

Predicting Cartel Formation

Daniel Herold, Johannes Paha

Justus-Liebig-University Giessen, Licher Strasse 62, 35394 Giessen (Germany)

Abstract

This paper analyzes 42 cartel cases prosecuted by the European Commission from 2010 to 2013. To provide insights on cartel formation the case study examines the industries' evolution preceding the cartels' set-up. Five parameters are included, namely, demand, capacities, intensity of competition, prices and regulatory characteristics. Cartel formation is not necessarily triggered by events negatively impacting the firms' profitability as was suggested by (Grout and Sonderegger, 2005), however, profit shocks and the resulting (expected) disturbance in the market seem to trigger collusive behavior. Factors that are commonly deemed to *destabilize* cartels, like entry of new competitors, may foster cartel *formation*. We explain this finding in a theoretical framework which allows for situations where the Participation Constraint of the cartel is more restrictive than the Incentive Constraint.

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Email addresses: daniel.herold@wirtschaft.uni-giessen.de (Daniel Herold),
johannes.paha@wirtschaft.uni-giessen.de (Johannes Paha)

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1. Introduction

This article studies the events that lead to the formation of 42 European cartels that were prosecuted by the European Commission between 2000 and 2013.¹ It may come as no surprise that the triggers for cartel formation are the same factors that also affect the sustainability of collusion, i.e., changes in prices, demand, individual or aggregate production capacities, the intensity of competition, or changes in the legal/regulatory environment of the firms. As a central result, our study however suggests that certain factors which are considered having a destabilizing effect on existing cartels may actually trigger the formation of new conspiracies.

For example, it has become textbook knowledge that market entry is considered a factor to destabilize collusive agreements (see, e.g., (Motta, 2004, p. 144), (Pepall et al., 2011, pp. 355-356)). However, our study indicates that the emergence of entrants into the market can cause the formation of new cartels such as the one in the Methionine industry. This is because entry intensifies competition and causes lower profits. If competitive profits fall more strongly than collusive profits, entry may loosen firms' participation constraint of collusion. In other words, the gain in profits brought about by collusion may exceed the expected costs of collusion after entry although this had not been the case prior to entry.

In our analysis, we use the case study method to identify events that lead to the formation of cartels in practice. We relate these observations to existing theories wherever possible and point out areas where future research

¹<http://ec.europa.eu/competition/cartels/cases/cases.html>

appears promising. This approach may appear intuitive at first sight but is less so when regarded more closely. Established theory indicates that under a variety of conditions it is harder to satisfy the incentive compatibility constraint of collusion than the participation constraint, i.e., firms cannot necessarily stabilize collusion although it would be profitable to collude even after considering the expected costs of doing so (i.e., fines, repayments for damages etc.). Under such conditions, research may concentrate on the study of factors that facilitate collusion. Such research has been done theoretically and empirically over the last decades, yielding results that found their way into textbooks.

So why would one need research as ours that specifically focuses on cartel formation? We provide a general model of collusion and point out situations where the participation constraint is stricter than the incentive compatibility constraint, i.e., where firms or managers do not find it profitable to collude although a collusive agreement could be stabilized. Under such conditions, the study of factors that facilitate the sustainability of collusion does not reveal everything than can be learned about cartels. In particular, one may hypothesize the existence of factors that facilitate cartel formation despite lowering the stability of collusion. Our case study provides evidence of factors such as entry or countervailing buyer power that have exactly this property.

Are there alternative ways (i.e., other than doing a case study) to examine the hypothesis that some factors facilitate cartel formation despite aggravating the sustainability of these conspiracies? One might prefer a full-fledged econometric analysis that, however, would be difficult to perform in this contextual setting. To see this, consider that the European Commission has

prosecuted 114 cartels since 1990, and information about the events that lead to the formation of these conspiracies is only available for a subset of these cases. Even if one adds cases decided by other competition authorities the number of data points would still be low. This makes statistical inference-making/hypothesis-testing difficult given that the characteristics of cartels can be quite diverse which requires the econometrician to include a decent number of control variables. Moreover, theories about cartel formation are still relatively rare. This precludes both theory-based hypothesis testing and the application of structural econometrics.

Our research therefore lays groundwork for future theoretical and empirical research. It identifies areas where further theory-building appears promising. To solidify theoretical foundations, we follow (Von Neumann and Morgenstern, 1944, ch. 1.2.4.) and aim at offering a richer description of observed phenomena. In doing so, our work also identifies cartels that share common characteristics. This makes it easier to build econometric models for these subsets than having to come up with a regression equation that would have to apply for the full sample of cartels. It is important to us to understand our work not as a singular, exploratory study but to design it in a way consistent with theoretical and empirical work. Therefore, this article stands in the tradition of earlier case studies such as Hay and Kelley (1974), Röller and Steen (2006), Grout and Sonderegger (2005), and Harrington (2006). These prior studies are reviewed in Section 3.1 further below in this article.

These studies typically pursue the objective to identify characteristics that must be met for collusion to be sustainable in certain industries. Our research question is complementary to this approach. We ask: *What changes*

in a market must occur such that firms also change their conduct from competition to collusion? In doing so, we focus on changes in price, demand, and capacity, along with changes in the intensity of competition, and the regulatory environment of the firms. This research does not only identify factors that have triggered cartel formation in the past. It also helps to identify industries where cartels may emerge in the near future.

Insofar, our work has two important policy-dimensions. First, our results help firms to screen for divisions where the risk of anticompetitive conduct is elevated. Such screening has been proposed as an important element of firms' antitrust compliance programs. Second, the results of our research may also help to further raise the effectiveness of competition authorities' detection efforts and use their resources more effectively. Competition authorities must not be expected to have the financial means to investigate all industries that would potentially allow for stable collusive outcomes. Given that only some of these industries have actually been cartelized it does not appear very economical to spend taxpayers' money on the investigation of the entire population of industries where collusion would be sustainable in theory. One gets better value-for-money by concentrating on the identification of observable changes in market characteristics that are likely to trigger cartel formation. The same logic applies to firms applying screening methodologies within their antitrust compliance programs.

Section 2 lays theoretic groundwork for our study by providing a simple model of collusion. Section 3 continues with methodological considerations, i.e., it critically analyzes the case study method and reviews prior work in this arena (Subsection 3.1), while Subsection 3.2 presents our sample. Having a

potential screening-application in mind, Section 4 analyzes changes in factors that have contributed to cartel formation in the past and that can be observed with relative ease. These factors are: Price, demand, production capacity, the intensity of competition, and the regulatory environment (e.g., changes in laws). Section 5 concludes.

2. Theoretical Considerations

This Section presents a model of collusion. It argues that the study of factors facilitating the *sustainability* of collusion may yield incorrect conclusions when predicting cartel *formation*. The model serves as theoretical foundation of the case study analysis performed in Section 4.

We start by defining relevant variables and describing the incentive compatibility constraint and the participation constraint that must both be satisfied for a cartel to be established. The variable $V_{c,t}$ denotes the present value of some firm i when it behaves competitively (i.e., non-cooperatively).

$$V_{c,t} = \pi_{c,t} + \delta V_{c,t+1} \quad (1)$$

The competitive per-period profit is denoted by $\pi_{c,t}$ while δ stands for firm i 's discount factor. When the firms in the market decide to behave collusively (i.e., cooperatively) firm i earns profits $\pi_{k,t}$ and is valued at $V_{k,t}$.

$$V_{k,t} = \pi_{k,t} - \rho F + \delta V_{k,t+1} \quad (2)$$

The variable ρ denotes the per-period probability that the conspiracy is detected and sanctioned. In this case, a sanction F (including, e.g., fines, repayments for damages and litigation costs) is levied on the firm. When firm i

decides to deviate from a collusive agreement by behaving non-cooperatively while (at least some of) the other firms continue with the collusive conduct, firm i earns profits $\pi_{d,t}$ and would be valued at $V_{d,t}$.

$$V_{d,t} = \pi_{d,t} + \delta V_{d,t+1} \quad (3)$$

Note that the notation $V_{k,t+1}$ ($V_{c,t+1}$) does not imply that firm i behaves collusively (competitively) in period $t+1$ or later but merely did so in period t . The same is true for $V_{d,t+1}$. Firm i 's conduct in period $t+1$ can differ from that chosen in period t . In particular, firms may form a cartel by switching from competitive conduct in period t to collusive conduct in period $t+1$. Or they terminate a collusive agreement by switching from collusive conduct in period t to competitive conduct in period $t+1$. In the following, we make two definitions that must be satisfied for collusion to occur.

Definition 1. *Participation Constraint (PC): A firm would optimally switch from competitive to collusive conduct in some period t when $V_{k,t} > V_{c,t}$ applies. This participation constraint can be written as follows.*

$$\pi_{k,t} - \pi_{c,t} > \rho F + \delta(V_{c,t+1} - V_{k,t+1}) \quad (4)$$

Definition 2. *Incentive Compatibility Constraint (ICC): Firm i would find it optimal not to deviate from collusive conduct when it is unprofitable to deviate. The incentive compatibility constraint for cartel stability (i.e., $V_{d,t} < V_{k,t}$) can be written as follows.*

$$\begin{aligned} \pi_{k,t} - \pi_{d,t} &> \rho F + \delta(V_{d,t+1} - V_{k,t+1}) \\ \pi_{k,t} - \pi_{c,t} &> \rho F + \delta(V_{c,t+1} - V_{k,t+1}) + (V_{d,t} - V_{c,t}) \end{aligned} \quad (5)$$

This model suggests that the firms would compete when at least one of the constraints (4) and/or (5) is violated. A cartel would be formed when a change in the determinants of (4) and (5) brings about one of the situations proposed in Axiom 1.

Axiom 1. *A cartel will be formed when a change in market determinants causes one of the following situations. First, both the PC (4) and the ICC (5) had been violated before the change in market determinants and are satisfied afterwards. Second, only the ICC (5) had been violated before the change in market determinants and is satisfied afterwards, while the PC (4) is satisfied in both situations. Third, only the PC (4) had been violated before the change in market determinants and is satisfied afterwards, while the ICC (5) is satisfied in both situations.*

The first and the second situation are in line with the majority of the existing theoretical and empirical literature on collusion that mainly concentrates on analyzing the determinants of the ICC (5). This approach suggests that it suffices to study the facilitating factors of collusion, i.e., to study the factors that contribute to stabilizing collusion in order to also understand cartel formation better. This approach is justified as long as the ICC is harder to satisfy than the PC, i.e., when the right-hand side of (5) is larger than that of (4). This is the case when the inequality $V_{d,t} > V_{c,t}$ applies. Therefore, a collusive agreement that can be stabilized would also be profitable for the firms and it suffices to analyze cartel stability. Many established models of collusion share the property that $V_{d,t} > V_{c,t}$ applies. However, one can as easily show that the inequality $V_{d,t} > V_{c,t}$ may also be violated as is argued in Proposition 1, which is central to our analysis as will be argued further

below.

