCAA). Cartels may engage in coordinated price discrimination, agreeing to customer-specific prices, prices in different geographic markets and for slightly different products (e.g., sorbates). Some cartels focus on the spread between prices in different markets in order to limit arbitrage. Cartels will also adjust prices in different markets, when necessary, for example as a result of exchange rate fluctuations.

While much of this is similar or the same as the behavior one would predict for a monopoly firm, some is specific to cartels. In particular, cartels attempt to hide their coordination from customers and competition authorities. They also make agreements to engage in specific behaviors that facilitate monitoring of one another's pricing by, for example, making public price announcements. Successful collusion requires extensive communication, both in private and via public signals.²⁹

Cartels set parameters for a wide range of dimensions along which they might compete. At times they agree to restrict or coordinate rebates, discounts, surcharges, transportation costs, or the provision of credit. The cartel may also agree to set the length of permissible contracts: agreeing to supply for two years at the current price is a way to undercut a competitor who only guarantees the price for a year. Cartels often limit long-term contracts and some specifically tie long-term contracts to spot prices (e.g., DRAM).

Where the product has multiple components that are combined to make a customer-specific product, collusion may be more difficult. This too can be overcome.³⁰ As was the case in the 1950s U.S. electrical equipment conspiracy, cartels publish a price list or a price book from

²⁹ For more discussion of how cartel conspirators collude see Harrington (2006) and Levenstein and Suslow (2006b).

³⁰ In the 1920s, the U.S. Federal Trade Commission encouraged firms to adopt uniform cost accounting systems in order to facilitate tacit collusion in markets like these where complicated products were believed to lead firms to charge prices below their own costs. It was hoped that using similar cost accounting systems to price their products would dampen competition. Levenstein (1998), 35.

which the collusive price can be constructed. For example, the electrical and mechanical carbon and graphite products cartel attempted to set prices in a market where there were “literally thousands of varieties ... Most often they are customer-designed.”³¹ They resolved this by establishing a "basic material price" and adding charges for additional machining or components:

[E]ach member would arrive in principle at exactly the same price increase, in relative terms, for each additional cubic centimetre of carbon used or for each additional screw or other tooling added. Then they multiplied by a "currency co-efficient" and "quantity co-efficient." Commission Decision (Electrical and Mechanical Carbon and Graphite Products).

In most cases, agreement on price is not sufficient. Thus, cartels generally assign output levels or market shares.³² In Levenstein and Suslow (2011), 80% of international cartels had some sort of market allocation (Table 1). They may allocate geographic markets to members, but increasingly, in a twenty-first century world of global supply chains, cartels allocate customers. This may make it harder to detect and enforce collusion on a national scale and highlights the importance of international coordination among antitrust authorities.

Where necessary, cartels buy output from one another in order to maintain these quantity agreements. This is similar to the behavior of an efficient monopolist who reallocates production among plants. One difference is that while more efficient cartel members may be able to extract larger quotas from their co-conspirators, there is rarely any systematic attempt to allocate production or output according to firm costs.³³ In Levenstein and Suslow (2011), about one-third of the cartels used a mechanism to compensate one another when one firm's sales exceeded its cartel allocation (Table 1).

³¹ Commission Decision 2204/.../EC (Electrical and Mechanical Carbon and Graphite Products), 2003 http://ec.europa.eu/competition/antitrust/cases/dec_docs/38359/38359_36_1.pdf.

³² Harrington and Skrzypacz (2011) provide a theoretical explanation of this common practice. Setting price and quantity is redundant in a world of perfect information, but not in the world of uncertainty in which these cartels operate.

³³ Athey and Bagwell (2001).

These agreements do not cover all dimensions along which cartel members could compete, but they certainly discuss and come to agreement on many of them. In some cases, where the cartel restricts sales in one geographical area, firms respond by competing in other parts of the world. Analogously, if a cartel restricts price and output, firms may compete in other dimensions, such as offering preferred terms or higher quality. Some of these other terms are much harder for cartels to set limits for and police. Cartels address these challenges by sharing information and monitoring one another, which virtually all cartels do (80% in Table 1). In order to protect the cartel's market share, they may agree to acquire competitors or to refrain from sharing technology with cartel outsiders (36% engaged in activity to exclude or eliminate non-cartel producers, Table 1).

