

# What Determines Cartel Success?

Margaret C. Levenstein and Valerie Y. Suslow\*

*Following George Stigler (1964), many economists assume that incentive problems undermine attempts by firms to collude to raise prices and restrict output. But the potential profits from collusion can create a powerful incentive as well. Theory cannot tell us, a priori, which effect will dominate: whether or when cartels succeed is thus an empirical question. We examine a wide variety of empirical studies of cartels to answer the following questions: (1) Can cartels succeed? (2) If so, for how long? (3) What impact do cartels have? (4) What causes cartels to break up? We conclude that many cartels do survive, and that the distribution of duration is bimodal. While the average duration of cartels across a range of studies is about five years, many cartels break up very quickly (i.e., in less than a year). But there are many others that last between five and ten years, and some that last decades. Limited evidence suggests that cartels are able to increase prices and profits, to varying degrees. Cartels can also affect other non-price variables, including advertising, innovation, investment, barriers to entry, and concentration. Cartels break up occasionally because of cheating or lack of effective monitoring, but the biggest challenges cartels face are entry and adjustment of the collusive agreement in response to changing economic conditions. Cartels that develop organizational structures that allow them the flexibility to respond to these changing conditions are more likely to survive. Price wars that erupt are often the result of bargaining issues that arise in such circumstances. Sophisticated cartel organizations are also able to develop multipronged strategies to monitor one another to deter cheating and a variety of interventions to increase barriers to entry.*

## 1. Introduction

The temptation to raise profits by fixing prices has, over the years, led many

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firms to abandon fierce competition with their rivals for more cooperative relations. Some of these attempts have fared well for producers, increasing prices for long periods of time. Others have imploded quickly with little or no long-term effect on consumers or industry structure. Still other cartels have raised prices for extended periods, only to fall gradually into irrelevance as a result of new entry, technological change, or increased competition along non-price dimensions.

Economists and policymakers have long tried to understand what determines the success of collusion, with varying success of

their own. Following Stigler (1964), many economists have argued that such attempts would inevitably fail as colluding firms succumbed to the temptation to shave prices secretly in order to increase their individual firm profits. Subsequent theoretical work has established that sufficiently patient and well-informed firms can, in principle, collectively deter cheating and allow collusion to survive. But the empirical question remains: Do firms manage to deter cheating? Does collusion survive? If so, for how long? If not, why not? What impact do cartels have on profits and prices while they are in existence? What impact do they have on industry structure after their demise?

This article examines a wide variety of empirical studies of cartels to extract answers to these questions. We find that while some cartels collapse relatively quickly—in less than one year—the median duration of cartels in a wide range of studies is quite a bit longer—five to six years. And many cartels measure their duration in decades, not months. Of course, these estimates of cartel duration must be treated with caution, as they are not based on random samples. To the contrary, because cartels are often secretive and even illegal, sample selection reflects the legal regime in which the cartels operated. In some cases, samples are literally selected by prosecutors; in such cases we simply do not know whether cartels that run afoul of legal authorities are similar to or different from cartels that manage to escape unnoticed.

Cartels do face challenges. Very generally, these challenges can be grouped into three categories: first, selecting and coordinating the behavior of all cartel participants on mutually consistent, collusive strategies; second, monitoring the behavior of cartel participants to detect and deter defections from these collusive strategies; and third, preventing entry (or expansion) by noncartel firms. Overcoming these challenges is easier in some industries than others. For example, industry concentration makes collusion easier,

both by simplifying the coordination issues and by increasing firms' gains from collusion. But successful cartels have operated in a wide variety of industries by developing organizations that can overcome these challenges. There are in fact many successful cartels in quite unconcentrated industries, but they almost always rely on industry associations. In a legal environment in which the activities of industry associations are restricted and monitored, cartels are much more likely to succeed in concentrated industries than in less concentrated ones.

Stigler (1964) highlights cheating as the preeminent challenge that cartels face and subsequent research in the area has focused on punishment strategies that allow firms to overcome the temptation to cheat. Although the evidence shows that cartels use a range of punishment mechanisms to deter cheating, including both "price wars" and side payments, successful cartels do not simply rely on ex post punishments. Instead, they invest in monitoring mechanisms, such as joint sales agencies or regular reporting to one another or third parties. Cartels much prefer to develop the means to monitor each other's behavior in order to deter or physically prevent cheating, rather than resorting to expensive punishments such as price wars. Designing effective monitoring mechanisms takes place over time as cartels learn about both their competitors and their customers, and then refine the organizational structure to provide the necessary incentives and information to sustain cooperation. For example, successful cartels will often develop a hierarchy, separating high-level policy decisions made by executives from the more frequent ongoing monitoring and negotiations undertaken by lower-level managers.

What, then, causes cartels to break down? The empirical literature has struggled to distinguish between cartel punishments and cartel breakdowns: do price wars reflect the demise of collusion or are they the mechanism by which the cartel endures? Most cross-sectional studies of large numbers of

cartels have a difficult time of identifying, let alone isolating, the specific causes of cartel breakdowns. Case studies of individual cartels have had more success in disentangling this issue. Overall, the most frequent causes of cartel failure are entry and bargaining problems. Bargaining problems sometimes decline over time as the cartel develops as an organization. Thus, some industries show a pattern of repeated cartel formation, with cartel duration increasing over time. The likelihood of entry, on the other hand, increases over time as outsiders have more opportunity to respond to high cartel prices.

Cartel duration is the most common measure of cartel success because it is the most easily measured, but it is clearly unsatisfactory in capturing the economic impact of cartels. There are cases where cartels have continued to exist on paper for many years with little sustained effect on price. Ideally, we would like to compare the prices and profits that prevailed with what would have obtained absent the cartel. This kind of rigorous counterfactual analysis is rarely attempted. Most cartel studies report that prices increased with the creation of the cartel and a very small number find that prices reached the joint profit-maximizing level. The best empirical research on the effects of cartels takes into account both selection issues, since cartels may be more likely to form in industries where prices have been falling, and the impact of cartels on non-price variables, such as investment and industry concentration.

Section 2 provides a very brief introduction to the economic theory of cartels. Section 3 reports the stylized facts on cartel duration as distilled from the cross-sectional and case studies surveyed here. We compare differences in the results found in the two types of research and discuss measurement issues that plague this literature. We compare the mean and variance of cartel duration in these studies. This comparison highlights the robustness of the extremes. That is, there are both short-lived and long-lived cartels.

Section 4 discusses the determinants of duration: who colludes, which cartels manage to last, and why? Section 5 turns the discussion of cartel duration on its head by inquiring into the proximate causes of cartel breakdowns. Section 6 examines the impact of cartels on prices, profits, and a variety of non-price variables such as investment. Concluding remarks are given in section 7.

## 2. *Theories of Collusion*

“Collusion in general implies . . . that the rival sellers in some manner arrive at an understanding as to what price to charge or what outputs to produce, or both.”<sup>1</sup> Producers form cartels with the goal of limiting competition to increase profits. By restricting output and increasing price, ideally to the price a monopolist would set, profits are jointly maximized. Upon its creation, a cartel immediately faces three key problems: coordination, cheating, and entry.<sup>2</sup> Firms must be able to coordinate on an equilibrium—in a situation in which there are often multiple equilibria—which increases prices and allocates reduced output among member firms. The equilibrium must increase profits to cartel members as a group and provide a mechanism for distributing those profits “fairly” to member firms. The cartel must develop an incentive compatible structure—a combination of monitoring, rewards, and punishments—to prevent cheating by members. The cartel must also prevent entry by outsiders. In a dynamic economy, the solution to all these problems will change over time, so successful cartels must develop an organizational structure that allows them to solve these problems continuously.

The discussion of cheating and its prevention dominates the theoretical literature. A cartel must somehow escape from the Prisoners’ Dilemma: by raising price above

<sup>1</sup> Joe S. Bain (1959), pp. 271–72.

<sup>2</sup> For a general overview of the theory, see Jean Tirole (1988), chapter 6 and Stephen Martin (2002), chapter 10.

marginal cost, the cartel creates an incentive for each producer to cheat. Each firm would like to lower its price, increase its output and market share, and thereby increase its profits. But if each one did so, collusion would immediately dissolve into competition. Stigler's (1964) classic article highlights this incentive to cheat as the most important source of instability undermining attempts to collude.

Repeated interaction (over time or across markets) can, in principle, by providing the incentive of future collusive profits, deter firms from cheating and allow them to escape the Prisoners' Dilemma.<sup>3</sup> In a repeated setting, a firm weighs the expected gain from cheating today (the benefit from cheating) with the expected reduction in future discounted profits that follows cheating (the cost of cheating). Collusion can be supported if the cost of cheating is higher than the benefit, so that firms refrain from undercutting the collusive price. This means that the likelihood that an industry will choose to exert the effort to establish a cartel will depend on several very basic factors that determine the expected profits associated with colluding. These include the benefits of colluding, the benefits of cheating, and the extent of repeated interaction.

### 2.1 *Is There a Collusive Equilibrium?*

If the benefits to colluding are sufficiently high relative to the benefits from cheating, the industry will find that it lies within the bounds in which collusion is *possible*.<sup>4</sup> Early Structure–Conduct–Performance theorists such as Bain (1951, 1956, 1959) argued that increases in concentration

<sup>3</sup> Most of the theoretical literature focuses on repeated interaction over time. James W. Friedman (1971) is the seminal piece in this line of research. Jean-Pierre Benoit and Vijay Krishna (1985) provide a theoretical basis for the argument that repeated interaction across space or markets may also support collusion.

<sup>4</sup> Our formulation of this as a question of the bounds of feasible collusion draws on the work of John Sutton (1991, 1998).

facilitate collusion.<sup>5</sup> This is because an increase in concentration increases each individual firm's payoff from collusion, while having no effect on the individual firm's incentive to cheat. (If firms are not capacity constrained, a cheating firm will capture the entire industry monopoly profit—minus epsilon—for one period.) Conversely, as the number of firms in the industry increases, the value of each firm's share of collusive industry profits declines: the same monopoly profit must be divided among more firms. In order for firms to be willing to refrain from cheating, the following must hold:

$$\sum_{t=0}^{\tau} \delta^t \frac{\Pi^m}{n} > \Pi^m,$$

where  $\Pi^m$  is the one-period monopoly profit,  $n$  is the number of firms in the industry, and  $\delta^t$  is the discount rate. Thus, the threshold discount rate of expected future profits necessary to sustain collusion increases as the number of firms in the industry increases (Tirole 1988, pp. 247–48).

Asymmetries may also affect the relative benefits of collusion versus cheating. Product homogeneity increases the benefits to collusion, but also increases the payoff to cheating. Not surprisingly, the net effect of product homogeneity or differentiation varies across models depending on their

<sup>5</sup> This approach has been critiqued extensively. Harold Demsetz (1973) writes, "if efficiency is associated with concentration, there should be a positive correlation between concentration and the difference between the rate of return earned by large firms and that earned by small firms; that is, large firms have become large because they are more efficient than other firms and are able to earn a higher rate of return than other firms" (p. 5). See also Demsetz (1974). See Richard Schmalensee (1987) for an empirical test of these alternatives. Sutton (1991, 1998), and following him, George Symeonidis (2002) emphasize that concentration is not exogenous to the history of collusion in the industry. Their models assume that profits are increasing in industry concentration and that there is free entry and exit. They argue that an industry will only be in long-run equilibrium (with the marginal firm earning a normal rate of profit) if any change in the "intensity of competition" is accompanied by a change in concentration. For example, if firms collude and raise prices, less efficient firms may be able to survive, reducing concentration.

particular specification.<sup>6</sup> Cost or firm-level asymmetries also have ambiguous effects on collusive stability.<sup>7</sup> Various authors have focused on the benefits to collusion of having one large firm serve as a swing producer or enforcer.<sup>8</sup> But a large firm can also itself be difficult to discipline, if the rest of the industry is relatively small.<sup>9</sup> Idiosyncratic differences in firm “types” can also affect the ease with which a cartel can discipline firms. Jonathan B. Baker (2002) considers the case where one firm is a “maverick” and is therefore more likely to undermine collusion. An increase in concentration resulting from the acquisition of the maverick firm by

a firm more willing to collude would give rise to an empirical association of increases in concentration with an increase in the likelihood of collusion.

## 2.2 Cheating and Punishment Mechanisms

Stigler (1964) argues that cartels are fundamentally unstable: firms agree to restrict output, but then engage in secret cheating that erupts in price wars. Eventually, they may try again to restrict output and raise prices, but the temptation to increase production when price is above marginal cost is too great for the cartel to last. This creates fluctuations in price as the cartel breaks down and then re-forms. In the hands of modern game theorists, Stigler’s observations have been reincarnated with an entirely different conclusion:

... collusive conduct may ... result in a pattern ... marked by recurrent episodes in which price and profit levels sharply decrease. ... Thus we reject the received view that performance of this type necessarily indicates an industry where firms are engaging in a sequence of abortive attempts to form a cartel. Since this opinion is often used ... to deny the need for intervention to promote competition in such industries ... our argument suggests the need to re-examine a widely held assumption about policy (Edward J. Green and Robert H. Porter 1984, p. 88).

Accepting Stigler’s intuition that cheating is the major threat to cartel stability, Porter (1983b) and Green and Porter (1984) argue that the threat of price wars is actually the *solution* that deters cheating: firms refrain from cheating in order to prevent a costly price war. “Price wars” arise when firms, unable to perfectly monitor one another’s output levels, cannot determine whether another firm has cheated (e.g., when price falls as the result of a decline in demand) and must respond with a “price war punishment.” In most formulations, these periodic punishment phases are triggered by unexpected downward shocks in demand. The episode of low prices does not reflect the breakup of the

<sup>6</sup> Useful summaries of this literature can be found in Ki-Eun Rhee and Raphael Thomadsen (2004) and Martin (2002, p. 313). Much of the literature argues that product differentiation facilitates collusion by limiting the benefits to cheating. Rhee and Thomadsen (2004) show that if one assumes that there is a cost to maintaining or coordinating collusion, and that those costs increase with product differentiation, then increased product differentiation will undermine the cooperative outcome.

<sup>7</sup> Susan Athey and Kyle Bagwell (2001) and Athey, Bagwell, and Chris Sanchirico (2004) examine the impact of cost asymmetry on the ability of firms to achieve the joint profit-maximizing outcome. They argue that cost asymmetries may explain the frequent observation that cartels agree to constant market share targets. (Such “market share rules” were suggested in earlier literature as a way of sustaining a cooperative equilibrium (e.g., Dale K. Osborne 1976), even assuming symmetric firms.) Since achievement of an “efficient” equilibrium, in their model, requires that some firms not produce in some periods (when they have high costs), this model is probably most relevant for industries where the production period is very short or there are discrete “jobs” such as in bidding rings.

<sup>8</sup> See, for example, Mukesh Eswaran (1997) who argues that a low-cost producer can help a cartel survive recession: “These (‘swing’) producers can curtail their own output in periods of slack demand in order to ensure the viability of the relatively inefficient cartel members. This prevents the collapse of collusive agreements in recessions by eliminating, for the inefficient firms, the prospect of inevitable bankruptcy; in addition, it ensures their good behaviour even in booms” (p. 645). James M. Griffin and Weiwen Xiong (1997) discuss the role that Saudi Arabia has played in OPEC, both as swing producer and potential enforcer.

<sup>9</sup> Olivier Compte, Frederic Jenny, and Patrick Rey (2002) argue that asymmetries in capacity can be important to undermining cooperation. They argue that the focus should not be on the overall level of concentration in the industry but rather on the size or capacity distribution of firms in the industry.



cartel but instead reflects actions taken to maintain firms' incentive not to cheat. Dilip Abreu, David G. Pearce, and Ennio Stacchetti (1986) extend Green and Porter's model by expanding the set of possible strategies beyond trigger strategies and allowing firms to choose the optimal strategy that maximizes expected profits.<sup>10</sup> Thus, the appearance of on-and-off collusion does not represent inherent cartel instability, but rather a mechanism that cartels use to stabilize themselves. The theory also indirectly implies a second mechanism: the cartel may invest in information collection in order to better monitor individual firm's activities. This both deters cheating and allows cartels to avoid costly price wars that arise from the inability to distinguish cheating from external shocks.

In Julio J. Rotemberg and Garth Saloner (1986), "price wars" arise from business cycle fluctuations even with perfect information. Fluctuations in demand change the optimal cartel price. An increase in current period demand increases the incentive to cheat on the cartel agreement and requires an adjustment in the cartel price to prevent such cheating. If demand fluctuations are independently and identically distributed, the counterintuitive implication is that price wars will occur during booms.<sup>11</sup> If demand

shocks are serially correlated—as is usually the case—"price wars" break out during cyclical downturns.<sup>12</sup> Whether the collusive price falls during a bust or a boom, however, it could easily lead the researcher to the mistaken conclusion that the cartel had ceased to function.

### 2.3 *Coordination and Cartel Organization*

Organizational issues can prevent cartel formation or undermine its stability. If there is a fixed "set-up" cost to establishing a cartel, firms will make the attempt only if the cartel is expected to be sufficiently profitable.<sup>13</sup> Those set-up costs may depend on the history of cooperation and number of firms in the industry. Bounded rationality and uncertainty may also make collusion difficult, particularly in a changing economic environment, because of increased complexity in formulating and monitoring any "contract."<sup>14</sup> Asymmetry in costs may mean that there is no focal price on which firms can agree, resulting in "costly haggling."<sup>15</sup>

Margaret E. Slade (1989, 1990) suggests that price wars arise from changes in firm or industry characteristics, but price wars may also lead to learning that permits reestablishing collusion. Cartel members' knowledge of fundamental structural parameters is necessarily incomplete. If

<sup>10</sup> Abreu, Pearce, and Stacchetti (1986) show that optimal punishments, stochastic in length, may be more severe than Nash reversion. More generally, Abreu, Pearce, and Stacchetti (1986) generalize the Folk Theorem result to games with imperfect monitoring. The Folk Theorem result says that, with infinitely repeated interaction and sufficiently low discount rate, there exists an equilibrium set of strategies that supports any level of profits between zero and the joint profit maximizing level (Friedman 1971).