Proposition 1. *The property $V_{d,t} > V_{c,t}$ does not apply for all models of collusion. This gives rise to situations where the PC (4) is harder to satisfy than the ICC (5).²*

Proof. We prove Proposition 1 by showing that there is at least one plausible model where the inequality $V_{d,t} > V_{c,t}$ is violated. Showing under what other conditions a similar result may be found is left to future research.

Consider the following model. Two symmetric firms produce a homogeneous good and compete in prices. The industry alternates deterministically between a state with high demand (denoted by upper bars) and a state with low demand (denoted by lower bars). If demand is high in period t it will be low in period $t + 1$ and reverse. Under these assumptions the firms make zero profits in competition $\bar{\pi}_c = \underline{\pi}_c = 0$. When the firms collude they split the monopoly profit evenly with the collusive profit being higher in the state with high demand, i.e., $\bar{\pi}_k = \underline{\pi}_k > 0$. A firm deviates from the collusive agreement by cutting its price marginally and stealing the other cartel firm's customers, i.e., $\pi_d = 2\pi_k$. Accordingly, deviation profits are also higher in the state with high demand, i.e., $\bar{\pi}_d = \underline{\pi}_d > 0$. A deviation from collusion is punished by a grim trigger strategy, i.e., eternal reversion to competitive conduct (Friedman 1971). The value of the expected sanction ρF is assumed to be independent of the state of demand.

²Equation (3), which defines $V_{d,t}$, implicitly assumes that a deviator also applies for leniency and is granted full immunity (i.e., $\rho F = 0$). This may not be the case in all cartels that can be observed in practice. However, this implicit assumption is innocuous for our analysis as Proposition 1 can also be proven under different assumptions.

Given $\pi_c = 0$ firm i 's value in case of a deviation equals its deviation profits (i.e., $V_d = \pi_d$). The collusive firm values are shown in (6) and (7) under the assumption that collusion is sustainable in both states of demand.

$$\begin{aligned} \underline{V}_k &= (\underline{\pi}_k - \rho F) + \delta (\bar{\pi}_k - \rho F) + \delta^2 (\underline{\pi}_k - \rho F) + \dots \\ &= (\underline{\pi}_k - \rho F) + \delta \bar{V}_k \\ &= \frac{(\underline{\pi}_k - \rho F) + \delta (\bar{\pi}_k - \rho F)}{1 - \delta^2} \end{aligned} \tag{6}$$

$$\bar{V}_k = \frac{(\bar{\pi}_k - \rho F) + \delta (\underline{\pi}_k - \rho F)}{1 - \delta^2} \tag{7}$$

For collusion to be sustainable in both states (i.e., $\underline{V}_{d,t} < \underline{V}_{k,t}$ and $\bar{V}_{d,t} < \bar{V}_{k,t}$) the discount factor δ of the firms must be sufficiently large because $\underline{V}_{k,t}$ and $\bar{V}_{k,t}$ tend towards infinity as $\delta \rightarrow 1$ while $\underline{V}_{d,t}$ and $\bar{V}_{d,t}$ are finite. Therefore, collusion is stable in both states although it is unprofitable in the state with low demand ($\underline{\pi}_k - \rho F \leq 0$). For this to occur collusion must be sufficiently profitable in the state with high demand $\bar{\pi}_k - \rho F > -(\underline{\pi}_k - \rho F) / \delta$. Hence, the firms would maintain collusion even through sour times when a deviation eliminates the chances to return to profitable collusion in the future.

This illustrates that although the ICC (5) is satisfied, there are situations where the PC (4) is satisfied only in the state with high demand. If no cartel had been established and, thus, no deviation occurred in the past and the firms (perhaps irrationally) committed to competing in period t no matter what the state of demand they would still establish collusion once the industry returns to the state with high demand. The resulting firm values are shown in (8) and (9).

$$\underline{V}_c = \underline{\pi}_c + \delta \bar{V}_k \tag{8}$$

$$\bar{V}_c = \underline{\pi}_c + \delta \underline{V}_k \quad (9)$$

As for $\delta \rightarrow 1$ the firm values $\underline{V}_{k,t}$ and $\bar{V}_{k,t}$ tend towards infinity we find situations where $V_{d,t}V_{c,t}$ applies. A similar point has been made by Paha (2013) in a more general model. \square

Proposition 1 is crucial for our analysis by pointing out that the PC (4) is sometimes harder to satisfy than the ICC (5). This is important as it is a prerequisite for the third situation described in Axiom 1, suggesting the establishment of a cartel when only the PC (4) had been violated before a change in market determinants and is satisfied afterwards, while the ICC (5) is satisfied in both situations. This gives rise to Axiom 2.

Axiom 2. *If $V_{d,t} > V_{c,t}$ applies and, thus, the PC (4) is harder to satisfy than the ICC (5) a situation may occur where a cartel is formed in response to a change in market determinants that lowers the stability of collusion. In other words, although the ICC (5) is satisfied before and after the change in market determinants, the shock has made it harder to satisfy the ICC (5). However, a collusive agreement is formed because the PC (4) had been violated prior to the shock and is satisfied thereafter.*

Axiom 2 is interesting in two respects. First, it may be relevant for scholars by indicating a constellation that deserves greater study. Second, it is relevant for practitioners such as compliance officers, internal auditors, legal counsel, or risk managers who aim at assessing the risk that collusive conduct occurs in their firms. When solely focusing on risk factors that raise the stability of collusive agreements (i.e., factors facilitating the satisfaction of the ICC (5)) they may underestimate the risk of cartel formation stemming

from changes in market determinants that make it harder for the ICC (5) to be satisfied while at the same time making it easier for the PC (4) to be satisfied. Our case studies presented in Section 4 suggests that the risk of incorrect assessments of factors facilitating cartel formation (rather than the factors facilitating collusive stability) may not be remote.

This model suggests that in principle all factors influencing the competitive, collusive, or deviant profits ($\pi_{c,t}$, $\pi_{k,t}$, or $\pi_{d,t}$) affect cartel formation via their effects on the ICC (5) and the PC (4). Therefore, the following factors need to be considered when studying cartel formation: Price, demand, production capacity, the intensity of competition, and the regulatory environment. It proves convenient to think about these factors in terms of a game-theoretic model that produces the profits named above as payoffs.

Rules of the Game, Exogenous Variables. Some events and parameters are beyond the control of the firms. For example, changes in demand and the regulatory/legal environment are mostly exogenous. We say *mostly* exogenous because demand can to some degree be influenced by advertising while lobbying may affect the process of lawmaking. However, this influence may be considered lower than the effect firms have on their own production capacity by (dis-)investing.

Players, Strategies, Strategy Combinations. Aggregate capacity in a market can only be controlled imperfectly by a single firm i as the level of aggregate capacity also depends on the investment and entry strategies of other firms. In other words, the equilibria of the firms' product market or investment games depend not only on the strategies chosen by firm i but on the strategy combinations chosen by all relevant market participants. This may include

a competition authority, which determines the value of the detection probability ρ and of the sanction F . The type of the players is also important because the ICC (5) and the PC (4) depend, for example, on firms' individual discount factors δ .

Information. A firm's information may be imperfect (e.g., it cannot perfectly predict the evolution of demand) or incomplete (e.g., it does not know the discount factors of the other firms).

Equilibria. The equilibria of the games played depend on all these elements (i.e., players, actions, payoffs, and information) in conjunction. Therefore, it is necessary to analyze, e.g., the evolution of prices or demand not in isolation but together with other relevant parameters. For example, Paha (2014) shows that a reduction of demand may either lower or raise firms' incentive to collude depending on the existence of capacity constraints.

It is important to make clear what can be learned from the analysis of certain parameters. For example, analyses of prices have only limited theoretical appeal if one wants to explain firms' conduct. This is because prices are outcomes of the product market game. Explanations of firms' conduct must, however, be found in the fundamentals of the game such as demand, the regulatory environment, and firms' strategies. Yet, changes in prices may be observable more easily than changes in these fundamentals, such that prices may be used as screening instruments for situations that may cause collusive conduct.

3. Methodological Considerations

Subsection 3.1 reviews prior case studies of collusive agreements and analyzes the validity of the case study method. Subsection 3.2 presents our sample of cartels.

3.1. The Case Study Methodology

Several industry case studies are related to our work. An example of an early case study of collusion is Hay and Kelley (1974). They examine several antitrust cases in terms of, e.g., product characteristics. Recent papers are, for example, Harrington (2006) and Röller and Steen (2006). While the latter focus on just one cartel (the Norwegian cement industry), Harrington (2006) describes the organizational stages and features of 20 different cartels. His source is also the EC's cartel data base and the structure of our case study is quite similar to the one of Joe Harrington (ibid. 2006).

Our case study is most closely related to Grout and Sonderegger (2005) who also examine cartel formation based on cases prosecuted by the European Commission. Their study is based on the notion that sustainability of collusion is prerequisite for cartel formation. Therefore, they concentrate on the factors for which theory predicts to have an effect on the ICC 5: (i) The number of firms in the market, (ii) entry barriers, (iii) capacity constraints, (iv) stability of demand, (v) frequency of firms' interactions, (vi) market transparency, (vii) multi-market contact, (viii) asymmetries in costs and quality, (ix) horizontal product differentiation, (x) cross-ownership and (xi) buyer power. Our study differs from Grout and Sonderegger (2005) in two ways. First, while they pursue a (descriptive) econometric approach we

rather give a detailed description of what happened prior to cartel formation. Hence, our study may be used as a foundation to build theoretical models of cartel formation that can then be tested by means of structural econometric models in the future. Second, Grout and Sonderegger (2005) analyzed only 24 cases that were decided between 1998 and 2002. Our study complements their (ibid. 2005) work by studying more and more recent cases.

We describe the formation process of certain cartels. (Yin, 2009, pp. 15-18, 54) suggests that a case study is the proper tool for this endeavor. (Yin, 2009, p. 9) specifically proposes to use a case study, when the researcher wants to answer questions such as "how" or "why" a certain pattern was observable. In these circumstances a case study can help deconstruct the events and distill the relevant factors. (Harrington, 2006, pp. 2-3) stresses that a case study has the advantage to work out the details of a given cartel which is necessary for our questions.

3.2. The Sample

Our case study relies on the public versions of the European Commission's cartel decisions that were also used by, e.g., Harrington (2006) and Grout and Sonderegger (2005). We focus on those cartels prosecuted between 2000 and 2011.

The EC provides very detailed descriptions of the cartels' internal mechanisms as well as the market environment of the respective industries. For the question we are asking the EC's description of the events that preceded the first meetings of the cartelists are especially important. Using these information we try to establish causal relationships and general patterns underlying cartel formation. Although the extensiveness of those descriptions varies

quite substantially between cases, they form the best possible data source for the questions at hand. The information relevant for us are available too sporadically or not at all in the press releases of other (national) competition authorities like, e.g., the FTC and the DOJ. To provide a systematic case study analysis of cartel formation, the EC's data hence seems to be the most reasonable approach.