Agreement alone is not sufficient. Cartels engage in three types of behavior to assure that their members adhere to the agreement. They enhance “the information that firms have about one another and the market; [compensate] one another when firms' sales vary from assigned quotas due to factors outside of their control, such as random fluctuations in demand; and [punish] firms when violations do occur” (Levenstein and Suslow 2012, 458-9). We have found that compensation schemes are very effective – much more so than punishments – at keeping cartels together. Nineteen percent of the cartels in Table 1 punished one another for violating cartel agreements, but these cartels tended to be less stable (Levenstein and Suslow 2012, 476). Harrington and Skrzypacz (2011) demonstrate that in markets with private quantities and prices, monitoring and compensation allow cartels to arrive at a collusive equilibrium. They do so by creating incentives for truthful reporting. These schema also create evidentiary trails that deserve attention from competition authorities. In particular, information sharing and inter-firm sales, while having potential pro-competitive justification, are shown both theoretically and in practice to be very useful collusive tools (Levenstein and Suslow 2006b).

The most successful cartels do not simply agree to a certain set of parameters. They create organizations or governance structures that allow them to address challenges that arise sequentially, expand the scope of the agreement, and provide flexibility in changing economic conditions. For example, Genesove and Mullin (2001) describe collusion among sugar producers in the 1920s and 1930s: “meetings embodied a governance structure for the

agreement, ensuring its adaptation to (typically endogenous) changing circumstances” (380). For a discussion of the variety of organizational structures that cartels used for self-governance in the late twentieth century, see Levenstein and Suslow (2006b). In the most sophisticated cartels, top level management sets overall cartel strategy, but the inherent uncertainty of the economic environment requires ongoing communication and decision-making among operational employees.³⁴

5. How do cartels affect prices?

While much attention has been given to the dynamic effects of collusion and cooperation, the price effects associated with collusion can have a sizable economic impact that should not be ignored. Unfortunately, objective estimates of the effects of cartels on prices (not to mention deadweight loss) are relatively few. In 1989 Cohen and Scheffman wrote that “there is a sparse ... economics literature attempting to estimate the markup in price-fixing cases” (344).³⁵ The situation has not changed dramatically in the intervening decades.

Science has been stymied because often the only researchers with access to the data necessary to estimate counterfactual prices that would allow one to make objective estimates of price effects are researchers who are hired in contested court cases. These estimates are, quite reasonably, influenced by their intended purpose, but this undermines their usefulness in establishing the overall effects of cartels. For example, Cohen and Scheffman (1989) attempt to back out price effects from Block, Nold and Sidak’s (1981) study reporting a 2.87% average settlement in seven class action cases in the mid-1970s (345 of Cohen and Scheffman). They suggest that the 2.87% should be divided by three (for treble damages) and the number of years of each case, resulting in a low estimate of the price effects of collusion. But it is odd to use settlements to estimate price effects, rather than the other way around. In particular, the size of settlements may depend more on what is possible to prove in court than on economic effects.

³⁴ See Levenstein and Suslow (2006b), table 1. For rich descriptions of the inner workings of these cartels see Connor (2008) and Harrington and Skrzypacz (2011).

³⁵ Cohen and Scheffman (1989), 344-345, report two studies estimating cartel effects: corrugated containers cartel allegedly raised prices between 7.8 and 26% (Finkelstein and Levenbach [1983]) and Washington bakers at least 15%, Federal Trade Commission (1967). Newmark (1988) argues that the bakers’ effect was closer to zero.