<sup>11</sup> Robert W. Staiger and Frank A. Wolak (1992) extend the Rotemberg and Saloner model by adding a capacity-setting stage of the game prior to the realization of demand. They find that "the conventional wisdom of slack demand implying a greater likelihood of price wars applies best in precisely those industries where capacity costs are high and capacity constraints most important. Thus, the importance of capacity constraints is a crucial determinant of the relationship between collusive prices and business conditions across industries" (p. 205).

<sup>12</sup> See John Haltiwanger and Joseph E. Harrington Jr. (1991). The intuition of this model is that high demand today indicates an increased probability of high demand tomorrow, increasing the payoff to future collusion even more than the increase in the payoff to cheating today. In such a case, the optimal cartel price would fall during an economic downturn. Bagwell and Staiger (1997) make a similar argument for a more general model.

<sup>13</sup> For example, Ralph M. Bradburd and Mead A. Over Jr. (1982) argue that the organizational costs of both cartel formation and cartel maintenance are expected to increase with the number of firms in the industry.

<sup>14</sup> Oliver E. Williamson (1975, pp. 238–47) frames the issues in terms of contingent claims contracting.

<sup>15</sup> Williamson (1975), p. 241. For more a more detailed discussion of the impact of cost asymmetry, see Tirole (1988, p. 242). For discussion of the role of focal points in providing collusive stability, see Frank M. Scherer (1980, pp. 190–93) and Thomas C. Schelling (1960).

there is a structural change (e.g., a negative demand shock), the joint-profit maximizing equilibrium will change. In the process of setting new prices, a price war may be triggered. Firms *learn* about the new market conditions through this price variation and eventually a new collusive equilibrium can emerge. The breakdown is not caused by difficulties in detection of individual firm's actions, as hypothesized by Stigler, but rather by permanent structural shifts that require renegotiation among cartel members.

#### 2.4 Barriers to Entry

Most theoretical models ignore or assume away the possibility of entry, which is in fact one of the biggest challenges cartels face.<sup>16</sup> When firms do manage to coordinate their conduct on incentive-compatible collusive strategies, they create an incentive for outsiders to enter the industry. Coping with and trying to prevent entry can undermine the best-laid collusive plans. In contestable or low barrier to entry industries, it may be that firms resist the temptation to collude because they know that it would only lead to entry (which might, given any cost of exit, make the incumbent firms worse off). The one area related to strategic entry deterrence by cartels that has been explored in the theoretical literature is the creation of excess capacity.<sup>17</sup>

The theoretical literature focuses our attention on the challenges that cartels face.

<sup>16</sup> Sutton (1991, 1998), and following him, Symeonidis (2002) are an exception; their models explicitly specify free entry.

<sup>17</sup> Avinash Dixit (1979) discusses the general role of excess capacity in deterring entry, but there is a straightforward application to cartels in which the existence of excess capacity makes punishment threats credible. David M. Kreps and Jose A. Scheinkman (1983) show that firms that engage in Bertrand competition achieve Cournot prices (and profits) if they can precommit to production levels. Strategic predation and other forms of entry deterrence that have been explored from a monopoly or dominant firm perspective could also be applied to analyzing cartels.

The empirical literature to which we now turn provides us with clues as to how cartels overcome these challenges. These include, but are not restricted to, price war punishments. But first we examine the descriptive statistics on cartels, in which we see that many cartels do survive.

### 3. Cartel Duration and Measuring Cartel "Breakdown"

Do cartels fall apart?<sup>18</sup> Cartel members have an incentive to cheat, but some cartels do manage to endure. In order to explain this puzzle, we examine case studies of individual cartels<sup>19</sup> and four types of cross-section samples of cartels:<sup>20</sup>

<sup>18</sup> There are a wide variety of organizations that might reasonably be described as cartels. The focus of this paper is explicit price-fixing or market division agreements among private producers, known in policy circles as "hard core" cartels. Under current law, virtually all such agreements are illegal in the United States and the European Union. For countries outside the United States, legal prohibitions on cartels are a relatively new phenomenon. Studies of U.S. cartels are often based on records from prosecutions of cartels; in other countries, where cartels were legal, there is often a public record that has provided the basis for study. We include studies of both legal and illegal cartels in this survey. However, we do not discuss state-run cartels, such as OPEC. State-run cartels can and do have an important impact on economic activity, but their goals are more complex than private cartels, including not only the maximization of joint profits, but national economic stability and international political influence as well. The enforcement tools at the disposal of state-run cartels differ from those available to private firms. The economic models that we use here, which presume a simple profit-maximizing objective function, are inadequate to address the functioning and impact of state-run cartels. Thus, we exclude them from our analysis. Finally, tacit collusion can have equivalent economic effects to explicit price-fixing. However, studies of tacit collusion usually focus on establishing that collusion in fact occurred, which is not our focus. Instead, we examine the characteristics of industries where formal collusion is acknowledged to have occurred, and then take a deeper look at the stability and economic impact of those agreements.

<sup>19</sup> We have constructed a sample of nineteen case studies in order to provide quantitative comparisons to the cross-section literature. This sample is not randomly selected, but rather was chosen for the quality and type of analysis undertaken in the study.

<sup>20</sup> Appendix A describes the data sets used in each of the cross-section studies. Appendix B lists the sources for the case studies.

(1) cartels convicted by antitrust authorities;<sup>21</sup> (2) legal international cartels;<sup>22</sup> (3) legal cartels that operated within a single national jurisdiction;<sup>23</sup> and (4) legal export cartels.<sup>24</sup> The average cartel in our cross-section samples lasted between 3.7 and 10 years (table 1).<sup>25</sup>

<sup>21</sup> This line of research follows from Richard A. Posner's (1970) path-breaking study. Recent prosecutions of international cartels by both the U.S. Department of Justice and the European Commission have created the basis for new wave of cross-sectional research (John M. Connor 2001, 2002, and 2004a) and Julian L. Clarke and Simon J. Evenett (2003), and Levenstein and Suslow (2004a). The surge in U.S. prosecutions of international cartels stems primarily from the revision and expansion of the Antitrust Division's corporate amnesty program in 1993. See Anne K. Bingaman (1996, p. 8). On the heels of this increased enforcement by the United States, the European Union, as well as some non-European countries, have strengthened their anti-cartel laws and stepped up enforcement. See also Evenett and Suslow (2000) and Evenett, Levenstein and Suslow (2001) for discussion of policy responses to these international cartels.

<sup>22</sup> These include international cartels outside of the United States, where antitrust laws were historically less stringent (certainly prior to World War II, and in many countries for decades after). Cartels in these settings generally assumed that they were signing legal, but not enforceable contracts. Although cartel member firms (or at least the non-U.S. firms) did not fear prosecution, they still had to solve the classic cartel incentive problem caused by conflicting individual and cooperative interests. Cartel members could openly communicate, seek information, and enact penalties, but they could not rely on a third party to enforce the agreement. These studies of international cartels all build on the earlier qualitative work of George W. Stocking and Myron W. Watkins (1946) and Ervin Hexner (1945).

<sup>23</sup> Several of these studies take advantage of a change in the legal status of collusion to examine where collusion is most likely, the effect of the legal environment on the success of collusion, and the long-term impact of collusion on industry structure and performance.

<sup>24</sup> The justification given for these exemptions is that firms need to cooperate in order to market and sell their goods abroad. In contrast to the United States, Australia, and a handful of other countries which continue to give explicit antitrust exemptions for export associations, Japan, Korea, and most European Union countries have eliminated explicit exemptions for exports. See Levenstein and Suslow (2005).

<sup>25</sup> The Great Britain Board of Trade (1976), not included in table 1, surveyed 125 cartelized products in the pre-WWII period. This study reports that the term of the typical cartel agreement varies considerably from cartel to cartel, but most often it is from 3–5 years (p. xiii). The studies by Paul L. Eckbo, Griffin, Jaime Marquez, and Suslow included cartels that were abruptly ended by the start of World War II. Average duration varies substantially within these samples, depending on whether all cartel episodes or only "uncensored" episodes are used to calculate the mean.

Most cartel scholars use duration to measure cartel success, well aware that duration is a highly imperfect proxy for performance.<sup>26</sup> Cartel duration is more easily measured than either excess cartel profits or even cartel-driven price increases.<sup>27</sup> Even so, part of the variation in these estimates of average cartel duration is due to measurement issues. The lowest average (3.7 years) comes from Suslow (2005), who dates cartel dissolution by determining a specific event ending or restructuring the cartel.<sup>28</sup> This suggests that other studies that rely on dates of formal dissolution overestimate the true economic duration of cartels. But some of the variation in duration is due to real economic differences among the samples. The estimate at the upper end of the range (10 years) comes from Alexis Jacquemin, Tsuruhiko Nambu, and Isabelle Dewez (1981), based on a sample of legal Japanese export cartels. The active support of the Japanese state for these cartels suggests that their lengthy duration reflects their real success. More importantly, there is considerable variation *within* each sample as well: the standard deviation of cartel duration in these studies ranges from 2.4 to 6.3 years.<sup>29</sup>

<sup>26</sup> Data limitations force many researchers to proxy cartel duration with the length of a formal agreement, but cartels can and do survive as organizations on paper without having significant economic effects. For example, a British survey of cartel agreements reports that "[t]here is indeed, sufficient evidence to show that in some industries the agreements were not carried out or were carried out only in part" (Great Britain Board of Trade 1976, pp. xli–xlii).

<sup>27</sup> The price–cost margin literature is much more sophisticated in its attempts to tie margins to industry and firm characteristics. See, for example, Ian Domowitz, Glenn Hubbard, and Bruce Petersen (1986). This is an interesting literature, but hard to map to cartel performance because we do not know whether there was a formal cartel in the industries that are found to have high price–cost margins.

<sup>28</sup> Suslow (2005) defines distinct cartels within an industry if the cartel contract was restructured either after the exit of a key member or to incorporate a significant new member. This method of dating cartel episodes yields duration estimates shorter than those specified in the actual written cartel contracts.

<sup>29</sup> These figures come from Eckbo (1976, "Sample 1") and Griffin (1989), respectively.



TABLE 1  
CARTEL DURATION: CROSS-SECTION STUDIES

	<i>Eckbo— Sample 1<sup>a</sup></i>	<i>Eckbo— Sample 2<sup>a</sup></i>	<i>Griffin/ Marquez<sup>b</sup></i>	<i>Suslow</i>	<i>Posner</i>	<i>Dick</i>	<i>Gallo et al.</i>	<i>Jacquemin et al.</i>	<i>Levenstein &amp; Suslow</i>
Number of Cartels	23	29	54	71	989	125	1348	40	42
Sample	Int'l Cartels, 1819–1964	Int'l Cartels, 1819–1964	Int'l Cartels, 1888–1984	Int'l Cartels, 1920–1939	U.S. DOJ cases, 1890–1969 <sup>f</sup>	Webb- Pomerene Export Assocs., 1918–1965	U.S. DOJ cases, 1955–1997	Japanese export cartels, 1967–1972	Int'l Cartels, 1990s
Average Duration (years)	3.8 <sup>c</sup>	4.6 <sup>c</sup>	7.3	3.7 <sup>e</sup>	7.5	5.3 <sup>g</sup>	5.4	10	5
Standard Deviation of Duration	2.4	4.7	6.3	3.0				4.5	4.5
Duration Range (years)	1–18	0–18 <sup>d</sup>	1–29	1–13				1–19	0–20
% less than 5 years	60%	57%	43%	40%		39%		12.5%	
% 10 or more years	12%	18%	32%	37%		24%		37.5%	

Notes:

- <sup>a</sup> Included in Eckbo's Table 3-3 on p. 37 is an iodine cartel lasting sixty-one years. However, the averages he presents later regarding cartel length are correct only if the iodine cartel is taken out of the calculations. The calculations reported above do not include the iodine cartel.
- <sup>b</sup> Marquez uses Griffin's sample, omitting two cartel episodes (Griffin has 54 episodes and Marquez has 52). The means and standard deviations reported in the two papers are very similar, but not identical.
- <sup>c</sup> Eckbo defines "efficient" cartels as those able to "raise price 200 percent above the unit cost of production and distribution" (Eckbo 1976, p. 26). Average duration for efficient Sample 1 cartels is 5 years and for inefficient Sample 1 cartels it is 3.1 years. For Sample 2 cartels, the efficient episodes lasted 8 years on average while the inefficient episodes lasted only 2.7.
- <sup>d</sup> There are several cartel episodes in Sample 2 that lasted less than a year, which Eckbo codes as "0" in length.
- <sup>e</sup> The mean duration of all cartel episodes is 8.3 years with a standard deviation of 6.2 years. The mean duration of the 28 uncensored (by World War II) cartel episodes is 3.7 years with a standard deviation of 3 years.
- <sup>f</sup> The average duration statistics are given in Posner's Table 25 only for cases from 1950–69.
- <sup>g</sup> Dick (1996a) states that "the median Webb-Pomerene cartel remained active for approximately 5.3 years" (p. 251). In footnote 28 on p. 251 he says that the "average cartel survived at least until year 5 with a 51.7 percent probability and at least until year 6 with a 45.8 percent probability. I assume a uniform distribution of cartel exits between these two durations to interpolate a median duration of 5.3 years." Dick also reports that the median life span among cartels operating as common sales agencies was roughly 4.5 years, compared to 7.4 years for cartels whose members shipped individually (p. 256). We suspect that this might be because the non-sales agency "cartels" were not actually colluding to fix prices and therefore did not face the same threats to their stability.

## Distribution of Duration for Contemporary International Cartels

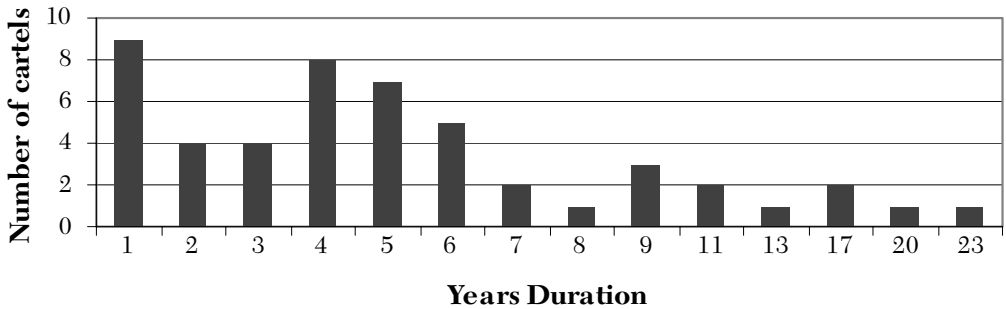


Figure 1.

Source: Levenstein and Suslow (2004b), table 1.

The duration story is quite similar for contemporary international cartels. Levenstein and Suslow (2004a) estimate average duration of a 1990s sample at approximately 5.4 years, with a standard deviation of 4.7 (table 1).<sup>30</sup> There are short-lived cartels, such as aluminum phosphide, where the price-fixing effort lasted only from January to November of 1990. In this case, one of the major producers refused to cooperate to raise prices and the conspiracy quickly collapsed. On the other hand, there is evidence of long-lived cartel activity as well: cartonboard (1986–91), graphite electrodes (1992–97), maltol (1989–95), and sorbates (1979–97), to name just a few. The distribution of duration in this sample is

bimodal, with a large number of cartels lasting only one year and about twice as many lasting between four and six years. There is also a long tail of cartels that endure for considerably longer (figure 1).

The case study evidence yields an average duration that is markedly higher (table 2). Comparing tables 1 and 2, we find that mean cartel duration for the nineteen case-study industries, with fifty cartel episodes among them, is fourteen years rather than the roughly four to ten years found in cross-sections. The median—six years—is comparable to the cross-section studies. The standard deviation in cartel longevity for the cases reported in table 2 is 19.6 years, which also exceeds that for the cartels studied in cross-sections. One suspects that this variance in cartel longevity from individual industry research reflects in part scholars' tendency to select industries for case study that have either a long history of cartel activity or an interesting history of on-again off-again cartel episodes. The selection of which cartel to study is not made by a prosecutor (as with many of the cross-section samples), but by a researcher relying on records that have been preserved or made

<sup>30</sup> See Levenstein and Suslow (2004a). This sample covers forty-two private international cartels that were successfully prosecuted for fixing prices by the United States or the European Commission (or both). Each cartel in the sample: (1) involves more than one producer, (2) includes firms from more than one country, and (3) attempted to set prices or divide markets. These cartels were prosecuted during the 1990s, but may have begun their activities prior to 1990. This sample, like its intellectual antecedents, may be biased as a result of its dependency on prosecution as a sample selection criterion.

TABLE 2  
CARTEL DURATION: SELECTED CASE STUDIES

<i>Industry</i>	<i>First year of cartel<sup>a</sup></i>	<i>Mean duration</i>	<i>Number of distinct episodes of cooperation<sup>b</sup></i>	<i>Maximum duration</i>	<i>Minimum duration</i>
Beer (U.S.)	1933	9 years	1	9 years	9 years
Beer (Sweden)	1894	29	2	50	8
Bromine	1885	6.25	4	10	3
Cement	1922	40	1	40	40
Coal	1893	20	1	20	20
Diamonds	1870s	60	2	100	20
Electrical Equipment	1950	8	1	8	8
Ocean Shipping	1870s	51	3	54	50
Oil	1871	2	3	3	1
Parcel Post	1851	28.5	2	40	17
Potash	1877	9.4	8	20	1
Railroad (U.S. Midwest)	1879	1.7	3	2	1
Railroad (U.S. South)	1873	5	2	8	1
Railroad—Oil	1871	7	5	30	< 1
Rayon	1932	8	1	8	8
Steel (Europe)	1926	7.3	4	13	4
Steel (U.S.)	1933	6	1	6	6
Sugar	1887	6.75	4	10	2
Tea	1929	3.5	2	6	1

*Notes:*

<sup>a</sup> The first year of the cartel is not necessarily the first year in which collusion was attempted or achieved in the industry. It is simply the first year of the first episode of cooperation in the cartel case studies surveyed here.

<sup>b</sup> These indicate the number of distinct cartels, whose existence we can clearly date by drawing on the case studies surveyed here. In these industries, there are undoubtedly a larger number of agreements in distinct product markets and distinct regions than is suggested by this table. There are also sometimes periods preceding the first formal cartel in which there are attempts to form cartels but which we cannot date or discern as separate cartel episodes, either because they never really got off the ground or because they left little or no historical record.