Nevertheless, there is no perfect availability of information which leads to two problems of the data. First, there is an inevitable selection bias because we had to filter out those cases where there are no or too few information available in the case descriptions. When the case study was conducted, 99 cases were reviewed, however, we could only extract the relevant information in 40 cases. Although the selection bias is present we still think that our findings are quite robust. One of our main results is that not only specific factors like, e.g., a decline in demand can trigger cartel formation but that in general many shocks have the potential to foster collusion. We think that it was rather the lack of information available to the EC which caused the lack of information in the case descriptions regarding peculiar developments in the respective markets than the fact that (hard core) cartels crop out of nowhere in reality. The second problem is that in some cases information is too scarce to understand the events in a scientifically satisfying way. In those cases we try to complement the EC's descriptions by external sources such as newspaper articles or reports of industry associations. Our goal is to provide a closed and grounded argumentation structure based on the findings.

4. Cartel Triggers

This Section presents the information from our case studies. We analyze how cartel formation relates to changes in price (Subsection 4.1), demand (Subsection 4.2), production capacity (Subsection 4.3), the intensity of competition (Subsection ??), as well as the legal and regulatory environment (Subsection 4.6).

4.1. Price

Price is an outcome of firms' interaction in the product market. Price changes must not be seen as a cause of cartel formation but as observable events that parallel or even precede cartel formation. Therefore, price changes may be used as screening devices to identify situations where cartel formation is more likely. We propose two hypotheses that will be examined by means of our case study.

Hypothesis 1. *Cartel formation is preceded by a decrease of competitive prices p_c as this helps to satisfy participation constraint (4).*

Hypothesis 1 follows directly from the definition of the participation constraint (4) because lower competitive prices p_c reduce both a firm's profits and its value ($\partial\pi_{c,t}/\partial p_C > 0$, $\partial V_{c,t}/\partial p_c > 0$) a drop in competitive prices makes collusion everything else equal more profitable relative to competition. Hypothesis 1 has been suggested by prior research on this topic ((Grout and Sonderegger, 2005, p. 59) , (Levenstein and Suslow, 2006, p. 12)). We however argue that this view on cartel formation may be too narrow because it does not capture the dynamics that led to the formation of conspiracies in

times where competitive prices p_c rose. Therefore, we suggest Hypothesis 2 and provide supportive case evidence in this section.

Hypothesis 2. *Cartel formation is preceded by a situation where the difference between collusive prices and competitive prices rises (i.e., $p_k - p_c$ goes up) as this helps to satisfy participation constraint (4).*

Hypothesis 2 is a generalization of Hypothesis 1, where the collusive price p_k was implicitly assumed to remain unaffected by the changes that affect the competitive price p_c . This implicit assumption is quite restrictive and may easily be violated because price is an outcome rather than a fundamental of a market and depends on further factors such as demand, capacity, or the mode of competition. Often, these factors do not only affect the competitive price but also the collusive price p_k which affects the cartel formation dynamics decisively. For example, an increase in demand may lead to an increase in competitive prices p_c , which according to Hypothesis 1 should make cartel formation less likely. However, the increase of p_c may be weaker than that of the collusive price p_k , which could, for example, be the case when the firms have excess capacities and compete fiercely. By raising collusive prices more strongly than competitive prices the participation constraint 4 of collusion would be satisfied more easily under higher demand despite the increase of competitive prices p_c . Hence, Hypothesis 1 would be violated while Hypothesis 2 is satisfied. This reconciles evidence that cartel formation frequently follows a drop in prices with contradictory evidence that suggests the opposite.

Citric Acid. We observe price movements prior to the formation of the citric acid cartel. This conspiracy consisted of five firms and was active from March 1991 to May 1995 (EC, 2002b, par. 1-3). In their case report, the European Commission (EC, 2002b, par. 72) identifies a 45% decrease in the price of citric acid in the period 1985-1990, i.e., prior to the setup of the cartel in 1991. However, demand was realistically expected to rise because due to its higher environmental acceptability citric acid was increasingly used in the detergents industry. Later, a demand increase of 9% annually was observed in 1991 and 1992 (EC, 2002b, par. 92). Under these conditions, the cartel aimed at stopping the decline of prices and even raise them. The EU Commission's decision remains imprecise to what extent the firms anticipated the increase in demand. However, the EC (EC, 2002b, par. 92) mentions that the demand increase was at least discussed during the meetings in May 1991.

Besides changes in demand the citric acid cartel was also affected by firms' investment strategies that, again, affected the degree of competition in the market. (Grout and Sonderegger, 2005, pp. 24-25) describe that the firm Jungbunzlauer became the market leader after it had massively increased production capacities between 1980-1990. This increase in capacities was a step towards excess capacities in the industry as the (EC, 2002b, par. 41) describes that worldwide annual demand was 750,000t while aggregated production capacities would have allowed to produce 900,000t annually in the period 1994-1997. These capacity constellations may have brought about an increase in the intensity of competition which lowered $\pi_{c,t}$ and $V_{c,t+1}$ and made collusion relatively more profitable (see Hypothesis 1).

The intensity of competition was raised further by greater imports from

abroad. By the end of the 1980s Chinese competitors had entered the market with a low quality variant of the product, which had made competition in the industry more intense. However, this effect is somewhat ambiguous because under the price umbrella of the cartel, imports from China rose to satisfy 23,6% of demand in Europe. This lowered the collusive profit $\pi_{k,t}$ and firm value $V_{k,t+1}$ and, thus, should have made collusion relatively less desirable.

Plasterboard. Hypothesis 1 and Hypothesis 2 can possibly be supported by the European plasterboard case. This cartel lasted from 1992-1998 and comprised four firms that had no other large competitors in the market and in 1998 served 97-100% of the market (EC, 2002c, table 2). Until the end of the 1980s the firms had mainly supplied their respective home markets but then started to enter foreign markets. For this purpose, the suppliers started to invest in production capacities in the respective markets. There was hardly any trade across borders which according to the producers was due to, first, different standards, accessories and technical terms in different countries and, second, transport costs that are high relative to the value of the product (EC, 2002c, par. 34, 199). Hence, to enter foreign markets, firms had to install production capacities in the respective markets which was done by acquisitions, an expansion of existing capacities, or the construction of new production facilities. This led to a greater integration of national markets within the EU (EC, 2002c, par. 26). The firms supplied the respective countries not only by production facilities in those markets but also with their own foreign plants. According to the EC (EC, 2002c, par. 26) this led to a consolidation in the industry. In 1987, the firm BPB bought out the second-largest German producer. This triggered a 'spectacular' wave of

mergers and acquisitions in the industry (EC, 2002c, par. 49).

These changes in the ownership structure of the firms caused a change in the competitive conduct of the firms leading to lower prices and margins (EC, 2002c, par. 55-56) The later cartel member BPB called the situation a 'ruinous price war' that should be ended. From 1988 to 1992 price had fallen by 50-75% and all suppliers made losses with a 'bleak outlook' according to BPB. One may infer that the plasterboard cartel arose from a situation where prices plummeted and competitive pressure rose. The latter may have resulted from the firms' expansionary strategies to enter new markets. The price drop of at least 50% may have had a direct impact on the firms' incentive to install an anticompetitive agreement.

Prestressing Steel. A price drop was also observable prior to the formation of the prestressing steel cartel. The cartel was formed in 1984 and consisted of 18 firms covering about 80% of the European market (EC, 2010a, par. 1, 6-92, 98). The (EC, 2010a, par. 123) describes a strong downward pressure on prices before the cartel was established. An industry journal suggests that especially overcapacities were responsible for the decline in prices and production in the 1970's. According to the journal, the reason for these overcapacities were overly optimistic expectations about future developments (stahlmarkt 06.2011:11). The goal of the cartel was to establish price stability in an industry characterized by large excess capacities by suppressing an increase in competition (EC, 2010a, par. 543). The documentation of the EC does not allow for an assessment of the exact importance of excess capacities. Nor do we have information on the reason for the price drop in the 1980s. However, in a related case concerning steel beams (see Subsection 4.2) the

EC describes a drop in the European demand for steel starting in the 1970s that may have contributed to the price decrease. We use this information to infer that the prestressing steel cartel was formed in an industry that was characterized by negative price trends, excess capacities and an increase in competition.

Preliminary Conclusions. The cases presented above illustrate that a fall in competitive prices may potentially be used as a screening device, for example, by compliance officers searching for segments of their firm where collusion might be likely in the near future. Prices may be a desirable screening device because they can be measured easily.

However, the cases presented above also emphasize the role of, e.g., demand, capacity, or the mode of competition as determinants of prices. Therefore, prices may not be an ideal object of study when one wants to learn more about the driving forces that lead to cartel formation. This is done in Subsections 4.2 to 4.6 that study the effect of demand, capacity, competition, and the regulatory environment on cartel formation.

4.2. Demand

There is a wide body of literature analyzing the effect of demand on the stability of collusive agreements: After Green and Porter (1984) provided a seminal analysis with unobservable i.i.d. demand shocks, Rotemberg and Saloner (1986) analyzed a model with observable demand shocks. Such i.i.d. shocks can be seen as transitory developments in a given market. Haltiwanger and Harrington (1991) offer a model for cyclical demand shocks. More recent papers take into account interaction effects of different parameters, for

Demand ...		
... decreases	16	38.10%
... permanently	8	
... temporarily	2	
... no information	6	
... fluctuates	1	2.38%
... increases	8	19.05%
... no information	17	40.48%
Sum	42	100.00%

Table 1: Changes in Demand

example, demand and capacities (Fabra (2006), Paha (2014)).

In addition to the analysis of collusive stability, it is frequently argued that a decrease in demand triggered the formation of certain cartels in practice. In our sample of 42 cartels 16 conspiracies were formed in times of decreasing demand as can be seen from Table 1. The firms in 8 of these cases could expect the decline to be permanent while being supposedly temporary in 2 cases (i.e., French beef and fine art auction houses). No clear assessment about the permanency of demand fluctuations can be made in 6 cases (e.g., prestressing steel and steel beams). Further below in this section, we present evidence both for a permanent and a temporary decline of demand prior to cartel formation. Our evidence suggests that a permanent decrease in demand can be caused, for example, by consumers who substitute a product through a different good or by structural changes in downstream markets.

Of the remaining 26 cartels in our sample that were not formed in times of decreasing demand only one (i.e., the conspiracy in liquid crystal displays) was established in times of fluctuating demand. It will be explained that demand in this market generally followed a positive trend path but was fluctuating considerably. Therefore, it is unclear whether demand had dropped prior to cartel formation. No information on demand movements is available in 17 out of the 42 conspiracies analyzed. This leaves 8 cases where explicit collusion was started when demand was growing that will be presented further below.