Werden (2008) provides a useful summary of the research in this area. Much of this research has focused on bid-rigging in which there is repeated price formation and the winning (sometimes even losing) bids are often public information.³⁶ He cites six studies of bid-rigging conspiracies found that collusion raised prices between 6.5 and 30 percent (436). Bid-rigging seems to be particularly common in public procurement, in part because government transparency and anti-corruption rules can make cartel enforcement easier. Transparency makes for good government, but it also makes it easier for cartel participants to detect, and therefore deter, defection. The problem is sufficiently pervasive that the U.S. Justice Department initiated a training program for government officials to “detect and report collusive and fraudulent conduct” during the implementation of the 2009 American Recovery and Reinvestment Act program.³⁷ Several competition agencies have been actively using econometric screens to detect price fixing. For example, Brazil used screening to identify which of several hundred gasoline markets was most likely to have been the victim of collusive pricing (Ragazzo 2012).³⁸

While noting that “studies of the effects of price fixing are far less common,” (436) Werden concludes that “cartels prosecuted as felonies in the U.S. typically had substantial effects – at least 10% on average” (436). Connor and Lande (2005) argue that the ten percent figure, which is used by the U.S. Justice Department in calculating damages, underestimates the impact.³⁹ Connor (2008) examines the price effects of several global cartels in food additive and related markets. He finds prices increases of between 12 and 28 percent.⁴⁰ Levenstein, Sivadasan, and Suslow (2011) examine price effects for seven international cartels and find significant declines

³⁶ See, for example, Porter and Zona (1999).

³⁷ Hammond (2009).

³⁸ See also, Mena-Labarthe (2012), who writes that, “the Mexican Competition Commission has made some efforts to use screening to detect collusion and to prioritize investigation resources” (3). For advances in screening techniques, see Abrantes-Metz et al. (2006). For an overview of the potential of screens to detect explicit collusion, see Abrantes-Metz and Metz (2012). See also, Bolotova et al. (2008).

³⁹ See also Connor and Bolotova (2006) which examines 800 cartels over the last 250 years. They find an average price effect of 29% (1134). OECD (2002) notes the general lack of any measure of cartel harm: “Real-world data on actual harm is sparse” (9). They do provide “estimates of harm” for fourteen cartels for which such an estimate could be determined. These estimates range from 3% to 65% (9, par. 21; Annex A). A useful and accessible summary of the effects of cartels can be found in Michael Whinston (2008), 20-38.

⁴⁰ Connor (2008) reports ranges for estimates of overcharges for vitamins (339), lysine (235), and citric acid (165).

in prices following the breakup of each of the cartels selected for analysis.⁴¹ However, these cartels were selected for further analysis precisely because of the decline in the price of the product at the time of the cartel's demise. Thus, one cannot extrapolate from these case studies to cartels generally. Comparing the four years before and four years after cartel breakup for each cartel, the average price decline significantly, from approximately seven percent in the case of Citric Acid to almost sixty percent for Vitamin E. The decline in price is significant in both the short (two-year) and long (four-year) run. This evidence "implies that the short-run price-declines were not simply the result of a temporary price war following breakup and that antitrust intervention, at least for these seven cartels, had a sustained impact on market outcomes" (Levenstein et al. (2011), 14).

This paper illustrates a more general point about research on cartels. Given the multiplicity of equilibria in oligopoly models, it is often most useful to generate stylized facts from meta-analysis of multiple case studies of individual markets. This is particularly true when studying price effects. It is simply impossible to estimate meaningfully the effects of collusion on price cross-sectionally. Sutton (1997, 67-68) makes this point and suggests alternative econometric techniques based on establishing "bounds" around possible outcomes consistent with particular of competition.

The obvious limitation of this line of research is the lack of necessary data for most cartels. Most civil cases end with settlement agreements that protect the confidentiality of the data used to estimate cartel effects. Criminal cases in the United States are almost all resolved with a plea bargain with virtually no information made public. The European Commission has published a great deal of descriptive information on how cartels organize and operate. Unfortunately, competition authorities are not charged with making data on prices, quantities, or costs available for scientific research.