See Appendix B for list of sources.

public for idiosyncratic reasons.<sup>31</sup> In both approaches, though, we have to keep in mind that the cartels that are revealed to us for study may have a different set of characteristics from those that manage to remain concealed.

Examining individual cartels reinforces this picture of dispersion in cartel outcomes. The shortest cartel in Eckbo's sample (1976) survived less than a year and the longest lasted eighteen years.<sup>32</sup> Similarly, Jacquemin, Nambu, and Dewez (1981) report cartel duration ranging from one to nineteen years. In Griffin's (1989) sample, the minimum cartel duration is one year, and the maximum is twenty-nine years, both in the same market—wheat. As shown in table 1, about half of the cartels studied lasted less than five years, but a significant fraction (between 12 and 37 percent) lasted more than ten years. In the case study sample, cartel duration ranges from less than one year (in the case of several cartels that barely or never got off the ground) to one hundred years between the formation of the DeBeers diamond cartel and its first breakdown. That two of the most stable cartels in this set are both South African—the

DeBeers diamond cartel and the South African cement cartel—highlights the potential importance of particular cultural and institutional environments. However, we also find very stable cartels in the United States, such as the parcel post (Railroad Express) cartel that was in force for much of the nineteenth century. Regardless of the research methodology or the time, date, and place of the sample, the empirical research shows that while some cartels fail quickly, others last for decades.<sup>33</sup>

Simply measuring cartel duration is complicated. This is because one of the most clearly established stylized facts is that cartels form, endure for a period, appear to break down, and then re-form again. Thus, the empiricist is faced with the question: Did she observe two short-lived cartels? Or one long-lived cartel? Does this process of cartel breakdown and re-formation represent cartel success or cartel failure? As emphasized above, a variety of theoretical models have provided rationalizations of this phenomenon, but different explanations have very different implications for empirical research on cartel success as well as antitrust policy.

Table 3 provides concrete examples of this on-and-off cartel phenomenon for seven industries included in cross-section studies by Eckbo (1976) and Griffin (1989). Some cartels re-formed several times within a very short span of years, while others continued on and off over fifty years or more.<sup>34</sup> In some cases, such as the copper cartel, each period of cartelization

<sup>31</sup> A related strand of the literature examines how competition policy offices select cases to prosecute. Martina Lauk (2002) examines the probability that the German antitrust authority makes an "adverse finding" against a firm or firms and how these decisions correlate with market structure variables. Her sample includes 196 cases on "abusive practices and cartels" from 1985 to 2000. A similar paper by Stephen W. Davies, Nigel L. Driffield, and Roger Clarke (1999) looks at decisions made by the UK Monopoly and Mergers Commission between 1973 and 1995. They study seventy-three investigations (including monopoly and predatory pricing, collusion, and vertical restraints) and find that about seventy-five percent of the decisions of the competition authority can be explained "purely in terms of the market share of the leading firm and knowledge of the broad nature of the alleged anticompetitive practice" (p. 263).

<sup>32</sup> This figure comes from Eckbo's "Sample 2," where he had only enough information to describe cartels along five dimensions. There are several cartel episodes in Sample 2 that lasted less than a year, which leads Eckbo to code them as "0" in length. This is one reason for the relatively high standard deviation of 4.7 years in Eckbo's Sample 2.

<sup>33</sup> We are certainly not the first to observe this. To give just one example, Andrew R. Dick (1996a) begins the abstract to his paper by saying: "Why do some industry cartels survive for decades, while others are quickly undermined by price wars and entry?" (p. 241).

<sup>34</sup> In a different take on this same phenomenon, Jean-Claude Bosch and E. Woodrow Eckard Jr. (1991) present an estimate of the number of firms indicted multiple times by the Department of Justice. Over the period 1962–80, they estimate that 1,300 firms were indicted for price fixing: "The proportion of recidivists (as much as four times) in our sample is roughly 14 percent" (p. 309, footnote 1).

TABLE 3  
 EXAMPLES OF EPISODIC CARTELS:  
 CROSS-SECTION STUDIES

<i>Industry</i>	<i>Length of Cartel Episodes (years); Beginning year of each cartel episode shown in superscript</i>							<i>Author</i>
Aluminum	5 <sup>1901</sup>	2 <sup>1906</sup>	2 <sup>1912</sup>	3 <sup>1923</sup>	4 <sup>1929</sup>	5 <sup>1931</sup>		Eckbo
Coffee	1 <sup>1957</sup>	1 <sup>1958</sup>	3 <sup>1959</sup>					Eckbo
Copper	2 <sup>1888</sup>	4 <sup>1918</sup>	6 <sup>1926</sup>	4 <sup>1935</sup>	19 <sup>1968</sup>			Griffin
Steel	4 <sup>1926</sup>	0.5 <sup>1930</sup>	0.17 <sup>1931</sup>	6 <sup>1933</sup>				Eckbo
Sugar	2 <sup>1926</sup>	4 <sup>1931</sup>	2 <sup>1937</sup>	2 <sup>1959</sup>	5 <sup>1968</sup>	3 <sup>1974</sup>	3 <sup>1978</sup>	Griffin
Sulfur	3 <sup>1907</sup>	10 <sup>1922</sup>	5 <sup>1934</sup>	11 <sup>1947</sup>				Griffin
Tin	2 <sup>1929</sup>	3 <sup>1931</sup>	2 <sup>1935</sup>					Eckbo

appears to endure for longer than the previous one. This suggests a pattern of learning on the part of cartel members. In other industries, such as sugar, there is no obvious pattern.<sup>35</sup>

One explanation for this on-and-off pattern is that there are monitoring issues, and that the industry has used price wars to enforce cooperation, as Green and Porter (1984) suggest. On the other hand, if Stigler is correct, and these cartels have failed, each of these instances of collusion should be counted as a distinct cartel episode. In these industries there is a disequilibrium phenomenon of cycling in and out of collusion.<sup>36</sup> Cross-section studies are

not well-suited to distinguish between these phenomena.<sup>37</sup>

The issues that arise in measuring cartel duration in cross-section studies do not disappear when one turns to case studies; the

<sup>35</sup> For more particulars of collusive behavior in the sugar industry, see Alfred S. Eichner (1969) and David Genesove and Wallace P. Mullin (1998, 2001).

<sup>36</sup> The “empty core” literature argues that cartels arise in industries in which perfect competition is not an equilibrium. See Lester G. Telser (1985), whose article discusses the existence of market equilibrium, William Sjostrom (1989), who tests his theory with data from ocean shipping markets, Pirrong (1992), who expands the empirical tests on ocean shipping by emphasizing the roles played by demand divisibility and discontinuities in marginal cost, and George Bittlingmayer (1995), discussed below.

<sup>37</sup> Unfortunately, data from the new crop of international cartel prosecutions from the United States, European Union, and other countries cannot be used to shed light on this “on-and-off” pattern of cartels. The vast majority of contemporary international cartel cases have been settled by plea bargains, with only a handful going to trial. In the course of plea bargains the government decides, behind closed doors, what the “cartel period” will be so that fines and possibly prison terms can be set. These cartel dates are then announced in a press release, and they are invariably a continuous set of years. For example, in the graphite electrodes case the Department of Justice lists July 1992–June 1997 as the cartel dates, while the European Commission used dates from May 1992 through either 1996 or 1998 depending on the company. (See Press Release, U.S. Department of Justice, “U.S. Company Agrees to Pay \$110 Million Fine for International Conspiracy” (April 7, 1998) and Press Release, European Union, “Commission Fines Eight Companies in Graphite Electrode Cartel” (July 18, 2001) and Commission Decision of 18 July 2001 Relating to a Proceeding Under Article 81 of the EC Treaty and Article 53 of the EEA Agreement, Case COMP/E-1/36.490—Graphite electrodes, 2002 O.J. (L 100).) Only when the case has gone to trial will data be revealed that allow economists to battle over the true dates of the cartel’s operations. See the discussion between Connor (2001) and Lawrence J. White (2001) regarding how to date the beginning and end of the lysine cartel, as well as the effect of the cartel on price.



difference is that the researchers' choices are more explicit and therefore more transparent. In particular, when dating the end of a cartel "episode" the researcher, using primary historical documents, may observe that conflict over the terms of a cartel agreement resulted in a price war. Such price wars, termed "bargaining price wars" by Levenstein (1996) in her examination of the bromine cartel, can in principle be distinguished from those that represent a "punishment phase" (à la Green–Porter) of an ongoing cartel. Bishnupriya Gupta (1997) also finds evidence of bargaining price wars for the tea industry cartels in 1931 and 1932.<sup>38</sup> Therefore the measure of duration in the Levenstein and Gupta papers tends to be shorter (all else equal) than in studies in which the cartel is presumed to "endure" during price wars.

The least stable cartel in our case study sample is the one that has received the most attention from modern economists—the nineteenth century railroad cartel known as the Joint Executive Committee (JEC). The JEC data, studied by Thomas S. Ulen (1979), Paul W. MacAvoy (1965), Porter (1983a), and others, show fairly conclusively that switches in competitive conduct occurred in the late nineteenth century railroad industry.<sup>39</sup> Nineteenth century northern trunk lines, such as the JEC, repeatedly formed pools to stymie competition. These pools generally lasted between two and five years, and each eventually broke down as a result of competitive entry or secret cheating.<sup>40</sup>

<sup>38</sup> These "bargaining price wars" are similar to what Slade (1990) calls "asymmetric information price wars."

<sup>39</sup> See also Green and Porter (1984), Porter (1985), Lung-Fei Lee and Porter (1984), Vassilis Hajivassiliou (1986), David Roth (1988), Slade (1990), and Glenn Ellison (1994) for further discussions of the JEC cartel.

<sup>40</sup> In contrast, the average length of cooperation in southern U.S. railroads was three times that of the JEC. The question of why the southern railroad pool was more successful than the northern is an interesting one. One possible explanation is that the limited integration of Southern railroad lines created less direct competition among them. Gabriel Kolko (1965) writes, "The Southern Railway and Steamship Association was the sole pool to operate successfully throughout 1876–86, if only because Southern railways were too weak and fragmented to survive extensive rate warfare" (p. 10). For an alternative view of the success of northern railways, see Ulen (1979), pp. 118–270.

The question then is whether an average cartel life span of five to six years is long or short? What is the standard of comparison? Economists differ in how to interpret such descriptive statistics. Consider, though, the amount of economic damage inflicted by the global graphite electrodes cartel, which lasted from mid-1992 until mid-1997.<sup>41</sup> Fines levied by U.S. and European antitrust authorities against these firms totaled more than US\$600 million.<sup>42</sup> Civil damages have also been awarded in multiple follow-on cases.<sup>43</sup> If we take these fines as a proxy, however imperfect, of the overcharge inflicted by this "average" cartel, in terms of its life span, it is certainly significant.

One final plausible benchmark is the average survival rate of firms. As Paul A. Geroski (1995) comments in his survey of empirical research on entry: "The mechanism of displacement, which seems to be the most palpable consequence of entry, affects young, new firms most severely. In the United States for example, the market share of each cohort of entrants over the period 1963–82 declined by about 50 percent

<sup>41</sup> Graphite electrodes are large carbon columns used by electric arc furnaces or "mini-mills" in the making of steel. These mini-mills use graphite electrodes to generate the enormous heat necessary to melt scrap metal and convert it back into a marketable steel product. UCAR International of the United States and SGL Carbon Corporation of Germany dominate the market, with a combined world market share of about two-thirds. Roughly five firms make up the bulk of the remaining market share. "Government's Sentencing Memorandum and Government's Motion for a Guidelines Downward Departure (U.S.S.G. §5K1.1)," U.S. Department of Justice, Filed October 19, 1999 (2001), p. 2.

<sup>42</sup> The Korea Fair Trade Commission also imposed fines of US\$8.5 million. See Press Release, Korea Fair Trade Comm., "Korea Fair Trade Commission Imposes Surcharge of US \$8.5 Million on International Cartel of Graphite Electrodes Manufacturers from the United States, Germany and Japan" (Mar. 21, 2002), available at <http://ftc.go.kr/data/hwp/pressreleae0321.doc>.

<sup>43</sup> For example, see the summary of graphite electrode class actions suits in the United States in "Carbide Graphite: Warns Investors about Graphite Litigation," (InterNet Bankruptcy Library, *Troubled Company Reporter*, vol. 3, no. 118, June 22, 1999, available at [http://bankrupt.com/TCR\\_Public/990622.MBX](http://bankrupt.com/TCR_Public/990622.MBX)).

during its first ten years post-entry, largely because 61.5 percent of all entrant firms exited within five years of entry and 79.6 percent exited within ten years of entry . . . .”<sup>44</sup> Cartels are not perfectly stable but perhaps not dramatically different from other economic organizations in a dynamic market system.

The powerful lesson learned from this is that cartels cannot be categorized as simply “unstable.” There are cartels that are relatively short-lived and cannot solve the classic problems of cheating, coordination, and entry. There are also, however, cartels with relatively long lives that do solve these problems. Theoretical models have focused on explaining cartel instability, but there are fewer guides to explaining cartel stability.

#### 4. *Determinants of Cartel Duration*

How do cartels survive? There are two answers: both are necessary but neither is sufficient. First, the cartels that survive are located in industries whose exogenous features make collusion easier. Second, cartels that survive organize themselves to address and overcome the problems of coordination, cheating, and entry.

##### 4.1 *Number of Firms and Industry Concentration*

There is considerable variety in the type of products and industries where collusion appears. Some industries in certain periods or certain countries attempt collusion repeatedly, such as railroads in the late 1800s in the United States, and can therefore be thought of as collusion-prone. However, the list of industries with frequent cartel activity is long and diverse: agriculture; stone, glass, and machinery; chemical and agricultural food products; textiles; steel; and highway construction, street construction, and electrical

contracting.<sup>45</sup> Most contemporary international cartels fixed prices on sophisticated intermediate goods and services. The most frequently represented industry in Levenstein and Suslow (2004a) was chemicals, with thirteen cartels. But the sample also includes seven transportation cartels, four steel, three graphite and carbon, two each in plastics and paper, and several in services.<sup>46</sup>

<sup>45</sup> The products listed constituted a significant percentage of the cartel samples in the following studies: agriculture (Dick 1996a, Posner 1970); stone, glass, and machinery (David B. Audretsch 1989, Stefan Fölster and Sam Peltzman 1997, Jacquemin, Nambu, and Dewez 1981, and Symeonidis 2002); chemical and agricultural food products (Connor 2002 and Levenstein and Suslow 2004a); textiles and steel (Audretsch 1989, Dick 1996a, Fölster and Peltzman 1997, Jacquemin et al. 1981, and Symeonidis 2002); and highway construction, street construction, and electrical contracting (Jon Joyce 1989). For example, “bricks, pottery, glass, cement” made up about 10 percent of the British sample (Symeonidis 2002); “stone, clay, and glass” represented 10 percent of the Swedish sample (Fölster and Peltzman 1997); and “stone and clay” made up 30 percent of the German sample (Audretsch 1989). “Nonelectrical machinery” comprises about 10 percent of Audretsch’s (1989) sample, with “machinery” about 10 percent. “Electric equipment,” “industrial machinery,” and “transportation machinery” each make up about 10 percent of Fölster and Peltzman’s (1997) sample. Electrical and mechanical engineering together make up over a quarter of Symeonidis’s (2002) sample.

<sup>46</sup> Levenstein and Suslow (2004a) sample forty-two international cartels prosecuted by the United States or European Union in the 1990s, and they report: “Cartel activity has occurred in a variety of industries—from commodities like cement and citric acid to specialized services like fine arts auctions and wastewater treatment facility construction. Chemical products top the list with thirteen different cartels. The next largest product category is transportation (seven cartels in our sample), followed by steel (four), carbon and graphite products (three), plastics and paper (two each), and several miscellaneous goods and services” (p. 806). Connor (2002) counts and classifies essentially the same set of cartels somewhat differently. His count is larger than that reported here in part because he includes cartels under investigation, while we include only cartels where there has been a conviction. His enumeration procedure is also somewhat different than ours; for example, we treat the vitamins cartel as one cartel, while he counts each group of firms—some, but not all, of whom overlap—conspiring to set the price of a vitamin, as a separate cartel. He also emphasizes the importance of agricultural chemicals and other agricultural products, while we have grouped both agricultural and nonagricultural chemicals together.

<sup>44</sup> Geroski (1995), p. 424.

There is no simple relationship between industry concentration and the likelihood of collusion. Most cartels in our case study sample were in relatively concentrated industries (see table 4). Similarly, most contemporary international cartels are in highly concentrated industries with a few very large multinational firms that compete with one another in many geographical and product markets.<sup>47</sup> The number of participants in these contemporary international cartels ranges from two to several hundred, but in each case where there were more than a half dozen or so firms, industry associations or even national governments played a key role in organizing and implementing the agreement. This finding of cartel activity in concentrated industries does not generalize to other cross-section studies of cartels.<sup>48</sup> While more than two-thirds of U.S. cartels had fewer than ten members (table 5), Posner (1970) says that a "large proportion [of the cartels in his study were] in industries not normally regarded as highly concentrated" (p. 410).<sup>49</sup> Dick (1996b) finds a negative association between concentration and the

likelihood of cartel formation.<sup>50</sup> There are three explanations for the lack of a clear empirical relationship between industry concentration and cartel prevalence. First, this ambiguity may reflect the bias introduced by focusing on cartels that were prosecuted by the U.S. Department of Justice; cartels with large numbers of firms or that had the active involvement of an industry association may have been more likely to get caught. Second, industries with a very small number of firms may be able to collude tacitly without resort to explicit collusion. Third, concentration is endogenous: collusion may have allowed more firms to survive and remain in the market.

As with cartel prevalence, our priors suggest that cartel duration is negatively related to the number of firms in the cartel and in the industry. The empirical results are ambivalent on the question (table 6). Two U.S. studies actually find that cartel duration *increases* with the number of firms.<sup>51</sup> Posner (1970) finds that 52 percent of the cartels with ten or fewer members persisted for six years or more. But duration was even longer for cartels with more than ten firms; 64 percent lasted six years or more. Jacquemin, Nambu, and Dewez (1981) find that concentration did not have a statistically significant impact on duration. This may reflect the role of both the Japanese government and Japanese trade associations in

<sup>47</sup> Levenstein and Suslow (2004a), table 1.