4.2.1. Permanent Decrease in Demand

Out of the 16 cartels that were formed in response to declining demand, 50% were established when the decrease in demand was supposedly permanent. From this sample of conspiracies, we present the events that lead to the formation of the cartels in thread, carbonless paper, and Betacam SP videotapes in greater detail.

Thread. The thread cartel covered the markets of industrial thread and automobile thread. Demand side substitution of the two products is low. Industrial thread is used in the production of clothing and automobile threads is used for, e.g., seat belts. Supply side substitution, however, is high. i.e., the two types of thread are easily substitutable in production. Therefore, the cartel also provides an example of a conspiracy that spills over from one to another market. The cartel was active from 1990 to 2001 while it solely covered the market for industrial thread in the beginning. This market had been hit by a negative demand shock. As a result of the decline in Europe's cloth-

ing industry, the industrial thread industry was in severe economic trouble. According to the French government, the clothing industry was shrinking by 8% per year since 1994, which had a negative impact on prices for thread ((EC, 2005a, para. 25-27)). It was not until 1998 that the conspiracy was also expanded to the automobile thread market. There, four of the seven firms that had previously conspired in the market for industrial thread also started to coordinate their conduct.

Carbonless Paper. The carbonless paper cartel provides an example where a permanent decline in demand led to the emergence of excess capacities (also see Section 4.3). This contributed to the coordination of conduct among eleven firms from 1992-1995. Besides the cartel firms, the market was served by some regional producers with negligible market shares (EC, 2004f, paras. 1, 3, 17). This case also illustrates that cartels may be formed in expectation of future (as compared to actual) changes in demand as can also be inferred from participation constraint 4. A decline in demand in some future period will lower the expected value $V_{c,t+1}$ of future competitive profits and *ceteris paribus* raises the relative profitability of collusion. This is at least true as long as the lower demand decreases $V_{c,t+1}$ more strongly than the expected present value $V_{k,t+1}$ of future collusive profits.

To see these effects, consider the following evolution of the carbonless paper market. The EC (EC, 2004f, para. 24-28) describes that the market had been rising during the 1980s. This upward trend ended at the beginning of the 1990s, while it started to decline from about 1995 onward. These changes may be explained, first, by users who started to exchange data electronically and, second, by the growing dispersion of inkjet printers. Accordingly, there

was less need of carbon copies of office communication and other documents. Noticeably, the conspiracy was already established in 1992 before the decline in demand actually started but could already be expected.

The industry was also characterized by excess capacities as in 1995 capacity utilization had fallen to only 65%. The EC (EC, 2004f, para. 128) refers to a 1995-report prepared by an industry association complaining about drastic drops in order inflows, increasing input costs, excess capacities, and declining prices. It is also interesting that production capacities had not been expanded since 1985 (EC, 2004f, para. 24). Stagnating capacity is sometimes considered an indicator of cartel activity (Blanckenburg and Geist, 2011, 19). This would be consistent with the European Commission's remark (EC, 2004f, para. 73) that some illegal contacts between the firms date back even to the 1980s. However, it was not until demand started or could be expected to fall that the conspiracy was established.

Betacam SP Videotapes. The Betacam SP videotapes cartel provides a further example of a conspiracy that was established in response to permanently falling demand. Betacam SP videotapes were used by professional TV studios to record and broadcast video content. Starting in 1997 demand for these videotapes began to shrink due to the reuse of old tapes and the introduction of new technologies like Betacam SX and MPEG IMX (EC, 2007a, para. 37). Therefore, three Japanese firms (i.e., Sony, Fuji, and Maxell) started to coordinate their market conduct in 1999 (EC, 2007a, paras. 1, 8-27). This cartel lasted until 2002 and controlled 89% of the market (EC, 2007a, para. 1, table 1). The videotapes case also illustrates the importance of factors affecting prices and competition (see section 4.4) for the process

of cartel formation. In particular, the EC mentions that the firms found the exchange rates unfavorable and that prices were decreasing (EC, 2007a, para. 58).

4.2.2. Temporary Decrease in Demand

Besides a permanent drop in demand, cartels are sometimes also formed in response to a temporary decline in demand. This can be illustrated with reference to the French beef and the fine art auction houses cartel.

French Beef. The French Beef cartel was formed in 2001 after bovine spongiform encephalopathy (BSE) had appeared in Europe and demand as well as prices for beef had dropped considerably since 2000 (EC, 2003b, paras. 1, 10-15). Despite national and EU-wide interventions (ibid., paras. 22-29) the suppliers felt in severe economic trouble (ibid., paras. 22-29, 30-31). This unexpected, negative demand shock may be considered a major cause for the establishment of a collusive agreement (Grout and Sonderegger, 2005, 36) involving six trade organizations covering 400 retailers and 300 cooperatives as well as 30 manufacturers (EC, 2003b, para. 7-9). The cartel had a significant political component: Despite EU-wide measures to reduce excess capacities in the market there had been massive protests by the farmers in 2001 (Rn. 31). Hence, even the French minister for agriculture pleaded for minimum prices (EC, 2003b, paras. 12-18. 33).

Fine Art Auction Houses. The fine art auction houses cartel provides not merely an example of a conspiracy being established in response to temporarily falling demand. Possibly, it is also an example where previous tacit collusion was made more explicit. The cartel lasted from 1993 to 2000 and

comprised Christie's and Sotheby's who were the two largest fine art auction houses in the world and had both been established in the 18th century (EC, 2002e, para. 2-10). Other auction houses had to be considered only minor competitors of the two (ibid., para. 1) when in the 1990s the fine arts market was hit by a recession after several years of growth.

Under the impression of these developments Sotheby's raised the Buyers Premium from 10% to 15% on January 1, 1993. Christie's followed with a similar measure on March 1, 1993 (ibid., para. 16). The Buyers Premium is a percentage markup on the Hammer price, the realized price in the auction that the winner has to pay (ibid., para. 15). The EC (ibid., para 79) describes that this increase in the Buyers Premium did not have the anticipated, positive effect on the firms' profits. Therefore, the firms 'were considering other ways to secure income' (ibid., para. 79). For example, the firms agreed upon more-favorable to them conditions in other service dimensions such as granting no loans below LIBOR. They also agreed to make no offers to trade vendors that are contracted by the respective other firm (ibid., para. 85). This case may also provide an example of a transition from tacit to explicit collusion. The two firms were interacting in a quite narrow oligopoly and had been around for about 200 years delivering similar services. This market, therefore, constitutes almost a textbook-example of a market suitable for tacit collusion.

4.2.3. Fluctuating Demand

The sustainability of collusion under the assumption of fluctuating demand has been an important subject in theoretical research. For example, Green and Porter (1984) and Rotemberg and Saloner (1986) model i.i.d. de-

mand shocks. However, evidence of cartels that were formed in response to or in times of fluctuating demand is more difficult to find. The only example in our sample of cases is the liquid crystal display (LCD) cartel.

This cartel was maintained between 2001 and 2006 among six firms who served about 65-80% of the market and aimed at keeping prices high (EC, 2010c, paras. 5-38, 43, 100). Generally, one could observe a strong increase in demand for LCD panels in the period 1998-2006 (ibid., para. 39). However, at the time of cartel formation in 2001 a contraction was observable. According to the cartel member Samsung, 'this growth was not stable over the whole period as there are ups periods, such as the year 1999, 2002 and 2004 and other periods of downs such as the year 2001' (ibid., para. 39).

4.2.4. Increase in Demand

We were surprised that in our sample the number of cartels being formed in times of decreasing demand is only twice as large as the number of cartels established when demand was going up, i.e., 16 cases for declining demand as opposed to 8 cases for rising demand. This evidence challenges conventional wisdom which appears to suggest that cartels are mostly formed when demand conditions turn sour. Therefore, we present cartels that were formed under benign demand conditions, i.e., the conspiracies in rubber chemicals, flat glass, copper plumbing tubes, animal feeding phosphates, and sodium chlorate. An increase in demand could also be observed prior to the sorbates and the alloy surcharges cases that will be described in Section ??.

Rubber Chemicals. The rubber chemicals cartel was formed among eight firms in 1996 and lasted until 2001. The EC (EC, 2005d, p. 10) remarks

that the annual growth rate of worldwide demand had been 2.5%-3% between 1995 and 2000 of which Europe accounted for up to 1%. As one of the cartel members Flexsys states that those years were 'economically strong for the rubber chemical industry'. However, it should also be considered that this phase was primarily a recovery from a demand reduction in the early 1990's which was due to the collapse of Eastern European economies (ibid., pp. 10-11). This cartel provides an example of a conspiracy that was formed under benign demand conditions that, however, must not be confused with benign conditions overall. For example, the EC (ibid., pp. 11-12) describes a process of price convergence when in the 1990s the firms started to serve new markets internationally. Moreover, the cartel may have emerged from tacitly collusive behavior as the EC (ibid., p. 17) cannot rule out that there had been occasional collusive activity in the market already since the 1970s.

Flat Glass. A further example of a conspiracy where a positive demand development was overshadowed by intense competition is the flat glass cartel. The cartel had been established between 2004 and 2005 by four firms who covered about 80% of the market. In parallel, an increase in demand for safety and e-glass in 2005 and 2006 was triggered by stricter regulations concerning power efficiency (EC, 2007c, pp. 13-14). Despite this development prices declined steadily. It was one objective of the agreement to counteract this price development (ibid., p. 22). Accordingly, the cartel-firm Guardian reported that the conspiracy had been initiated because of the intense competition in the industry (also see section24).

Copper Plumbing Tubes. The copper plumbing tubes cartel was active from 1988 to 2001 and consisted of nine firms (EC, 2004g, p. 10). A report com-

missioned by the EC suggested an increase in demand for copper plumbing tubes (ibid., p. 12). However, the EC (ibid., pp. 209-210) also notes that by the end of the 1980s the industry had been characterized by excess capacities, entry into the market, and an increase in competition among the incumbents (ibid., p. 61). These developments and features may have led to decreasing prices or at least the expectation of decreasing prices.

Animal Feed Phosphates. The animal feeding phosphates cartel was not merely formed in times of increasing demand but is also the longest-lived cartel in our sample. It was established in 1969 among five firms and lasted for 35 years until 2004 (EC, 2010b, pp. 5-13). The cartel was formed as a means to allocate an expected increase in demand. The cartel firms also issued the existing excess capacities in the industry.

Sodium Chlorate. The sodium chlorate cartel was formed in 1994 after a phase of strong demand growth had ended. The cartel consisted of four firms controlling at least 65% of the market and broke apart in 2000. Between 1988 and 1993 demand for sodium chlorate had drastically increased in the European Economic Area. This was 'the result of a regulation-driven substitution of SC for chlorine as a bleaching agent for chemical pulp' (EC, 2008a, p. 10). In 1993 and 1994, demand stagnated (ibid., pp. 6-12).