Measurement of price effects is also complicated by the difficulty in estimating a counterfactual price. This is not only because prices are often hidden. It is also that cartels influence more than price: they influence entry, the pace of technological change, etc., and that in turn affects

⁴¹ We define price as the ratio of trade value to trade quantity for each specific product. We calculate the average price for each product, for each year, for each bilateral trade pair.

price. Levenstein and Suslow (2011) found that over a third of contemporary international cartels engaged in behavior designed to restrict entry. For example, “members of the electrical carbon cartel refused to supply any graphite to an East German competitor that had entered the international market after unification” (472). Thus a counterfactual price, absent explicit collusion today, but given today’s industry structure, might not be the right counterfactual. Symeonidis (2002) is the exception that proves the rule in that his analysis does examine the endogeneity of industry structure. He is able to do this because there was a specific historical episode with an exogenous change in competition rules that allows him to identify the counterfactual industry structure. He uses this to infer the effects of collusion on productivity, advertising and research and development expenditures.⁴² But in even in this case, it is not possible to estimate counter-factual prices.

6. What causes cartel breakup?

Since Stigler (1964), economists have focused on cheating as the most significant challenge to cartels and the most important cause of cartel breakup, but historically, bargaining, coordination, and entry have been the biggest challenges to explicit collusion (Levenstein and Suslow 2006a, 45). With the advent of the a global consensus against “hard core” cartels and the adoption of the leniency policies discussed above, antitrust action is responsible for most cartel breakup today: about eighty percent of the cartels in Levenstein and Suslow (2011) were ended by antitrust intervention. The precipitating cause of cartel breakup in this sample of contemporary international cartels is reported in Table 2.

There are several lessons to draw from this sample about the economic causes underlying cartel breakup.⁴³ Our statistical analysis suggests two primary factors that increase the likelihood of cartel breakup: one cartel member’s financial instability or the entry of a new producer (485). Cartels are fairly savvy about the challenges that they face, including the oft-discussed incentive of members to cheat on cartel agreements. We find that,

⁴² For details on the impact on R&D and advertising see Symeonidis (2002). For productivity, profitability and wages, see Symeonidis (2007) and Symeonidis (2008).

⁴³ This is consistent with the repeated game literature on cartels, but suggests that firm-specific discount rates are more relevant than market interest rates in determining cartel stability.

cartels that have to punish their members are relatively unstable cartels. Many cartels suffer from a “little” cheating; this cheating does not result in punishment, let alone cartel death. Cartels use compensation mechanisms to limit the incentive to cheat as well to respond to variation in demand – which they know will occur. Cartels that use such compensation mechanisms are more likely to endure. Cartels that punish are frequently suffering from fundamental disagreements about how to divide markets or set prices. Pervasive and repeated violations of the terms of a cartel agreement do result in retaliatory punishments, but these punishments do not save the cartel. They undermine trust and lead to cartel breakup (485).

As discussed above, substantial attention has been given to cartel stability over the business cycle. In Levenstein and Suslow (2011) we test for the impact of the business cycle on cartel breakup among international cartels. We find that, “[n]either common knowledge measures of business cycles nor measures of unexpected shocks to demand appear to have any significant effect on cartel stability” (483). This contrasts with studies of earlier cartels that found significant effects of the Great Depression on cartel duration. This may reflect the greater severity and depth of business cycle fluctuations before World War II. However, Levenstein and Suslow (2006a) report that case studies, even during this earlier period, rarely find any role for macroeconomic fluctuations on cartel stability (67).

Since 1993 when the DOJ revised and expanded its amnesty policy to offer automatic amnesty to the first cartel member to confess voluntarily, leniency policies have been the primary tool of cartel detection and breakup.⁴⁴ The European Commission adopted a similar policy in 1996 and strengthened it in 2002.⁴⁵ Both the DOJ and the EC have increased the severity of penalties,

⁴⁴ The DOJ has had a corporate amnesty program since 1978, but the earlier program was ambiguous and ineffective. See Corporate Leniency Policy, Department of Justice Antitrust Division, Aug. 10, 1993, <http://www.justice.gov/atr/public/guidelines/0091.htm>; Individual Leniency Policy, Department of Justice Antitrust Division, Aug. 10, 1994, <http://www.justice.gov/atr/public/guidelines/0092.htm>. Hammond (2009) states that: “The revised Corporate Leniency Program has resulted in a surge in amnesty applications. Under the old policy, the Division obtained roughly one amnesty application per year. Under the new policy, the application rate has jumped to roughly two per month” (10).