<sup>48</sup> The structure-conduct-performance and price-cost margin literatures have found a consistent, though small, relationship between concentration and profits and/or markups across industries. David I. Rosenbaum and Leslie D. Manns (1994) for example, in their price-cost margin study of Fortune 500 corporations from 1974 to 1977, find that stable market concentration is the only variable that consistently increases elasticity-adjusted markups. This stability may reflect the increased ease of coordination among a small number of firms in industries that are highly concentrated or whose membership does not fluctuate. The stability of industry membership, however, also suggests that there are barriers to entry that allow the cartel to flourish. What these barriers are may well vary from one industry to another. Since our focus is on explicit collusion, we do not discuss these results in further detail here.

<sup>49</sup> Peter Asch and Joseph J. Seneca (1975) measure only firm size, not industry concentration. They find that the average size of firms is larger in their sample of firms convicted of collusion than in a random sample of firms (not charged with collusion). On the other hand, they also find that industries with high entry barriers are less likely to be found in the collusive sample.

<sup>50</sup> Dick (1996b) finds that, in comparison with other export-oriented industries, American "Webb-Pomerene cartels were more likely to ship nondurable, capital intensive, standardized products, to form in industries with low seller concentration, and to form in growing export markets where the United States had a large market shares" (p. 213). Jacquemin et al. (1981) examines 545 Japanese export cartels in forty sectors between 1960 and 1970. The average four-firm concentration ratio in these industries is 59.5 percent compared to a 62.7 percent average for all of Japanese manufacturing. However, collusion occurs in both very concentrated and very unconcentrated industries. For example, the combined market share of the largest four firms in cotton textiles was only 10.3 percent while it was 100 percent in aluminum ingot; both had export cartels (Jacquemin et al. 1981, table 2, p. 696).

<sup>51</sup> Posner (1970) and Dick (1996a).

TABLE 4  
CONCENTRATION AND NUMBER OF FIRMS:  
SELECTED CASE STUDIES

<i>Industry</i>	<i>Number of Participants</i>	<i>Concentration<sup>a</sup></i>
Beer (U.S.)	550–780	C1 = 4% <sup>b</sup>
Beer (Sweden)	23–193	Very low, but increasing over cartel period
Bromine	7–15	
Cement	4	C3 = 95%
Coal	70–100	HHI between 256 and 396
Diamonds		C1 declined from nearly 100% in 1880 to 80% in 1994
Electrical Equipment	40	
Ocean Shipping	2–8	C2 = 50% in one South African market
Oil	19–50	
Parcel Post	5	C5 nearly 100%
Potash	3–30	
RR (U.S. Midwest)	3–4	
RR (U.S. South)	15	
Railroad—Oil	3–4	C3 = 75%
Rayon	2	C2 = 50%
Steel (Europe)	4–8 countries represented by national associations	
Steel (U.S.)	8	C4 = 60%; C1 = 35%
Sugar	8–19	C1 declined from 92% in 1892 to 25% in 1927; C3 = 60% in 1927
Tea	349 (3 countries)	C4 > 20%

*Notes:*

<sup>a</sup> Concentration is measured using either an *n*-firm concentration ratio (e.g., C1 = market share for largest firm in the industry, C2 = sum of market shares of first and second largest firms, etc.) or the Herfindahl–Hirschman Index, which is the sum of the squared market shares of all firms in the industry.

<sup>b</sup> Anheuser–Busch, the largest firm in the United States, had 4 percent of the national market. During this period, most producers and markets were regional so that the concentration ratios of regional markets would be higher than reported here.

See Appendix B for list of sources.

TABLE 5  
NUMBER OF PARTICIPANTS AND INDUSTRY CONCENTRATION

	<i>Hay &amp; Kelley</i>	<i>Fraas &amp; Greer</i>	<i>Posner</i>	<i>Gallo et al.</i>
Mean Number of Firms in Conspiracy	7.25 <sup>a</sup>	16.7	29.1 <sup>b</sup>	2.45 <sup>c</sup>
Median Number of Firms in Conspiracy	7	8	Between 6 and 10	
Fewer than 10 Cartel Members	79%	60%	64%	
Average Industry C4	77%			

*Notes:*

<sup>a</sup> Excluding four cases with 50 or more conspirators.

<sup>b</sup> The mean number of firms for all horizontal conspiracies in Posner's sample is 29.1, but the average falls to 19.9 if one omits the cases brought between 1920 and 1934. The average number of conspirators that Posner reports for those years is as follows: 1920–24: 53; 1926–29: 95; 1930–34: 56.

<sup>c</sup> This is the mean of all 2,689 Commerce Clearing House cases. The average number of defendants was 3.9 for the 688 horizontal conspiracy cases (the average number of firms is not given).

organizing and facilitating these export cartels. On the other hand, George A. Hay and Daniel Kelley (1974) find that industry concentration is associated with increased cartel duration (table 6).<sup>52</sup> Dick (1996a), Marquez (1994), and Suslow (2005) all find that cartel duration increases with the share of the market controlled by cartel members (table 6).

This conundrum is perhaps explained best by Symeonidis's (2003) finding of a concave association between cartel prevalence and concentration. His sample consists of 151 industries, of which 71 are classified as "collusive" (legal cartels registered under Britain's 1956 Restrictive Trade Practices Act) and 80 "competitive."<sup>53</sup> The frequency of collusion increases with concentration but decreases with concentration squared. Symeonidis hypothesizes that high concentration is associated with

asymmetry among firms and that asymmetry makes collusion more difficult. Alternatively, firms may have no reason to collude when concentration reaches a sufficiently high level: there is some level above which explicit collusion is superfluous. The ambiguous relationship between concentration and collusion may also reflect the fact that collusion itself allows more firms to survive in an industry and, therefore, lowers industry concentration relative to what would exist without collusion.

Another explanation for the prevalence of cartels in unconcentrated industries is the role played by trade associations. In the case studies and in contemporary international cartels, industry associations were involved whenever the number of cartel participants was large.<sup>54</sup> This finding does generalize to

<sup>52</sup> There is not sufficient dispersion in the small sample of Hay and Kelley (1974) to test the effect of the number of firms on cartel duration.

<sup>53</sup> Symeonidis consults a variety of sources to decide which industries had colluded over the sample period. See Symeonidis (2003, pp. 53–54) for a discussion of whether nonregistration of agreements introduces a bias in the sample. Symeonidis concludes that there is no significant bias.

<sup>54</sup> A 2002 speech by William Kolasky, Deputy Assistant Attorney General for Antitrust, analyzing recent cartel prosecutions by the U.S. Department of Justice, also comments on the role of trade associations: "cartels can involve a fairly large number of firms . . . industry concentration matters . . . trade associations and industry publications that report detailed market information are important in facilitating cartel activity. . . and, finally, while product homogeneity and high entry barriers may facilitate cartel behavior, they are not essential to it" (pp. 17–20).



TABLE 6  
IMPACT OF CONCENTRATION ON CARTEL DURATION

<i>Author</i>	<i>Dick</i>	<i>Marquez</i>	<i>Suslow</i>	<i>Posner</i>	<i>Hay &amp; Kelley</i>
Number of Firms or Number of Countries	Positive <sup>*</sup>		Negative	Positive <sup>b</sup>	Insignificant <sup>c</sup>
Industry Concentration					Positive <sup>d</sup>
Cartel Market Share	Positive <sup>*</sup>	Positive <sup>*</sup>	Positive		
Cartel Concentration		Positive <sup>*, a</sup>			

*Notes:*

<sup>\*</sup> = statistically significant as reported by author.

<sup>a</sup> Marquez uses Griffin's (1989) calculation of the Herfindahl-Hirschman Index, which is based on each cartel member's share of cartel output.

<sup>b</sup> Posner compared the number of conspirators with length of time between inception of conspiracy and filing of complaint. He found that of 79 cases with 10 or fewer firms, 52% persisted for 6 years or more. Of the 28 cases involving more than 10 firms, 64% persisted 6 years or more.

<sup>c</sup> "Since most of the cases had ten or fewer conspirators the dispersion of observations was not great enough to allow any significant pattern to emerge" (Hay and Kelley 1974, p. 26).

<sup>d</sup> "... the preponderance of conspiracies lasting ten or more years were in markets with high degrees of concentration" (Hay and Kelly 1974, p. 26).

the larger cross-sections. Posner (1970), for example, reports that 44 percent of the cartels in his sample used an industry association to facilitate the price-fixing agreement. Hay and Kelley (1974) and Arthur G. Fraas and Douglas F. Greer (1977) both find that trade associations were involved in about a third of the U.S. price-fixing conspiracies in their samples.<sup>55</sup> Similarly, the vast majority of cartels in Symeonidis's sample were organized and maintained by trade associations.<sup>56</sup>

#### 4.2 Large Customers

Stigler (1964) hypothesized that large customers would increase the incentive for a

cartel member to defect and, therefore, contribute to cartel instability. Empirical evidence of this proposition is limited. In the only explicit econometric test, Dick (1996a) finds that Webb-Pomerene cartels—legal export cartels granted an exemption from antitrust law under the Webb-Pomerene Act of 1918—selling to relatively larger buyers tended to dissolve more quickly (p. 261).<sup>57</sup> Anecdotal evidence from other cartels tends to be less supportive of this proposition.

Evidence from contemporary international cartels suggests that successful collusion is possible in industries with large customers.<sup>58</sup> Many of these cartels sold intermediate goods to large, concentrated industries. For example, citric acid cartel members sold to

<sup>55</sup> The mean number of firms in U.S. price-fixing cases ranges across the samples from 2.45 to 29.1, but the majority of price-fixing agreements involved fewer than ten members (79 percent of Hay and Kelley's sample, 60 percent of Fraas and Greer's sample, and 64 percent of Posner's sample). Trade association involvement occurred primarily when the conspiracy consisted of a large number of firms.

<sup>56</sup> Of the 394 British industries listed by Symeonidis (2002) in Appendix A, only about thirty do not appear to have any trade association involvement in any of the cartels active in the industry.

<sup>57</sup> Dick is not able to measure the size of individual customers. He proxies this with the percentage of exports purchased by the four largest importing countries (p. 261).

<sup>58</sup> William J. Kolasky (2002) concludes that "the ability of large sophisticated buyers to defeat cartel activity may be overrated" (p. 18). See also Levenstein and Suslow (2002), table 15.

such companies as Mars, Coca-Cola, and Procter & Gamble while the vitamin cartel was selling to the Kellogg Company, Quaker Oats, and Tyson Foods. These large corporate customers presumably had both knowledge and bargaining power on their side when ordering inputs. At times, these firms may have used their bargaining power to lower their input prices, but they seem not to have used their resources to break up these cartels. The one exception that we know of is in the investigation of the graphite electrodes cartel, which was initiated by a steel firm that complained to the U.S. Department of Justice.<sup>59</sup> Several other antitrust investigations of international cartels have been initiated by customers filing civil suits, but in each of these cases the customers were small firms or individuals. Triple damages were not enough to catch the attention of the legal staffs of large corporate purchasers prior to government action.<sup>60</sup>

This indicates that the impact of large customers on cartel stability may be more complex than Stigler expected. One possible explanation of this behavior is that the proportion of total cost represented by the cartelized product is small. Alternatively, some of these downstream industries may be sufficiently oligopolistic themselves such that it is possible for them to pass along higher input prices to consumers, decreasing any incentive they might otherwise have to

disrupt the upstream cartel. Thus customer size, in and of itself, may destabilize the upstream cartel, but customer concentration may have the opposite effect.

The case study literature also reflects this complex relationship between customers and supplier cartels. Table 7 summarizes the role of customers in the sample of case studies surveyed. In five of these industries, customers engaged in explicit strategic behavior to try to break the cartel that charged them high prices. In some cases (e.g., bromine and potash), customers attempted to enter the industry, vertically integrating to get around the cartel. In other cases, customers attempted to encourage defections by telling suppliers that others already had defected (as in the rayon industry) or by contracting with defectors, as predicted by Stigler (Eswaran 1997, Levenstein 2000). Recent research on the potash cartel suggests that fertilizer manufacturers organized a national merger *in order to* undermine the potash cartel that supplied them with an essential raw material (Levenstein 2000). Some customers also looked to legal remedies, even before the Sherman Act offered triple damages, as when crude oil producers had the corporate charter of an early railroad cartel revoked (Elizabeth Granitz and Benjamin Klein 1996). In virtually every case, large customers happily took advantage of price wars to stock up on supplies (e.g., Levenstein 1996). For example, grain brokers regularly stored their goods in Chicago waiting for the next breakdown in the JEC railroad cartel (Ulen 1979).

Thus, as Stigler (1964) argued, large customers can and do undermine cartel stability. But there are other cases in which customers were intimately involved in stabilizing a cartel, providing information and punishment mechanisms not otherwise available, and sharing, indirectly, in cartel rents (Granitz and Klein 1996, Levenstein 1993a). Daniel Barbezat (1994) argues that the existence of a cooperative organization of steel customers

<sup>59</sup> Adam Jones, "Blowing the Whistle—American-Style," *The Times of London*, February 24, 2000. This complaint may reflect the large increases in price implemented by the cartel. See section 6.1 for further discussion.

<sup>60</sup> Daniel F. Spulber (1989, chapter 19, pp. 594–98) and Baker (1988) have argued that this behavior is to be expected, as customers may simply include expected civil damages in their demand for the product and bid up the price prior to any enforcement action, so that only unanticipated civil damages will have a deterrent effect. Stephen W. Salant (1987) formally models this, incorporating the cartel's expectation that demand will shift in this fashion. He finds that in most cases triple damages have no effect on either output, total surplus, or the division of surplus between cartel members and their customers; there are cases, however, in which triple damages increase output and total surplus, with a larger proportion of the surplus going to customers. In either case it raises price.

TABLE 7  
 HOW DOES DOWNSTREAM STRUCTURE AFFECT CARTEL STABILITY?:  
 SELECTED CASE STUDIES

<i>Industry</i>	<i>Customer Size</i>	<i>Customer Concentration</i>	<i>Customer Participation in Cartel</i>	<i>Did Customers Try to Destabilize Cartel?</i>
Beer (U.S.)	Small	Low	No	No
Beer (Sweden)	Small	Small	No	No
Bromine	Medium	High	Yes	Downstream pharmaceutical firms tried to integrate backward into bromine
Cement	Small	Low	Vertical Integration	
Coal			No	No
Diamonds	Medium	Low	Yes	
Electrical Equipment	Varied	Low	No	
Ocean Shipping	Varied	Low	No	In tramp shipping and other geographic routes
Oil			No	
Parcel Post	Varied	Low	No	
Potash	Increased over time	Increased over time	No	Attempted vertical integration, attempted to induce cheating
Railroad (U.S. Midwest)	Varied	Low	No	Strategic shipping by customers
Railroad (U.S. South)				
Railroad—Oil	Large	High	Yes	Crude producers had cartel charter revoked
Rayon			No	Customers spread rumors of cheating, in order to induce it
Steel (Europe)	Large		Yes, in some cases	Large customers bargained for lower prices than small customers received
Steel (U.S.)	Large			
Sugar	Varied		No	No
Tea			No	No

See Appendix B for list of sources.

restricted the possibility of cheating by steel producers.<sup>61</sup> Large customers sometimes benefit from the existence of a cartel if they receive preferential pricing relative to their smaller competitors. For example, the graphite electrodes cartel of the 1990s permitted cartel members to give discounts to large customers.<sup>62</sup> Similarly, German steel finishers received rebates from the German steel cartel on their export-oriented purchases, giving them an advantage in international competition.<sup>63</sup> Large firms may be willing to tolerate higher input prices in order to gain additional advantage over smaller competitors. That is, they would rather face an upstream cartel than downstream competition.<sup>64</sup>

### 4.3 Nature of Demand

How does demand affect cartel prevalence? We would expect collusion to be more prevalent in industries with relatively inelastic demand, as the potential profits

arising from fixing prices are greater (Robert S. Pindyck 1979). The empirical work is very limited but generally consistent with this expectation. How does demand affect cartel duration? We expect that instability would undermine cartels. Cyclical fluctuations, to the extent that they are predicted or predictable, do not appear to undermine well-working cartels, but rapid industry growth and unexpected fluctuations in demand do. Here we explore the impact of both elasticity and the many facets of demand instability.

Eckbo (1976) is the only large cross-section that examines the relationship between demand elasticity and cartel success. He finds that cartels are able to raise price substantially only if demand is sufficiently inelastic and there are few short-term substitutes (p. 42). Measuring demand elasticity should be easier in case studies, but there are such estimates for only three of the nineteen industries included in our sample (table 8). In two of these cases, demand is inelastic. Five case studies simply describe demand as "inelastic." The one industry in the sample for which demand was clearly very elastic (the brewing industry, with an elasticity of  $-10$ ), had a remarkably unsuccessful cartel, with price wars occurring in every year of the study. The prices charged by the U.S. beer cartel may have, in fact, been higher than the monopoly price, moving demand out to a very elastic range, because the cartel was operating in the immediate post-Prohibition era and there was significant political pressure to keep the price of alcoholic beverages high.

Demand fluctuations play a critical role in several theoretical models of cartel stability, and several cross-sectional studies have examined the relationship between some measure of demand stability and cartel duration or formation (table 9). The specific measures vary from study to study depending on the particular model specified (and, of course, the data actually available). Dick (1996b) finds that Webb–Pomerene

<sup>61</sup> "... [C]heating does not appear to have been a problem. In fact, there were no provisions at all under the original agreement outlining specific penalties for cheating. The centralization of both [producers and consumers] made the producers' information very good and acted to strengthen the terms of the agreement" (p. 486). Steel consumers, including bicycle, machinery, and freight car manufacturers, belonged to an association of steel finishers known as the *Arbeitsgemeinschaft der Eisen verarbeitenden Industrie* or Working Community of the Iron Finishing Industries.

<sup>62</sup> A memo written by an executive of one of the participating firms read, "UCAR, therefore, has decided to give up the price increase as originally demanded, especially for the 7–8 customers, including Aichi, who is an important customer for UCAR" (*United States v. Mitsubishi Corp.*, No. 00–033 E.D. Pa., Daily Trial Transcript, Day 6, Jan. 31, 2001, p. 82). For further discussion of the graphite electrodes cartel, see Levenstein and Suslow (2004a), pp. 826–42.