Preliminary Conclusions. Our evidence suggests that cartels have frequently been formed in times of growing demand or shortly after such a growth phase. Therefore, when screening for cartels one should not merely focus on industries where demand stagnates or declines. It is notable that rising demand is rarely the cause of cartels. They may rather be formed because

of other adverse conditions (e.g., increased competition or excess capacities) and despite the increase in demand.

4.3. Capacity

Binding capacity constraints restrict the output that firms may supply and, thus, soften competition. Likewise, competition will be intense when capacity constraints are non-binding because firms may supply any quantity at a given price, which leads to lower prices overall. Therefore, the present value $V_{c,t}$ of competitive profits is typically higher in a situation with binding capacity constraints. The present value $V_{k,t}$ of collusive profits, however, often respond less to the existence of capacity constraints because the collusive output contraction makes them less binding anyway. This suggests Hypothesis 3, which is supported by the evidence provided in this section.

Hypothesis 3. *Excess capacities (or equivalently: a decrease in capacity utilization) facilitate cartel formation. Excess capacities and, thus, cartel formation may be triggered by the following events: (a) New competitors enter the market and, by stealing business, lower the capacity utilization of incumbents. (b) Capacities had been built when demand was high and remain existent when demand falls. (c) Capacities had been built in expectation of an increase in demand that did not come about. (d) Excess capacities are an equilibrium of firms' investment game.*

4.3.1. Entry into the Market

One cause of a decrease in capacity utilization is an increase in the number of competitors who steal business from the incumbents and make competition more intense. One example of a cartel that was formed in response to market

entry is the Needles case. In the needle industry, three firms engaged in collusive activity from 1994 to 1999 (EC 2004h: 1). The EC (2004h: 19) identifies two important developments prior to cartel formation: Declining demand and excess capacities. In fact, production capacities of two firms would have been sufficient to cover world demand. On June 30, 1993, the CEO of Prym, one of the cartel firms, wrote in a letter to the CEO of Coats, a further cartel firm, that given increasing competition from Asian producers the European firms should cooperate to ensure that the European needle market does not suffer from further self inflicted wounds (EC 2004h: 19).

Note that entry into a market does not necessarily raise firms' incentive to collude. First, besides lowering competitive profits entry also lowers collusive profits. It remains unclear whether the net effect on the additional profits from collusion is positive or negative. Second, collusion is typically harder to stabilize in cases where the entrants are included in the collusive agreement. Therefore, entry should rather be considered a factor that may change firms' conduct while this change does not necessarily constitute a switch from competitive to collusive conduct.

4.3.2. Decrease in Demand

Excess capacities may emerge in times of decreasing demand when capacities had been built to serve demand in times of a boom. Evidence of cartels that were formed under these conditions is provided by the conspiracies in the markets for graphite electrodes, industrial bags, and calcium carbide.

Graphite Electrodes. In 1992 a cartel was formed among eight producers of graphite electrodes while there were nine producers in the Western world.

The cartel broke down in 1998 (EC, 2002a, pp. 1-5). Graphite electrodes are used for producing steel. During the 1980s the usage of graphite electrodes per ton of steel was reduced due to the development of more efficient electrode performance in steel production. As a result, world demand for graphite electrodes plummeted. A decline in the production of steel exerted a further negative effect on the demand for graphite electrodes (Grout and Sonderegger, 2005, pp. 61-62)³ worsening the situation for the producers. Although this led to a reduction of capacities and the number of firms the industry's capacity utilization in 1982 was only 60%. Moreover, the European firms' entry into Asian markets led to a decline in the number of Japanese producers from 6 to 4 (EC, 2002a, p. 4, para. 12). During the cartel firms' first meeting, the firms agreed that in their point of view price increases were necessary (ibid., p. 10). This case illustrates that cartels can rarely be explained by a single cause. One observes four interrelated factors: A drop in demand, excess capacities, increased competition, and a drop in prices. The drop in demand may have been the starting point for the further developments.

Industrial Bags. The Industrial Bags cartel may provide an example of a conspiracy where a decline in demand facilitated collusion in two ways. First, it led to exit and, thus, a greater concentration in the market and, second, it caused more intense competition. The resulting conspiracy lasted from 1982 to 2002 and comprised 14 firms. Demand for the simplest version of

³The development of the steel market in the 1980s is also described in the context of the prestressing steel (see Section 4.1) and steel beams cases (see Section 4.6).

industrial bags had been on the decline since the end of the 1980s by a rate of 5-7% per year. Although demand for more sophisticated products (e.g., 'FFS bags') rose by around 7% per year overall demand stagnated or even declined. This was due to the increasing importance of transport of raw materials in containers (EC, 2005b, pp. 10-13, para. 20). The EC (ibid., pp. 10-13) further describes that supply-side concentration was increasing. This was due to higher investments being necessary to serve larger markets in a profitable way. Besides these large producers there were some small suppliers focusing on local markets. The EC (ibid., p. 30) has evidence for anticompetitive meetings in 1982 and also some indications that those meeting took place in the 1970s as well. The meeting were initiated in a trade association which was substituted by Valveplast in 1984. In the opinion of the EC (ibid., p. 34) the association was used to camouflage illegal conduct.⁴ This point of view is based on a report from the early 1980s which describes that excess capacities led to price wars and that proposes to coordinate the supply for valve bags in Western Europe.

Calcium Carbide. The cartel for calcium carbide and magnesium based reagents covered seven firms and was active from 2004 to 2007. Seven producers outside the cartel served 15% of the calcium carbide powder and 31% for calcium carbide granulates. The powder was used in the steel industry. The

⁴The case study describes many cases which provide evidence that cartel formation is strongly connected to the activities of trade associations. Although we did not focus on those associations they seem to be an important factor for the formation and success of a collusive agreement. They can for example be seen as mediators (Rahman 2015) that help to monitor the cartel members.

granulate was used in the gas industry but could also be used for the desulfurization of steel (EC, 2009a, pp. 5-13). A substitute for calcium carbide in the desulfurization of steel are magnesium based reagents that have even better properties in the production process. This led to a decrease in demand for calcium carbide powder from 310,000t in 2003 to 260,000t in 2006 accompanied by a drop in prices.

Moreover, magnesium granulate was increasingly imported from foreign countries, especially from China (*ibid.*, pp. 7-17). There was only one producer for magnesium, Ecka, remaining in Europe since a lot of energy was necessary to produce the good. Therefore, other European producers either had to import the good or buy it from Ecka. This may have made the firms more symmetric in production/sourcing technologies with symmetry being commonly considered a facilitating factor for collusion. Hence, collusive activities for calcium carbide powder started in 2004 in a situation with shrinking demand, falling prices, increasing competition, and excess capacities.

As a side note, this case also provides an example of a conspiracy that spread to a related market. Collusive activity expanded to calcium carbide granulate used as an input in the gas industry. The EC (*ibid.*, pp. 25-26) describes that the same persons were involved as in the former cartel and it was only logical that they discussed the gas market as well. The same people also coordinated the production of magnesium granulate. The collusive practices of the calcium products were used as guidelines for the magnesium products.

4.3.3. Incorrect Expectations

Besides decreasing demand, excess capacities can also emerge when capacities are built to cater a future increase in demand that fails to come about. One example of a cartel being formed as a result of incorrect expectations is the Hydrogen Peroxide (HP) cartel that was active from 1994 to 2000 and covered four firms. The cartel firms also coordinated on sodium perborate (PBS) and sodium percarbonate (PCS) which was made from Hydrogen Peroxide while sodium percarbonate was seen as a more efficient version than HP (EC, 2006d, pp. 7-9). Besides the cartel firms there were some small firms active in the market (*ibid.*, pp. 21-22). In the beginning of the 1990's it was expected that a new method for bleaching, e.g., paper would be introduced that did not require the use of chlorine and was expected to be environmentally friendly. This new method would have relied on the use of Hydrogen Peroxide as a bleaching agent which would have lead to an increase in demand for HP. This expected increase was not realized as it turned out that the new method was not as advantageous as expected.

However, the firms had already invested in production capacities causing excess capacities. Additionally, some producers found it difficult to reorganize their production towards sodium percarbonate instead of sodium perborate that are produced using hydrogen peroxide as an input. Since many producers were vertically integrated (i.e., they produced their own HP) these difficulties further aggravated the problem of excess capacity in HP-production. In addition to these events, Northern European producers expanded their activity in Mid Europe leading to a further increase in competition. On January 31, 1994, the firms started to communicate and tackle the

capacity-problem in the HP-market. The coordination expanded to PBS on May 15, 1998. As a side note, prices continued to fall despite the conspiracy because between 1995 and 1997 more production facilities were completed in Eastern Germany. This led to a further increase in aggregate capacity by 10%. Finally, prices reached their minimum in 1997 (ibid., pp. 27-28).

4.3.4. Equilibrium of the Investment Game

Theoretical literature (Besanko and Doraszelski (2004) and Paha (2014)) indicates that firms may enter into a preemption race when their investment decision is modeled endogenously. Each firm attempts to gain a dominant position in the market so that (at least in the short run) they sometimes build aggregate capacities that exceed total demand. The intensity of competition that results from such a strategy may create a basis for collusion among the firms. It is not entirely clear what caused the emergence of excess capacity in the stainless steel industry. However, this case provides an example of a cartel that was formed in response to excess capacity that had not been caused by, e.g., falling demand as demand was actually on the rise.

The cartel for alloy surcharges covered six firms and was active from 1993 to 1994 (EC, 2006b, pp. 6.7). The firms produced stainless steel for which they needed nickel, chrome and molybdenum as inputs. The prices of these inputs made up a large fraction of total cost and were highly fluctuating. Therefore, the firms priced their products by setting a base price that was adjusted only infrequently and added to this base price an alloy surcharge that reflected the true raw material purchase costs and could be adjusted more frequently. This alloy surcharge was subject to the cartel agreement.

To be more specific about the market conditions, the industry was fairly

concentrated and characterized by excess capacity. Moreover, prices for stainless steel had fallen since 1993 despite an increase in demand. Demand in Western Europe had been high since the 1960s. In the 1990s, the emerging markets were also gaining increasing importance. Nonetheless, two cartel firms stated that given the existence of excess capacities the economic situation had been bad in general (ibid., pp. 10-14). This contributed to the formation of the cartel.

4.4. Imports and Entry

This section presents cartels that according to the decisions of the European Commission were characterized by intense competition prior to cartel formation. In our discussion of the topic, we emphasize the importance of greater imports from abroad or foreign competitors establishing new production facilities in the markets that will later become cartelized.