⁴⁵ Leniency Policy, European Commission, last updated April 16, 2012, <http://ec.europa.eu/competition/cartels/leniency/leniency.html>. There are other conditions required for full immunity, such as immediately ending the infringement and not serving as the cartel ring leader. See also,

with multiple fines above the DOJ's older statutory limit of \$10 million and more frequent prison sentences in the U.S. Multiple jurisdictions have expanded the opportunities for customers to undertake private actions, suing for damages caused by cartels. The number of cartel prosecutions has increased dramatically since the adoption of these policies. Despite almost two decades of more active enforcement, the rate of cartel discoveries seems not to have abated.⁴⁶

As discussed above, theory suggests that leniency may have positive, insignificant or even perverse negative effects. Spagnolo (2000, 2007) demonstrates that partial amnesty can be used as a threat to prevent cheating, which could facilitate collusion.⁴⁷ Thus, the existence of private damage suits limits the effectiveness of leniency policies. While these suits bring sizable private resources to bear in the anti-cartel fight, those resources are primarily directed toward known cartels, not new cartel detection. These private damage suits may increase deterrence by increasing expected penalties, but they may create perverse effects if they allow cartels to use the threat of reporting a cartel to authorities as a tool of cartel enforcement. This suggests that deterrence might be better enhanced by increasing individual penalties, including jail terms, rather than creating or expanding private anti-trust enforcement.

Harrington and Chang (2009) distinguish between the impact of leniency on detection of existing cartels and deterrence of future cartels. The continuing stream of confessions suggests that while leniency policies may have increased deterrence, many firms still find it profitable to form cartels. There is a small but growing empirical literature aimed at evaluating the impact of leniency policy. Levenstein and Suslow (2011) find that the average duration of international cartels ending with amnesty application is 10.3 years, somewhat longer than average cartel duration (see Table 2). Disentangling the effects of leniency policy is methodologically very challenging, but those studies that have attempted it have found that leniency is effective.

Directorate-General for Competition, European Commission (2003), 32nd Report on Competition Policy 2002, par. 19-20, Belgium: Office for Official Publications of the European Communities, http://ec.europa.eu/competition/publications/annual_report/2002/en.pdf.

⁴⁶ See, for example, Joseph Wayland's 2012 speech, "Litigation in the Antitrust Division," reporting that the U.S. Department of Justice "have obtained more than \$2 billion in criminal fines and more than 88,000 days of jail time for criminal defendants since the start of 2009" (6).

⁴⁷ For further discussion of strategic responses to amnesty, see Harrington and Chang (2009) and Miller (2009).

Miller (2009) examines all U.S. Department of Justice cartel indictments between 1985 and 2005. He finds “that leniency enhances deterrence and detection capabilities [leading to] a 59 percent lower cartel formation rate and a 62 percent higher cartel detection rate....”⁴⁸

Even a successful leniency program is likely to discover the least profitable cartels. For example, when Rhône-Poulenc requested amnesty for its participation in the methionine cartel, it continued to participate and hide its participation in the methylglucamine cartel. The methionine cartel was at risk of collapse due to entry from a large, well-established firm. The methylglucamine cartel was a successful duopoly with no imminent threat to its stability.⁴⁹ This suggests that while leniency is a useful tool, it is not sufficient. The most profitable cartels will not be destabilized.

While the optimal level of deterrence is presumably not perfect deterrence, the continuing stream of cartel confessions suggests that current policy should be strengthened. This is particularly challenging in current economic conditions. If anything, there has been pressure on competition authorities to reduce fines so as not to bankrupt fragile firms (Levenstein and Suslow 2010). It may be that punishments that target individual managers with both fines and imprisonment or removal from corporate leadership (e.g., industry or leadership disbarment) will be more effective than simply increasing corporate fines (Ginsburg and Wright 2010). Other tools targeting corporate behavior and structure, such as consent agreements that provide ongoing monitoring or enhanced scrutiny of post-cartel mergers, may also be necessary.