<sup>63</sup> Barbezat (1994), p. 484.

<sup>64</sup> These agreements between cartels and large customers are similar to exclusive contracts in that they can help to eliminate competition and entry in both the upstream and downstream industries. Philippe Aghion and Patrick Bolton (1987) write, "Our analysis [of exclusionary contracts] provides a rationale for the practices described here and explains why rational customers cooperate with firms in these anticompetitive practices" (p. 399). See also Ilya R. Segal and Michael D. Whinston (2000).

TABLE 8  
DEMAND ELASTICITY ESTIMATES:  
SELECTED CASE STUDIES

<i>Industry</i>	<i>Elasticity Estimate</i>
Beer (U.S.)	-10.3
Beer (Sweden)	
Bromine	-0.38 to -3
Cement	Inelastic
Coal	
Diamonds	Very inelastic
Electrical Equipment	
Ocean Shipping	
Oil	Assumed to be inelastic
Parcel Post	
Potash	
Railroad (U.S. Midwest)	
Railroad (U.S. South)	
Railroad—Oil	
Rayon	Elastic
Steel (Europe)	Inelastic in long run; short run elasticity high
Steel (U.S.)	Inelastic in long run; short run elasticity high
Sugar	Relatively inelastic
Tea	Low, especially at higher incomes (-0.32)

See Appendix B for list of sources.

Associations are more common in growing export industries. In contrast, Asch and Seneca (1975) find that firms characterized by low rates of sales growth are significantly more likely to collude than those with high growth. Symeonidis (2003) provides a possible explanation for these conflicting results. He finds that collusion appears most likely in markets with moderate growth, and less likely in either rapidly declining or rapidly growing markets. His explanation for the nonmonotonicity in the relationship between

collusion and demand growth is that although demand growth increases the weight that firms put on the future, very rapid growth increases uncertainty and invites entry.

To distinguish between the Green-Porter (1984) prediction that price wars will arise in response to unobserved negative demand shocks and the Rotemberg-Saloner (1986) prediction of "price wars during booms," Dick tests whether Webb-Pomerene cartels were more or less likely to collapse during downturns in export demand



TABLE 9  
IMPACT OF DEMAND ON CARTEL DURATION

<i>Author</i>	<i>Dick</i>	<i>Marquez</i>	<i>Suslow</i>
Demand Instability	Negative*		
Rate of Demand Growth		Negative	Negative*
Business Cycle	Negative		Negative*
Anticipated Cycle	Negative*		
Unanticipated Cycle	Insignificant		Negative*
Interest Rate		Negative	

\* Indicates that the author reported a statistically significant result.

(1996a, p. 271).<sup>65</sup> He finds that cartels were more likely to end during anticipated downturns, but that their stability was unrelated to unanticipated business cycle fluctuations. In contrast, in a study of a cross-section of legal German cartels before World War I, Steven B. Webb (1982) finds that downturns did not contribute to cartel instability. He argues that German cartels used dumping (exporting at lower prices than prevailed domestically) to maintain their stability during recessions. His characterization of the effect of business cycle upturns on pre-World War I German cartels is remarkably similar to the logic of Rotemberg and Saloner: “When the depression was followed by prosperity, the more successful entrepreneurs got tired of the restrictions imposed on them by the cartels and tried to get rid of them.”<sup>66</sup>

Jacquemin, Nambu, and Dewez (1981) find that a higher growth rate of demand is negatively correlated with cartel duration. Building on Jacquemin, Nambu, and

Dewez’s work, Marquez (1994) finds that an increase in demand growth has a negative effect on duration, but his result is not statistically significant (table 9). Suslow (2005) focuses instead on deviations from trend demand and finds that demand uncertainty destabilizes cartels. This effect is more important than either industry structure or cartel organization variables (table 9). A comprehensive British government study during the 1940s noted that cartel instability is a prominent feature in those industries susceptible to “violent” changes in economic conditions.<sup>67</sup> More stable industries—such as matches, electric lamps, and quinine—saw steady cartel activity over long periods (p. xxxii). This finding is consistent with the econometric results described above—demand instability appears to destabilize cartels.

It has frequently been claimed that cartels cannot survive the increased competitive pressure of economic recessions: as demand and prices fall, the pressure to maintain revenue increases firms’ willingness to cheat. This seems to have occurred in both the tin and steel cartels, both of which fell apart

<sup>65</sup> His measure of demand variability is the coefficient of variation of an index of quarterly export prices for one of four broad product categories during the cartel’s life span.

<sup>66</sup> Webb (1982, p. 216), quoting Gustav Stolper (1940, p. 85).

<sup>67</sup> Great Britain Board of Trade (1976), pp. xxix–xxx.

during the depression of the early 1890s (Naomi Lamoreaux 1985). Table 10 summarizes the evidence on cyclicity and cartel stability in our sample of case studies. The table sheds light on whether a particular cartel ever came together or fell apart in response to cyclical fluctuations. 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. The limited information in this table reflects the limited contribution of case study research (up to this point) in informing our understanding of the relationship between cyclicity and cartel stability. The only case that is reported to have collapsed as the result of an observable demand shock was that of the international steel cartel. It may be that, in some other cases, bargaining issues arose as a result of a decline in demand. Similarly, it may be that in cases where we report that cheating undermined the cartel, it was a shock to demand that led to the cheating. One study that finds the opposite result, and one consistent with the Rotemberg–Saloner (1986) hypothesis, is Srabana Gupta (2001). In this examination of the importance of multimarket contact in rigging bids in the highway construction industry, Gupta finds that average bids actually fell when employment increased (p. 464). In general, though, cross-sectional analyses have more frequently included explicit measures of the impact of business cycle fluctuations and have been more successful at finding such effects.

When one turns to our case study sample, what is perhaps most striking is how little relevance macroeconomic fluctuations seem to have one way or the other (table 10). This “non-finding” is consistent with the Green–Porter/Abreu literature, which implies that price wars will follow unobserved fluctuations in demand, but not observed

fluctuations. From the point of view of the cartel, macroeconomic fluctuations are close to common knowledge; it is idiosyncratic demand that may not be observed. It is also consistent with our view on expensive, disruptive punishments: successful cartels do not break apart in response to demand fluctuations; they develop organizational machinery of some sort that allows them to weather cyclical fluctuations. Cartels that are disrupted by observable cyclical fluctuations may be fairly fragile to begin with.

#### 4.4 *Cartel Organization and Cartel Learning*

Successful cartels overcome this fragility through the development of sophisticated and flexible organizations. Cartels must identify a collusive equilibrium, coordinate on it, and then continuously update as demand and costs fluctuate. Cartels develop these organizations over time as a result of organizational learning. When cartels “learn,” what are they learning? They learn how to monitor output and prices of individual cartel members in order to detect cheating. They learn how to structure incentives so that collusion is more profitable in the long run than cheating. Successful cartels fashion self-imposed penalties or other compensation schemes for firms that exceed cartel quotas. They learn how to structure cartel-imposed punishments and other disciplinary actions in response to cartel violations. They develop and implement exclusionary practices to prevent entry or expansion by nonmembers. Finally, they develop an elaborate internal hierarchy that allows communication on various levels (executive and middle-management) not only to provide flexibility in the details of the agreement, but to build trust as well.

Hierarchy and communication are important to cartel success because the world is dynamic and contracts are inherently incomplete. Firms’ expectations about their competitors’ propensity to cooperate can have a significant impact on the success of collusion.

TABLE 10  
HOW DOES DEMAND AFFECT THE FORMATION & ENDURANCE OF CARTELS?:  
SELECTED CASE STUDIES

<i>Industry</i>	<i>Formed During Downturn</i>	<i>Formed During Upturn</i>	<i>Broke up During Downturn</i>	<i>Broke up During Upturn</i>	<i>Industry Cyclicality</i>
Beer (US)	Yes	No	Yes		Countercyclical
Beer (Sweden)	No	No	No	No	
Bromine	No	No	No	No	Low
Cement					High
Coal					
Diamonds					
Electrical Equipment	No				Varied across products
Ocean Shipping	No				
Oil	No				High
Parcel Post	No				
Potash	No				
RR (U.S. Midwest)	No				High
RR (U.S. South)	No				High
Railroad—Oil	No				High
Rayon	Yes			Yes	
Steel (Europe)	Yes		Yes		High
Steel (U.S.)	Yes				High
Sugar	Yes				Countercyclical
Tea	Yes				Countercyclical

See Appendix B for list of sources.

These expectations may be influenced by previous interaction, interaction in other markets, and cultural similarities or differences. Trust is also important to coordinating on a collusive equilibrium rather than spiraling down into competition. For example, Debora L. Spar (1994) examines how the internal organization of competitors can

affect their capacity for external cooperation. She argues that commitment and credibility are the critical determinants of cartel duration. Her study of the diamond industry describes how cooperation among individualist diamond miners in solving a variety of problems (such as the resolution of property rights and production problems) created the

context for cooperation in pricing and distribution. Studies of the rayon industry note that a “culture of collusion” among firms in the industry facilitated cooperation (Craig A. Gallet and John R. Schroeter 1995, Jesse W. Markham 1952). Similarly, the 1930s steel industry benefited from the experience of the Gary dinners of the 1890s (Baker 1989).

While most cross-sectional studies acknowledge the importance of cartel organization and learning, the difficulties in observing and quantifying such information for a large number of industries has meant that these critical subjects are usually ignored. Case studies are much more amenable to studying organizational issues, and there have been several important recent contributions in this area.<sup>68</sup>

#### 4.4.1 *Monitoring Output and Prices*

A joint sales agency, the strongest organizational form used to “monitor” output, plays an important role in cartel success. One function of a joint sales agency is that it removes individual firm discretion over pricing decisions and therefore eliminates the possibility that individual firms will engage in secret cheating. There is a long history of the use of joint sales agencies by cartels (see, for example, James W. Hughes and Barbezat (1996) on the use of joint sales agencies in the steel industry; Levenstein (1993a, 1995) on bromine and salt).<sup>69</sup>

<sup>68</sup> Jeffrey K. MacKie-Mason and Pindyck (1987) argue that organizational issues were *not* important in determining the success of the mercury cartel, an on-and-off alliance between Spain and Italy between 1928 and 1972. External conditions, not organizational issues, undermined the mercury cartel. More generally, they argue that if sufficient profits are available, organizational means will be found. But they do not examine the internal records of the cartels involved, so it is difficult to know whether a different cartel organization could have affected these “external conditions,” for example by creating barriers to entry or increasing demand, so that the cartel could have enjoyed continued success.

<sup>69</sup> The converse of this is demonstrated by the sugar case. Genesove and Mullin (2001) note that the sugar industry’s use of independent sales agents “was at odds with the collusive agreement” (p. 393).

Cartels that control the distribution of goods, through a joint sales agency or some other mechanism, appear to be more stable.<sup>70</sup> Seven of the nineteen industries in our case studies used joint sales agencies: bromine, cement, diamonds, ocean shipping, oil, potash, and European steel. Most of these seven cases were among the more successful cartels (see table 15, discussed further below). While only a small percentage of the U.S. cross-sections report that the cartel used a joint sales agent (table 11), Dick (1996a) finds that the use of a single sales agent is associated with a decreased likelihood of cartel failure. Joint sales agencies are sometimes able to segment markets, allowing the cartel to dispose of output above the collusive level in some “outside” market where it cannot be re-exported to the cartelized market. For example, Frode Steen and Lars Sjørgard (1999) argue that a joint sales agency helped to protect the cartel price by exporting excess supplies of Norwegian cement.

Cartels have devised other schemes for sharing information that do not also centralize sales. Industry associations often engage in the collection and dissemination of information, which may facilitate collusion. Between a quarter and a half of the cartels in U.S. cross-section studies report the involvement of trade associations (table 11). The state may also play a role, as the U.S. federal

<sup>70</sup> B. Douglas Bernheim and Whinston (1985, 1986) provide a theoretical model in which a joint sales agency changes production firms’ incentives so that they do not want to increase output beyond the joint-profit maximizing level. Telser (1985), on the other hand, argues that joint sales agents increase efficiency. Other types of vertical restraints may also facilitate collusion. For example, loyalty contracts, or rebates to customers who buy only from the cartel, are discussed by Pedro L. Marin and Richard Sicoite (2003) in a study of U.S. shipping cartels in the 1950s and 1960s. They find that the ability to use such contracts increased the stock market valuation of these shipping conferences (as they are known) on the New York Stock Exchange. Karen Clay, Gillian Hamilton, and Joanne Roberts (2003) come to a similar conclusion regarding the use of loyalty contracts by American Tobacco in the late nineteenth and early twentieth centuries.

TABLE 11  
 CARTEL ORGANIZATION: THE USE OF VARIOUS TECHNIQUES FOR MONITORING,  
 REWARDING, AND DISCIPLINING CARTEL MEMBERS

	<i>Hay &amp; Kelley</i> <sup>a</sup>	<i>Fraas &amp; Greer</i>	<i>Posner</i>	<i>Gallo et al.</i>
Trade Association Involvement	29%	36%	44%	23%
Market Allocation <sup>b</sup>	35%	26%	26%	27%
Single Sales Agent		3%	6%	
Terms and Conditions of Sales Set	14%	5%	14%	
Disciplinary or Coercive Practices; Exclusion	5%	12%		
Policing; Fines; Audits			4%	

*Notes:*

<sup>a</sup> There are 65 cases in the Hay and Kelley sample, but not all industry characteristics were available for each case. For example, trade association information is available in 62 cases.

<sup>b</sup> Market allocation includes use of production quotas, division of markets, division of territories, allocation of customers.

government did during the Great Depression (Barbara Alexander 1994), as the Federal Trade Commission did during the 1920s by encouraging the adoption of uniform accounting systems (Levenstein 1998), or as nineteenth century state governments did even more directly in the salt industry (Levenstein 1995). Genesove and Mullin (1999) and Levenstein (1996) examine the information collection procedures of cartels in the sugar and bromine industries, respectively. Finally, some European cartels have used the Fides company of Switzerland, alternately called either a “trust company” or “secretarial company” in European Commission decisions, to assist in data collection. For example, in a 1998 judgment concerning the European cartonboard (or paperboard) cartel, Fides’ role is explained: “According to the Decision, the Commission also took the view that the activities of the PG Paperboard were supported by an information exchange organised by Fides, a secretarial company, whose

registered office is in Zurich, Switzerland. The Decision states that most of the members of the PG Paperboard sent periodic reports on orders, production, sales and capacity utilisation to Fides. Under the Fides system, those reports were collated and the aggregated data were sent to the participants.”<sup>71</sup>

Thus, there are a variety of organizational alternatives to the joint sales agency—which is likely to be too formal and too easily detected by antitrust authorities. We have

<sup>71</sup> Judgment of the Court of First Instance, Case T-337/94, 14 May 1998, paragraph 19. See also the decision relating to a cartel in bulk thermoplastic LdPE (low density polyethylene) where the “FIDES statistical exchange system” is described (89/191/EEC: Commission Decision of 21 December 1988, Official Journal L 074, paragraph 11). Finally, the 1985 Commission Decision on the bleached sulphate pulp cartel describes how Fides “runs the Research and Information Center for the European Pulp and Paper Industry” (85/202/EEC: Commission Decision of 19 December 1984, Official Journal L 085, paragraphs 43 and 109).



mentioned only a few common information sharing mechanisms. Although it has not been formally tested, our hypothesis is that the more elaborate these sharing and monitoring mechanisms—or the closer they bring the cartel to a joint sales agency—the more stable the cartel.

#### 4.4.2 *Incentives and Self-Imposed Penalties*

Cartels use various mechanisms to create inducements and punishments to support collusion (table 11). Side payments are also sometimes used to hold a cartel together. These payments are agreed upon by members in recognition of the fact that demand uncertainties can create differences between expected and actual sales by each firm, even in the absence of cheating. For example, the graphite electrode cartel seemed to have such an informal system. According to one of the company executives, “the goal was that there would not be any cheating but . . . they had set up a system so that if someone did cheat, people could complain, and then if it was determined that someone had cheated, then they might have to give up tons somewhere else. So it was a check and a balance.”<sup>72</sup>

Suslow (2005) finds that the existence of self-imposed penalties has a significant positive effect on duration. The more experienced the cartel, and the more specialized and complex the governance structure (greater use of penalties and of central sales agencies, for example), the longer the cartel is likely to endure.<sup>73</sup> Similarly, cartel agreements in pre-WWII Britain were rarely renewed without substantial modification to the cartel organizational form or penalty structure.<sup>74</sup>

Genesove and Mullin (2001) provide a rich and detailed illustration of the cartel learning process in their analysis of the evolution of agreements among U.S. sugar producers. They describe how weekly meetings of sugar refiners allowed them to “complete the contract” by adjusting the agreement to changing external conditions, such as fluctuations in demand, and by addressing issues originally left ambiguous. Cartel members also developed new restrictions as participants responded to the agreement by finding new dimensions on which to cheat (pp. 386–87). These modifications of the original agreement provided principles, analogous to legal principles, to guide firm actions and further modifications of the cartel agreement.

A large percentage of price fixing cases, both in the United States and in other countries, target bid-rigging.<sup>75</sup> There are certain organizational issues that are specific to cartels that fix bids at auctions.<sup>76</sup> Several case studies of auctions explore the rules and mechanisms that cartels have used to sustain collusion in auctions. For example, William S. Comanor and Mark A. Schankerman (1976) hypothesize that, in markets characterized by open bidding, cartels with few members are more likely to use rotating bids than identical bid strategies. Compared to an identical bids strategy, rotating bids provide a clear market

<sup>75</sup> See Luke M. Froeb (1988) and Japanese Fair Trade Commission (2001).

<sup>76</sup> There are also very interesting papers that address the question of how to *detect* collusion in auctions. Because our focus here is exclusively on examining cartels where there is essentially no disagreement that a cartel existed, at least formally, we do not review these papers. For examples of this literature focusing on collusion in bidding for school milk contracts, see Robert F. Lanzillotti (1996), In K. Lee (1999), Porter and J. Douglas Zona (1999), and Frank A. Scott Jr. (2000). An important new contribution to this literature that surveys the various methodological approaches to detecting collusion in auctions is Patrick Bajari and Garrett Summers (2002). Kenneth Hendricks and Porter (1989) provide a useful survey of the theoretical and empirical literature on collusion in auctions.