Food Flavor Enhancers. An example for a cartel that was initiated following the threat of entry of new competitors is the case of food flavor enhancers. The cartel was active from 1988 to 1998 and consisted of four firms. When two Japanese firms left the market in 1994, all producers of the product, who were active on a global scale, were involved in the cartel (EC, 2004c, pp. 3-7). The EC (ibid., p. 8) mentions a report of a Korean producer which describes a request for a meeting of one of the Japanese suppliers who expected an increase in competitive pressure due to the entry of an additional Korean supplier. The penetration of the Japanese market was to be limited. One of the firms who dropped out in 1994 further describes that there was some collusion going on between the Japanese producers prior to 1988. It

is interesting to see that after the breakdown of the cartel, prices decreased dramatically from 22-27 per kg in 1997 to 8-12 per kg in 2000 (ibid., p. 5). If one assumes that market conditions did not change much between 1997 and 2000, and that the industry moved from collusive pricing to competitive pricing, this would imply an overcharge of about 170%. This would indicate that the cartel-related overcharge was exceptionally high because (Connor and Bolova, 2006, p. 1134) estimate a medium overcharge of only 29%.

Sorbates. The sorbates cartel was active from 1979 to 1996. A German firm was the largest producer for sorbates while there were four Japanese firms active with an aggregate market share of 50%. There were further large producers and some small Chinese and Russian producers active in the market. One of the cartel firms entered the market in the 1980s and another firm entered the European market in 1994 (EC, 2003d, pp. 6-13). Prior to cartel formation, the four Japanese firms entered the European market which led to a downward pressure on prices. Demand for sorbates increased at that time due to higher demand for convenience products, as sorbates were used to conserve these products. Despite this increase in demand, the firms were complaining about a low price level (ibid., 14-15).

Chloroprene Rubber. Between 1993 and 2002, six firms participated in the chloroprene rubber (CR) cartel. Among those firms, two were Japanese, one from Germany, two from America and one from Italy. Until 2005, the two American firms had a joint venture which became a subsidiary of DuPont in 2005. There were no additional suppliers in the European market. Until 1998 existing excess capacities were reduced by plant closures (EC, 2007b, 7-16). The EC (ibid., pp. 19-20) notes that except Bayer and DDE (DuPont)

all firms only employed one single production facility. That is why economic activity was concentrated in those markets, where the respective facilities were built. The situation changed when Japanese producers started entering the European market. Additionally, there was a drop in demand for CR. This drop in demand was due to a substitution process which leads to the conclusion that this was not a temporary drop. Worldwide overcapacities followed. However, it is not clear, what the sequence of the events was. One could hypothesize that the Japanese producers expanded their activities to the European market because of the demand drop, although, it is not clear why it was not also the other way around. This is supported by the fact that one of the Japanese producers started to serve the European market from European stocks by the end of 1993 (ibid., para. 22). However, the respective firm was already involved in the cartel at that time. According to the EC (ibid., p. 19) the goal of the cartel was to prevent a worldwide decrease in CR-prices. A special feature of the market was that there were relatively few customers with a high loyalty to their suppliers. To attract new customers, a supplier had to offer very low prices. Hence, a 'downward price spiral' emerged when one producer tried to do business with another firm's customer (ibid., para. 83). Due to the existing excess capacities and the drop in demand, firms therefore expected retaliatory measures when entering a competitor's market. This could be an indication for tacit collusion comparable to the medical gases case presented further above in this section.

Choline Chloride. Prior to the formation of the choline chloride cartel in 1992, imports from American suppliers increased from 71t to 2,500t between 1989 and 1991. Given a total market size of 40,000t, this meant an increase

in the share of US imports from 0.18% to 6.25%. The cartel was active until 1998 and consisted of six firms (EC, 2004a, pp. 14-26). When BASF, one of the cartel firms, in turn planned to expand its activity in the American market through its subsidiary in Mexico, the American producers met with BASF to discuss the aggressive actions in the market. Other suppliers entered the talks later. The main reason for cartel formation were excess capacities and unsuccessful attempts of single producers to gain market shares with an aggressive pricing policy. Another feature of this time was that the profitability of choline chloride decreased because of inflation. Price adjustments were hardly possible (ibid., pp. 26-28). The EC (ibid., pp. 13-14) nonetheless describes that demand increased in America and Asia, however, it is not clear at what time. Production surpluses were exported occasionally to earn a positive return to cover fixed costs (ibid., para. 39). BASF describes that in 1992 all six producers had excess capacity and that production surplus was sold in South and Latin America as well as Asia for very low prices. Although we cannot clearly pin down the reason for overcapacities, we see in this case how excess capacities can lead to an increase in competition and, finally, to a collusive agreement.

French Beer. In the French beer market there was a collusive agreement between two firms owned by Danone and Heineken. The cartel was active from 1990 to 1999 and covered at least 60% of the market. Beer demand decreased by 8% from 1990 to 2000. It is important to note that beer demand in restaurants, pubs etc. dropped by 25%. Furthermore, the ownership structures on the downstream level of the market has changed: In 1995, 70-80% of distributors were independent while in 2000 the two cartel firms and

Interbrew controlled 65-75% of the distribution channels (EC, 2004d, pp. 2-9). The cartel firms' first meetings were considered with a price war in the wholesaler market. Note that, in this case, the price war constitutes a situation of increasing prices for distribution capacities. Therefore, it is not clear how this is connected with the drop in demand for beer. Four days before the confirmable collusive agreement was set up it is described that 'Interbrew has now entered the battle field and tries to buy the remaining free wholesalers' (ibid., pp. 12-13). According to the EC (ibid., p. 10), the cartel was meant to act as a 'cease fire' and 'a return to normal competition'.

4.5. Changes in Customers' Conduct

We elaborate on changes in customers' conduct (e.g., increasing substitution of an older product by a newer variant) leading to more intense competition for the remaining customers.

Copper Alloy Fittings. According to the EC's (2006c) evidence, the cartel for copper and copper alloy fittings was active from 1991 to 2001. Nonetheless, one cartel firm states that there were bilateral meetings as early as 1985 (EC, 2006c, p. 29). Nine firms were coordinating the market for copper and copper alloy fittings. The EC (ibid., p. 9) notes that according to a professional journal in 1997-1998 'copper was still the dominant material [...]' while its substitute made from plastic 'have shown strong growth since the 1990s'. The EC's report (ibid., pp. 8-21) furthermore reveals a wave of expansionary activities of many firms active in the market. This led to a consolidation of the industry. In combination with the buyer power of wholesalers there was additional pressure on prices arising from small suppliers and Asian

firms (ibid., pp. 24-29). A further interesting detail in this case is that downstream resellers made increasing use of computers to compare prices. This most likely increased bargaining power for the wholesalers.

Zinc Phosphate. Zinc phosphate is used as an anti-corrosive material in protective coating systems, for example on cars (EC, 2003c, p. 2). Customers are chemical firms. A cartel of six firms was active in the market from 1994 to 1998. However, there are indications that there were potentially collusive contacts earlier than 1994. Besides the cartel firms there were some smaller suppliers in the market. In 1990, one firm started to enter the Norwegian market where demand had dropped by that time. Hence, the first meetings of the cartel firms were initiated to end the price wars (ibid., pp. 2-9). Furthermore, there was a trend of substitution away from zinc phosphate towards calcium phosphate and the customers had some degree of buyer power (ibid., p. 32). We cannot clearly say when these developments became relevant, however, we know that competition intensified at least in one of the relevant markets.

Specialty Graphites. The speciality graphites case shows how a demand side substitution process can lead to a decrease in the number of competitors and increase in competitive pressure. The cartel covered essentially two products: unmachined isostatic graphite products and unmachined extruded graphite products. While the latter is used, e.g., for electrolytic anodes and cathodes, isostatic graphite is for example used to produce electrodes for electrical discharge machining and is more expensive. The collusive agreement for extruded graphite product consisted of two firms and was active from 1993 to 1996. The cartel for isostatic graphite products covered eight

firms and was active from 1993 to 1998 (EC, 2002d, pp. 5-9). There was one additional producer who was active on a global scale. Together with the cartel firms, those firms controlled 80% of the world market from 1993 to 1998. Concerning extruded graphite, there were three firms active in the market. During the 1980's demand shifted to isostatic graphite and away from extruded graphite products which led to a reduction of suppliers in the industry (ibid., pp. 10-14). The EC (ibid., p. 16) furthermore adds that the activity of Japanese producers increased in Europe. Although the cartel's confirmable activity started in 1993, there are indications that there was collusive activity between three European producers already in the 1970s. One of the Japanese producers describes that the first meeting were initiated because of increasing exports of Japanese suppliers to Europe. The European producers were complaining about the low prices for which the Japanese had sold their products and that they should not steal their market shares by charging low prices (ibid., p. 33).

We can conclude that this is again an example for increased competition. What is special about this case is that the demand for one product increased while the substitute's demand decreased and both were supplied by the cartel firms. The case shows the dichotomy between demand drops and increases. Isostatic graphite experienced an increase in demand while extruded graphites experienced a decrease, however, the cartel covered both products. Both cartel firms who colluded in the extruded graphite were also involved in the collusive agreement for isostatic graphite. The case makes clear that also demand increases can lead to collusive activity. However, the question remains whether and how the collusive activity evolved between

the two substitutes. Since the collusive agreement started in February 1993 for the extruded graphite, we can hypothesize that the cartel expanded its activity to isostatic graphite.

Vitamins. Another example of intensified competition prior to cartel formation is the vitamins case. The cartel was active from 1989 to 1999, consisted of 13 firms and covered vitamins A, E, B1, B2, B5, B6, C, D3 and H, as well as folic acid, beta-carotene and carotinoides. Only the firm Roche was active in all of these cartels (EC, 2003e, pp. 1-3). The EC (ibid., p. 16) describes that prices for vitamins A and E decreased before the cartel was set up and that this would have been due to increased competitive pressure from Japanese producers. Additionally, prices for vitamin B dropped during the 1980's, e.g., vitamin B6 prices decreased by 15-20% from 1989 to 1990. A weak dollar worsened the situation (ibid., pp. 30-33). Grout and Sonderegger (ibid., p. 64) add that prices dropped for all vitamin products. However, it is described that there was some collusive activity going on covering vitamin B5 since the mid 1980's. We can see that, together with the calcium carbide and magnesium based reagents case, the vitamins cartel is a good example how a collusive agreement in one market can spread to other market when multi-product firms are active. Additionally, we see an increased competitive pressure before the cartels were initiated in both cases.