It is possible that leniency generates so many confessions that it consumes the resources of competition authorities to the neglect of other methods for detecting cartels. If it is the most successful and stable cartels that leniency misses, it is important that the authorities have both the resources and the strategic vision to continue active detection beyond leniency. This may be particularly challenging in a resource-constrained environment when it appears that leniency is doing all that is necessary.

⁴⁸ Brenner (2009) examines 53 EC cartel cases from 1990-2003 and concludes that “the program provides incentives to reveal information on criminal activities” but he was unable to show conclusively whether leniency increased cartel breakup or reduced the incentive to collude (639).

⁴⁹ For details regarding these two cartels, see Levenstein and Suslow (2012), 466-67.

7. Conclusion

As with examinations of any kind of criminal activity, empirical research on cartels is challenging. Cartel members hide their activities. Legal authorities, balancing numerous demands in deciding how much information to make public, suppress much of what they learn about cartels. Despite this, creative research strategies have been employed to establish some basic stylized facts about cartels. Cartels exist, and they do not fall apart easily. There is wide variance in cartel duration, but on average and across time, space, and industries they last between five and eight years. The incentive to cheat, rather than causing cartel breakdown, leads to extensive communication and the adoption of sophisticated countervailing organizational mechanisms.

Cartels are pervasive. They are probably less pervasive than in previous centuries, but they still operate in a wide variety of markets. Cartels form in response to declining prices, but do not form disproportionately during business cycle downturns. Similarly, cartel breakup is remarkably free of cyclicalities, especially since the Great Depression.

Firms attempt to collude along as many dimensions as firms attempt to compete. These include prices, quantities, market shares, contract duration, credit terms, transportation costs, and access to technology. Understanding how cartels actually set prices can inform the design of more effective techniques for detecting collusion. For example, some cartels set customer-specific prices. This implies that looking for uniform prices may be an unsatisfactory screen for collusion in markets with large or concentrated customers. On the other hand, some cartels strategically reduce price variance across markets, so changes in price spreads may be a meaningful signal of active cartel efforts.

While some individual cartels do not succeed in raising prices, virtually all studies find that, on average, they raise prices to some extent. Because the U.S. DOJ has long used ten percent as a guideline in its sentencing, many studies implicitly or explicitly ask whether this is a good estimate of cartel effect. Most studies find effects at least that large, but there are surprisingly few rigorous studies of price effects because data availability is severely limited.

Antitrust is the most important force leading to cartel breakup. The adoption of amnesty and leniency policies, combined with dramatic increases in the largest fines, has led to the demise of many cartels that had negatively affected global markets. However, there are limitations to the effectiveness of these policies as currently designed. Cartels continue to form, suggesting that deterrence may still be insufficient. Leniency policy is also more likely to catch cartels that are generating limited profits at the time they are revealed. Given scarce resources, it is important not to let leniency policies crowd out other anti-cartel enforcement tools.

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Table 1: What do cartels do?

CARTEL MECHANISM	FREQUENCY
Shares, regions, or customers were explicitly assigned to cartel members	80%
Sales information exchanged for monitoring purposes	79%
Trade association facilitated agreement	31%
Cartel members agreed to and implemented compensation scheme	33%
Cartel took actions to exclude non-members	36%
Cartel took retaliatory actions against members who cheated	19%

Adapted from Levenstein and Suslow (2011), 471, Table 3.

Table 2: What causes cartel breakup?

Cause of Breakup	Number of cartels	Average duration (years)
Antitrust death:		
Follow-on investigation	13	8.8
Customer complaint	7	4.0
Other sources (including whistleblowers)	29	8.2
Natural death:		
Amnesty application	17	10.3
Cheating	6	7.7
Growing fringe	7	6.4
Unknown cause of breakup	2	4.5
All cartels	81	8.1

Adapted from Levenstein and Suslow (2011), 468, Table 2.