<sup>72</sup> Levenstein and Suslow (2004a), p. 835.

<sup>73</sup> However, when she includes a dummy variable to capture pre-WWI cartel experience of sixteen industries in the sample, Suslow (2005, p. 727) finds no significant effect on post-WWI cartel episode duration.

<sup>74</sup> Great Britain Board of Trade (1976), p. xxxi.

sharing rule. However, they argue that the coordination costs will be higher since the cartel must agree on a division of cartel profits. This in turn implies that we should see a rotating bids scheme used when there are relatively few coordinating firms.<sup>77</sup> Comanor and Schankerman test this hypothesis using data from successfully prosecuted cartel-bidding cases between 1945 and 1974 and confirm that rotating bid arrangements were used more frequently by cartels with few members (eight or less in their study) than by cartels with more members.<sup>78</sup>

Bid-rigging schemes require some mechanism for compensating any firm that agrees to lose the auction. As described in the next section, the electrical equipment conspiracy of the 1950s solved this compensation problem by rotating bids among participating firms. John E. Kwoka Jr. (1997) describes a particularly ingenious bid rigging scheme organized by real estate investors in the Washington D.C. area in which they used a second auction and side payments to compensate “losers.” After the public auction, in which a cartel-designated “winner” would purchase the property, the conspirators would resell the property at their own auction. The bids made at this second “knock-out” auction determined the true winner and the payoffs to the nonwinning bidders. John McMillan’s (1991) study of collusion in the Japanese construction industry examines many aspects of the organization of these conspiracies, including the importance of

repeated interaction and side-payments to their success. In these “dango,” winning bidders paid “cooperation money” to losing bidders; the enticement of future cooperation money provided a disincentive to cheat on the collusive agreement. Martin Pesendorfer (2000) finds, however, that the inability to use side payments does not reduce the efficiency of a cartel if the cartel is large enough and there are a large number of projects to distribute among the cartel members. Comparing school milk bidding in Florida and Texas between 1980 and 1991, he finds that Floridian conspirators used side payments and allowed market shares of individual firms to fluctuate, while Texan conspirators appeared to have divided up the market among the members. In both cases, collusion was successful, durable, and nearly achieved the monopoly outcome.

#### 4.4.3 *Internal Organizational Hierarchy*

Many successful cartels develop hierarchical organizations to effect cartel policies. By dividing responsibility, these organizations may in part reflect an attempt to protect participants from legal liability. They also allow for flexibility in response to changing economic circumstances that might otherwise undermine cartel stability.

Wayne E. Baker and Robert R. Faulkner (1993) argue that organizational structure was important for the success of the electrical equipment cartel of the 1950s: collusion was easier for standardized products in which the management of the cartel could be fairly decentralized. This cartel, made up of some forty electrical equipment manufacturers, set prices on twenty products with annual sales of \$2 billion, including switch gears, transformers, turbine generators, industrial controls, and other electrical equipment. This case, involving both General Electric and Westinghouse Corporations, generated the first jail sentences imposed under the Sherman Act. For many product lines, there were two levels of cartel organization: a high level group of top executives and general

<sup>77</sup> Comanor and Schankerman (1976), pp. 283–84.

<sup>78</sup> A different way to create a “carrot” for colluding firms is discussed in Jonathan Feinstein, Michael Block, and Frederick Nold (1985), where cartels mislead customers and raise their expectations of the equilibrium price on future purchases. They analyze a sample of 1,200 highway contracts from North Carolina’s Department of Transportation before 1980, 45 percent of which the DoT classified as collusive. Through repeated bidding with the same customers, colluding firms were able to raise the nonwinning bids (as well as the winning bids) so as to mislead customers regarding the costs of completing future road construction projects.

managers and a working level group of sales managers. It was the working level group in charge of pricing switch gears that devised the famous “phases of the moon” formula for determining which firm was to submit the winning bid for any order, with the winning firm rotating every two weeks.<sup>79</sup> This kind of rotation worked well for a product like switch gears in which individual orders were relatively small and frequent. In contrast, these kinds of mechanisms were not used for products for which demand was very lumpy, such as turbine generators, where a single order could provide the year’s sales. In such cases, resorting to a formula was impossible and regular communication among the conspirators was required.<sup>80</sup> Baker and Faulkner (1993) argue that collusion was much more difficult for customized products that required frequent contact among colluding firms.

This type of elaborate structure is similar in principle to the organization of the contemporary citric acid cartel in which firms fixed prices from approximately July 1991 to June 1995.<sup>81</sup> The senior executives responsible for determining the broad outline of the cartel agreement were nicknamed “the masters.” The lower-level executives responsible for the day-to-day workings of the cartel were “the sherpas.” They shared monthly sales figures and took stock at the end of the year of each company’s total sales. A company selling more than its quota was required the next year to purchase citric acid from a cartel member that was under quota.<sup>82</sup>

Several studies examine the importance of social and cultural cohesion to cartel stability. Joel M. Podolny and Fiona M. Scott Morton

(1999) find that the response of a British shipping cartel to a new entrant depended on cultural bonds, such as the social status of the entrant. The entry of firms whose owners were of high social status was more likely to be accommodated, while low social status entrants were more likely to be subject to predatory behavior. Hugo Van Driel (2000) examines the importance of group development in creating common bonds and shared culture among firm managers that then facilitates collusion. He provides evidence of the importance of these cultural and organizational factors in cartel formation and stability for four European transportation industries.

Alexander (1994) argues that, in many industries, firms learned to cooperate under the U.S. National Industrial Recovery Act in ways that improved their ability to avoid price competition even after explicit collusion was prohibited. NIRA lasted from 1933 to 1935, when the Supreme Court ruled it unconstitutional. During those two years, roughly 700 “codes of fair competition” were written—effectively creating exemptions from antitrust laws—in exchange for increased wages and other employee rights. Examining the case of steel, Baker (1989) argues that the adoption of a NIRA code made cooperation a dominant strategy for U.S. steel producers between 1933 and 1935, so that even when there were unexpected declines in demand, producers believed that they were observing fluctuations in demand, not cheating by other firms. After the abandonment of the code, firms apparently engaged in equilibrium punishments in response to unexpected demand fluctuations, but cooperation was maintained: “. . . the NRA taught the steel producers how to collude” (p. S72).<sup>83</sup>

<sup>79</sup> For a detailed description, see Charles A. Bane (1973), pp. 5–6, 346–47.

<sup>80</sup> Baker and Faulkner (1993), pp. 838–41 and Scherer (1980), pp. 170–75, 222.

<sup>81</sup> “Justice Department’s Ongoing Probe Into the Food and Feed Additives Yields Second Largest Fine Ever,” U.S. Department of Justice Press Release, January 29, 1997.

<sup>82</sup> Kurt Eichenwald “U.S. Wins A Round Against Cartel,” *New York Times*, January 30, 1997, p. D1.

<sup>83</sup> Baker’s empirical methodology falls within the class of studies that seek to distinguish competitive and collusive behavior using structural demand and supply equations. Baker builds on Bresnahan (1987), which finds that tacit collusion was sustained in the American automobile market in 1954 and 1956, while the competitive solution fits more precisely in 1955.

Several cartels in our case study sample got off to a rocky start but later managed to sustain collusion for longer periods.<sup>84</sup> This was the case for the Swedish beer, railroad-oil, tea, potash, and sugar cartels. It appears that the participants learned about each other and about organizational features that would help to support collusion in their industry. For example, Torbjörn Lundqvist (1998) tells us that, after a decade of largely unsuccessful negotiations among Swedish breweries, a cartel was formed in 1894 that “excelled compared with earlier ones by virtue of its more sophisticated control machinery.”<sup>85</sup> An even more successful cartel (lasting fifty years) was formed in 1906, and Lundqvist credits both learning from prior failures and the development of a stronger industry association with this achievement.<sup>86</sup> It seems likely that this kind of early history of failure characterizes many successful cartels. (In some cases, these early failed attempts may have left little or no historical record.) This was the case in many of the European cartels; the post-World War I steel and potash cartels, for example, display more complex organizational structures than did their prewar predecessors. Dick (1996a) and Suslow (2005) use cross-sectional data to test for evidence of cartel learning, and both find a positive relationship between cartel experience and cartel duration (table 12).

<sup>84</sup> Kolasky (2002) examines a set of recent cartel prosecutions in the United States to conclude that “cartel participants tend to be recidivists” (p. 20).

<sup>85</sup> Lundqvist (1998), p. 51.

<sup>86</sup> “Organisational developments during the 1890s were a direct consequence [of the fight against the temperance movement] . . . the brewing organisation was changed from a representative organisation to a control organisation speaking for the entire industry with the help of salaried officials. The organisation and knowledge built up during these years were necessary prerequisites of national cartel-making. Moreover, lessons had been learnt from the error of [earlier cartel agreements]. One of the reasons why the [earlier] endeavour had failed was that the Brewers’ Association still lacked a control mechanism . . . The transaction costs of supervising and establishing respect for the agreements entered into were too high” (Lundqvist 1998, p. 61).

Studying the relationship between organization and cartel stability is difficult because organization is clearly not an exogenous variable. In the electrical equipment case, the participating firms used different organizations for different products, in part because of differences in product homogeneity. Thus one could argue that standardization of the product and the smoothness of demand were the real determinants of cartel stability, more so than organization per se. On the other hand, organizational improvements are developed by cartels in particular product markets, and these improvements enhance cartel stability.

#### 4.4.4 *Exclusionary Practices*

Cartels know that entry will undermine their attempts to increase profits. Dick’s study of export associations finds that they tended to form in industries where entry was slow (1996b, p. 214). Similarly, Symeonidis (2003) finds that the probability of collusion increases with capital intensity, which he interprets as a proxy for high barriers to entry. But the most successful cartels do not simply treat barriers to entry as exogenous; they actively try to create them. Sometimes this is done through collective predation, as in Scott Morton (1997) and Podolny and Scott Morton (1999). In other cases, cartels have turned to the state to create regulations (e.g., salt), impose export tariffs (potash), or provide antidumping protection (citric acid) with the goal of excluding outsiders. In other cases, a cartel’s joint sales agency uses vertical exclusion to prevent entry by nonmembers (as well as prevent cheating by members). Levenstein (1995) examines repeated attempts by U.S. salt producers to collude during the nineteenth century. Salt producers created the very first known price-fixing cartel in the United States. They employed a wide variety of legal and extra-legal mechanisms to fix prices, limit output, and provide exclusive access to geographic markets. Each of these collusive arrangements collapsed within a year or two at the

TABLE 12  
IMPACT OF EXPERIENCE ON CARTEL DURATION

<i>Author</i>	<i>Dick</i>	<i>Suslow</i>
Experience	Positive*	Positive
Age in Single Episode	Positive* . <sup>a</sup>	

*Notes:*

\* Indicates that the author reported a statistically significant result.

<sup>a</sup> Cartel in 10th year had 28–48% higher probability of dissolving than cartel in 5th year.

most. Levenstein argues that, despite much hard and creative work on the part of the manufacturers, as well as some state regulators, there were not sufficient barriers to entry to sustain collusion. Clay and Werner Troesken (2002) come to a similar conclusion regarding attempts to control the markets for distilled alcohol during the late nineteenth century: barriers to entry were simply too low to allow colluding firms to maintain market share as they increased price.<sup>87</sup>

Scott Morton (1997), in contrast, documents successful entry deterrence by merchant shipping cartels against financially weaker and smaller entrants. Her data set consists of forty-seven cases of attempted entry: sometimes entrants were peacefully accommodated and other times a price war ensued. She finds that: “A typical price war might last three months and feature a price drop of 50 percent to the ports the entrant has chosen to serve. Price decreases greater than 50 percent are also observed, as well as wars that lasted as little as two days or as long as one year” (p. 697).

### 5. Cartel Breakdown

If cartels address monitoring, incentives, organization, and entry, why do they fail? Are some cartels less successful at resolving

these issues? If so, which problems are not solvable, and why? Is it cheating, as economists tend to presume? Examining the proximate cause of cartel breakdowns can help us to answer these questions. Eckbo (1976) categorizes cartel failures with a series of binary variables: Was the breakdown market related or political? If market related, was it due to external forces? If externally caused, was it an increase in nonmember supply that strained cooperation to the breaking point? The main cause of breakdown, as most theorists would expect, is internal conflict or defection: this accounted for ten of the twenty-three breakdowns, or roughly 44 percent of his “Sample 1”<sup>88</sup> (table 13). The same holds true for Eckbo’s twenty-nine “Sample 2” cartel episodes: 59 percent ended due to internal conflict. In Suslow’s (2005) sample, about one quarter of the cartels ended because of internal conflict and cheating; only World War II ended a larger proportion of these agreements (table 13).<sup>89</sup>

<sup>88</sup> See appendix A for information on Eckbo’s Sample 1 and Sample 2.

<sup>89</sup> Some have claimed that some international cartels which allegedly ended cooperation at the commencement of World War II actually continued to cooperate secretly (e.g., Josiah E. DuBois Jr. 1952). But it does seem that at the onset of both World Wars I and II most international cartels broke down. For example, in the case of the bromine cartel, as soon as it became clear to the Dow Chemical Company (U.S.) that the Deutsche Bromkonvention was no longer able to export from Europe, and therefore could not punish Dow for violating their collusive agreement, Dow began exporting bromides into regions reserved in their agreement exclusively for German producers (Levenstein 1994).

<sup>87</sup> Lamoreaux (1985) makes this point more generally in her definitive study of mergers at the end of the nineteenth century.



TABLE 13  
 CAUSES OF CARTEL BREAKDOWN:  
 INTERNATIONAL CROSS-SECTION CARTEL STUDIES

<i>Causes of Cartel Breakdown</i>	<i>Eckbo— Sample 1</i>	<i>Eckbo— Sample 2</i>	<i>Griffin<sup>a</sup></i>	<i>Suslow</i>
Cheating and Disagreement	43.5%	58.6%	33.3%	23.9%
External Shock	30.4%		50.0% <sup>c</sup>	42.3%
Entry and Substitution <sup>b</sup>	26.1%	41.4%	33.3%	15.5%
Entry	13.0% <sup>b</sup>		25.9%	15.5%
Substitution	8.7% <sup>b</sup>		9.3%	
Technological Change			9.3%	
Antitrust Indictment				18.3%
TOTAL # EPISODES	23	29	54	71

*Notes:*

<sup>a</sup> This is based on both Griffin's discussion on pp. 198–99 and the information in his Table 4 (pp. 200–201).

<sup>b</sup> The sum of entry and substitution does not always add to the total because of underclassification in the case of Eckbo and double counting in the case of Griffin. Eckbo categorizes six episodes, or 26.1 percent of the twenty-three observations in Sample 1, as breaking down due to either entry or substitution. Of the six, three were due to entry, two to substitution, and one is unclassified. Two of Griffin's cartels ended as a result of both substitution and entry.

<sup>c</sup> This overstates the significance of external shocks as we classify them in this paper. Griffin groups together wars, antitrust and other governmental actions, and cartel reorganizations. We cannot separately categorize the cartel reorganizations in his sample, but some of them may more properly be classified as asymmetric information or bargaining problems, which may or may not have resulted from an external shock.

As with Eckbo, Griffin (1989) examines the reasons for cartel “disintegration.” He finds that for his sample of fifty-four cartels, half ended primarily for political or “external” reasons (table 13). New entry or the increased use of substitutes ranks as the second most important cause of cartel failure, contributing to the failure of a third of the cartels in his sample. What Griffin calls “behavioral problems” or “opportunistic behavior” also contributed to the end of a third of his sample.<sup>90</sup>

<sup>90</sup> Griffin enumerates more than one cause of failure for several of the cartels in his sample, so that the total sums to more than 100 percent. Note that the figures here represent the classification of the “causes of cartel disintegration” in his table 4 (pp. 200–201). The description of the data in the text (p. 198) is somewhat at variance with the table.

This category includes cheating and disagreement over market shares, encompassing both what we would classify as “monitoring” price wars and “bargaining” breakdowns. World War II brought twelve cartels to an end. Finally, technological change was decisive in ending four cartels (rubber, zinc, sulphur, and nitrate).

The most common cause of cartel breakdown in the nineteen case studies was entry, which was the primary cause of cartel disruption in just over a third of the individual episodes studied (table 14).<sup>91</sup> That is larger

<sup>91</sup> Baker (1995) argues that new entry is particularly important in cartelized industries because incumbent firms are less likely to adopt new innovations than are new entrants. Thus entry is induced not only by high cartel profits but also by the incumbents' neglect of potentially profitable innovations.



TABLE 14  
CAUSES OF CARTEL BREAKDOWN:  
SELECTED CASE STUDIES

<i>Industry</i>	<i>Entry and Cartel's Reaction<sup>a</sup></i>			<i>Cheating<sup>b</sup></i>	<i>War or Antitrust</i>	<i>Technological Change</i>	<i>Bargaining Problems</i>
	<i>Entry Occurred</i>	<i>Disrupted Cartel</i>	<i>Accommodated by Cartel</i>				
Beer (U.S.)				Yes	Yes		
Beer (Sweden)	Yes	Yes		Yes	Yes		Yes
Bromine	Yes	No	Yes	Little	Yes	Yes	Yes
Cement	No						
Coal	Yes		Yes	Yes			
Diamonds	Yes	No	Yes	No			Yes
Electrical Equipment					Yes		
Ocean Shipping	Yes	Yes	Yes	No			Yes
Oil	Yes	Yes	Yes	No			
Parcel Post	Attempted	Yes			Yes		Yes
Potash	Yes	No	Yes	No	Yes		Yes
RR (U.S. Midwest)	Yes	Yes	Yes	Yes	Yes		
RR (U.S. South)				Little			
Railroad—Oil	Yes	Yes	Yes	No	Yes	Yes	Yes
Rayon					Yes		
Steel (Europe)				Little	Yes		
Steel (U.S.)				Yes	Yes		
Sugar	Yes	Yes	Yes	Yes	Yes	No	Yes
Tea	Yes		Yes	Yes	Yes		Yes

*Notes:*

<sup>a</sup> "Entry occurred" indicates whether there was any entry during the period covered by the case study.