4.6. Legal and Regulatory Environment

Alonso-Nuez et al. (2015) have recently suggested that de-regulation may cause anti-competitive behavior and find empirical support for this hypothesis in Spanish competition cases. They (ibid, p. 1048) argue that their

”study is a pioneer in the field of competition policy, as there is no prior literature that has, empirically and in the same terms, analyzed the effect of sector regulation and deregulation on the expected activities of antitrust enforcement.” We build on and extend their work by adding evidence from other jurisdictions and analyzing changes not only in regulatory but also in other laws. Hence, we propose that the legal and regulatory environment along with actions of public bodies may cause violations of competition laws. We establish the following hypotheses:

Hypothesis 4. *When a change of competition laws renders previously legal conduct illegal the conduct may persist if the firms (a) have imperfect information about the change in the law or (b) do not know all their feasible strategies (i.e., doing business without violating competition laws).*

Hypothesis 5. *Policy interventions may cause a change in demand that facilitates collusion.*

Hypothesis 6. *If a regulatory intervention in an upstream market raises selling prices in this market, the costs of downstream firms rise and their competitive profits $\pi_{c,t}$ fall. This may lead to the formation of a cartel in the downstream market, i.e., downstream firms coordinate their conduct to exercise countervailing buyer power.*

Hypothesis 7. *If the de-regulation of a market or the reduction of protective measures lowers firms’ competitive profits $\pi_{c,t}$ their participation constraint (4) will be satisfied more easily.*

Hypothesis 4 (i.e., previously legal conduct is rendered illegal by changes in competition laws) is probably the most straightforward case where the

legal environment affects cartel formation. Hypothesis 5 (i.e., policy interventions affecting demand) must be seen in connection with our hypotheses on the relationship between demand and cartel formation (see Subsection 4.2 above). Hypotheses 6 and 7 may be particularly relevant for policymakers if they want to design their policies and laws in a way that does not facilitate collusion.

The term *de-regulation* in Hypothesis 7 can be defined as the removal of obstacles to competition that relate to price, production quantity or capacity, or firms' entry/exit decisions (Alonso-Nuez et al., 2015, p. 1036). They (ibid., p. 1041) hypothesize that (1) regulated "sectors have less competitive tradition and are thus more likely to be the subject of proceedings; (2) Industry deregulation involves establishing a new scope of competition for a sectors firms, thus increasing the likelihood of new proceedings against those firms in subsequent years". The first of these two hypotheses is reminiscent of our Hypothesis 4. The second shares similarities to Hypothesis 7 without, however, suggesting a specific mechanism why de-regulation facilitates anti-competitive conduct. Alonso-Nuez et al. (2015, p. 1046) also argue that anti-competitive conduct in de-regulated markets may be more likely because of a selection effect: Formerly regulated markets may be more concentrated than unregulated markets, which may facilitate, for example, collusion or the abuse of a dominant position.

We study cases that support Hypotheses 4 to 7 in Subsections 4.6.1 to 4.6.3. Subsection 4.6.4 shows that some public procurement procedures may facilitate collusion. This last subsection is not only devoted to the study of cartel formation but presents a factor that facilitates the sustainability of

collusion.

4.6.1. Competition Laws

Austrian Banking. The Austrian banking case may be taken to support Hypothesis 4 as it provides an example of a cartel where some conduct, which was previously legal, was maintained after it had been rendered illegal. The Austrian banking sector was subject to anticompetitive conduct from 1995 to 1998 (EC, 2004b, p. 69). Eight banks were involved (ibid., pp. 4-6). According to Austrian banking law in the version of 1979 collusion on interest rates was legal. In 1989, these activities became illegal after the Austrian banking law had been harmonized with EU law. However, banks felt unable to set interest rates without communication (ibid., pp. 8-9). The EC (ibid., para. 4) describes that 'on their own admission, the responsible banking executives were not able to make calculations based on business economics' and that competition could have resulted in exit and uncontrollable risk. Furthermore there was a culture of collusive behavior in the Banking sector which manifested in maintaining the collusive agreements although it was known to the banks that they became illegal after Austria joined the EU in 1995 (ibid. p. 9, para. 32-39).

Gas Market. The market-sharing agreement in the French and German gas markets constitutes an illegal agreement that emerged from a previously legal horizontal cooperation agreement among E.On and GDF covering a common construction project. The project under consideration concerned the MEGAL-Pipeline which was meant to supply Germany and France with natural gas. When the project started in 1975, the firms agreed not to serve

the respective foreign market, which constituted a market sharing agreement. The pipeline went to an operating state, the collusive agreement lasted until 2005 (EC, 2009b, pp. 15-19). This case can be seen as a regulatory specificity because horizontal agreements are regulated in the horizontal guidelines of the EU which are meant to prevent horizontal agreements which might promote harmful anticompetitive conduct.

4.6.2. Policy Interventions

The cartel between exchange banks may serve as an example where a policy intervention caused a change in demand that subsequently led to collusion (Hypothesis 5). The conspiracy was active from 1997 to 2001 (EC, 2003f, p. 31) and consisted of five banks who agreed on fixing the fees for the exchange of currencies. As a policy intervention, the introduction of the Euro had eliminated exchange-rate risks and there was a discussion on the EU-level whether the exchange of banknotes should still be costly. By the end of 1997, it was agreed that banks were still allowed to charge fees for exchanging banknotes but that those fees should be reduced. Moreover, the German central bank was obliged to offer the service for free.

The goal of the first meeting of the banks which was aimed at exerting political pressure against this policy. Several meetings later, the banks met on 15th October 1997 to finally fix prices (ibid., pp. 6-9). The collusive agreement was targeted at fixing fees with the objective of extracting the highest possible profits from the markets before profits would shrink in 1999. Additionally, in the beginning of 1999 a common structure of fees was introduced by the cartel firms. Importantly, it is described that the situation starting in 1999 was not seen as being existence-threatening for the firms

(ibid., p. 19). Therefore, this cartel must not be confused with crisis cartels that we define as conspiracies among firms who expect to bankrupt. In such a situation the competitive firm value $V_{c,t}$ would fall such that the participation constraint (4) will be satisfied more easily. Moreover, a firm that has gone bankrupt will not be able to pay fines in the future. This reduces the probability ρ that the cartel is detected and the firms sanctioned. Again, this softens the participation constraint (4).

4.6.3. (De-)Regulation

In the following, we present examples to support our hypotheses on (de-)regulation and cartel formation.

Spanish Raw Tobacco. The market for Spanish raw tobacco was opened for entry in the 1990s. Before this time, initial processing, manufacturing, and wholesale was done by legal monopolists. The cartel was active between 1996 and 2001 comprising the former legal monopolists and a small number of entrants. The goal of the collusive agreement was to coordinate on input prices for raw tobacco. During the mid 1990s, the former monopolist on the initial processing stage suffered from excess capacities (EC, 2004e, pp. 6-11). The raw tobacco was bought from a number of small producers which were organized in different associations. When three firms entered the initial processing market in 1994-1995, their prices were set according to the prices of the former monopolist. In 1996, competition started to rise and input prices increased (ibid., p. 26). The EC (ibid., p. 14) states that the costs for acquiring raw tobacco steadily increased and that despite the collusive agreement raw tobacco prices increased by 20% or more starting from 1996.

Another reason for that development could be a change in EU regulations as described in the next case.

Italian Raw Tobacco. The cartel between four Italian tobacco processors was active from 1995 to 2002. Similar to the case in Spain, the goal of the cartel was to decrease purchasing prices for raw tobacco (EC, 2005c, p. 6, para. 1), i.e., the conspiracy aimed at exercising buyer power towards tobacco farmers in the upstream market. By 2001, the four cartel firms controlled about 55.94% of the purchase of raw tobacco (ibid. paras. 31, 35, 37, 40). In the 1990s the market had undergone a structural change. The total number of tobacco processors had fallen from 140 in 1993 to 49 in 2005 (ibid., fn. 10). Moreover, the number of raw tobacco farmers (27,000 in 1993) had decreased by about 50% in 2000 (ibid., para. 46).

More importantly, the market was regulated. In 1992, production quotas had been imposed for the processing of raw tobacco. In 1995, these quotas have become production quotas that were imposed on the tobacco farmers and their associations (ibid. para. 51). The Italian state paid premia to raw tobacco processors for production within the quotas. These premia were only paid if processors and producers had entered into a cultivation contract before 30 May of each year that specifies the purchase price of tobacco. "The obligation to conclude cultivation contracts in advance guarantees greater stability of revenue for producers, enabling them to step up their efforts or investments aimed at delivering better-quality tobacco" (ibid., para. 59).

The quota system produced several (interrelated) distortions. First, quotas were apparently allocated to firms who committed fraud by faking invoices "and certifying that they were producing tobacco in order to receive

the Community premiums” (ibid., para. 95). This allegedly led to a ”scarcity of tobacco and over-capacity in the processing industry” (ibid., para. 103). Second, other producers exceeded the quotas on a regular basis (EC 2005c: para. 85) and were advised by the farmers’ union ”to hold back their surplus production to enable them to auction it off after the quota tobacco has been all sold” (ibid., para. 147). As a consequence, the four largest processors met to agree on maximum purchasing prices and to allocate farmers/producers to processors.

This cartel supports Hypothesis 6: The regulatory intervention caused distortions in the upstream market and raised selling prices for raw tobacco. This led not only to the purchasing cartel in the downstream market but also induced the farmers’ union to violate competition laws by advising farmers to hold back surplus production. One of the cartel firms explained to the Commission that up to the regulatory intervention competition among processors had been strong (ibid., para. 103).

Steel Beams. The steel beams conspiracy is another case that supports Hypothesis 7, which states that the de-regulation of a market or the reduction of protective measures may facilitate cartel formation. This cartel had been active from July 1988 to January 1991. It comprised more than 14 steel producers and one trade association.

The EC (EC, 2008b, para. 4) reports that the European steel industry was in a state of so called *manifest crisis* in the 1970s, where a fall in demand had caused low prices and excess supply. Therefore, in 1980 the Commission imposed a system of mandatory production quotas for steel beams and other

steal products in accordance with Article 58 ECSC Treaty.⁵ The Commission fixed a general production objective and allotted compulsory production quotas to each firm, which were backed between 1984 and 1986 by a system of minimum prices (EC 1994: para. 23). These measures were meant to ensure that the social (e.g., job losses) and regional consequences of the industry's restructuring (e.g., reduction of excess capacity, plant closures) were not too severe (EC 1987)⁶. The Commission (1987: p. 4) however recognized that the "quota system itself can be an impediment to the restructuring of the industry" and abandoned the system in 1988.

When the quota system came to an end in 1988, the steel producers started a cartel. This was although the market had been growing at least since 1984 from 4.8m t of steel beams in 1984 to 8.0m t of steel beams in 1990 (EC 1994: para. 5)⁷. However, the Commission (1987) recognized an ongoing necessity to restructure the industry, suggesting that firms' competitive profits were still fairly low. Moreover, the firms were equipped with the right "technology" to collude. For example, a "monitoring system under which the participating companies informed each other on a regular basis about the order they had received for delivery in a specific quarter [had] been in operation at least since the third quarter of 1984" (EC 1994: para. 39). The firms were also required to declare production and deliveries to the

⁵The Treaty constituting the European Coal and Steel Community (ECSC) states in Article 58: "In case of a decline in demand, if [...] the Community is faced with a period of manifest crisis [...], it shall [...] establish a system of production quotas[...]" <http://goo.gl/vGlwKv> (accessed on December 13, 2015)

⁶See Communication on Steel Policy (Official Journal C 272/3, 10.10.87)

⁷See the decision of the earlier case (Official Journal L 116/1, 6.5.94)

Commission, which made it easy for them to distribute this information also among each other. The firms also cooperated legally by, for example, setting up joint production and marketing agreements. Evidence indicates that the firms were well aware of the illegality of their conduct and tried to conceal it.

One may speculate whether the regulatory intervention in the market along with the legal forms of cooperation had contributed to the development of a culture within the firms and in the market that – apart from the threat of being fined – deemed coordinated conduct acceptable. These observations suggest that markets, where competition had been softened by regulatory measures, might be particularly vulnerable to collusive conduct once the protectionary measures are loosened. It may be particularly important for competition authorities to keep these markets under close scrutiny and communicate this clearly. In this context, Alonso-Nuez et al. (2015, p. 1041) argue that sanctions are important to create discipline in certain sectors and to establish a competition-based culture. Therefore, we add that firms' legal and compliance departments should make sure that employees working in segments where protectionary measures are about to be removed are being trained particularly well in competition laws.

Belgian Beer. The cartel in the Belgian beer market was active from 1993 to 1998 and consisted of two large, multinational firms and two small Belgian producers (EC, 2003a, pp. 3-47, paras. 11-16, 281). With a CR5 of 80% in 1998, the market was quite concentrated (ibid. para. 4). The EC (ibid. para. 3) further notes that the number of brewers dropped from 76 to 68 between 1991 and 2000. Hence, although we cannot derive precise concentration

ratios for the time before cartel formation from the EC's documentations, we can expect the market to be also quite concentrated in 1993. Until May, 1993, the Belgian beer market had been regulated. A Ministerial Order was required for price increases for which firms could apply for either individually or together with other brewers through a trade association. (ibid., para. 10). The EC describes that beer imports doubled from 1993 to 1998 (ibid., para. 19). Together with the increase in imports, we hypothesize that after the price regulation was abandoned in 1993, more intense competition was the consequence. Additionally, there was a small drop in demand and a shift of demand to retail sale from 1993 (ibid., para. 6-9). Unfortunately we do not know whether these developments started prior to 1993 or whether they were expected by the firms. If they were expected, this case is another example for a market where the producers' situation was about to worsen. In combination with the cancellation of regulation, this case shows strong parallels to the Austrian banks cartel.

4.6.4. Public Procurement

Sometimes, public procurement procedures facilitate collusion and harm the public clients. As the public procurement procedures differ across countries and industries we abstain from formulating a general hypothesis on what exact procedures facilitate collusion. We rather describe the conditions that facilitated the Dutch bitumen cartel.

This conspiracy was active from 1994 to 2002. It had both a horizontal and a vertical dimension because eight bitumen producers fixed bitumen prices upstream and then negotiated rebates with a buyer cartel of six road construction companies downstream (EC, 2006a, paras. 1-2). The up-

stream cartel contained almost all Dutch bitumen producers (only Exxon's subsidiary was not involved), and covered at least 85% of the market. The downstream cartel controlled about 40-50% of the road construction market (ibid., para. 29).

During the so called "bitumen consultations" upstream and downstream firms came together to fix (1) the gross price of bitumen, (2) a rebate for the group of road builders that participated in the downstream conspiracy, and (3) a smaller rebate for other road builders (ibid., para. 48). It is immediately clear that being granted a larger rebate on bitumen gave the participants of the downstream cartel a competitive advantage over smaller road builders who, thus, were harmed by the cartel. But why would the construction companies agree to higher bitumen prices in the first place?

This becomes clear if one knows that Dutch road construction contracts provided the option to include a risk settlement procedure. The construction companies and their clients settled on a certain price for the construction of a road. However, the risk settlement procedure entitled the road builders to receive a compensation from their clients should the price of bitumen rise above a certain threshold. This standard price of bitumen was determined by a non-profit organization based on the *gross* price of bitumen, i.e., before the subtraction of rebates. Therefore, the road construction companies had an interest in stable bitumen prices when the construction contracts were concluded and a steep increase thereafter. They were (partly) compensated for this increase by the rebates that they received from the bitumen producers. These rebates were not considered when calculating the standard price of bitumen that was, thus, overstated (ibid., paras. 25-26). Hence, the road

builders harmed their clients by deceiving them about the true development of bitumen prices in order to receive a compensation for (manipulated) price increases of their input bitumen.

The Commission decision (*ibid.*, paras. 88-92) remains silent about the exact events that led to the formation of this cartel. However, this cartel with vertical its horizontal elements would not have been profitable without the badly-designed risk settlement procedure. It would be wrong to conclude that (public) buyers evoked the establishment of this cartel. However, one learns that certain contract conditions can facilitate conspiracies among suppliers; and buyers should not make it too easy for them.

5. Conclusion

This article has shown how cartels may be formed and what circumstances in a given industry can lead to cartel formation. In line with Grout and Sonderegger (2005), we find that negative demand shocks in combination with overcapacities have a strong potential to trigger cartel formation. However, the case study also encompasses cases where demand actually *increased* prior to cartel formation (e.g., rubber chemicals). We conclude that, generally, profit shocks trigger cartel formation. These shocks may be expected or unexpected, negative or positive and permanent or transitory. We also argue that there is rarely a single cause for cartel formation. It seems that rather the combination of different events in a market and their (expected) impact on profits bears the potential to trigger firms' collusive behavior.

We explain this finding in a theoretical framework where the participation constraint that determines whether the firms prefer to be in a cartel rather

than in a competitive state is more restrictive than the incentive constraint. The latter determines whether a firm prefers collusion to deviation. The idea is that a change in a market parameter (e.g., a demand drop) can trigger the formation of a stable cartel. In a given industry, firms are sufficiently patient to stabilize a cartel (ICC is satisfied). However, the firms prefer to compete because, e.g., cartel fines are too high (PC is violated). The change in the market parameter now decreases competitive relative to cartel profits in a way that collusion is now preferred to competition (PC is satisfied) and can be stabilized – a stable cartel will be formed. This approach explains why factors that are expected to destabilize collusion such as firm entry can actually *trigger* cartel formation. The destabilizing effect of the change in this case might not be as strong as to make the firms prefer to deviate from a collusive agreement.

The findings of the case study and the underlying model can help to conduct future research both theoretically and empirically. A next step could be to develop models of cartel formation that can explain case study evidence with the final goal to be based econometrically.

Literature

Alonso-Nuez, M., Rosell-Martínez, J., Muñoz Porcar, A., 2015. Does deregulation encourage anticompetitive behavior. *The Journal of Competition Law & Economics* 11 (4), 1033 – 1048.

Besanko, D., Doraszelski, U., 2004. Capacity dynamics and endogenous asymmetries in firm size. *The RAND Journal of Economics* 35, 23 – 49.

Blanckenburg, K. V., Geist, A., 2011. Detecting illegal activities: the case of cartels. *European Journal of Law and Economics* 32, 15–33.

Connor, J. M., Bolova, Y., 2006. Cartel overcharges: Survey and meta-analysis 24, 1109 – 1137.

EC, 2002a. Case comp/e-1/36.490.

EC, 2002b. Case comp/e-1/36.604.

EC, 2002c. Case comp/e-1/37.152 ?? plasterboard.

EC, 2002d. Case comp/e-2/37.677.

EC, 2002e. Comp/e-2/37.784 ?? fine art auction houses.

EC, 2003a. Case iv/37.614/f3 po.

EC, 2003b. Comp/ c.38.279/f3.

EC, 2003c. Comp/e-1/37.027.

EC, 2003d. Comp/e-1/37.370.

EC, 2003e. Comp/e-1/37.512.

EC, 2003f. Comp/e-1/37.919.

EC, 2004a. Comp iv/e-2/37.533.

EC, 2004b. Comp/36.571/d-1.

EC, 2004c. Comp/c37.671.

EC, 2004d. Comp/c.37750/b2.
EC, 2004e. Comp/c.38.238/b.2.
EC, 2004f. Comp/e-1/36.212.
EC, 2004g. Comp/e-1/38.069.
EC, 2005a. Comp 38.337 po.
EC, 2005b. Comp/38354.
EC, 2005c. Comp/c.38.281/b.2.
EC, 2005d. Comp/f/38.443.
EC, 2006a. Comp/38.456.
EC, 2006b. Comp/39.234.
EC, 2006c. Comp/f.1/38.121.
EC, 2006d. Comp/f/38.620.
EC, 2007a. Comp/38.432.
EC, 2007b. Comp/38.629.
EC, 2007c. Comp/39.165.
EC, 2008a. Comp/38.695.
EC, 2008b. Comp/c.38.907.
EC, 2009a. Comp/39.396.

- EC, 2009b. Comp/39.401.
- EC, 2010a. Comp/38.344.
- EC, 2010b. Comp/38.866.
- EC, 2010c. Comp/39.309.
- Fabra, N., 2006. Collusion with capacity constraints over the business cycle. *International Journal of Industrial Organization* 24 (1), 69 – 81.
- Green, E. J., Porter, R. H., 1984. Noncooperative collusion under imperfect price information. *Econometrica* 52 (1), 87 – 100.
- Grout, P., Sonderegger, S., 2005. Predicting Cartels (OFT 773). Office of Fair Trading.
- Haltiwanger, J., Harrington, J., 1991. The impact of cyclical demand movements on collusive behavior. *The RAND Journal of Economics* 22 (1), 89 – 106.
- Harrington, J., 2006. How do cartels operate? *Foundations and Trends in Microeconomics* 2 (1), 1 – 105.
- Hay, G. A., Kelley, D., 1974. An empirical survey of price fixing conspiracies. *Journal of Law and Economics* 17 (1), 13 – 38.
- Levenstein, M. C., Suslow, V. Y., 2006. What determines cartel success? *Journal of Economic Literature* 44 (1), 1 – 53.
- Motta, M., 2004. *Competition Policy*. Cambridge University Press.
- URL <http://EconPapers.repec.org/RePEc:cup:cbooks:9780521816632>

- Paha, J., 2014. Cartel formation with endogenous excess capacity and demand uncertainty. MAGKS Discussion Paper Series (43-2013).
- Pepall, L., Richards, D., Geroge, N., 2011. Contemporary Industrial Organization - A quantitative approach. Wiley.
- Röller, L.-H., Steen, F., 2006. On the workings of a cartel: Evidence from the norwegian cement industry. *The American Economic Review* 96 (1), 321 – 338.
- Rotemberg, J. T., Saloner, G., 1986. A supergame-theoretic model of price wars during booms. *The American Economic Review* 76 (3), 390 – 407.
- Von Neumann, J., Morgenstern, O., 1944. *Theory of Games and Economic Behavior*. sixtieth-anniversary edition, Princeton University Press, Princeton and Oxford.
- Yin, R., 2009. *Case Study Research, Design and Methods*. SAGE Publications, Thousand Oaks, CA.