"Disrupted cartel" indicates that there were instances in which the cartel responded to entry with punitive or predatory behavior. Entry which was followed by an invitation to join the cartel, but in which the firms could not reach a new distribution of quotas or rents, is classified as "bargaining problems," and not included under "disrupted cartel." "Accommodated" indicates that there were instances in which a new entrant was invited to join the cartel without a disruption in cooperative pricing. For the other columns, a "yes" indicates that such an event disrupted the cartel, not simply that it occurred. For example, there was technological change in the oil industry during the period of study, but that technological change did not disrupt collusion.

<sup>b</sup> "Cheating" indicates that the study reported cheating or output above that permitted by the cartel. Unlike the category "entry occurred," it is not necessarily the case that cheating disrupted collusion.

See Appendix B for list of sources.

than the figures given in table 13 for most cross-section studies, although it is roughly equal to Griffin's 33 percent figure. Nonmarket forces, such as the outbreak of WWI or WWII (15 percent of the cartels) and legal action (a little over 10 percent) account for about a quarter of the dissolutions in the group.<sup>92</sup> Trailing far behind are three cartel episodes, or less than 10 percent of the case study sample episodes, that ended due to cheating.

In many case studies, authors asserted that cheating was simply not a problem for the cartel. Bargaining problems were much more likely to undermine collusion than was secret cheating. Bargaining problems affected virtually every cartel in the sample, ending about one-quarter of the cartel episodes. The most successful cartels were those that developed organizational mechanisms that accommodated fluctuations in the external environment, such as cyclical fluctuations in demand, without requiring costly renegotiations. Secret cheating undermines cartels in some industries, but our hypothesis is that, if collusion is really to be successful, the firms in the industry will probably have to make such a significant investment in the collusive organization and in the development of organizational skills that cheating becomes a secondary issue. Industries that continue to suffer from cheating after making such formal agreements are often industries that cannot really sustain collusion. Of course, the story of the modern industrial organization literature is that firms do not actually cheat, but their competitors cannot discern that due to noise in the economic environment. It appears, however, that the costliness of many of the theoretically hypothesized punishments is such that successful colluders would rather invest in mechanisms to assure that cheating is

observable, and therefore prevent it, than to implement costly punishments because of ex-post uncertainty.

For example, Genesove and Mullin (2001) tell us that the Sugar Institute "served as a court in which an accused firm might prove its innocence, in some cases on factual, in others on logical, grounds" (p. 389). This does not mean that cheating did not occur; in fact it did. But, according to Genesove and Mullin, ". . . outside the South, neither in prices nor in rules were these [violations] met by reversion to competitive conditions à la Green and Porter (1984) let alone sub-competitive conditions à la Abreu, Pearce, and Stacchetti (1986). . . . Rather, deviations were either *ignored* or *matched*" (pp. 390–91). Baker (1989) also finds that unexpected declines in demand in the steel industry during the 1930s were met not by severe price wars, but rather "shallow episodes of increased competition" (p. S67). Similarly, after the adoption of an international price-fixing agreement in the bromine industry, the response to violations in the agreement was a negotiated punishment, usually a side-payment between firms, rather than the instigation of a price war (Levenstein 1994, 1997). In each of these cases, successful collusion required the development of alternative organizational responses both to actual violations of the collusive agreement and to events that were, absent further investigation by the cartel, observationally equivalent to violations. As repeatedly discovered by these cartel members, the threat of Cournot reversion is an inefficient way to sustain collusion.

In some industries, it would not be accurate to say that cartels break down; they simply never get off the ground. It is important that we learn to distinguish failed attempts that pave the way for future collusion from failed attempts that reflect the inherent difficulty of sustaining collusion in a particular industry. One can speculate that there are a large number of industries that followed the pattern of the Canadian oil industry, in

<sup>92</sup> Note that this breakdown of the causes of cartel failure does not sum to one hundred percent because for several studies there was no discussion of the cause of the cartel breakdown. In some cases that was because the cartel was still in existence at the time of writing.

which the failure to sustain collusion led to consolidation of the industry (Hugh Grant and Henry Thille 2001). This has certainly been asserted about the attempts to control prices by late nineteenth and early twentieth century trusts (Lamoreaux 1985). Similarly, the repeated failure of railroads to sustain collusion is often offered as an explanation for the creation of the Interstate Commerce Commission (ICC). With state power, the ICC could accomplish for the railroads what they could not accomplish with voluntary accords (MacAvoy 1965, Kolko 1965).

Case studies that examine failed attempts to form cartels add enormously to our understanding of the basic cartel problem. Close examination of the reasons for failure illuminates our understanding of why cartels appear where they do and the extent to which successful cartels are idiosyncratic in nature or endemic to certain industries. Because successful cartels are more likely (despite the cartels' best efforts) to leave records, and because success is more appealing as a subject of study, most studies focus on successful cartels. There is also a certain reluctance to label a cartel a failure, even when it might be more informative to do so. One important exception is MacAvoy's (1965) study of nineteenth century railroad cartels. He argued strongly that these cartels *failed* because of the impossibility of preventing cheating by member firms. This point has been lost in the literature on the Joint Executive Committee, which has tried to discern the characteristics of a successful cartel from the JEC experience.<sup>93</sup>

<sup>93</sup> This perspective follows from the reliance on Ulen's (1979) work, which disputes Kolko (1965) and MacAvoy's (1965) characterization of the JEC experience. There are a few other treatments of cartel failure in addition to MacAvoy's work. For example, Alexander (1997) argues that cost heterogeneity in the 1930s pasta industry was so great that it was impossible for macaroni producers to collude, even during the NIRA, when many other U.S. industries were able to do so in the new, more sympathetic legal environment. The optimal collusive price was very different for large firms with low costs than it was for smaller firms with higher costs.

There is no clear line in economic theory or standard in empirical research to distinguish between the breakdown of a successful cartel and cartel failure in a more global sense. This line has become fuzzier because of the complex role played by price wars and threats of price wars, which can be seen either as the quintessential evidence of cartel failure or the crucial prop to cartel success. Our overview of the empirical literature suggests that, first, the outbreak of a price war—as opposed to the threat of a price war—is rarely a sign of cartel success, second, that the most successful cartels are able to develop alternative punishments and punishment threats that enhance stability at lower cost, and third, that cartels break down in some cases because of cheating, but more frequently because of entry, exogenous shocks, and dynamic changes within the industry.

## 6. *Effects of Cartels*

### 6.1 *Effects of Cartels on Prices*

Having established that some cartels survive, we now turn to the obvious question, what consequences do they have? Can they raise prices and profits relative to what they would have been absent the cartel? As we shall see, some cartels are apparently able to raise prices and profits. In order to maintain these higher prices and profits, cartels engage in a range of other activities that also affect industry performance.

In an early study, Asch and Seneca (1975) find that colluding firms have *lower* profits than noncolluding ones. Their methodology, however, does not allow them to control for differences across industries or other determinants of profitability.<sup>94</sup> Subsequent

<sup>94</sup> They attempt to clarify the relationship between low-profits and collusion by examining whether low profitability is correlated with other characteristics that might lead firms to collude. For example, they find that firms characterized by low profits and low rates of sales growth demonstrate a tendency toward collusive behavior. They also find that large, low-profit firms are clearly associated with collusive behavior to a much greater degree than small, high-profit firms. But what we know from this analysis is that these are the characteristics associated with price-fixing cases that were prosecuted, as opposed to all firms engaged in collusion. Asch and Seneca do not know whether the fifty randomly selected "noncolluding" firms were in fact not colluding, only that they were not prosecuted for price fixing.

cross-section studies suggest that some cartels do increase prices and profits. Griffin (1989) and Eckbo (1976) both find that cartel profits are increasing in industry concentration and cartel market share. They also conclude that homogeneity of firms within the cartel increases price: cartels are more successful when member firms had similar costs, and when they consist of a small number of similar sized firms. Griffin finds that more centralized cartels are more effective at raising price.<sup>95</sup>

Although price information from cross-section studies is haphazard, there are a handful of studies that document a range of price increases.<sup>96</sup> Eckbo, for example, finds that nineteen of fifty-one cartels in his sample were able to raise price 200 percent above the unit cost of production and distribution" (p. 26). Griffin (1989) finds that on average cartels charged a 45 percent markup over marginal cost. The most "successful" cartel in his sample (the rubber cartel of 1923 to 1928) had a 400 percent markup, while the least successful cartel (the wheat cartel from 1933 to 1934) priced below cost.

For contemporary international cartels, the reported price increases (based on anecdotal evidence, primarily from the trade press) range from 10 percent to 100 percent.<sup>97</sup> For example, the graphite electrodes cartel occurred in a highly concentrated industry and allegedly raised prices significantly over a five-year period. In the United States, graphite electrode prices increased over fifty percent during the cartel period, 1992 to 1997. In Canada, where the industry

consisted of only two firms with a combined market share of over 90 percent, prices rose by more than 90 percent.<sup>98</sup>

In a cross-section study of legal cartels in West Germany between 1973 and 1986, Audretsch (1989) finds that cartels restricted output and raised prices. Two studies of Swedish cartels between 1976 and 1990 also take advantage of a period of public registration of legal cartels. Fölster and Peltzman (1997) find that legal Swedish cartels did not raise price and that, in fact, average prices increased following the demise of cartels. Examining the same data but with a somewhat different specification, Aitor Ciarreta (2001) finds that horizontal agreements did raise price, though price also increased following the termination of a cartel agreement.

Another approach to determining whether cartels increase prices is to examine the effect of antitrust prosecution on prices. For example, Michael F. Sproul (1993) surveys twenty-five price-fixing cases between 1973 and 1984, examining price levels four years after the indictment. He finds a slight (7 percent) increase in prices after indictment for the entire sample. However, the evidence for those cases filed after 1976 (i.e., after the antitrust penalties were significantly increased), shows that price declines at first but then rises about seventeen months after the indictment.<sup>99</sup> Harrington (2004) challenges this approach, arguing that postprosecution prices are not good measures of the "but-for" price, that is, the price that would have obtained in the industry if not for the cartel, because firms have an incentive to

<sup>95</sup> Griffin does not elaborate on how he measures organization. He simply states that it "is a subjective measure assigned after reading the available descriptions of the effectiveness of the cartel structure" (Griffin 1989, p. 191).

<sup>96</sup> Connor (2004b) provides a useful and extensive review of 500 different studies that include some measure of price-fixing overcharges.

<sup>97</sup> Levenstein and Suslow (2004a), p. 806. Of course, evidence of increased cartel prices must be interpreted with care because some portion of the increase may reflect other factors such as rising raw materials costs or increases in demand.

<sup>98</sup> "Foreign Corporation Fined \$12.5 million for Price Fixing." Industry Canada, Competition Bureau, News Release, July 20, 2000.

<sup>99</sup> Bosch and Eckard (1991) use an event study of stock prices following antitrust indictments to ask whether the demise of a cartel lowered investors' expectations of future profits. They conclude that indictments did have this effect, suggesting that investors expected prices to fall or competition to increase following antitrust prosecutions. Froeb, Robert A. Koyak, and Gregory J. Werden (1993) provide a useful survey and critique of studies that use post-prosecution prices to infer the impact of cartels.

maintain higher prices in order to limit their civil liability.

Somewhat remarkably, case studies have given little attention to measuring or evaluating cartel success (table 15). Most case studies simply assume that the cartel was a success, with little or no analysis of what that means. There are a few studies, however, that address the question seriously. Case studies generally use one of three approaches to measuring cartel success: changes in price following cartel formation, comparison between “good times” and “price war” periods, and, comparison between the cartel price and a counterfactual or “but-for” price that might have prevailed absent collusion.

Virtually every cartel case study included here reports that the cartel was able to raise prices immediately following cartel formation, but most do not make an explicit comparison to a counterfactual or “but-for” price (table 15). William J. Hausman (1984) does provide this kind of counterfactual analysis in his examination of the “Limitation of the Vend,” a coal cartel that operated in northeast England between 1770 and 1845. He concludes, “When regulations were in force, equilibrium price increased by something like 6–8 percent over what it would have been without the regulations” (p. 326).<sup>100</sup> The bromine and ocean shipping cases also provide such explicit comparisons: these two cartels apparently raised price to the joint profit-maximizing level.<sup>101</sup> In the case of German steel, cartel prices were lower than the joint profit-maximizing price, but still significantly above the competitive price. In cases where the cartel was regional or national, the cartel price may be compared to the world price. In two such cases, cement

and oil, national cartels were able to raise price above the world price. Thus, there is considerable evidence of price increases, but it is often not the right kind of evidence to determine conclusively whether the cartel raised prices and profits above what they would otherwise have been.

The U.S. breweries cartel illustrates some of the complexities in estimating the effect of cartelization on price. Breweries colluded during the 1930s, increasing prices to levels above the joint-profit-maximizing price, partly in order to assuage prohibitionists’ concerns (which remained influential immediately following Repeal).<sup>102</sup> But these high prices were not sustainable. When evaluating the success of a cartel it is not sufficient to examine the price the cartel charges during “collusive” periods. Because many cartels go through price wars or other breakdowns in collusion, our measurement of cartel success must take into account profitability over the entire period of collusion, not just during periods in which high prices are charged. Anita McGahan (1995) finds that the brewing industry had price wars in each of the three years in which it attempted to collude. To describe this as successful collusion just because a high cartel price was briefly achieved would ignore the overall failure of the cartel to maintain this price for any length of time.

## 6.2 *Other Performance Effects*

There is a small empirical literature that uses changes in antitrust law to study both the effects of the legal environment on cartels and, more generally, the effects of cartels on prices, profits, and industry structure. Alexander (1994) uses the NIRA period of antitrust suspension to examine not only whether NIRA directly facilitated collusion, but whether the temporary legality of cartels

<sup>100</sup> The most in depth treatment on these English coal cartels is found in Paul M. Sweezy (1938).

<sup>101</sup> Marin and Sicotte (2003) use an event study approach to examine the effects of ocean shipping conferences; they conclude that “loyalty (dual-rate) contracts improved ocean carriers’ financial performance and that the contracts enabled carriers to exploit market power to the disadvantage of their customers” (p. 211).

<sup>102</sup> Lundqvist (1998) reports that activism for prohibition led to increased organization among Swedish breweries, eventually facilitating their cooperation around price, output, and terms of sale.

TABLE 15  
 CARTEL PRICES AND PROFITABILITY:  
 SELECTED CASE STUDIES

<i>Industry</i>	<i>Price and Profitability Trends</i>
Beer (U.S.)	Possibly above the monopoly level, due to political pressure to keep price high
Beer (Sweden)	Small increase in some regions immediately following formation of national cartel
Bromine	Close to joint-profit maximizing level in some periods; other collusive periods barely above Cournot price level
Cement	10 percent above world price
Coal	
Diamonds	Prices nearly doubled after initial formation of cartel
Electrical Equipment	
Ocean Shipping	Close to joint-profit maximizing level
Oil	Prices sometimes approached import price (New York price plus tariff)
Parcel Post	
Potash	Prices rose following agreements; in 1910, prices were double "average cost"
Railroad (U.S. Midwest)	
Railroad (U.S. South)	
Railroad—Oil	
Rayon	
Steel (Europe)	Less than joint profit maximizing price, but one-third higher than world price (Germany)
Steel (U.S.)	
Sugar	Prices rose after cartel formation
Tea	Prices rose 80 percent in 1933 after cartel was reestablished

See Appendix B for list of sources.



in the United States made it easier for industries to maintain cooperation after the resumption of antitrust enforcement.<sup>103</sup> She finds that the “critical concentration level” below which collusion is not sustainable declines following NIRA, especially for those industries that adopted NIRA codes quickly. Although Alexander asserts that the critical four-firm concentration ratio falls from 60 percent prior to the adoption of an industry code to 38 percent after the repeal, Matthew B. Krepps (1997) shows that the drop is due to a change in the sample composition. He finds that in a balanced sample the critical four-firm concentration ratio remains unchanged at 60 percent. Krepps also shows that only codes with open-price agreements are associated with increased markups.

Two other NIRA-based studies examine its effects on output. Bittlingmayer (1995) argues that NIRA led to increases in output, rather than the decreases presumed by traditional cartel theory.<sup>104</sup> He hypothesizes that this apparently paradoxical result reflects an “empty core” in many industries; in such industries, competition is not sustainable and output shrinks under competitive conditions because firms do not expect to be able to recoup sunk costs. Jason E. Taylor (2002) tests Bittlingmayer’s proposition and concludes that NIRA had no negative effect on output; rather, the increases in output are the result of increased government spending during the NIRA period.

<sup>103</sup> Alexander’s article, it is important to note, addresses the relationship between concentration and price-cost margins, rather than collusive stability per se. Baker (1989), discussed above, argues that steel cooperation following NIRA was far from perfect but that “the NRA taught the steel producers how to collude” (p. S72). Russell Cooper and Haltiwanger (1993) similarly argue that the NIRA facilitated automobile manufacturers’ move to a more efficient equilibrium, coordinating the annual introduction of automobile models and cooperating in organizing auto shows.

<sup>104</sup> In contrast, Stephen N. Broadberry and N. F. R. Crafts (1992) argue that pervasive collusion in British industry contributed to its poor economic performance during the Great Depression of the 1930s.

Once again, we see that it is important to compare the pattern of output and prices that did occur to what would have occurred absent the cartel. In the NIRA case, it is not surprising that output increased as the country moved out of the depths of the worst depression in its history. The question is whether the specific effect of NIRA was to increase or decrease output relative to what it would have been absent these industry codes.

Another set of studies examines a shift in anticartel policy in the opposite direction. Great Britain abandoned its long-held tolerance of cartels with the passage (and implementation) of the 1956 Restrictive Trade Practices Act.<sup>105</sup> Symeonidis (2002) uses the registration of collusive agreements required by the Act to create a cross-sectional data set of 76 cartel agreements in 150 industries. The subsequent rulings by the British court that virtually all agreements that fixed price or limited output were not in the public interest led to an abandonment of most of these collusive agreements and an increase in competition in industries that had previously had such agreements. Symeonidis finds that the ban on British cartels led to increases in industry concentration. He also finds that, in advertising-intensive industries, advertising expenditures fell slightly following the elimination of cartels. Advertising was apparently an alternative to price competition. When price competition increased, firms no longer needed and could no longer afford the same level of advertising expenditures. Concentration increased in advertising-intensive industries, but the

<sup>105</sup> The European Union established its competition policy framework with the adoption of the Treaty of Rome in 1957, but consistent prohibition of price fixing awaited the 1980s. Most European countries first introduced legal limits to cartels in the post-World War II period; these regulations generally required cartel registration with a government agency. While in Britain this registration policy became the basis for a de facto ban on price fixing by the late 1950s, in most European countries price fixing remained permissible well into the 1990s.

increase in concentration took place over a longer period of time than in industries with relatively low levels of advertising. A perhaps even more significant finding is that increased competition did not have any apparent effect on the rate of innovation (Symeonidis 2000, 2002). He finds that, in research and development-intensive industries, the number of innovations produced did not change following the increase in competition. However, he does find substantial increases in concentration in R&D-intensive industries.

A similar pattern of increased concentration followed the introduction of antitrust prohibitions in the United States in the late nineteenth century. The Sherman Act (1890) banned price fixing for twenty-five years before the Clayton Act regulated mergers. In the intervening twenty-five years, concentration increased significantly in a large number of U.S. industries.<sup>106</sup> Many factors, including changes in technology, finance, and the integration of national and international markets, contributed to the increase in concentration during this period. Nonetheless, laws that make it legal for a combined firm to do something denied to independent firms do create an incentive for merger. In a remarkable repetition of the previous experience of the United States and the United Kingdom, current European Union policy aggressively enforces anticartel laws, but is relatively weaker in its merger enforcement, in part because of decisions of the European Court.<sup>107</sup> Discussions of the adoption of competition policies both at the World Trade Organization and in developing countries often favor a sequencing of

such policies, so that bans on explicit price-fixing and output-restriction precede the enactment of merger rules. Symeonidis's research provides a timely reminder about the unintended consequences of such sequencing. Rather than increasing competition, we may instead find that these policies encourage firms to resort to an even more effective method of increasing prices—consolidation.

Perhaps the least studied, but most important issues are the effect that cartels have on investment and productivity. As discussed above, in some theoretical models in which firms first choose investment levels and then prices, investment is higher than with perfect competition; excess capacity facilitates collusion and increases profits above competitive levels.<sup>108</sup> An alternative—that investment undermines collusion—is argued by Switgard Feuerstein and Hans Gersbach (2003) in a model of “semicollusion” in which the timing of the investment is critical.<sup>109</sup> For example, firms in the German coal (Lon L. Peters 1989) and Norwegian cement (Steen and Sørgard 1999) cartels apparently did respond to an increase in the cartel price with increases in investment. In other cases, such as the European steel cartels, there were specific agreements regarding the type and amount of investment permitted (Barbezat 1994). Symeonidis argues that the British cartels he studies did not collude on investment. He finds that collusion occurs less often in “high-sunk costs industries” where those sunk costs are in the form of R&D and advertising. In contrast, investments in fixed capital are positively associated with the likelihood of collusion in his sample.

<sup>106</sup> Lamoreaux (1985), pp. 2–4.

<sup>107</sup> In 2002, the Court of First Instance overturned several European Commission merger decisions, finding that the Commission's analysis was “vitiated by a series of errors of assessment” (Guy de Jonquieres and Francesco Guerrera, “Something is Rotten Within Our System”: Europe's Mighty Competition Authorities are Cut Down to Size,” *Financial Times*, October 28, 2002, p. 25).

<sup>108</sup> Kolasky (2002) surveys recent cartel prosecutions by the U.S. Justice Department and argues “excess capacity in the hands of leading firms can be an effective tool for punishing cheating and thereby enforcing collusive agreements” (p. 19).

<sup>109</sup> See also Chaim Fershtman and Neil Gandal (1994), Fershtman and Eitan Muller (1986), and Fershtman and Ariel Pakes (1998).

Advocates of cartels have argued that cartels stabilize prices at profitable levels in industries that have high fixed costs or are prone to “cut-throat competition.” In such industries, competition may lead prices to fall below long run average total costs. Firms do not have an incentive to invest in such an industry, especially if industry investment is mostly sunk, perhaps because it is specific to the industry or firm. By stabilizing prices at levels that cover average total costs, cartels encourage investment and productivity growth. Thus, in the long run they can have positive efficiency effects, as increased productivity growth allows for lower prices and increased output. In Joseph A. Schumpeter’s words, “In the last resort, American agriculture, English coal mining, the English textile industry are costing consumers much more and are affecting *total* output much more injuriously than they would if controlled, each of them, by a dozen good brains” (Schumpeter 1950, p. 106).<sup>110</sup>

Several empirical studies test one form or another of these propositions: Bittlingmayer (1995) and Taylor (2002) come to opposite conclusions regarding the efficiency impact of NIRA cartels in the United States during the 1930s; Sjoström (1989) and S. Craig Pirrong (1992) argue that the shipping industry suffers from an empty core and conclude that cartels help to stabilize the industry; Webb (1980) argues that German steel cartels stabilized the industry and contributed to increases in investment and productivity. In contrast, Audretsch (1989) argues that German cartels were associated with reduced output rather than lower costs.

There are also a parallel set of studies that argue that cartels, by limiting competitive pressure to cut costs, limit productivity growth. Many of these studies locate themselves in the literature on British industrial

decline, arguing that Britain’s poor performance in the twentieth century can be attributed, at least in part, to its permissive attitude toward collusion (e.g., Broadberry and Crafts 1992, Ben Fine 1990). This question is of particular policy import at the present moment, as many developing countries consider whether or not to adopt U.S.-style competition policies. They are often encouraged to do so on the presumption that increased competition will increase productivity and encourage development.<sup>111</sup> But there are many technologically dynamic, high-income countries that allowed pervasive price-fixing and other forms of domestic inter-firm cooperation during their early stages of development. Germany and Japan are the most obvious examples. Clearly, there is not a one-to-one correspondence between any particular competition policy and economic development. While this is not the primary focus of this paper, this brief survey of the empirical literature testing relationships between antitrust policies for or against cartels and their effects reinforces the view that competition policies must be designed to fit the needs of the particular country, taking into account its history, its legal and economic institutions, and its level of development.

## 7. Conclusion

Some cartels last—on average about five years. Not all last—variance in cartel duration is high—but enough do last that we need to address cartel stability as both a matter of economic theory and policy. Cartels have to solve three problems: coordination, cheating, and entry. Successful cartels develop organizations that can address all three problems. Which cartels are able to do this? The empirical evidence on the relationship

<sup>110</sup> See Scherer (1980), pp. 212–20, for a discussion of cut-throat competition and the social welfare benefits of state support of cartels.

<sup>111</sup> It is worth noting that it has been argued that many markets in developing countries are actually more competitive than those in developed markets because of the preponderance of small scale firms (Ajit Singh 2002, pp. 3–4).

between industry concentration and cartel stability is mixed. All else equal, concentration undoubtedly aids cartel stability, both directly by increasing individual firm profits and attenuating coordination problems and indirectly as a reflection of existing barriers to entry. But organizational responses, such as industry associations, can overcome the challenges posed in forming a cartel in an un-concentrated industry, and cartels can, by increasing profitability, allow marginal firms to survive and so decrease concentration. Demand instability—particularly unanticipated shocks and very rapid growth—like other fluctuations in the economic environment, undermines cartel stability. Cyclical fluctuations, however, to the extent that they are common knowledge, have little impact on cartel stability. Regular, predictable fluctuations are exactly what a functioning cartel organization can manage. Successful cartels develop mechanisms for sharing information, making decisions, and manipulating incentives through self-imposed carrots and sticks.

What impact do cartels have? They appear to increase prices and profits, but more careful studies with explicit counterfactual analysis would make a significant contribution to our understanding of the full economic effects of collusion. More work—both theoretical and empirical—is also necessary to address the important question of the long-run, dynamic impact of cartels on investment, productivity, and entry. One thing that all such research should be prepared to explain is the multiple possible outcomes of any attempt at collusion.

#### Appendix A

##### Brief Description of Data Sets Used in Cross-Section Cartel Studies Surveyed

###### Alexander (1994)

- Sample selection criteria: U.S. manufacturing industries defined at the four-digit SIC code level, excluding industries in which competition is local,

organized under the National Industrial Recovery Act.

- Number of observations: 55–56 (varies by regression); 50 industries are common to all regressions
- Years: 1933–1937

###### Asch and Seneca (1975)

- Sample selection criteria:
  - 51 colluding firms: found guilty or entered a plea of *nolo contendere* in response to a Sherman Act conspiracy charge. Based on *Trade Regulation Reporter* summaries of antitrust cases.
  - 50 randomly selected noncolluders.
- Number of observations: 101 large U.S. manufacturing corporations
- Years: 1958–1967

###### Audretsch (1989)

- Sample selection criteria: West German cartels organized as (a) rationalization cartels, or (b) specialization cartels involving a price agreement. Rationalization cartels coordinate production to improve members' profits through higher efficiency and productivity, and these cost savings must be passed on to the consumer. Specialization cartels limit participants to specific product lines. The cartels are divided into three samples:
  - Sample 1: 33 products observed during the three years prior to being granted cartelization status
  - Sample 2: 18 products that had legalized cartel status over the entire 1977 to 1983 period
  - Sample 3: 13 products observed during the three years following the removal of legalized cartel status
- Number of observations: Between 33 and 64 (Audretsch does not report whether membership overlaps in his three samples)
- Years: 1958–1986

###### Bittlingmayer (1995)

- Sample selection criteria: Macroeconomic

output data from 1930 through 1939. Supplemental data used for 45 industries.

- Number of observations: 45 industries
- Years: 1930–1939

#### Dick (1996a)

- Sample selection criteria:
  - All active Webb–Pomerene cartels for which data on industry characteristics was available.
  - He distinguishes between registered and active cartels, and includes only the active cartels. “Active” is defined as either operating a common sales agency or setting an export price guideline for the industry.
  - 20 cartel episodes are right censored (dissolution year is not observed).
- Number of observations: 111 cartel episodes in 93 industries. Each episode is an uninterrupted period of cartel activity.
- Years: 1918–1965

#### Dick (1996b)

- Sample selection criteria: All Webb–Pomerene cartels that first registered between 1918 and 1965 that remained active for longer than one year. “Active” is defined as either operating a common sales agency or setting an export price target.
- Number of observations: 250 industries, with 125 cartels and 125 randomly sampled exporting industries that did not organize into a cartel at any time between 1918 and 1965.
- Years: 1918–1965

#### Eckbo (1976)

- Sample selection criteria: International cartel agreements divided by availability of data.
  - Sample 1: sufficient data to describe cartels along 17 dimensions
  - Sample 2: sufficient data to describe cartels along 5 dimensions
- Number of observations:
  - Sample 1: 23 cartels, 8 industries

- Sample 2: 29 cartels, 13 industries
- Years: 1819–1964

#### Fölster and Peltzman (1997)

- Sample selection criteria: Swedish cartels registered with the SPK (Swedish National Price and Control Board). They chose 34 manufacturing products (at the 7-digit US SIC level) for which cartel registration status changed during the period 1976–1990. An additional 49 products were randomly selected.
- Number of observations: 83 products
- Years: 1976–1990

#### Fraas and Greer (1977)

- Sample selection criteria: All successfully prosecuted U.S. horizontal price-fixing cases initiated between 1910 and 1972 by the Department of Justice. Summaries of all antitrust cases are published by Commerce Clearing House (CCH). Each of the following criteria had to be met to include a case:

- Price fixing had to be explicitly charged or obviously part of illegal conduct.
- The number of firms allegedly involved had to be specified in the CCH record, the complaint, or the indictment.
- The ultimate settlement had to be averse to the defendants.
- Redundant listings in CCH were eliminated.
- All labor cases were excluded.
- Defendant firms competed in the same (geographical and product) market.

- Number of observations: 606 cases
- Years: 1910–1972

#### Gallo et al. (2000)

- Sample selection criteria: U.S. cases reported in the CCH Trade Regulation Reporter (the CCH Bluebook). Following Posner (1970), Gallo et al. disregarded “all civil and criminal contempt



proceedings, indictments, informations and ancillary civil cases from cases as reported by the CCH . . ." (p. 77). Several individual cases reported by CCH may be the result of a single investigation. To calculate the number of "cases," the cases reported by CCH which flow from a common investigation are counted as one consolidated case. In contrast, "CCH cases" counts each case reported separately.

- Number of observations: 1,348 consolidated cases, of which 688 involve horizontal per se violations
- Years: 1955–1997

Griffin (1989)

- Sample selection criteria: 54 international cartels were selected "for which most of the relevant data were available."
- Number of observations: 54 cartels in 22 industries (4 cartels then eliminated due to non-positive Lerner indices)
- Years: 1888–1984

Hay and Kelley (1974)

- Sample selection criteria: U.S. price fixing cases that were filed and won in trial or settled by *nolo contendere* pleas, excluding vertical agreements and those which were not covert (e.g., price fixing by professional groups was excluded).
- Number of observations: 65 cases, but not all desired industry characteristics were available for each case (e.g., trade association information is available in 62 cases, concentration in 50 cases)
- Years: 1963–1972

Jacquemin et al. (1981)

- Sample selection criteria: Fair Trade Commission reports on Japanese export cartels for which data about concentration, production and exports are available.
- Number of observations: 40 cartelized sectors (where a sector corresponds to a four-digit classification according to the Japanese standard industrial classification).
- Years: 1967–1972

Joyce (1989)

- Sample selection criteria: All U.S. four-digit SIC industries in which price fixing or bid rigging was successfully litigated between 1983 and 1987.
- Number of observations: 279 cases in 36 industries
- Years: 1983–1987

Krepps (1997)

- Sample selection criteria: 245 U.S. industries for which price–cost margins were calculable from Census of Manufactures data in both 1933 and 1937.
  - 127 industries operated under Codes of Fair Competition enforced by the National Recovery Administration (NRA)
  - 118 industries did not have codes (more precisely, 118 industries that "did not appear to match" the list of industries with codes).
- Number of observations: 245 industries (127 with codes, 118 without)
- Years: 1927–1937

Marquez (1994)

- Sample selection criteria: International cartels based on Griffin's (1989) sample, but excluding the fifth cartel episode in copper and the second cartel episode in magnesium.
- Number of observations: 52 cartels in 22 industries
- Years: 1888–1984

Posner (1970)

- Sample selection criteria: Three samples of U.S. cases:
  - 1,551 cases instituted by the Department of Justice from 1890 to 1969 (from the "Bluebook" published by Commerce Clearing House): 989 of these involved a horizontal conspiracy. (Note: These are cases "instituted" or "filed" not cases that necessarily resulted in a conviction.)
  - 1,061 Federal Trade Commission



restraint of trade cases from 1915 to 1969 (from the FTC Docket of Complaints published by Commerce Clearing House)

- 9,728 private antitrust cases initiated between 1890 and 1969 (data after 1938 are from the Administrative Office of the United States Courts annual reports, and data before 1938 are estimated)
- Number of observations: See above
- Years: 1890–1969

#### Suslow (2005)

- Sample selection criteria: International cartels created to fix prices or allocate production before World War II
  - Agreements with any of the following organizational structures were eliminated:
    - Explicit intergovernmental cartels
    - Horizontal contracts with interlocking directorates or wholly owned foreign subsidiaries
    - Cartels in operation before World War I
  - Any cartel restructuring (tied to entry or exit of an important member, etc.) is identified as a new contract.
- Number of observations: 71 international manufacturing and commodity cartels in 45 industries
- Years: 1920–1939

#### Symeonidis (2002, 2003)

- Sample selection criteria: Industries that filed an agreement with the Register of

Restrictive Trading Agreements (after 1956) or were covered by a report of the Monopolies and Restricted Practices Commission (pre-1956).

- An industry was assigned to the group of industries that experienced a change in competition regime if it had been subject to significant collusive agreements in the 1950s covering at least 50 percent of total sales revenue and these agreements were subsequently abandoned.
- An industry was assigned to the control group if less than 10 percent of the industry was affected by the legislation.
- Intermediate cases were excluded.
- Number of observations: 149 total (65 changed collusive regime, 84 did not)
- Years: 1951–1975

#### Taylor (2002)

- Sample selection criteria: U.S. manufacturing cartels registered under the National Industrial Recovery Act (NIRA) of 1933.
- Number of observations: 130
- Years: 1926–1937

#### Webb (1982)

- Sample selection criteria: Germany's "heavy" industries in coal, iron and steel (hard coal, pig iron, crude steel, rails, wire, sheets, bars and beams)
- Number of observations: not clear (since number of cartels in each industry varied and cartel-specific data are not given)
- Years: 1880–1913

*Appendix B*  
SOURCES FOR SELECTED CASE STUDIES

<b>Industry</b>	<b>Source</b>
Beer (U.S.)	McGahan 1995
Beer (Sweden)	Lundqvist 1998
Bromine	Levenstein 1993a, 1993b, 1994, 1995, 1996, 1997, 1998
Cement	Leach 1994; Fourie and Smith 1994
Coal	Peters 1989
Diamonds	Spar 1994
Electrical Equipment	Baker and Faulkner 1993, Fuller 1962, Smith 1963, Sultan 1974, Scherer 1980
Ocean Shipping	Pirrong 1992; Podolny and Scott Morton 1999; Scott Morton 1997; Sjostrom 1989; Marin and Sicotte 2003
Oil	Grant and Thille 2001
Parcel Post	Grossman 1996
Potash	Levenstein 2000, Schroter 1994, Wilkins 1974
Railroad— U.S. Midwest	Ulen 1979; Porter 1983b, 1985; Green and Porter 1984; Lee and Porter 1984; Roth 1988; Hajivassiliou 1986; Berry and Briggs 1988; Ellison 1994; Briggs 1996
Railroad— U.S. South	Hudson 1890
Railroad-Oil	Granitz and Klein 1996
Rayon	Markham 1952; Eswaran 1997; Gallet and Schroeter 1995
Steel—Europe	Barbezat 1989, 1990, 1994; Hughes and Barbezat 1996
Steel—U.S.	Baker 1989; Gallet 1997
Sugar	Genesove and Mullin 1998, 1999, 2001; Eichner 1969
Tea	B.Gupta 1997, 2001

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